

DISTRACTION

THE NEWSLETTER OF

The Limb Lengthening and Reconstruction Society/ AMASI-North America
Spring 2008

Stuart A Green, Editor

Spirit of Ilizarov To Visit ASAMI International Meeting

As the Russian people move towards increasing spirituality, organizers of the ASAMI-International Meeting in St. Petersburg have conjured up the ghost of Gavriil Ilizarov for a special appearance at the May 28-30, 2008 gathering. The apparition is expected to materialize briefly during one of the sessions on distraction osteogenesis. The program chairman, however, was uncertain about exactly where in the conference room the specter would become visible—and for how long. Nevertheless, anticipating mysterious activity, the organizing committee has asked that the text of all presentations be submitted by May 1 as protection from mischievous meddling by the Professor's poltergeist.

Surgeons from more than thirty countries will make podium presentations at the Conference. American Ilizarovians will have six offerings, including one from the Texas Scottish Rites Hospital, three from the Baltimore group, and one each from Drs. J Wang and S. Green.

George Cierny and Doreen DiPasqual will represent LLRS/ASAMI-NA at the international president's meeting. Social and guest programs, tours, special visits to museums and the like will round out the event. Your Distraction reporter will provide full coverage in a newsletter soon after the conference.

Green's 1981 Book on Amazon

The out-of-print cult classic "Complications of External Skeletal Fixation: Causes, Prevention, and Treatment" by Stuart Alan Green has reappeared on Amazon.com. As of this writing, about a dozen copies are available as used books on the bookseller's website. Hailed when published as a "masterpiece without equal" by orthopaedic surgeon Leo A Green (author's late father), the volume features a cross-section anatomy atlas designed to aid surgeons insert external

See "Book" page 2

SF Gathering Exceeds Expectations

When Tony Bennett croons, "The little cable cars climb half way to the stars" he's singing the praises of LLRS luminaries Jim McCarthy and John Sontich, organizers of the LLRS Specialty Day program in San Francisco this year. Symposium attendees heard thirty presentations, each focusing on one of three topics: correction of foot and ankle deformities, trauma, and pediatrics. By limiting the number of presentations,

See "SF" page 2

Book

fixator pins without harming vital nerves and vessels. The monograph includes chapters on pin tract infection, failure to obtain union, nerve and vessel injury, fixator problems, and unsuccessful arthrodesis. The book also contains a historical review of external fixation, starting with these now immortal words: "The external skeletal fixator was invented before the plaster cast." More significantly, the history chapter contains the first American illustration of Professor Gavriil Ilizarov's ring fixator. The author, according to rumor, was clueless at the time about the fixator's role in distraction osteogenesis, thinking the apparatus was an absurdly complicated method of fracture reduction and stabilization. Except for this slight boo-boo, the rest of the book remains "as useful today as when written," according to orthopedist Hillary Green Redlin, the author's daughter.

SF

the speakers had enough time to develop their talks in a more comprehensive manner than usual at Academy meetings. More than 80 registrants attended the day's presentations.

**The Limb Lengthening and
Reconstruction Society
ASAMI-NA
EXECUTIVE COMMITTEE**

George Cierny, III, M.D.	President
Paul T. Freudigman, Jr., M.D.	First Vice Pres.
John K. Sontich, M.D.	2nd Vice Pres.
Doreen DiPasquale, M.D.	Secretary
S. Robert Rozbruch, M.D.	Treasurer
Sanjeev Sabharwal, M.D.	Memb At Large
David S. Feldman, M.D.	Memb At Large
Janet Conway, M.D.	Memb At Large
James McCarthy, M.D.	Membership Chair
James J. Hutson, Jr., M.D.	Nominating Chair
Reggie C. Hamdy, M.D.	Research Chair
Stuart A. Green, M.D.	Distractions Editor
James C. Binksi, M.D.	BOS Rep
Doreen DiPasquale, M.D.	BOS Rep
David W. Lowenberg, M.D.	Immed. Past Pres.

LLRS Plans New Mexico Meeting; Native Americans Concerned

"Leg lengtheners are coming, leg lengtheners are coming!" The rumor spread like a wind-whipped brush fire through New Mexico's Native American towns and villages. Fearing for their offspring, blanket-wrapped mothers transported children to relatives in remote corners of their reservation, far from the impending July 11-13 LLRS meeting at Albuquerque's Hyatt Regency Hotel.

"We are naturally a short statured people," declared Chief Russell Hot Summers in an interview with Distraction's reporter. "Adding just four inches to our kids' legs would force us to raise the height of every room of our multilevel adobes," he said, "toppling these ancient structures and with it, our way of life."

"We mean you no harm," asserted the reporter, an *ex officio* member of LLRS's Executive Committee, "but don't you want the next generation to stand tall at the craps tables and roulette wheels of your casinos and in your gift shops?"

"We don't see a favorable risk:benefit ratio," replied the respected elder, who holds a master's degree in economics from the University of New Mexico.

"Well then," proclaimed the reporter, "we'll restrain our Stature-People in exchange for a tribal blessing on our forthcoming gathering. Agreed?" "Agreed."

And so it was said; and so it was done. And they smoke the pipe of peace together.

ABSTRACTS IN A MINUTE

Arch Orthop Trauma Surg. 2008 Apr 16 [Epub ahead of print]

Elbow arthrolysis in severely stiff elbows.

Kayalar M, Ozerkan F, Bal E, Toros T, Ademo_lu Y, Ada S.

EMOT Hospital, Izmir, Turkey, elmikro2003@yahoo.com.

INTRODUCTION: This study involves the results of open elbow arthrolysis performed on a series of patients having fixed joint contracture. PATIENTS AND METHODS:

Eighteen patients were treated with open arthrolysis. Eleven patients had very severely stiff elbows (flexion arc less than 30 degrees), five patients had severely stiff elbows (31 degrees -60 degrees) and two patients had moderately stiff elbows (60 degrees -90 degrees). Fixed flexion deformity was observed in nine patients preoperatively. The mean interval between the trauma and arthrolysis was 14.8 months. The mean age was 27 years. After radiological examination, lateral Kocher incision was used on 13 patients, medial and lateral incision on 3 patients, transolecranon approach on 1 patient and anterior and posterior approach on 1 patient. External fixator was applied on four patients. Fasia lata interposition was performed in three patients. Additional procedures were as follows, bone fixation in five patients, bone grafting in two patients, nerve grafting in one patient, subcutaneous ulnar nerve transposition in three patients. The average follow-up time was 47 months. RESULTS: At the final evaluation, the mean extension deficit had improved from 55 degrees to 32 degrees. The mean end flexion increased from 81 degrees to 124 degrees postoperatively.

The flexion arc of three patients in whom heterotopic ossification was excised had increased to 65 degrees. Infection was diagnosed in two patients (11%).

CONCLUSION: The importance of this study is that the patients have fixed deformities and a long follow-up time. Severely stiff elbow is one of the main indications of open arthrolysis in the patients without muscle atrophy. We suggest sequential arthrolysis as an effective way to obtain good range of motion especially in severe stiff elbows as well as to maintain the ligamentous stability of the elbow joint.

Int Orthop. 2008 Apr 16 [Epub ahead of print]

Tibial lengthening using a reamed type intramedullary nail and an Ilizarov external fixator.

Kim H, Lee SK, Kim KJ, Ahn JH, Choy WS, Kim YI, Koo JY.

Department of Orthopedic Surgery, Eulji University College of Medicine, 1306 Dunsan-dong, Seo-gu, Daejeon, 302-799, South Korea.

The aim of this study was to evaluate the efficacy of tibial lengthening using a reamed type intramedullary nail and an Ilizarov external fixator for the treatment of leg length discrepancy or short stature. This retrospective study was performed on 18 tibiae (13 patients) in which attempts were made to reduce complications. We used an Ilizarov external fixator and a nail (10 mm diameter in 17 tibiae and 11 mm in one tibia) in combination. Average limb lengthening was 4.19 cm (range, 2.5-5.5). The mean duration of external fixation was 12.58 days per centimetre gain in length, and the mean consolidation index was 40.53 (range, 35.45-51.85). All distracted segments healed spontaneously without refracture or malalignment. Gradual limb lengthening using a reamed type intramedullary nail and circular external fixation in combination was found to be reliable and effective and reduced external fixation time with fewer complications.

Int Orthop. 2008 Apr 15 [Epub ahead of print]

Management of trochanteric fractures of the femur with external fixation in

high-risk patients.

*Karn NK, Singh GK, Kumar P, Singh MP, Shrestha BP, Chaudhary P.
Department of Orthopaedics, B. P. Koirala Institute of Health Sciences, Dharan,
Nepal, navinkarn@yahoo.com.*

The aim of this prospective study was to assess the outcome of trochanteric fractures of the femur after external fixation in a group of elderly patients with high surgical risk. The study population consisted of 50 patients with trochanteric fractures of the femur and a mean age of 87 years who were classified by an anaesthetist as ASA 3 or 4 and considered not suitable for conventional fractures fixation. The fracture was fixed with an external fixator under spinal anaesthesia. The final follow-up was at 12 months. All fractures healed within 12 weeks. Superficial pin tract infection occurred in 30 patients, and fracture united with a shortening of 14 mm (5-20) in 12 patients. No implant failures or limitation of knee movements were recorded. Five patients died within 1 year. External fixation is a valuable treatment alternative for trochanteric fracture of the femur in elderly patients.

Int Orthop. 2008 Apr 15 [Epub ahead of print]

Management of trochanteric fractures of the femur with external fixation in high-risk patients.

*Karn NK, Singh GK, Kumar P, Singh MP, Shrestha BP, Chaudhary P.
Department of Orthopaedics, B. P. Koirala Institute of Health Sciences, Dharan,
Nepal, navinkarn@yahoo.com.*

The aim of this prospective study was to assess the outcome of trochanteric fractures of the femur after external fixation in a group of elderly patients with high surgical risk. The study population consisted of 50 patients with trochanteric fractures of the femur and a mean age of 87 years who were classified by an anaesthetist as ASA 3 or 4 and considered not suitable for conventional fractures fixation. The fracture was fixed with an external fixator under spinal anaesthesia. The final follow-up was at 12 months. All fractures healed within 12 weeks. Superficial pin tract infection occurred in 30 patients, and fracture united with a shortening of 14 mm (5-20) in 12 patients. No implant failures or limitation of knee movements were recorded. Five patients died within 1 year. External fixation is a valuable treatment alternative for trochanteric fracture of the femur in elderly patients.

J Orthop Trauma. 2008 Apr;22(4):248-57.

Comparison of three different treatment modalities in the management of humeral shaft nonunions (plates, unilateral, and circular external fixators).

*Atalar AC, Kocaoglu M, Demirhan M, Bilsel K, Eralp L.
From the *Istanbul University, Istanbul Medical Faculty, Dept of Orthopaedics and Traumatology,
Istanbul-Turkey.*

OBJECTIVES:: To compare 3 different fixation methods for the treatment of humeral shaft nonunions in terms of union time, functional outcome, and complications. **DESIGN::** Retrospective case series. **SETTING::** University hospital. **PATIENTS::** Between 1996 and 2004, 80 patients (mean age, 49; range, 15 to 86; 30 women and 50 men) with nonunions of the humeral shaft were treated surgically in our institution. Circular external fixators (CEF) were used in 35 patients, unilateral limb reconstruction system (LRS) fixators in 24 patients and fixation with plates in 21 patients. **INTERVENTION::** Surgical procedure included hardware removal in previously operated patients, autogenous grafting in all patients in the plate group and in those patients with atrophic nonunions in the external fixator groups, compression of the nonunion site in all patients. **MAIN OUTCOME MEASUREMENTS::** Radiological union time, complications, shortening, and disabilities of the arm, shoulder, and hand (DASH) score. **RESULTS::** Mean follow-up period was 48.1 months (range, 12 to 121). Mean radiological union time was 5.5 months (range, 1.5 to 12) in the CEF group, 5.2 months (range, 3 to 10) in the LRS group, and 5.7 months (range, 3 to 12) in the plate group. Mean DASH score was 23.7 in the CEF group, 18.6 in the LRS group, and 26 in

the plate group. There were no statistical differences in terms of union time and the DASH score among the 3 groups. Successful union was achieved in 77 (96.3%) patients. **CONCLUSION:** Both external fixation and plate fixation produce excellent results in humeral shaft nonunions if applied properly. The procedure can be tailored to the surgeon's experience, keeping in mind that plate fixation demonstrates a longer healing time in those cases that had previous surgeries.

Instr Course Lect. 2008;57:37-49.

External fixation: how to make it work.

Ziran BH, Smith WR, Anglen JO, Tornetta Iii P.

Neoucom, St. Elizabeth Health Center, Youngstown, Ohio.

The external fixator has been in use for more than a century. Wutzer (1789-1863) used pins and an interconnecting rod-and-clamp system. Parkhill (1897) and Lambotte (1900) used devices that were unilateral with four pins and a bar-clamp system. By 1960, Vidal and Hoffmann had popularized the use of an external fixator to treat open fractures and infected pseudarthroses. The complications associated with the use of external fixation in the late 20th century were predominantly caused by a lack of understanding of the principles of application, the principles of fracture healing with external fixation, and old technology. Its use was reserved for the most severe injuries and for cases complicated by infection. Thus, pin problems, nonunions, and malunions were common. Better technology and understanding have since allowed for greater versatility and better outcomes. Simultaneous with developments in the Western world, Ilizarov developed the principles of external fixation with use of ring and wire fixation. It was not until the late 1980s and early 1990s, when more interaction and exchange between the West and East (Russia) became possible, and with the help of Italians who embraced the philosophy of external fixation, that the use of external fixation was proven to be successful. Several variations of external fixation have been developed, and its use is now widespread. However, in the United States, all but a minority of surgeons still have substantial apprehension about the use of external fixation.

Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi. 2008 Mar;22(3):314-7.

[Less invasive leverage reduction with external fixator supported and bone graft for treatment of unstable fractures of distal radius]

Zhang Y, Tian D, Liu C, Liu L, Han J, Zhang J, Yu K.

Department of Orthopaedics, 3rd Hospital of Hebei Medical University, Shijiazhuang Hebei, 050051, P. R. China. zhangyilong267@126.com

OBJECTIVE: To assess the results of treatment of unstable distal radius fractures with leverage reduction and bone graft assisted by external fixators. **METHODS:** From September 2005 to May 2007, 27 cases of unstable distal radius fractures were treated by leverage reduction and bone graft, meanwhile assisted by external fixators. The cases included 16 males and 11 females, aged from 18 to 69 years with an average of 49.3 years. Fractures were caused by falling in 19 cases, crash from high place in 1 case, traffic accident in 6 cases, and obtuse strike directly in 1 case, which were all closed fresh bone fractures. According to the standard of AO, all cases were classified as type C1 in 13 cases, type C2 in 11 cases, and type C3 in 3 cases. The palmar inclination was from -38 degrees to 10 degrees (mean -12.2 degrees); the ulnar deviation angle was from 6 degrees to 30 degrees (mean 19.1 degrees) before operations. The operations were performed from 1 to 3 days after injuries. The function of the carpal joints and the bone healing conditions were evaluated after operations. **RESULTS:** All cases were followed up for 4-24 months (mean 13.1 months). No complications such as pin loosening dislocation of fixators, injury of blood vessels and radial nerves, pin track infections occurred. According to McBride scoring, the results were excellent in 10 cases, good in 13 cases, fair in 3 cases and poor in 1 case, the excellent and good rate being 85.2%. One case had traumatic arthritis and 1 case had wrist joint stiffness. All achieved fractures union 8-10 weeks (mean 9.3 weeks) after operations. The palmar inclination angle was from 0 degree to 20 degrees (mean 13.40 degrees); the ulnar deviation angle was from 10 degrees to 33 degrees (mean 22.1 degrees) after operations. **CONCLUSION:** Treatment of unstable fractures of the distal radius by use of leverage reduction and bone graft with external fixator offers many advantages, such as simple operation, satisfactory reduction, rigid fixation, excellent function and lower incidence rate of traumatic arthritis.

J Am Acad Orthop Surg. 2008 Apr;16(4):228-36.

Congenital pseudarthrosis of the tibia.

Vander Have KL, Hensinger RN, Caird M, Johnston C, Farley FA.

Congenital pseudarthrosis of the tibia is characterized by anterolateral deformity of the tibia and shortening of the limb. Its etiology remains unclear. Although several classification systems have been proposed, none provides specific guidelines for management. Treatment remains challenging. The goal is to obtain and maintain union while minimizing deformity. The basic biologic considerations with surgical intervention include resection of the pseudarthrosis and bridging of the defect with stable fixation. Intramedullary stabilization, free vascularized fibula, and Ilizarov external fixation are among the most frequently used methods of treatment. In addition, bone morphogenetic protein recently has shown promise. Nevertheless, despite improvements in healing rates with congenital pseudarthrosis of the tibia, the potential for amputation in failed cases persists.

J Biomed Mater Res B Appl Biomater. 2008 Apr 3 [Epub ahead of print]

Efficacy of titanium dioxide photocatalyst for inhibition of bacterial colonization on percutaneous implants.

Oka Y, Kim WC, Yoshida T, Hirashima T, Mouri H, Urade H, Itoh Y, Kubo T.

Department of Orthopaedics, Graduate School of Medical Science, Kyoto Prefectural University of Medicine, Kyoto 602_8566, Japan.

The purpose of this study was to evaluate the efficacy of titanium dioxide photocatalyst in inhibition of bacterial colonization on percutaneous implants. Titanium dioxide photocatalyst was prepared by direct oxidization of pure titanium substrate, and a comparative study with pure titanium was performed. The bactericidal ability of the photocatalyst was examined using methicillin-resistant *Staphylococcus aureus* (MRSA) suspensions in a colony-forming assay according to the Japanese Industrial Standards committee standard. After exposing the MRSA suspension on sample plates to ultraviolet A (UVA) light, the number of surviving bacteria was estimated. Next, an animal model for inhibition of colonization was examined in vivo. Pins were inserted into the femurs of rabbits, were infected with 10(8) colony-forming units of MRSA suspension, and were illuminated with UVA light for 60 min daily; the number of colonizing bacteria was estimated after 7 days. The bactericidal ability of the photocatalyst was apparent after 60 min, when the bacteria had almost disappeared. The number of colonizing bacteria on photocatalytic pins was decreased significantly in vivo. The photocatalyst was effective even against resistant bacterial colonization. Clinically, the incidence of percutaneous implant infection such as pin tract infection in external fixation could be reduced using the titanium photocatalyst. (c) 2008 Wiley Periodicals, Inc. J Biomed Mater Res Part B: Appl Biomater, 2008.

Vestn Rentgenol Radiol. 2007 Mar-Apr;(2):23-6.

[Role of computed tomography in the estimation of the density of the bony block of an injured vertebral column segment at different stages of treatment with an external transpedicular fixation apparatus]

A Somatom AR.

HP computed tomograph (Siemens) was used to make studies in 54 patients with injury to the vertebral column and spinal cord in order to determine the formation of a bony block and its density in different portions of an injured segment at the stages of treatment. During therapy, the highest values of bony block density were observed in the dorsal portions of an injured segment (mean 377.32 +/- 184.57 HU). This may be accounted for by a slight effect of artefacts of an external transpedicular fixation apparatus, the main components of which are present at the posterior supporting complex. After treatment, the highest values of bony block density were noted in the central portions of an injured segment (mean 353.11 +/- 208.01 HU). This may be associated with rather serious intervertebral disk damage in this portion. The bony block density index was 339.75 +/- 139.41 HU in the left lateral portions and as high as 312.56 +/- 135.07 HU in the right ones. In the late period, the highest bony block density index (mean 397 +/- 193.07 HU) was seen in the right portions of an injured segment, which may be due to slight scoliotic deformity with the angle being open to the right.

J Pediatr Orthop. 2008 Apr-May;28(3):314-9.

The effect of circular external fixation on limb alignment.

Sabharwal S, Badarudeen S, McClemens E, Choung E.

From the Department of Orthopedics, UMDNJ-New Jersey Medical School, Newark, NJ.

INTRODUCTION: A full-length standing radiograph of the entire lower extremity is the standard imaging modality for assessing lower limb alignment. However, the effect of an overlying circular external fixator

on the radiographic alignment of the lower extremity is not well documented. **METHODS:** After correction of angular deformity using a circular external fixator, 29 patients (31 limbs) underwent 2 sets of full-length standing radiographs, one done before, and the other, after removal of the fixator. The difference in the measurement of frontal plane alignment, limb lengths, and rotation between the 2 radiographs was analyzed. **RESULTS:** The mean absolute difference in the measurement of mechanical axis deviation (MAD) between the 2 radiographs was 11.5 mm ($P < 0.0001$) for the ipsilateral limb (with the external fixator) and 8.9 mm ($P < 0.0001$) for the contralateral limb. The mean difference in the radiographic measurement of limb lengths was 20 mm ($P < 0.0001$) for the ipsilateral and 20.2 mm ($P < 0.0001$) for the contralateral limb. As the magnitude of MAD and external rotation of the ipsilateral limb increased, a progressive increase in the magnitude of discrepancy in the measurement of MAD between the 2 sets of radiographs was noted. There was no significant effect ($P > 0.05$) of the patient's age, sex, body mass index, primary diagnosis, duration between the 2 radiographs, and the direction of malalignment found on the discrepancy in the measurement of MAD for both limbs. **CONCLUSIONS:** The standing full-length radiograph with an overlying circular external fixator may not be a reliable indicator of limb alignment and length of the operated extremity. Moreover, the presence of the circular external fixator on the lower extremity can affect the alignment and length of the opposite limb. Clinicians using circular external fixators for lower extremity trauma and reconstruction should be aware of the pitfalls of using a full-length standing radiograph for assessing limb alignment and length during osseous healing. **LEVEL OF EVIDENCE:** Diagnostic level II.

J Orthop Trauma. 2008 Feb;22(2):138-41.

A technique for nailing severely shortened and displaced tibia fractures.

Krause PC, Whatley AN, Mautner JF.

Louisiana State University, Department of Orthopaedic Surgery, New Orleans, Louisiana 70112, USA.

pckrause@post.harvard.edu

Previously described techniques using external fixators or large distractors can simplify the closed nailing of tibia fractures and nonunions. However, delayed intramedullary nailing can be especially challenging when significant shortening or translation has occurred. We present a modification of an old technique for external fixator-assisted closed tibial nailing in these difficult cases.

J Orthop Trauma. 2008 Feb;22(2):126-30; discussion 130-1.

Reuse of external fixation components: a randomized trial.

Sung JK, Levin R, Siegel J, Einhorn TA, Creevy WR, Tornetta P 3rd.

Boston Medical Center, Boston, MA 02118, USA.

OBJECTIVES: External fixation devices are sold in the United States as single-use devices and can be costly. Approved processes for refurbishment of nonimplantable components are available. We evaluated one such program for safety, efficacy, and fiscal ramifications. **DESIGN:** Randomized clinical trial **SETTING:** Single center, Level I trauma center **PATIENTS/PARTICIPANTS:** During the 30-month enrollment period (November 16, 2001 to May 16, 2004), 41 patients (13%) of 315 patients were not able to consent and were excluded. A total of 178 (65%) of the 274 eligible patients who were offered entry into a randomized trial of new versus refurbished external fixation components for their injury refused to participate, leaving 96 (35%) of the 274 eligible patients entered into the study. **INTERVENTION:** Consented patients were entered into a trial of new versus refurbished nonimplantable external fixation components for their injury (all pins were new). **MAIN OUTCOME MEASUREMENTS:** The frames were evaluated at the time of removal for efficacy and the complications of pin tract infections, loss of fixation, or loosening of components. **RESULTS:** A total of 48 distal radius fractures, 29 pilon fractures, and 19 tibial plateau fractures were entered into the study. With the 96 fractures treated in our study (50 new frames, 46 reused frames), we found no statistical differences in the incidence of pin tract infections (46% versus 52%, $P=0.32$), loss of fixation (4% versus 4%, $P=0.70$), or loosening of the components (1% versus 1%, $P=1.0$). **CONCLUSIONS:** Sixty-five percent of consentable patients did not wish to have an external fixation frame with refurbished clamps. Our study demonstrated that this type of program is safe and effective with an actual cost savings of \$65,452. The potential savings of such a program is 25% of the cost of all new frames.

Foot Ankle Int. 2008 Mar;29(3):334-41.

A biomechanical comparison of micromotion after ankle fusion using 2 fixation techniques: intramedullary arthrodesis nail or Ilizarov external fixator.

Fragomen AT, Meyers KN, Davis N, Shu H, Wright T, Rozbruch SR.

Hospital for Special Surgery, 535 East 70th Street, New York, NY 10021. FragomenA@hss.edu.

BACKGROUND: In difficult ankle arthrodesis situations, intramedullary (IM) arthrodesis nails and external fixation are often considered in lieu of standard fusion techniques. The purpose of this study was to compare the amount of micromotion measured across an ankle fusion site stabilized with either an IM nail or with the Ilizarov external fixator. **MATERIALS AND METHODS:** The relative bone mineral density of 8 pairs of human cadaveric lower legs was measured by DEXA scanning. One specimen from each pair was randomly assigned to be stabilized with a new generation IM nail and the other with an Ilizarov external fixator. Specimens were tested in compression, rotation, and dorsiflexion. Optical motion capture was used to measure the direct motion occurring at the fusion site. **RESULTS:** No significant difference was found between the axial displacements ($p = 0.94$), torsional displacement ($p = 0.07$), or the dorsiflexion angular displacement ($p = 0.28$) for the IM rod group and the external fixation group. A weak correlation was found between BMD and displacement. **CONCLUSION:** Both the new generation IM nail and the Ilizarov external fixator imparted excellent stability to the fusion site despite a wide range of bone mineral densities. Medialization of the talus, the ability to compress the nail, and the addition of a posterior-to-anterior locking screw were thought to improve the performance of the nail. **CLINICAL RELEVANCE:** Both IM nail and Ilizarov external fixation provided excellent fusion site stability. The decision of which implant to use for complex arthrodesis should be dictated by the clinical needs.

Clin Podiatr Med Surg. 2008 Apr;25(2):285-299.

Treatment of Displaced Intra-Articular Calcaneal Fractures with Triangular Tube-to-Bar External Fixation: Long-Term Clinical Follow-Up and Radiographic Analysis.

Roukis TS, Wünschel M, Lutz HP, Kirschner P, Zgonis T.

Limb Preservation Service, Vascular/Endovascular Surgery Service, Department of Surgery, Madigan Army Medical Center, 9040-A Fitzsimmons Avenue, MCHJ-SV, Tacoma, WA 98431, USA.

Sixty-six feet (62 patients) with displaced intra-articular calcaneal fractures underwent manual reduction and distraction with the use of a triangular tube-to-bar external fixation device and were retrospectively reviewed at a minimum of 1-year post-operative. Final radiographic follow-up revealed complete consolidation in all fractures, maintenance of reduction, and limited degenerative osteoarthritis about the subtalar joint. Our results indicate that with proper application and attention to detail, restoration of calcaneal morphology using triangular tube-to-bar external fixation should be considered a viable alternative in the treatment of displaced intra-articular fractures of the calcaneus.

Clin Podiatr Med Surg. 2008 Apr;25(2):277-84.

Circular external fixation for the midshaft and distal tibial fractures: a report on healing times.

Marin LE, Caban G, Thompson S, Zgonis T.

Palmetto General Hospital, 7150 W 20th Avenue, Suite 114, Hialeah, FL 33016, USA.

Circular external fixation for the treatment of any tibio-fibular fracture should be taken into consideration as a versatile, minimally invasive technique. Patients should be given this option (when indicated) as one of their fixation alternatives. The healing times we reported are comparable to IM nailing healing times in the mentioned article. Further studies with outcome scores, complications, and long-term outcomes are necessary for circular external fixation in the treatment of tibial fractures.

J Hand Surg [Am]. 2008 Mar;33(3):322-6.

Biomechanical characteristics of nonbridging external fixators for distal radius fractures.

Yamako G, Ishii Y, Matsuda Y, Noguchi H, Hara T.

Venture Business Laboratory, Niigata University, Niigata City, Niigata, Japan. yamako@gs.niigata-u.ac.jp

PURPOSE: Nonbridging external fixation is becoming popular for distal radius fractures, although its biomechanical characteristics have not been documented. This study evaluated the biomechanical characteristics of nonbridging external fixators for distal radius fractures. **METHODS:** We tested 3 currently available nonbridging fixators (F-Wrist fixator, Hoffman II Compact, and Pennig Dynamic Wrist Fixator) and determined their relative stiffness under axial compression, torsion, and bending moments (dorsal, volar, radial, and ulnar aspects) using a uniform unstable distal radius fracture model. The contact pressure and its total load on the fracture plane were also measured to evaluate the mechanical stimuli at

the stable fracture site using a pressure-sensitive conductive rubber sensor. RESULTS: Differences were observed in the stiffness: the Pennig fixator was the stiffest, whereas the F-Wrist fixator was the least rigid. The total load transmitted from the wrist joint to the fracture plane depended on the fixator stiffness in axial compression. CONCLUSIONS: By determining the biomechanical characteristics of nonbridging external fixators, these data may help the clinician when deciding on a particular device for nonbridging external fixation.

J Shoulder Elbow Surg. 2008 Mar 12 [Epub ahead of print]

Open intercondylar fractures of the distal humerus: Management using a mini-external fixator construct.

Chaudhary S, Patil N, Bagaria V, Harshavardhan NS, Hussain N.

Department of Orthopedics, Government Medical College, Nagpur, India.

Intercondylar fractures of the distal humerus are a challenging entity to treat. Open reduction-internal fixation with plating is well accepted as the standard treatment for these fractures, because it allows early mobilization and prevents joint stiffness. However, this technique may be associated with inferior postoperative results and a higher risk of infection in open fractures. External fixation appears to be an interesting option in such cases, where the results of open reduction-internal fixation with plating may be suboptimal. We present a bilateral uniplanar mini-external fixator construct for the treatment of open intercondylar distal humeral fractures. We managed 8 cases with this external fixation technique, with 6 of 8 patients achieving good to excellent results as determined by Cassebaum's rating system.

J Shoulder Elbow Surg. 2008 Mar 12 [Epub ahead of print]

Interposition arthroplasty of the elbow with hinged external fixation for post-traumatic arthritis.

Nolla J, Ring D, Lozano-Calderon S, Jupiter JB.

Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, MA.

This retrospective case series reviewed 9 men and 4 women (mean age, 41 years) with severe post-traumatic elbow arthrosis treated with interposition arthroplasty and temporary hinged external fixation. In 2 patients, treatment was considered to have failed because of early postoperative instability, and their results were classified as poor. The remaining 11 were followed up for a mean of 4 years (range, 1-11 years). The mean arc of flexion improved from 48 degrees before surgery to 110 degrees after surgery. The mean postoperative Broberg-Morrey score was 77 points, reflecting a mean improvement of 41 points (range, 13-68 points) and corresponding with 1 excellent, 4 good, 4 fair, and 4 poor results. Four patients had severe instability associated with bone loss of the distal humerus or trochlear notch. Interposition arthroplasty can improve elbow motion and function but at the expense of elbow stability despite hinged external fixation.

J Trauma. 2008 Mar;64(3):736-9.

Treatment of distal femur and proximal tibia fractures with external fixation followed by planned conversion to internal fixation.

Parekh AA, Smith WR, Silva S, Agudelo JF, Williams AE, Hak D, Morgan SJ.

Denver Health Medical Center, University of Colorado School of Medicine, Denver, Colorado, USA.

anandp@doctors.org.uk

PURPOSE: To evaluate healing rates and complications in patients treated with temporary external fixation (EF) and subsequent open reduction and internal fixation (ORIF) for high-energy distal femur or proximal tibia fractures. METHODS: Retrospective analysis of prospectively collected data 1999 to 2005.

Demographic data and injury severity score were obtained from medical records. Factors reviewed included perioperative complications (nonunion, postoperative infection, loss of fixation) and time to radiographic and clinical union. RESULTS: Forty-seven patients with 16 distal femur and 36 proximal tibia fractures were treated using temporary EF. Patients subsequently underwent ORIF (mean time from EF to ORIF = 5 days, range 1-23 days). Thirty-five fractures were open (Gustilo I = 8, II = 6, IIIA = 3, IIIB = 13, IIIC = 5) and 17 closed. Forty patients with 44 fractures reached 1-year follow-up. Of these, 36 patients with 40 (91%) fractures had healed both radiographically and clinically. The mean postoperative follow-up time was 14 months (range 3-68). Eight (16%) deep infections occurred, all in open fractures (Gustilo I = 2, IIIB = 3, IIIC = 3), with one patient requiring above knee amputation. Other complications included one hematoma, two malunions, one fixation failure, and one pin site infection. One patient died as a result of a stroke. CONCLUSIONS AND SIGNIFICANCE: Temporary bridging EF offers the advantage of early soft

tissue and bone stabilization without the potential local risks of immediate ORIF in severely injured soft tissues, or the potential systemic risks in a severely traumatized patient. The 16% infection rate in this study, all occurring in open fractures, falls within the reported range for grade III open fractures (15%-20%). We conclude that the initial treatment of high-energy periarticular knee fractures with bridging EF, followed by planned conversion to internal fixation is a safe option in patients who are unsuitable for initial definitive surgery.

J Pediatr Orthop B. 2008 May;17(3):152-7.

Humeral lengthening and deformity correction in Ollier's disease: distraction osteogenesis with a multiaxial correction frame.

Tellisi N, Ilizarov S, Fragomen AT, Rozbruch SR.

Hospital for Special Surgery, New York, New York, USA.

A case of Ollier's disease with deformity and shortening of the humerus is presented. Lengthening of 9 cm and deformity correction of 50 degrees were accomplished with excellent functional and cosmetic results. Unique features of this case were the use of a multiaxial correction monolateral frame and the formation of normal bone within the region of diseased Ollier's bone.

Arch Orthop Trauma Surg. 2008 Apr 16 [Epub ahead of print]

Elbow arthrolysis in severely stiff elbows.

Kayalar M, Ozerkan F, Bal E, Toros T, Ademo lu Y, Ada S.

EMOT Hospital, Izmir, Turkey, elmikro2003@yahoo.com.

INTRODUCTION: This study involves the results of open elbow arthrolysis performed on a series of patients having fixed joint contracture. PATIENTS AND METHODS: Eighteen patients were treated with open arthrolysis. Eleven patients had very severely stiff elbows (flexion arc less than 30 degrees), five patients had severely stiff elbows (31 degrees -60 degrees) and two patients had moderately stiff elbows (60 degrees -90 degrees). Fixed flexion deformity was observed in nine patients preoperatively. The mean interval between the trauma and arthrolysis was 14.8 months. The mean age was 27 years. After radiological examination, lateral Kocher incision was used on 13 patients, medial and lateral incision on 3 patients, transolecranon approach on 1 patient and anterior and posterior approach on 1 patient. External fixator was applied on four patients. Fasia lata interposition was performed in three patients. Additional procedures were as follows, bone fixation in five patients, bone grafting in two patients, nerve grafting in one patient, subcutaneous ulnar nerve transposition in three patients. The average follow-up time was 47 months. RESULTS: At the final evaluation, the mean extension deficit had improved from 55 degrees to 32 degrees . The mean end flexion increased from 81 degrees to 124 degrees postoperatively. The flexion arc of three patients in whom heterotopic ossification was excised had increased to 65 degrees . Infection was diagnosed in two patients (11%). CONCLUSION: The importance of this study is that the patients have fixed deformities and a long follow-up time. Severely stiff elbow is one of the main indications of open arthrolysis in the patients without muscle atrophy. We suggest sequential arthrolysis as an effective way to obtain good range of motion especially in severe stiff elbows as well as to maintain the ligamentous stability of the elbow joint.

Int Orthop. 2008 Apr 16 [Epub ahead of print]

Tibial lengthening using a reamed type intramedullary nail and an Ilizarov external fixator.

Kim H, Lee SK, Kim KJ, Ahn JH, Choy WS, Kim YI, Koo JY.

Department of Orthopedic Surgery, Eulji University College of Medicine, 1306 Dunsan-dong, Seo-gu, Daejeon, 302-799, South Korea.

The aim of this study was to evaluate the efficacy of tibial lengthening using a

reamed type intramedullary nail and an Ilizarov external fixator for the treatment of leg length discrepancy or short stature. This retrospective study was performed on 18 tibiae (13 patients) in which attempts were made to reduce complications. We used an Ilizarov external fixator and a nail (10 mm diameter in 17 tibiae and 11 mm in one tibia) in combination. Average limb lengthening was 4.19 cm (range, 2.5-5.5). The mean duration of external fixation was 12.58 days per centimetre gain in length, and the mean consolidation index was 40.53 (range, 35.45-51.85). All distracted segments healed spontaneously without refracture or malalignment. Gradual limb lengthening using a reamed type intramedullary nail and circular external fixation in combination was found to be reliable and effective and reduced external fixation time with fewer complications.

Int Orthop. 2008 Apr 15 [Epub ahead of print]

Management of trochanteric fractures of the femur with external fixation in high-risk patients.

Karn NK, Singh GK, Kumar P, Singh MP, Shrestha BP, Chaudhary P.

Department of Orthopaedics, B. P. Koirala Institute of Health Sciences, Dharan, Nepal, navinkarn@yahoo.com.

The aim of this prospective study was to assess the outcome of trochanteric fractures of the femur after external fixation in a group of elderly patients with high surgical risk. The study population consisted of 50 patients with trochanteric fractures of the femur and a mean age of 87 years who were classified by an anaesthetist as ASA 3 or 4 and considered not suitable for conventional fractures fixation. The fracture was fixed with an external fixator under spinal anaesthesia. The final follow-up was at 12 months. All fractures healed within 12 weeks. Superficial pin tract infection occurred in 30 patients, and fracture united with a shortening of 14 mm (5-20) in 12 patients. No implant failures or limitation of knee movements were recorded. Five patients died within 1 year. External fixation is a valuable treatment alternative for trochanteric fracture of the femur in elderly patients.

Injury. 2008 Apr;39(4):485-90. Epub 2008 Feb 14.

Cadaver specimens investigation of three articulated external fixator types for the human ankle joint An experimental study from the external fixation working group from German chapter of the AO/ASIF.

Schmickal T, Hoentzsch D, Wentzensen A.

Klinikum Neumarkt i.d. Opf, Germany; Trauma Clinic Tuebingen, Berufsgenossenschaftliche Unfallklinik Tuebingen, Germany.

Injury. 2008 Apr;39(4):395-403. Epub 2007 Dec 3.

Pathological fractures in primary bone sarcomas.

Papagelopoulos PJ, Mavrogenis AF, Savvidou OD, Benetos IS, Galanis EC, Soucacos PN. First Department of Orthopaedics, Athens University Medical School, Athens, Greece.

Pathological fractures in patients with primary bone sarcomas should not be considered an absolute indication for amputation. Initial fracture management should include cast immobilisation or external fixation avoiding tumour-cell dissemination. The extent of fracture displacement and the type of fracture stabilisation may affect the outcome of patients with primary bone sarcomas presenting with pathological fractures. Patients with high-grade primary bone sarcomas should be treated by neo-adjuvant chemotherapy, and limb-salvage surgery. Pathological fractures in chemo-resistant primary bone sarcomas are a relative contraindication for limb salvage surgery.

J Am Acad Orthop Surg. 2008 Apr;16(4):228-36.

Congenital pseudarthrosis of the tibia.

Vander Have KL, Hensinger RN, Caird M, Johnston C, Farley FA.
 Congenital pseudarthrosis of the tibia is characterized by anterolateral deformity of the tibia and shortening of the limb. Its etiology remains unclear. Although several classification systems have been proposed, none provides specific guidelines for management. Treatment remains challenging. The goal is to obtain and maintain union while minimizing deformity. The basic biologic considerations with surgical intervention include resection of the pseudarthrosis and bridging of the defect with stable fixation. Intramedullary stabilization, free vascularized fibula, and Ilizarov external fixation are among the most frequently used methods of treatment. In addition, bone morphogenetic protein recently has shown promise. Nevertheless, despite improvements in healing rates with congenital pseudarthrosis of the tibia, the potential for amputation in failed cases persists.

J Bone Joint Surg Br. 2008 Apr;90-B(4):488-493.

Refracture after Ilizarov osteosynthesis in atrophic-type congenital pseudarthrosis of the tibia.

Cho TJ, Choi IH, Lee SM, Chung CY, Yoo WJ, Lee DY, Lee JW.
 Department of Orthopaedic Surgery, Seoul National University Children's Hospital, 28 Yeongeon-dong Jongno-gu, Seoul 110-744, Korea.

We investigated patterns of refracture and their risk factors in patients with congenital pseudarthrosis of the tibia after Ilizarov osteosynthesis. We studied 43 cases in 23 patients. Temporal and spatial patterns of refracture and refracture-free survival were analysed in each case. The refracture-free rate of cumulative survival was 47% at five years and did not change thereafter. Refracture occurred at the previous pseudarthrosis in 16 of 19 cases of refracture. The risk of refracture was significantly higher when osteosynthesis was performed below the age of four years, when the tibial cross-sectional area was narrow, and when associated with persistent fibular pseudarthrosis. Refracture occurs frequently after successful osteosynthesis in these patients. Delaying osteosynthesis, maximising the tibial cross-sectional area and stabilising the fibula may reduce the risk of refracture.

J Cell Physiol. 2008 Apr;215(1):265-75.

Exercise running and tetracycline as means to enhance skeletal muscle stem cell performance after external fixation.

Shefer G, Carmeli E, Rauner G, Yablonka-Reuveni Z, Benayahu D.
 Department of Cell and Developmental Biology, Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel.

Prolonged limb immobilization, which is often the outcome of injury and illness, results in the atrophy of skeletal muscles. The basis of muscle atrophy needs to be better understood in order to allow development of effective countermeasures. The present study focused on determining whether skeletal muscle stem cells, satellite cells, are directly affected by long-term immobilization as well as on investigating the potential of pharmacological and physiological avenues to counterbalance atrophy-induced muscle deterioration. We used external fixation (EF), as a clinically relevant model, to gain insights into the relationships between muscle degenerative and regenerative conditions to the myogenic properties and abundance of bona fide satellite cells. Rats were treated with tetracycline (Tet) through the EF period, or exercise trained on a treadmill for 2 weeks after the cessation of the atrophic stimulus. EF induced muscle mass loss; declined expression of the muscle specific regulatory factors (MRFs) Myf5, MyoD, myogenin, and also of satellite cell numbers and myogenic differentiation aptitude. Tet enhanced the expression of MRFs, but did not prevent the decline of the satellite cell pool. After exercise running, however, muscle mass, satellite cell numbers (enumerated through the entire length of myofibers), and myogenic

differentiation aptitude (determined by the lineal identity of clonal cultures of satellite cells) were re-gained to levels prior to EF. Together, our results point to Tet and exercise running as promising and relevant approaches for enhancing muscle recovery after atrophy. (c) 2007 Wiley-Liss, Inc.

J Trauma. 2008 Apr;64(4):975-81.

Evaluation of a novel, nonspanning external fixator for treatment of unstable extra-articular fractures of the distal radius: biomechanical comparison with a volar locking plate.

Strauss EJ, Banerjee D, Kummer FJ, Tejwani NC.

Department of Orthopedic Surgery, NYU-Hospital for Joint Diseases, New York, New York, USA. ericstraussmd@gmail.com

PURPOSE: To compare the stability of a novel, nonspanning external fixator with a standard volar locked plate for treatment of unstable distal radius fractures.

METHODS: A simulated, unstable, extra-articular distal radius fracture was created in six matched pairs of fresh frozen human distal radii. One of each pair was treated with a nonspanning external fixator [Mirza Cross Pin Fixator (CPX), A.M. Surgical Inc. Smithtown, NY] and the other was treated with a volar locked plate [Distal Volar Radial Plate (DVR), Hand Innovations, Miami, FL]. Each specimen was axially loaded in central, dorsal, and volar locations, loaded in cantilever bending in volar to dorsal, dorsal to volar, and radial to ulnar directions and loaded in torsion. Load-displacement curves were generated to determine the construct stiffness for each loading schema, with comparisons made between the two treatment groups. Specimens were then cyclically loaded with 50 N axial loads applied for 1,000 and 10,000 cycles. Measurement of construct stiffness was repeated and comparisons made both between the two treatments and within treatments to their precycling stiffness. **RESULTS:** There was no significant difference in the mechanical stiffness of the nonspanning external fixator and the volar locking plate after axial loading in any of the loading modalities. Cyclic loads of 1,000 and 10,000 cycles resulted in no significant difference in construct stiffness between the nonspanning external fixator and volar locked plate. However, the nonspanning external fixator demonstrated decreasing stiffness after cyclic loading with 10,000 cycles ($p < 0.02$).

CONCLUSION: This study demonstrated no significant difference in the mechanical stiffness of the CPX nonspanning external fixator and volar locked plate in a cadaveric fracture model. Both constructs appear to be biomechanically equivalent in this experimental model; however, this is only one factor in the choice of fixation device for the management of unstable distal radius fractures.

Clin Biomech (Bristol, Avon). 2008 Mar;23(3):329-33. Epub 2007 Nov 7.

Weight bearing after tibial fracture as a guide to healing.

Joslin CC, Eastaugh-Waring SJ, Hardy JR, Cunningham JL.

Winford Unit, Avon Orthopaedic Centre, Southmead Hospital, Bristol BS10 5NB, UK.

BACKGROUND: Judging when it is safe to remove an external fixator or plaster cast requires clinical and radiological assessment, both of which are subjective.

Weight bearing has been shown to increase with time post-fracture and we hypothesised that it could be used as an objective measure of fracture healing.

METHODS: Ground reaction force (and hence weight bearing) and fracture stiffness were measured serially in a group of 12 patients with tibial fractures treated by external fixation. Ground reaction force was measured for both fractured and non-fractured limbs using a force plate and the fracture stiffness was measured using the Orthometer, a commercially produced device for measuring the stiffness of fractures treated by external fixation. **FINDINGS:** In 10 patients who made good recoveries, prior to fixator removal, weight bearing through the injured leg was seen to approach 90% of that through the uninjured leg and the fracture stiffness exceeded 15 Nm/deg. Two patients with delayed union achieved weight bearing of

40% of normal and a fracture stiffness of less than 5 Nm/deg at 20 weeks.
INTERPRETATION: Weight bearing correlates reasonably well with fracture stiffness. It is quicker and easier to measure than fracture stiffness and potentially has relevance to other fracture fixation methods.

Foot Ankle Clin. 2008 Mar;13(1):123-43, vi.

Hindfoot salvage with external fixation.

Thabet AM, Kupcha PC.

Orthopedics Department, Benha Medical School, Benha University, Egypt.

ahmed_thabetortho@yahoo.com <ahmed_thabetortho@yahoo.com>

Hindfoot salvage procedures by definition present circumstances requiring extraordinary measures to prevent or limit damage or destruction. Although this technique is used at some centers as the only means of correcting and fixing foot and ankle deformities, it is an expensive procedure. Other available methods may be more expeditious depending on the circumstances. However, the benefits of external fixation in certain circumstances are invaluable. Circular frame external fixators are important tool for the foot and ankle surgeon.

Foot Ankle Clin. 2008 Mar;13(1):69-121, vi.

Perioperative planning for two- and three-plane deformities.

Taylor JC.

jctaylornd@mindspring.com <jctaylornd@mindspring.com>

Primary multiplanar external fixation is efficacious for a variety of fractures and may avoid a salvage situation. Complex deformity in conjunction with fractures, nonunions, and malunions can be measured and corrected with the Taylor Spatial Frame using the chronic and especially the total residual correction methods. Distal referencing-characterizing a deformed proximal fragment with respect to a normal distal fragment-is very useful in most lower-limb salvage cases. Corrections may be performed in stages using way points, and additional total residual corrections may be performed as needed. The same frame and analysis used for gradual correction may be used in conjunction with intramedullary nailing or plating in some cases.

Foot Ankle Clin. 2008 Mar;13(1):15-27,v.

The basics of ring external fixator application and care.

Beaman DN, Gellman R.

Summit Orthopaedics, LLP, 501 North Graham Street, Suite 250, Portland, OR 97227,

USA. dbeaman@gorge.net <dbeaman@gorge.net>

The advantages of ring external fixation for correction of complex deformities of the foot and ankle include the ability to correct severe deformity, perform gradual correction, modify treatment during correction, and minimize neurovascular damage. External fixation can provide opportunities to operate on scarred and contracted tissues, preserve joints and joint function, maintain or gain foot length, and allow weight bearing during treatment.

Foot Ankle Clin. 2008 Mar;13(1):1-13, v.

Simple solutions for difficult problems: a beginner's guide to ring fixation.

Pinzur MS.

Loyola University Medical Center, 2160 South First Avenue, Maywood, IL 60153,

USA. mpinzul@lumc.edu <mpinzul@lumc.edu>

Ring external fixation is a surgical method for leg lengthening and deformity correction. It allows limited surgical exposure and dissection and can be tolerated for prolonged periods as compared to threaded uniplanar or multiplanar constructs. Because of the complexity in application and adjustment of the frame constructs, most orthopedic surgeons avoid using these devices. Surgeons are advised to apply these techniques initially to less complicated clinical

situations, expanding application with comfort and proficiency. This discussion introduces ring fixation and provides guidelines for simple applications. Experience with these simple applications allows surgeons to expand their spectrum of proficiency and provides alternatives for solving complex clinical problems.

Foot Ankle Int. 2008 Mar;29(3):334-41.

A biomechanical comparison of micromotion after ankle fusion using 2 fixation techniques: intramedullary arthrodesis nail or Ilizarov external fixator.

*Fragomen AT, Meyers KN, Davis N, Shu H, Wright T, Rozbruch SR.
Hospital for Special Surgery, 535 East 70th Street, New York, NY 10021.
FragomenA@hss.edu.*

BACKGROUND: In difficult ankle arthrodesis situations, intramedullary (IM) arthrodesis nails and external fixation are often considered in lieu of standard fusion techniques. The purpose of this study was to compare the amount of micromotion measured across an ankle fusion site stabilized with either an IM nail or with the Ilizarov external fixator. **MATERIALS AND METHODS:** The relative bone mineral density of 8 pairs of human cadaveric lower legs was measured by DEXA scanning. One specimen from each pair was randomly assigned to be stabilized with a new generation IM nail and the other with an Ilizarov external fixator. Specimens were tested in compression, rotation, and dorsiflexion. Optical motion capture was used to measure the direct motion occurring at the fusion site. **RESULTS:** No significant difference was found between the axial displacements ($p = 0.94$), torsional displacement ($p = 0.07$), or the dorsiflexion angular displacement ($p = 0.28$) for the IM rod group and the external fixation group. A weak correlation was found between BMD and displacement. **CONCLUSION:** Both the new generation IM nail and the Ilizarov external fixator imparted excellent stability to the fusion site despite a wide range of bone mineral densities. Medialization of the talus, the ability to compress the nail, and the addition of a posterior-to-anterior locking screw were thought to improve the performance of the nail. **CLINICAL RELEVANCE:** Both IM nail and Ilizarov external fixation provided excellent fusion site stability. The decision of which implant to use for complex arthrodesis should be dictated by the clinical needs.

J Bone Joint Surg Am. 2008 Mar;90(3):560-4.

The safety of forefoot metatarsal pins in external fixation of the lower extremity.

*Barrett MO, Wade AM, Della Rocca GJ, Crist BD, Anglen JO.
Anderson Orthopaedic Research Institute, 2501 Parkers Lane, Alexandria, VA 22306,
USA. barrettmat@yahoo.com*

BACKGROUND: External fixation is widely used for trauma and reconstruction of the lower extremity. External fixator devices spanning the ankle or portions of the foot often utilize pins placed across the metatarsal bases. While this forefoot fixation is occasionally necessary to achieve reduction and alignment, it is also useful to prevent an equinus contracture. We undertook an anatomical study to evaluate the safety of pins placed across the bases of the first and second metatarsals, spanning the first intermetatarsal space. **METHODS:** Under fluoroscopy, a single 4.0-mm Schanz pin was advanced percutaneously from medial to lateral across the bases of the first and second metatarsals in ten cadaver feet. This was accomplished in a fashion identical to the application of typical forefoot external fixation as described in the literature. Specimens were then dissected. Injury to the deep plantar branch of the dorsalis pedis artery, when present, was recorded. When injury was not present, the distance from the pin to the deep plantar branch was recorded. **RESULTS:** In five of the ten feet, the deep plantar branch of the dorsalis pedis artery was lacerated by the transmetatarsal pin. In

four feet, the pin contacted the artery but did not visibly damage it. In the remaining foot, the pin was noted to be only 4 mm from the artery. Any pin with a starting point within 18 mm of the first metatarsocuneiform joint placed the artery at risk. **CONCLUSIONS:** Placement of external fixation pins through the proximal bases of the first and second metatarsals, within 2 cm of the first tarsometatarsal joint, consistently places the deep plantar branch of the dorsalis pedis artery at risk. Given the clinical importance of this artery, transmetatarsal pinning in this fashion is not advised. Other methods of obtaining forefoot or midfoot external fixation are recommended in order to avoid vascular injury.

J Foot Ankle Surg. 2008 Mar-Apr;47(2):172-4.

A technique to protect external fixation devices.

Bevilacqua NJ, Dankert JP, Rogers LC, Armstrong DG.

Foot and Ankle Surgery/Amputation Prevention Center, Broadlawns Medical Center, Des Moines, IA 50314, USA. nicholas.bevilacqua@gmail.com

The indications for external fixation in foot and ankle surgery are expanding and now include the use on patients with significant comorbidities. Protecting the contralateral limb from inadvertent injury is important especially in patients with diabetes where the contralateral limb is already "at risk". The authors describe a simple and inexpensive technique to protect the external fixator and the contralateral limb from potential injury.

J Orthop Trauma. 2008 Mar;22(3):183-9.

Combined single-stage osseous and soft tissue reconstruction of the tibia with the Ilizarov method and tissue transfer.

McKee MD, Yoo DJ, Zdero R, Dupere M, Wild L, Schemitsch EH, Mahoney J. Division of Orthopaedics, St. Michael's Hospital and the University of Toronto, Toronto, Ontario, Canada. mckeem@smh.toronto.on.ca

OBJECTIVE: To determine the outcome of single-stage soft tissue and osseous reconstruction using the Ilizarov method and soft-tissue transfer. **DESIGN:** A retrospective review. **SETTING:** A university-affiliated, tertiary-care center. **PATIENTS/INTERVENTION:** We identified 11 patients from a retrospective review from January 1994 to July 1999 who underwent single-stage soft tissue and osseous reconstruction using the Ilizarov method. All 11 patients had an initial traumatic mechanism to their tibia and had previous operative intervention before the combined procedure. The Ilizarov procedure was performed for infected tibial nonunion (8 cases), or complex fracture with soft-tissue loss (3 cases). **MAIN OUTCOME MEASUREMENTS:** Soft tissue transplant survival, union, range of motion, leg length discrepancy, the Association for the Study and Application of the Method of Ilizarov (ASAMI) score, radiographic parameters. **RESULTS:** There were 8 concomitant free tissue flaps and 3 local pedicled flaps. Two patients had primary bone grafting, and 5 others had addition of an antibiotic impregnated bone substitute. There were 8 cases of elective reconstructive surgery and 3 cases of acute traumatic fracture. The mean duration of Ilizarov application was 26 weeks (range, 7 to 42). Eight tibiae united primarily, and 3 healed after delayed bone grafting. There were 2 major flap complications. Both were successfully managed with repeat surgery. One patient sustained a repeat open fracture and subsequently received an amputation. According to the ASAMI score, there were 9 excellent results, 1 good result, and 1 poor result. **CONCLUSION:** Our study suggests that concomitant osseous and soft-tissue reconstruction with the Ilizarov technique and free or pedicled flaps is a viable option for patients with composite tissue defects.

Prosthet Orthot Int. 2008 Mar;32(1):50-6.

First ray reconstruction with distraction osteogenesis.

Kömürçü M, Kürklü M, Demiralp B, Atesalp AS, Alsancak S, Basbozkurt M. Gülhane Military Medical Academy, Department of Orthopedic and Traumatology, Ankara, Turkey.

Disarticulation of the thumb at the metacarpophalangeal joint level is not beneficial either aesthetically or functionally without additional surgery because it requires a bulky and an unacceptable prosthesis to be made for this amputation level. In this study, the authors have presented our experience of 12 metacarpal distractions in thumb amputated patients. Twelve male patients who had thumb amputation due to gunshot wounds were included in the study. Before the operation, aesthetic hand prostheses were made for 5 of the 12 patients. Callus distraction was performed with the use of a mini Ilizarov type external fixator in 7 cases and uniplanar dynamic mini external fixator in 5 cases too. External fixators were removed after the completion of the radiographic consolidation. Five patients whose prosthesis had been made before the operation wore their prosthesis for an average 6.8 months (5 - 14) due to poor appearance and poor construction. Union of the lengthened segment was observed in all cases. Average lengthening was 28.9 mm (range from 25 - 37). Average healing time was 2.1 months (range from 1.8 - 2.5). Average healing index was 0.73 month/cm (range from 0.65 - 0.88). Pin tract infection was seen in 7 cases (58.3%). Volar angulation developed after removing the external fixator in 1 case. Webplasty was performed in all cases. Patients were evaluated by means of Disability of the Arm, Shoulder and Hand (DASH) score and pick-up test. It was concluded that the metacarpus lengthening by callus distraction technique may be a functionally and cosmetically effective reconstruction method for traumatic thumb amputations. It is believed that the possibility for a functionally and aesthetically acceptable fabrication of a thumb prosthesis, by providing a suction suspension with distraction and/or webplasty procedures.

Arch Orthop Trauma Surg. 2008 Feb 23 [Epub ahead of print]

Histology of the regenerate and docking site in bone transport.

Garcia FL, Picado CH, Garcia SB.

Department of Biomechanics, Medicine and Rehabilitation of the Locomotor System, Faculty of Medicine of Ribeirão Preto, University of São Paulo, Av. Bandeirantes, 3900, Ribeirão Preto, SP, 14048-900, Brazil.

INTRODUCTION: Bone transport is based on the principle of distraction osteogenesis described by Ilizarov and is a consecrated method for the treatment of segmental bone defects. One of its most problematic and, paradoxically, least studied aspects is the consolidation of the docking site. We studied histologically the ossification of the docking site and regenerate to determine any difference between them. **MATERIALS AND METHODS:** Nine adult sheep were submitted to correction of a 1-cm tibial diaphyseal defect using a system of plate-fixed bone transport, with latency period of 1 week and 0.2 mm distraction of the transported segment four times a day. The sheep were divided into three groups of three animals each, according to the observation period of 3, 6 or 12 weeks between the fixation of the transported fragment and the euthanasia. The docking site and the regenerate were studied histologically on sections stained with Masson trichrome. **RESULTS:** The main mode of docking site ossification was the endochondral one and although intramembranous ossification was also observed simultaneously, it was limited to rare and small foci. In contrast, intramembranous ossification played the major role in the regenerate, with bone formation evolving from the base segment to the target segment. **CONCLUSION:** The experimental bone transport model proposed in the present study permits us to conclude that there is a clear difference between the ossification of the docking site and of the regenerate.

J Biomed Mater Res B Appl Biomater. 2008 Feb 19 [Epub ahead of print]

A biomechanical and histological analysis of standard versus hydroxyapatite-coated pins for external fixation.

Moroni A, Cadossi M, Romagnoli M, Faldini C, Giannini S.

Rizzoli Orthopaedic Institute, University of Bologna, Bologna, Italy.

This sheep study was designed to make a comparative evaluation of two external fixation pin types each with and without hydroxyapatite (HA) coating. The two pins had different taper, pitch, and self drilling capabilities. Twenty Orthofix standard, self-tapping pins (group A), 20 Orthofix HA-coated, self-tapping pins (group B), 20 X-caliber, self-drilling, self-tapping pins (group C), and 20 X-caliber HA-coated, self-drilling, self-tapping pins (group D) were selected. Four pins were implanted in the right femurs of 20 adult sheep that were euthanized at 6 weeks. Mean pin insertion torque was 2745 +/- 822 Nmm in group A, 2726 +/- 784 Nmm in group B, 2818 +/- 552 Nmm in group C, and 2657 +/- 732 Nmm in group D (ns). Mean pin extraction torque was 1567 +/- 541 Nmm in group A, 2524 +/- 838 Nmm in group B, 1650 +/- 650 Nmm in group C, and 2517 +/- 726 Nmm in group D. HA-coated pins (group B and D) had a significantly greater mean pin extraction torque compared to similar uncoated pins (group A and C) ($p < 0.0005$). Histological analysis showed good osteointegration of the two coated pin types. This study shows that HA-coating is more important for optimal pin fixation than the particular combination of design parameters used in each pin type. (c) 2008 Wiley Periodicals, Inc. *J Biomed Mater Res Part B: Appl Biomater*, 2008.

J Biomed Mater Res B Appl Biomater. 2008 Feb 19 [Epub ahead of print]

Fibroblast growth factor-2-apatite composite layers on titanium screw to reduce pin tract infection rate.

Mutsuzaki H, Ito A, Sakane M, Sogo Y, Oyane A, Ochiai N.

Department of Orthopaedic Surgery, Institute of Clinical Medicine, Graduate School of Comprehensive Human Sciences, University of Tsukuba, 1_1_1 Tennodai, Tsukuba, Ibaraki 305_8575, Japan.

Fibroblast growth factor-2 (FGF-2)-apatite composite layers were formed on anodically oxidized titanium screws to improve bone-screw interface strength and to reduce pin tract infection rate through enhanced skin tissue healing in external fixation. A calcium-containing solution supplemented with FGF-2, a phosphate-containing solution, and a sodium bicarbonate solution were mixed at a Ca/P molar ratio of 2.0 to prepare a calcium phosphate solution supersaturated with respect to calcium phosphates. Screws were individually immersed in 10 mL of the calcium phosphate solution at 37 degrees C for 2 days. Low-crystalline apatite layers incorporating FGF-2 were formed on the screw surface at FGF-2 concentrations in the supersaturated calcium phosphate solution equal to or lower than 10 mug/mL. The amounts of FGF-2 immobilized on the screws ranged from 2.3- to 2.4-mug per screw. The immobilized FGF-2 retained biological activity, as demonstrated by NIH3T3 cell proliferation. Titanium screws with the composite layer were percutaneously implanted into the bilateral proximal tibial metaphyses in rabbits for 4 weeks. The titanium screws with the composite layer formed at the optimum FGF-2 concentration showed a significantly higher bone-screw interface strength and a lower pin tract infection rate than those without the composite layer: the extraction torque and infection rates were respectively 0.230 +/- 0.073 Nm and 43.8% for the screws with the composite layer, and 0.170 +/- 0.056 Nm and 93.8% for those without the composite layer. Therefore, titanium screws with the FGF-2-apatite composite layer are useful for improving bone-screw interface strength and infection resistance in external skeletal fixation. (c) 2008 Wiley Periodicals, Inc. *J Biomed Mater Res Part B: Appl Biomater*, 2008.

J Biomed Mater Res B Appl Biomater. 2008 Feb 6 [Epub ahead of print]

Stress corrosion cracking of an aluminum alloy used in external fixation devices.

Cartner JL, Haggard WO, Ong JL, Bumgardner JD.

Biomedical Engineering Department, Herff College of Engineering, The University of Memphis and the Joint Program in Biomedical Engineering, The University of Memphis_University of Tennessee Health Science Center_Memphis, Memphis, TN, 38152.

Treatment for compound and/or comminuted fractures is frequently accomplished via external fixation. To achieve stability, the compositions of external fixators generally include aluminum alloy components due to their high strength-to-weight ratios. These alloys are particularly susceptible to corrosion in chloride environments. There have been several clinical cases of fixator failure in which corrosion was cited as a potential mechanism. The aim of this study was to evaluate the effects of physiological environments on the corrosion susceptibility of aluminum 7075-T6, since it is used in orthopedic external fixation devices. Electrochemical corrosion curves and alternate immersion stress corrosion cracking tests indicated aluminum 7075-T6 is susceptible to corrosive attack when placed in physiological environments. Pit initiated stress corrosion cracking was the primary form of alloy corrosion, and subsequent fracture, in this study. Anodization of the alloy provided a protective layer, but also caused a decrease in passivity ranges. These data suggest that once the anodization layer is disrupted, accelerated corrosion processes occur. (c) 2008 Wiley Periodicals, Inc. *J Biomed Mater Res Part B: Appl Biomater*, 2008.

Acta Orthop. 2008 Feb;79(1):48-52.

Inferior fixation with a new pin design for external fixation: A randomized study in 50 patients operated on by the hemicallotasis technique.

Toksvig-Larsen S, W-Dahl A.

Department of Orthopedics, Lund University Hospital, Lund, Sweden.

Background and purpose Tibial osteotomy by the hemicallotasis technique (HCO) requires strong pin fixation. We compared pin fixation in HCO using a new self-drilling XCaliber pin (Orthofix) with optimized thread and tip design, with the commonly used standard pin (Orthofix). Patients and methods 50 patients, mean age 51 (35-66) years, to be treated by HCO were randomized to standard pins or XCaliber pins. In the metaphyseal bone, hydroxyapatite-coated (HA-coated) pins were used in both types of pins. In the diaphyseal bone, non-coated pins were used. The torque forces for insertion and extraction (in Nm) were measured. Results The insertion torque was higher for both the proximal and distal standard pins (2.1 Nm (SD 0.9) and 7.0 Nm (1.3), respectively) than for the XCaliber pins (1.3 Nm (0.8) and 3.6 Nm (1.4)). The extraction torque force was higher for the proximal standard pins (4.3 Nm (3.1)) than for the proximal XCaliber pins (1.5 Nm (1.7)) ($p < 0.001$). The extraction torque for the distal standard pins was 1.9 Nm (2.0) and for the distal XCaliber pins it was 1.4 Nm (1.1). Interpretation The commonly used standard pin gives stronger fixation during the treatment of HCO.

Acta Orthop Belg. 2008 Feb;74(1):109-13.

A simple external fixator for complex finger fractures.

Thomas RK, Gaheer RS, Ferdinand RD.

Dumfries and Galloway Royal Infirmary, Dumfries, United Kingdom.

thomas_rkt@yahoo.com

Complex fractures of phalangeal bones in the hand are difficult to treat.

External fixation is an effective method of treatment particularly when internal fixation is not possible due to comminution and associated soft tissue injury. A variety of commercial fixators are available for the treatment of hand fractures. However, these fixators are costly and need a sufficient degree of expertise and familiarity for their use. We describe a very simple fixator which is stable, lightweight and can be easily constructed with materials readily available in most trauma theatres.

Artif Organs. 2008 Feb;32(2):167-74.

Studies of photokilling of bacteria using titanium dioxide nanoparticles.

Tsuang YH, Sun JS, Huang YC, Lu CH, Chang WH, Wang CC.

Department of Orthopedic Surgery, Taipei City Hospital, Taipei, Taiwan.

Metal pins used to apply skeletal traction or external fixation devices protruding through skin are susceptible to the increased incidence of pin site infection. In this work, we tried to establish the photokilling effects of titanium dioxide (TiO₂) nanoparticles on an orthopedic implant with an in vitro study. In these photocatalytic experiments, aqueous TiO₂ was added to the tested microorganism. The time effect of TiO₂ photoactivation was evaluated, and the loss of viability of five different bacteria suspensions (*Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Enterococcus hirae*, and *Bacteroides fragilis*) was examined by the viable count procedure. The bactericidal effect of TiO₂ nanoparticle-coated metal plates was also tested. The ultraviolet (UV) dosage used in this experiment did not affect the viability of bacteria, and all bacteria survived well in the absence of TiO₂ nanoparticles. The survival curve of microorganisms in the presence of TiO₂ nanoparticles showed that nearly complete killing was achieved after 50 min of UV illumination. The formation of bacterial colonies above the TiO₂ nanoparticle-coated metal plates also decreased significantly. In this study, we clearly demonstrated the bactericidal effects of titanium dioxide nanoparticles. In the presence of UV light, the titanium dioxide nanoparticles can be applicable to medical facilities where the potential for infection should be controlled.

Curr Opin Pediatr. 2008 Feb;20(1):46-51.

Advances in management of limb length discrepancy and lower limb deformity.

Friend L, Widmann RF.

Hospital for Special Surgery, New York, USA.

PURPOSE OF REVIEW: Limb length discrepancy and lower extremity angular deformity are among the most common nontraumatic conditions in children for which orthopedic referral is sought. There are a number of developments in the surgical management of these problems which have facilitated and improved the quality of care of affected individuals. **RECENT FINDINGS:** In recent years, we have developed an improved understanding of ramifications of limb length discrepancy on gait. New treatment options for both limb length discrepancy and deformity include the method of 'guided growth' using small, extraphyseal plates. External fixator technology continues to improve, allowing correction of limb length discrepancy and angular and rotational deformities simultaneously. **SUMMARY:** The development of these techniques for the treatment of limb length discrepancy and angular deformity has expanded the indications for surgical management and decreased the incidence and severity of potential complications.

Foot Ankle Int. 2008 Feb;29(2):178-84.

Ankle arthrodesis using an Ilizarov external fixator in patients wounded by landmines and gunshots.

Bek D, Demiralp B, Kürklü M, Atealp AS, Bağcıoğlu M.

Gülhane Military Medical Academy, Department of Orthopedics & Traumatology, 06018, Ankara, Turkey. doganbek@hotmail.com

BACKGROUND: We evaluated the results of ankle arthrodesis performed with circular external fixators (CEF) in those patients who had developed tibiotalar arthritis secondary to a landmine or a gunshot injury. **MATERIALS AND METHODS:** Nineteen ankles in 19 patients were fused using CEF. All patients had approximately 3 (range, 1 to 5) operations for bone and soft tissue reconstruction preceding the arthrodesis. Ankle arthrodesis was performed an average of 2.3 (range, 1 to 7) years after the initial trauma. The mean age at operation was 22 (range, 20 to 31) years old and all patients were male. **RESULTS:** The average time spent in the

CEF was 3.5 (range, 2 to 7) months. The mean followup was 59 (range, 31 to 90) months. Successful arthrodesis was achieved in all patients in an acceptable position. Clinically, 6 patients were assessed as excellent, 9 patients as good, 3 patients as fair, and 1 patient had a poor result. Twelve patients reported no pain postoperatively, 4 patients reported reduced to mild and/or occasional pain, 2 patients reported moderate pain, and 1 patient reported persistent pain. Sixteen patients described their outcome as satisfactory, one was somewhat satisfied, and two were dissatisfied. There were pin track infections in 10 patients and ring sequestration in one patient. **CONCLUSION:** Patients who have degenerative ankle arthritis due to gunshot wounds and land-mine injuries with poor bone quality and soft tissue conditions at the distal tibia can be successfully managed by using CEF.

Injury. 2008 Feb;39(2):196-202. Epub 2008 Jan 31.

A retrospective analysis of comminuted intra-articular fractures of the tibial plafond: Open reduction and internal fixation versus external Ilizarov fixation.

Bacon S, Smith WR, Morgan SJ, Hasenboehler E, Philips G, Williams A, Ziran BH, Stahel PF.

Department of Orthopaedic Surgery, Denver Health Medical Centre, University of Colorado School of Medicine, Denver, CO 80204, USA.

Intra-articular fractures of the tibial plafond are complex injuries which continue to challenge orthopaedic surgeons in achieving anatomic reduction, while allowing early weight bearing and return to activity. Although a wide range of treatment options has been described for fixation of pilon fractures, the unique characteristic of each injury makes it difficult to advocate a general method of choice. We have attempted to compare a subset of AO/OTA type C pilon fractures treated either by a staged procedure of external fixation and conversion to open reduction and internal fixation (ORIF) versus definitive external Ilizarov fixation. Between 1998 and 2004, 42 patients admitted to our level 1 trauma centre underwent either procedure and were followed prospectively. Twenty-eight patients were treated with ORIF and 14 were treated by Ilizarov ring fixator. The outcome measures included time to union, as well as the rates of union, nonunion, malunion and infection. Although the ORIF group had a longer time to heal, the rates of nonunion, malunion and infection were lower compared to the Ilizarov group. However, these differences between the groups were not statistically significant. Thus, based on these results, no clinical recommendation can be made as to which procedure is better and safer for the patient. Future prospective randomised trials are required to determine with more scientific accuracy the optimal treatment strategy for these challenging injuries.

Injury. 2008 Feb;39(2):155-60. Epub 2008 Jan 29.

Management of infected nonunion of long bones: the last decade (1996-2006).

Motsitsi NS.

University of Pretoria, Department of Orthopaedic Surgery, Kalafong Hospital, Private Bag X396, Pretoria 0001, South Africa. silas.motsitsi@up.ac.za

Infected nonunion is one of the most challenging orthopaedic complications to manage. There is considerable morbidity associated with infected nonunion. There is significant impact on the life of the patient; social, financial, physical, and mental. Infected nonunion may be a limb-threatening complication. Significant progress has been made in the management of infected nonunion in the last decade. There are clear guidelines for pre-operative evaluation and treatment strategy. The recommended strategy is the 'infection-elimination first' strategy. This strategy involves two steps: control of infection by local radical debridement of dead tissue followed by reconstruction. There are four operative techniques (with considerable overlap among them) which have been used in the past decade: Ilizarov, intramedullary devices with or without the use of external fixator,

free tissue transfer, and in situ reconstruction. Bone results are, in general, better compared to functional results. Overall, the outcome following treatment of infected nonunion are good to excellent.

J Neurosurg Spine. 2008 Feb;8(2):186-92.

Two-stage decompression, reduction, and interbody fusion for lumbosacral spondyloptosis through a posterior approach using Ilizarov external fixation.

Doita M, Uno K, Maeno K, Shimomura T, Nishida K, Fujioka H, Kurosaka M.

Department of Orthopaedic Surgery, Kobe University Graduate School of Medicine, Kobe, Japan. doita@med.kobe-u.ac.jp

The suggested methods of treatment for spondyloptosis have included benign neglect, in situ fusion and variations, decompression and fusion, and vertebrectomy (the Gaines procedure). On review of the literature, the authors found no previous report in the English-language literature in which external fixation was used in the treatment of spondyloptosis. This 33-year-old woman with spondyloptosis underwent a 2-stage operation involving decompression, reduction, and posterior fusion in which an Ilizarov external fixator and transpedicular fixation system were used. Spondylolisthesis with a slippage of angle 78 degrees and > 100% slippage was partially reduced to 30 degrees and 60% without neurological alterations and without complications. The postoperative follow-up showed marked improvement in her symptoms and a good cosmetic result. Reconstructed computed tomography scanning at 18 months demonstrated complete fusion. The use of external fixation in the treatment of spondyloptosis may be preferable because of its neurological safety, despite the longer duration of treatment, than single-stage operation. The authors believe posterior decompression of the cauda equina, partial reduction of the spondylolisthetic deformity, interbody fusion, and stabilization with an external fixator and transpedicular fixation system can be successfully and safely used as a 2-stage treatment for adult high-grade spondyloptosis.

J Oral Maxillofac Surg. 2008 Feb;66(2):265-71.

Rigid versus semirigid fixation for condylar fracture: experience with the external fixation system.

Cascone P, Spallaccia F, Fatone FM, Rivaroli A, Saltarel A, Iannetti G.

Department of Craniomaxillofacial Surgery, La Sapienza University, Rome, Italy.

PURPOSE: Although mandibular condylar fractures are very common, the treatment remains controversial. Many techniques of reduction and many devices have been suggested. The purpose of this study was to evaluate the advantages and drawbacks of semirigid fixation compared with rigid fixation using an external fixation system. **PATIENTS AND METHODS:** Between 1990 and 2005, 137 patients (83 males, 54 females; median age, 24.2 years; 116 with monocondylar fracture and 21 with bicondylar fracture) were treated with an external fixation system (Mand-X-Fix, Leibinger, Germany). In these cases, the distal fragment was dislocated medially and out of the glenoid cavity (stadium IV of MacLennan). **RESULTS:** At the 12-month follow-up, 91% of treated patients regained their pretrauma occlusion with good functional results (maximum mouth opening: 100% >30 mm, 81% >35 mm, 59% >40 mm; articular pain: <2%; clicking: <7%) and morphostructural results (fragment overlap significant in 2% of cases, light in 53% of cases, and absent in 45% of cases) and a very low rate of complications in the immediate postsurgical period (temporary paresis of the facial nerve: <7%; infection of the surgical wound: <2%). No long-term facial palsy was noted. **CONCLUSION:** Our findings indicate that a semirigid fixation technique, represented by the external fixation system, seems to be a better approach to treating condylar fractures with luxation out of the glenoid fossa.

J Orthop Trauma. 2008 Feb;22(2):88-95.

Repair of tibial nonunions and bone defects with the Taylor Spatial Frame.

Rozbruch SR, Pugsley JS, Fragomen AT, Ilizarov S.

Institute for Limb Lengthening and Reconstruction Limb Lengthening and Deformity Service, Hospital for Special Surgery, Weill Medical College of Cornell University, New York, New York, USA. Rozbruchsr@hss.edu

OBJECTIVE: To investigate the outcomes of tibial nonunions and bone defects treated with the Taylor Spatial Frame (TSF) using the Ilizarov method. **DESIGN:** Retrospective. **SETTING:** Limb Lengthening and Deformity Service at an academic medical center. **PATIENTS:** Thirty-eight consecutive patients with 38 tibial nonunions were treated with the TSF. There were 23 patients with bone defects (average 5.9 cm) and 22 patients with leg-length discrepancy (LLD) (average 3.1 cm) resulting in an average longitudinal deficiency (sum of bone defect and LLD) of 6.5 cm in 31 patients (1-16). The average number of previous surgeries was 4 (0-20). At the time of surgery, 19 (50%) nonunions were diagnosed as infected. **INTERVENTION:** All patients underwent repair of the nonunion and application of a TSF. Patients with bone loss were additionally treated with lengthening. Infected nonunions were treated with 6 weeks of culture-specific antibiotics. **MAIN OUTCOME MEASUREMENTS:** Bony union, time in frame, eradication of infection, leg-length discrepancy, deformity, Short Form-36 (SF-36) scores, American Academy of Orthopaedic Surgeons (AAOS) lower-limb scores, and Association for the Study of the Method of Ilizarov (ASAMI) bone and functional results. **RESULTS:** Bony union was achieved after the initial treatment in 27 (71%) patients. The presence of bone infection correlated with initial failure and persistent nonunion ($P=0.03$). The 11 persistent nonunions were re-treated with TSF reapplication in 4, intramedullary rodding in 3, plate fixation in 2, and amputation in 2 patients. This resulted in final bony union in 36 (95%) patients. The average LLD was 1.8 cm (0-6.8) (SD 2). Alignment with deformity less than 5 degrees was achieved in 32 patients and alignment between 6 degrees and 10 degrees was achieved in 4 patients. Significant improvement of Short Form-36 (SF-36) scores was noted in physical role ($P=0.03$) and physical function ($P=0.001$). AAOS lower-limb module scores significantly improved from 56 to 82 ($P<0.001$). ASAMI bone and functional outcomes were excellent or good in 36 and 34 patients, respectively. The number of previous surgeries correlated inversely with the ASAMI bone ($P=0.003$) and functional ($P=0.001$) scores. **CONCLUSIONS:** One can comprehensively approach tibial nonunions with the TSF. This is particularly useful in the setting of stiff hypertrophic nonunion, infection, bone loss, LLD, and poor soft-tissue envelope. Infected nonunions have a higher risk of failure than noninfected cases. Treatment after fewer failed surgeries will lead to a better outcome. Internal fixation can be used to salvage initial failures.

Orthopade. 2008 Feb;37(2):143-152.

[Lower limb salvage using Pirogoff ankle arthrodesis : Minimally invasive and effective fixation with the Ilizarov external ring fixator.]

Einsiedel T, Dieterich J, Kinzl L, Gebhard F, Schmelz A.

Klinik für Unfall- und Wiederherstellungschirurgie, Klinikum Heidenheim, Schlosshausstraße 100, 89522, Heidenheim, Deutschland, thomas.einsiedel@t-online.de.

BACKGROUND: Irreversible destruction of the forefoot and midfoot generally leads to amputation. So-called limited surgical procedures such as transmetatarsal or Chopart/Syme amputations often result in poor clinical outcomes. Prostheses for these stumps are difficult to fit, a fact that reduces mobility for these patients, so reamputations are not rare. The very old method of tibiocalcaneal arthrodesis introduced by Pirogoff in 1854 can be an interesting surgical alternative in these cases, and the use of an Ilizarov external ring fixator may solve the stabilisation problem. **MATERIAL AND METHODS:** From 1 January 1990 to 1 January 2007, six patients underwent surgery for tibiocalcaneal Pirogoff

arthrodesis with an external Ilizarov ring fixator. RESULTS: All patients could be evaluated postoperatively, with a medium follow-up time of 45.8 months. Outcome was measured with a modified ankle disarticulation score. In four cases, the outcome was good or excellent. Two cases (33%) with initially successful arthrodeses required transtibial reamputations because of secondary infection. All other cases healed very well. There was no delayed union or nonunion of the arthrodeses in our series. CONCLUSIONS: Tibiocalcaneal Pirogoff arthrodesis can be a surgical alternative in forefoot and midfoot destructions to achieve a well-covered, comfortable stump with a minimum of leg-length shortening that is easy to fit with a prosthesis and even allows some limited barefoot mobility. Bony fixation and healing of the arthrodesis are the challenges, but these difficulties can be avoided by using an external ring fixator system. Despite a failure rate of up to one-third, this method can be an effective solution due to the good functional outcome.

J Orthop Res. 2008 Jan 31 [Epub ahead of print]

Temporary distraction and compression of a diaphyseal osteotomy accelerates bone healing.

Claes L, Augat P, Schorlemmer S, Konrads C, Ignatius A, Ehrnhaller C. Institute of Orthopaedic Research and Biomechanics, University of Ulm, Helmholtzstraße 14, 89081 Ulm, Germany.

Mechanical strain during callus distraction is known to stimulate osteogenesis. It is unclear whether this stimulus could be used to enhance the healing of a normal fracture without lengthening the bone. This study tested the hypothesis that a slow temporary distraction and compression of a diaphyseal osteotomy accelerates fracture healing. Fourteen sheep underwent a middiaphyseal osteotomy of the right tibia, stabilized by external fixation. An external fixator allowed either a temporary axial distraction (TD group; n = 6) or a constant fixation (C group; n = 8). Distraction began 7 days postoperatively at a rate of 0.5 mm twice per day for 2 days with subsequent shortening of 1.0 mm twice on the third day. The procedure was repeated four times. Fluorochrome labeling was performed postoperatively. After 8 weeks the sheep were sacrificed and healing was evaluated using densitometric, biomechanical, and histological methods. Bending stiffness of the tibiae after 8 weeks was 58% higher in the TD group than in the C group. The volume of the periosteal callus was significantly ($p = 0.05$) higher in the TD group (3.9 cm³) than in the C group (2.7 cm³). There was 20% more bone in the fracture gap of the TD group than the C group. There was a significantly higher bone formation rate in the TD group than in the C group. This study demonstrated the feasibility of fracture healing stimulation by the temporary application of distraction and compression. (c) 2008 Orthopaedic Society. Published by Wiley Periodicals, Inc. J Orthop Res.

Cochrane Database Syst Rev. 2008 Jan 23;(1):CD006522.

Different methods of external fixation for treating distal radial fractures in adults.

Handoll HH, Huntley JS, Madhok R.

Royal Infirmary of Edinburgh, c/o University Department of Orthopaedic Surgery, Old Dalkeith Road, Little France, Edinburgh, UK, EH16 4SU. h.handoll@ed.ac.uk

BACKGROUND: Fracture of the distal radius is a common injury. A surgical treatment is external fixation, where metal pins inserted into bone on either side of the fracture are then fixed to an external frame. OBJECTIVES: To evaluate the evidence from randomised controlled trials comparing different methods of external fixation for distal radial fractures in adults. SEARCH STRATEGY: We searched the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (June 2007), the Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE and other databases, conference proceedings and reference lists of articles. No

language restrictions were applied. **SELECTION CRITERIA:** Randomised or quasi-randomised controlled clinical trials which compared different methods of external fixation in adults with a distal radial fracture. **DATA COLLECTION AND ANALYSIS:** All review authors independently performed study selection. Two authors independently assessed the included trials and performed data extraction. **MAIN RESULTS:** Nine small trials involving 510 adults with potentially or evidently unstable fractures, were grouped into five comparisons. The interventional, clinical and methodological heterogeneity of trials precluded data pooling. Only one trial had secure allocation concealment. Two trials comparing a bridging (of the wrist) external fixator versus pins and plaster external fixation found no significant differences in function or deformity. One trial found tendencies for more serious complications but less subsequent discomfort and deformity in the fixator group. Three trials compared non-bridging versus bridging fixation. Of the two trials testing uni-planar non-bridging fixation, one found no significant differences in functional or clinical outcomes; the other found non-bridging fixation significantly improved grip strength, wrist flexion and anatomical outcome. The third trial found no significant findings in favour of multi-planar non-bridging fixation of complex intra-articular fractures. One trial using a bridging external fixator found that deploying an extra external fixator pin to fix the 'floating' distal fragment gave superior functional and anatomical results. One trial found no evidence of differences in clinical outcomes for hydroxyapatite coated pins compared with standard uncoated pins. Two trials compared dynamic versus static external fixation. One trial found no significant effects from early dynamism of an external fixator. The poor quality of the other trial undermines its findings of poorer functional and anatomical outcomes for dynamic fixation. **AUTHORS' CONCLUSIONS:** There is insufficient robust evidence to determine the relative effects of different methods of external fixation. Adequately powered studies could provide better evidence.

Arch Orthop Trauma Surg. 2008 Jan 22 [Epub ahead of print]

Acute correction using focal dome osteotomy for deformity about knee joint.

Watanabe K, Tsuchiya H, Sakurakichi K, Matsubara H, Tomita K.

Department of Orthopaedic Surgery, Graduate School of Medical Science, Kanazawa University, 13-1 Takara-machi, 920-8641, Kanazawa, Japan,

tsuchi@med.kanazawa-u.ac.jp.

BACKGROUND: Correction of deformities about knee joint may prevent or delay the onset of osteoarthritis or mitigate its effects. Accurate correction of such deformities without production of secondary deformities depends on precise localization and quantification of the deformities. **METHODS:** We corrected deformities around the knee using acute correction with focal dome osteotomy in 21 segments (15 patients). Five segments underwent limb lengthening postoperatively. **RESULTS:** The mean correction angle was 16.0 degrees. We were able to correct all segments. In the five lengthening cases, the mean external fixation index (EFI) was 70.9 days/cm, which is much higher than the generally reported EFI. There were eight complications, all but one of which occurred in lengthening cases. **CONCLUSIONS:** We believe that acute correction with focal dome osteotomy is very useful for cases of alignment correction, but is not indicated for cases of alignment correction with lengthening, due to a high risk of complications related to poor callus formation.

Int Orthop. 2008 Jan 12 [Epub ahead of print]

Comparison of external fixation, locking and non-locking palmar plating for unstable distal radius fractures in the elderly.

Schmelzer-Schmied N, Wieloch P, Martini AK, Daecke W.

Department of Hand and Plastic Surgery, University of Heidelberg, Heidelberg, Germany.

This study compares the effectiveness of locking and non-locking palmar plating and external fixation for unstable distal radius fractures in the elderly. In a retrospective match-paired study, 45 patients aged 50 to 70 years who underwent surgery for C1/C2 distal radius fractures were evaluated. The surgical procedures were external fixation or plating with locking or non-locking palmar plates. Radiological and functional outcomes were assessed. Outcomes according to Gartland and Werley, Martini and the Disability of the Arm, Shoulder and Hand (DASH) questionnaire were compared. The locking palmar plate fixation method demonstrated significantly better radiological and functional results in comparison to external fixation and the non-locking palmar plating methods. The subjective assessment of plate fixation proved to be better than that of external fixation. Complications and reoperations were fewer for both plate fixation groups. Our data indicates that most displaced intra-articular distal radius fractures can be treated successfully with the locking palmar plate.

Eur J Surg Oncol. 2008 Jan 11 [Epub ahead of print]

Intercalary segmental reconstruction after bone tumor resection.

Fuchs B, Ossendorf C, Leerapun T, Sim FH.

Department of Orthopedics, Balgrist University Hospital, Forchstrasse 340, 8008 Zurich, ZH, Switzerland.

BACKGROUND/AIMS: Intercalary resection can be used for primary as well as metastatic tumors. Reconstruction options include vascularized fibula graft, interposition of an allograft, combination of vascularized fibula and allograft, segmental prosthesis, insertion of an extracorporally irradiated autograft, segmental transportation, either with external fixation or by using an intramedullary rod, intercalary scaffolds augmented with growth factors, and technical refinements for the resection of tumors located close to the growth plate. The purpose of this review is to discuss the indications, limitations and pitfalls of each of these techniques. METHODS: The PubMed database was searched for articles on intercalary reconstruction after bone tumor resection and for the different reconstruction options presented in this review. Additionally, cross-referencing was used to cover articles eventually undetected by the respective search strategies. The resulting articles were then reviewed with regard to the different techniques, outcomes and complications of the reconstruction options. RESULTS: With the advance of imaging techniques and the use of chemotherapy for malignant bone tumors, surgical techniques can be refined. There are many techniques for the reconstruction of large intercalary defects of long bones, with which the orthopedic oncologist needs to be familiar. General oncologic principles of achieving a wide margin still need to be respected. CONCLUSION: The techniques presented in this review will allow a better functional outcome of patients. It will continue to be important to carefully analyze each patient's situation and to adapt and individualize the method of reconstruction used.

Arch Orthop Trauma Surg. 2008 Jan 4 [Epub ahead of print]

Open reduction and internal fixation versus hybrid fixation for bicondylar/severe tibial plateau fractures: a systematic review of the literature.

Mahadeva D, Costa ML, Gaffey A.

Department of Orthopaedics, University Hospitals Coventry and Warwickshire, Warwickshire, Coventry, Warwickshire, CV2 2DX, UK, mahadeva501@yahoo.co.uk.

INTRODUCTION: Bicondylar/Schatzker 6 type tibial plateau fractures are a significant challenge to the trauma and orthopaedic surgeon. These injuries tend to be complex, high energy and are activated with significant morbidity. Two surgical methods are commonly in use: (1) hybrid external fixation or (2) internal fixation. We performed a systematic analysis of papers comparing these two techniques. METHODS: The Medline database was used and the MeSH terms

associated with bicondylar/severe tibial plateau fractures were inserted.
RESULTS: Forty-nine studies were retrieved but only five papers presented data to directly compare the two techniques as these studies actually compared the implants. Study designs and outcome measures were not consistent in all studies and therefore no direct comparison could be made between the papers. The first two studies were laboratory based and suggested that hybrid external fixation may have a benefit over internal fixation with respect to failure load and its use in compromised bone. Two further papers presented only type 4 evidence. The final paper was a multicentre randomised controlled trial and it demonstrated a marginal non-significant benefit of hybrid external fixation over internal fixation although there was suggestion of beta error [i.e. accepting the hypothesis when it is not true]. **CONCLUSION:** Bicondylar/Schatzker 6 type fractures are difficult to manage. The treatment of such fractures, need to pay specific attention to the soft tissue envelope around the knee. Hybrid external fixation has theoretical advantages in terms of the soft tissues but the benefit over internal fixation is modest at best and has not demonstrated improved outcome. Newer fixed angle screw and plate systems are increasingly in use and need comparative studies to determine their role in this complex group of fractures.

Bull NYU Hosp Jt Dis. 2008;66(1):65-7.

Use of an Ilizarov fixator for deformity correction prior to revision knee arthroplasty.

[No authors listed]

Malalignment is associated with an increased rate of loosening of knee prostheses. We present a case of primary knee replacement failure due to pre-existing tibial deformity. Correction of the deformity and associated malalignment was undertaken using the Ilizarov osteotomy method prior to full knee revision surgery.

Chir Organi Mov. 2008 Jan;91(1):3-6. Epub 2008 Feb 10.

The use of external fixation in complex trauma of upper limb.

Corain M, Carità E, Vassia L, Cugola L.

U.O. Chirurgia della Mano, Ospedale Policlinico G.B. Rossi, Verona, Italy.

From 1997 to 2003 (7 years follow-up) we treated 33 complex traumas of the upper limbs with the use of external fixation: forearm or humeral complete amputation, complex crash, sometimes with hand crash associated. Often a revascularisation was necessary like as a secondary skin coverage for soft tissue loss or following ischaemic necrosis. Three patients were reluctant to agree to a secondary amputation for large soft tissue necrosis and infection. A high percentage of cases need a successive operation because of bone non-union. Revision of our casistic helps us answer the following: how complex and long is the prognosis of this kind of patient, which are the most important choices we have to make, how important is the length of time taken to make a decision and what are the weak spots in the treatment of these traumas.

Clin Orthop Relat Res. 2008 Jan;466(1):189-97. Epub 2008 Jan 3.

Leg lengthening with a motorized nail in adolescents : an alternative to external fixators?

Krieg AH, Speth BM, Foster BK.

Pediatric Orthopaedic Department, University Children's Hospital, PO Box Römeggasse 8, 4005 Basel, Switzerland. andreas.krieg@ukbb.ch

Leg lengthening by external fixation is associated with various difficulties. We evaluated eight adolescent patients who underwent leg lengthening with a motorized intramedullary lengthening device. We asked whether this method could reduce the time of hospitalization and rehabilitation and whether the incidence

of complications commonly associated with external fixators could be reduced. We compared our preliminary results with those from other reports, with a focus on leg length achieved, time of rehabilitation, and rate of complications. The average leg-length discrepancy was 3.8 cm (range, 3-5 cm). The average lengthening distance was 3.8 cm (range, 2.9-4.7 cm). In six patients, leg lengthening was combined with successful correction of the mechanical axis alignment. The consolidation index averaged 26 days/cm (range, 19-41 days/cm). The average hospital stay was 9.6 days. No bone or soft tissue infections were observed. In comparison to other studies (1.0-2.8 complications/patient), our results suggest that the difficulties commonly associated with external fixators can be reduced with this method. It also allows good angular correction in patients with mechanical axis deviation. These features combined with a short time of hospitalization and rehabilitation make it a promising procedure for limb lengthening. LEVEL OF EVIDENCE: Level IV Therapeutic study.

Clin Podiatr Med Surg. 2008 Jan;25(1):95-120.

Surgical reconstruction of the Charcot rearfoot and ankle.

Burns PR, Wukich DK.

Foot and Ankle Division, University of Pittsburgh School of Medicine, Roesch-Taylor Medical Building, North Suite 7100, 2100 Jane Street, Pittsburgh, PA 15203, USA. burnsp@upmc.edu

Charcot arthropathy of the rearfoot and ankle is a complex disorder. To date there are no evidence-based, universally agreed upon treatment protocols. As the number of patients who have these deformities continues to increase, surgeons' skill levels and experience grow as well. With increased technical skill, knowledge, and advances in fixation, these deformities are becoming more manageable. In the future this experience should afford the general community with evidenced-based protocols. This article discusses basic techniques in deformity planning and current uses of internal and external fixation techniques for rearfoot and ankle limb salvage.

J Bone Joint Surg Am. 2008 Jan;90(1):16-22.

Comparison of external and percutaneous pin fixation with plate fixation for intra-articular distal radial fractures. A randomized study.

Leung F, Tu YK, Chew WY, Chow SP.

Department of Orthopaedics and Traumatology, Queen Mary Hospital, the University of Hong Kong, Pokfulam, Hong Kong. kkleunga@hkucc.hku.hk

BACKGROUND: The most effective method for the fixation of an intra-articular distal radial fracture has not been established. Two commonly used treatment methods are external fixation combined with percutaneous pin fixation and plate fixation. We performed a prospective multicenter randomized trial to compare these two treatment strategies. **METHODS:** A total of 137 patients with 144 intra-articular distal radial fractures were recruited into the study. The average age of the patients was forty-two years, and all patients were sixty years old or less. The patients were randomized to fracture fixation with one of the two methods. At six, twelve, and twenty-four months postoperatively, the patients were assessed with use of the Gartland and Werley point system and the modified Green and O'Brien scoring system. Arthritis was graded on radiographs according to a modification of the Knirk and Jupiter criteria. **RESULTS:** Seventy-four (51%) of the fractures were treated with external fixation and percutaneous pin fixation, and seventy were treated with dorsal, volar, or combined plate fixation. At the time of the twenty-four-month follow-up, the results for the plate fixation group were significantly better than those for the external fixation and percutaneous pin fixation group according to the Gartland and Werley point system ($p = 0.04$) and the radiographic arthritis grading system ($p = 0.01$). The difference was especially notable among patients with AO group-C2

fractures. **CONCLUSIONS:** Plate fixation is better than external fixation combined with percutaneous pin fixation for the treatment of intra-articular fractures of the distal part of the radius.

J Bone Joint Surg Br. 2008 Jan;90(1):1-6.

External fixation devices in the treatment of fractures of the tibial plafond: a systematic review of the literature.

Papadokostakis G, Kontakis G, Giannoudis P, Hadjipavlou A.

University Hospital of Crete, P.O. Box 1352, 7110 Heraklion, Crete, Greece.

We have compared the outcomes of the use of external fixation devices for spanning or sparing the ankle joint in the treatment of fractures of the tibial plafond, focusing on the complications and the rates of healing. We have devised a scoring system for the quality of reporting of clinical outcomes, to determine the reliability of the results. We conducted a search of publications in English between 1990 and 2006 using the Pubmed search engine. The key words used were pylon, pylon, plafond fractures, external fixation. A total of 15 articles, which included 465 fractures, were eligible for final evaluation. There were no statistically significant differences between spanning and sparing fixation systems regarding the rates of infection, nonunion, and the time to union. Patients treated with spanning frames had significantly greater incidence of malunion compared with patients treated with sparing frames. In both groups, the outcome reporting score was very low; 60% of reports involving infection, nonunion or malunion scored 0 points.

J Foot Ankle Surg. 2008 Jan-Feb;47(1):46-50.

Use of external fixation and primary wound closure in an open comminuted first metatarsal fracture: a case report.

Miller JC, Shever S.

Kingwood Medical Center, Kingwood, TX 77339, USA.

drmillerc@houstonfootandankle.com

Management of open, comminuted fractures presents a challenge for the foot and ankle surgeon. Reconstructive surgery for such injuries has a high potential for the development of serious complications, and factors such as the extent of soft tissue injury, neurovascular status to the foot, and fracture stability must be taken into consideration before determining a surgical plan. This article describes the case of a patient who presented with an open, comminuted first metatarsal fracture as a result of a chainsaw injury. The patient was treated with a uniplanar mini-external fixator, demineralized bone matrix, primary wound closure, and external bone growth stimulation. At 1-year follow-up, the interview and examination revealed the patient to be pain free with a functional first ray. ACFAS Level of Clinical Evidence: 4.

J Foot Ankle Surg. 2008 Jan-Feb;47(1):19-25.

Dynamic and functional gait analysis of severely displaced intra-articular calcaneus fractures treated with a hinged external fixator or internal stabilization.

Besch L, Radke B, Mueller M, Daniels-Wredenhagen M, Varoga D, Hilgert RE, Mathiak G, Oehlert K, Seekamp A.

Department of Traumatology, University Medical Center Schleswig-Holstein, Kiel, Arnold-Heller-Strasse 7, 24105 Kiel, Germany. lutz.besch@uksh-kiel.de

The purpose of this article was to assess functional gait outcome. Fifty-five patients with severely displaced intra-articular calcaneus fractures and soft tissue damage were evaluated prospectively with computerized dynamic pedography and a clinical scoring scale. The treatment protocol assigned 30 patients to open reduction and internal fixation (ORIF) and 25 to closed reduction and stabilization with a biomechanically tested hinged external fixator. Gait

parameter was evaluated by measuring plantar pressure distribution, length of a double-step, double-step duration, standing duration, effective foot length, and width of gait. Pedographic measurements were performed with a custom-made gait analysis system (medilogic Gangas, Berlin, Germany). Results were graded by an extended protocol of questionnaires and the American Orthopaedic Foot and Ankle Society (AOFAS) ankle and hindfoot scales. Radiographs were reviewed according to the Sanders classification at the time of follow-up (7.3 years). All measurements were statistically analyzed (t test; Mann-Whitney U test). Aberrations were associated with all calcaneal fractures in both groups. Dynamic gait analysis showed gait asymmetry in all patients. The type of treatment (ORIF or a hinged fixator) of severely displaced calcaneus fractures did not affect gait analysis nor result in significantly different ($P > .05$) patient outcome scores. The gait analysis system allows a valid dynamic pedographic measurement. The hinged external fixator can be recommended in displaced intra-articular calcaneal fractures with severe soft tissue damage to reduce complications associated with ORIF. ACFAS Level of Clinical Evidence: 2c.

J Hand Surg [Am]. 2008 Jan;33(1):19-25.

Use of dynamic distraction external fixation for unstable fracture-dislocations of the proximal interphalangeal joint.

Ruland RT, Hogan CJ, Cannon DL, Slade JF.

Bone and Joint/Sports Medicine Institute, Naval Medical Center Portsmouth, Portsmouth, VA 23708, USA.

PURPOSE: Unstable fracture-dislocations of the proximal interphalangeal (PIP) joint remain a difficult management problem, often leading to residual pain, stiffness, and recurrent instability. In a military setting, an easily applied, simple to operate, and inexpensive device becomes an attractive option. The purpose of this clinical investigation was to retrospectively review use of dynamic distraction external fixation (DDEF) for unstable fracture-dislocations and pilon injuries of the PIP joint in an active-duty population. **METHODS:** The fixator is assembled under a local anesthetic from three 1.4-mm (0.045-inch) K-wires and rubber bands. It uses the principles of a lever and ligamentotaxis to assist and maintain reduction. Thirty-four members of the Armed Services, 27 men and 7 women (average age, 30 y), had DDEF for pilon fractures and unstable fracture-dislocations of the PIP joint. A retrospective review of these individuals was conducted. Final range of motion was determined from the clinical records at the final visit. **RESULTS:** There were 26 PIP fracture-dislocations (3 chronic, average 6 weeks) and 8 PIP pilon injuries. The average follow-up period was 16 months (range, 6-84 months). The final arc of motion at the PIP joint averaged 88 degrees, and the average distal interphalangeal joint arc of motion was 60 degrees. Eight patients experienced superficial pin-track infections that were easily controlled with oral antibiotics. There were no cases of septic arthritis or osteomyelitis requiring intravenous antibiotics or premature fixator removal. Loss of reduction did not occur. All patients returned to their prior level of activity and duties. **CONCLUSIONS:** Our results are comparable with other techniques used in the management of unstable PIP joint fracture-dislocations. Easily applied and simple to operate, DDEF is a valuable addition to the hand surgeon's armamentarium. We recommend its use for both primary and adjunctive treatment of acute and chronic unstable PIP joint fracture-dislocations and for primary treatment of PIP pilon injuries. **TYPE OF STUDY/LEVEL OF EVIDENCE:** Therapeutic IV.

J Pediatr Orthop. 2008 Jan-Feb;28(1):17-9.

Femoral shaft fracture in a newborn infant treated with axial external fixator: a case report.

D'Andrea L, Catena N.

Traumatology Unit, University of Messina, Messina, Italy. ldandrea@unime.it

BACKGROUND: The authors present a case of femoral shaft fracture in a newborn infant treated with axial external fixator. **METHODS:** The patient presented at the time of birth with a lumbar myelomeningocele and right femoral shaft fracture. The common methods of treatment cannot be used, so 24 hours after birth before neurosurgery, we applied a Mini Penning Orthofix External Fixator for fracture stabilization. **RESULTS:** The external fixator was maintained for 30 days and removed after taking a radiograph that showed fracture healing. At the last follow-up (2 years), the patient did not present axial or torsional defects of right lower limb. **CONCLUSIONS:** External fixation is not a traditional method for treatment of femoral shaft fractures in patients younger than 6 years, but we think that in some cases, when traditional methods (splinting, cast, Pavlik harness) cannot be used, an external fixator is also a good option in patients younger than 2 years and in newborn infants.

Arch Orthop Trauma Surg. 2007 Dec 21 [Epub ahead of print]

Deformity correction for vitamin D-resistant hypophosphatemic rickets of adults.

Matsubara H, Tsuchiya H, Kabata T, Sakurakichi K, Watanabe K, Tomita K. Department of Orthopaedic Surgery, Graduate School of Medical Science, Kanazawa University, 13-1 Takara-machi, Kanazawa, 920-8641, Japan, tsuchi@med.kanazawa-u.ac.jp.

We performed correction for bowing deformity of the lower extremities due to vitamin D-resistant hypophosphatemic rickets of three adults, six segments. The operative method was gradual correction and lengthening using distraction osteogenesis by Ilizarov external fixator or Heidelberg external fixator. The orders of the corrections were simultaneous correction of the bilateral femur for one patient, simultaneous correction of the ipsilateral leg for one patient, and diagonal correction of the bilateral leg for one patient. The mean correction angle was 30.5 degrees. The mean external fixation period was 146 days. Each order of the corrections had its merits and demerits. All patients obtained a physiological alignment and good bone formation by taking Vitamin D and oral phosphate supplements even an adult patient. All the patients had articular pain, such as hip, knee, and ankle, however, these pains healed up. All the patients were satisfied with the outcomes at the time of the final follow-up interview in terms of their cosmetic improvement. Distraction osteogenesis for bowing deformity of the lower extremities due to vitamin D-resistant hypophosphatemic rickets was a very effective method and could be applied to adult patients. However, the order of the corrections should be considered carefully depending on each patient.

Arch Orthop Trauma Surg. 2007 Dec 5 [Epub ahead of print]

Biomechanical and functional analysis of the pins and rubbers traction system for treatment of proximal interphalangeal joint fracture dislocations.

Kneser U, Goldberg E, Polykandriotis E, Loos B, Unglaub F, Bach A, Horch RE. Department of Plastic and Hand Surgery, University of Erlangen Medical Center, Krankenhausstrasse 12, 91054, Erlangen, Germany, Ulrich.Kneser@uk-erlangen.de.

INTRODUCTION: Dynamic external fixation systems are considered as optimal devices for treatment of fracture dislocations of the proximal interphalangeal joint (PiP). The pins and rubbers traction system (PRTS) is cheap, easy to assemble and comfortable and allows early mobilization of the affected digit. We investigated the influence of different wire positions and rubber strength and provided a follow-up of five consecutively treated patients. **METHODS:** Sixteen cadaver fingers (dig 2-5) were included into the biomechanical study. Forces for flexion of the PiP joint (30 degrees, 60 degrees, and 90 degrees) were measured by pulling the flexor digitorum profundus tendon; width of the PiP joint was assessed radiologically. Measurements were obtained prior and after assembly of

PRTS and were repeated with three different types of rubbers and two different positions of the retention wire (distal and proximal). The clinical part of the study included five patients (21-72 years) who were treated using the PRTS. Mean follow-up was 272 days. RESULTS: The PRTS increased flexion force of the PiP joint. Proximal position of the retention wire increased forces for 30 degrees flexion. Different rubber strengths did neither increase PiP width nor influence flexion forces. In the clinical part of the study total range of motion was 74 degrees and DASH score was 10.1. Pinch grip of the affected digit was 72% of the unaffected side. DISCUSSION: The PRTS allows for efficient treatment of intraarticular fractures with PiP involvement. Although standardized positioning of the wires is important, proximal position of the retraction only increased forces for 30 degrees flexion.

Acta Orthop Belg. 2007 Dec;73(6):696-9.

Shoulder arthrodesis using combined internal and external fixation: a review of 9 cases.

Vancabeke M, Baillon B, Rémy P, Schuind F, Burny F.

Department of Orthopaedics and Traumatology, Université Libre de Bruxelles, Cliniques Universitaires de Bruxelles, Brussels, Belgium.

michelvancabeke@hotmail.com

A technique of shoulder arthrodesis is presented. Fixation of the arthrodesis combines scapulohumeral half-frame Hoffmann external fixation and internal fixation using a cancellous screw. Cancellous bone autografts are packed at the site of arthrodesis. The functional results of nine cases are presented.

Arch Orthop Trauma Surg. 2007 Dec;127(10):889-93. Epub 2007 Sep 8.

Plating after lengthening (PAL): technical notes and preliminary clinical experiences.

Uysal M, Akpinar S, Cesur N, Hersekli MA, Tando_an RN.

Department of Orthopedics and Traumatology, Adana Medical Center, Baskent University School of Medicine, Adana, Turkey. mstfysl@hotmail.com

INTRODUCTION: Shortening the period of time for the external fixator after limb lengthening decreases the complication rate and increases the patient satisfaction. MATERIAL AND METHOD: We describe the plating after lengthening (PAL) as a new technique on five patients with limb length discrepancy (1 femoral, 4 tibial) who had lengthening procedure with Ilizarov technique. The mean amount of lengthening was 50 mm. The mean lengthening period was 100 days (5-135 days). When the lengthening period ended, the locking compression plate was applied percutaneously by using the technique of minimal invasive plate osteosynthesis, and the Ilizarov external fixator was removed. RESULTS: The fixator-free period was achieved at the beginning of the consolidation phase, except in two patients, which were delayed for plating because of pin-tract infection. No complication was encountered except in one patient who had limited flexion of knee joint. There was no need for blood transfusion. DISCUSSION: The PAL, which shortened the period of time for the external fixator, was an easy and safe method for the fixation of the bone after limb lengthening.

J Bone Joint Surg Br. 2007 Dec;89(12):1615-9.

The management of cubitus varus and valgus using the Ilizarov method.

Piskin A, Tomak Y, Sen C, Tomak L.

Department of Orthopaedic Surgery.

Cubitus varus and valgus are the most common complications of supracondylar and lateral condylar fractures. Various combinations of osteotomy and fixation have been described to correct these deformities but each is associated with significant complications. In this study, we used distraction osteogenesis and Ilizarov frame fixation to treat 24 elbows in 23 patients with cubitus varus or

valgus. Their clinical outcome was evaluated using the protocol of Bellemore et al. The mean time to follow-up was 18.3 months (10 to 36) and the mean time to frame removal was 13.5 weeks (8 to 20). The mean carrying angle was corrected from -18.7 degrees (-10 degrees to -30 degrees) to 6.1 degrees (2 degrees to 10 degrees) in patients with cubitus varus and from 36.5 degrees (25 degrees to 45 degrees) to 9.4 degrees (4 degrees to 15 degrees) in patients with cubitus valgus. There were 18 excellent and six good results. The Ilizarov method with gradual distraction is a safe, stable, adjustable and versatile method of treating deformities at the elbow without the problems of an unsightly scar or limited range of movement, and gives a good clinical and radiological outcome. Tardy ulnar nerve palsy should be treated first by anterior transposition.

J Hand Surg [Am]. 2007 Dec;32(10):1624-37.

External fixation of distal radius fractures.

Slutsky DJ.

South Bay Hand Surgery Center, Torrance, CA 90503, USA. d-slutsky@msn.com

External fixation has been used for the treatment of distal radius fractures for more than 50 years. Although the fixator configurations have undergone considerable modification over time, the type of fixator itself is not as important as the underlying principles that provide the foundation for external fixation. Although volar plate fixation is currently in vogue, the indications for external fixation remain largely unchanged. Newer fixator designs have also expanded the traditional usage to include nonbridging applications that allow early wrist motion. The following discussion focuses on the myriad uses for external fixation as well as the shortcomings and potential pitfalls.

J Orthop Surg (Hong Kong). 2007 Dec;15(3):380-3.

Ilizarov external fixator for burst fracture of the lumbar spine: a case report.

Matsubara H, Tsuchiya H, Kawahara N, Kobayashi T, Morinaga T, Tomita K.

Department of Orthopaedic Surgery, School of Medicine, Kanazawa University, Kanazawa, Japan.

A 50-year-old man presented with severe back pain and tenderness throughout the lumbar area after falling from a ladder. He had an unstable type-B burst fracture, with a spinal canal narrowing of 36% and an anterior height loss of 65%. His lower-limb neurological function was intact. An Ilizarov external spinal fixator was used; the pedicular half pins were inserted into the bilateral T11, T12, L2, and L3 pedicles; bilateral pedicular half pins were fixed at each level with external plates and rods. Postoperatively, the patient had a lordosis of 2 degrees and was able to walk 7 days later. The external fixator was removed at 10 weeks. Six years and 10 months after surgery, the patient had a kyphosis of 19 degrees that did not affect his activities of daily living.

J Pediatr Orthop. 2007 Dec;27(8):930-7.

Treatment of knee flexion contractures in patients with arthrogyrosis.

van Bosse HJ, Feldman DS, Anavian J, Sala DA.

Center for Children, NYU Hospital for Joint Diseases, New York, NY 10003, USA. Harold.vanBosse@nyumc.org

BACKGROUND: Knee flexion contractures in children with arthrogyrosis are difficult to treat. The purpose of this study was to assess the effectiveness of posterior knee releases and gradual contracture distraction with an Ilizarov external fixator in correcting and maintaining correction of knee flexion contractures of 40 degrees or greater. **METHODS:** The medical records and radiographs of 7 consecutive pediatric patients (10 knees) with arthrogyrosis and knee flexion contractures of 40 degrees or greater were reviewed. The mean age at surgery was 7.3 years, and the mean length of follow-up was 52.7 months. All patients' knee flexion contractures were treated with posterior soft tissue

releases and an Ilizarov external fixator for gradual contracture distraction. Posterior soft tissue releases included hamstrings lengthenings, proximal gastrocnemius release, and release of posterior capsule. RESULTS: The mean total fixator time was 102 days, with a mean correction rate of 1 degree per day. The mean knee flexion contracture was 72.5 degrees preoperatively, and all knees were corrected to full extension, +/-5 degrees. At latest follow-up, the mean contracture was 20.5 degrees, and all knees were ligamentously stable. The mean total arc of motion was 56 degrees preoperatively and 54 degrees at follow-up. Five patients who were previously nonambulatory became ambulatory. Complications included 3 fractures, 2 posterior tibial subluxations requiring frame adjustment, and 3 contracture recurrences (1 in a patient with a popliteal pterygium). CONCLUSIONS: Posterior knee releases and flexion contracture distraction by Ilizarov fixator was effective in improving the mobility of pediatric patients with arthrogyposis. At follow-up, the gradual loss of correction that occurred did not impact on the ambulatory gains made.

J Pediatr Orthop. 2007 Dec;27(8):867-72.

Transradioulnar single Kirschner-wire fixation versus conventional Kirschner-wire fixation for unstable fractures of both of the distal forearm bones in children.

Jung HJ, Jung YB, Jang EC, Song KS, Kang KS, Kang SY, Lee JS.

Department of Orthopaedic Surgery, Medical Center of Chung-Ang University, Seoul, Republic of Korea. sunu@cau.ac.kr

The purpose of this study was to introduce transradioulnar single Kirschner-wire (K-wire) fixation technique for unstable fractures of both of the distal forearm bones in children and to evaluate the differences in clinical and radiographic results of osteosynthesis between this method and conventional K-wire fixation. Forty-one patients (20 conventional K-wire fixation, 21 transradioulnar single K-wire fixation) were reviewed who underwent a closed or mini-open reduction with K-wire fixation for fractures of both of the distal forearm bones. Their mean age at operation was 10.7 years (range, 8-16 years). Surgical intervention was indicated (1) when in addition to a complete ulnar fracture, the radius showed a 50% of displacement or greater, or 20-degree angulation or greater, (2) when in addition to an incomplete ulnar fracture, the radius was completely displaced, and (3) when reangulation was 15 degrees or greater in any direction at follow-up. The minimum follow-up period was 2 years. Bony union was achieved in both groups at approximately 7 weeks after surgery, and there were no significant differences in the operative time, duration of hospitalization, and duration of external support between the 2 groups. There were no major complications such as nonunion, radioulnar synostosis, premature physeal closure, or redisplacement or reangulation. Transradioulnar single K-wire fixation technique was a relatively simple procedure with comparable outcomes compared with conventional K-wire fixation technique. In addition, physeal injuries could be avoided, and there was no need for passing across the fracture line. Thus, it is suggested that transradioulnar single K-wire fixation technique can be a good alternative method for high-risk fractures of both of the distal forearm bones in children.

Orthopedics. 2007 Dec;30(12):1033-8.

Hybrid external fixation of proximal tibia fractures: biomechanical analysis of four commercial systems.

Voor M, Antoci V, Kam B, Roberts C.

Orthopedic Bioengineering Laboratory, Department of Orthopedic Surgery, University of Louisville, Kentucky 40202, USA.

To compare commercially available hybrid external fixator systems, mechanical testing was performed on fiberglass composite tibias with proximal metaphyseal fractures fixed with 4 hybrid systems (Ace-Fischer, Hoffmann II, Synthes Hybrid, and EBI DynaFix) and a custom "rigid" frame. The only significant difference

between commercial systems was in axial loading where the Ace-Fischer allowed less motion than the other frames. In all cases the "rigid" reference frame allowed significantly less motion than the commercial systems. Approximately 50% of the motion comes from frame deformation and 50% from deformation of the pins and wires.

Int Orthop. 2007 Nov 24 [Epub ahead of print]

Biological approach to treatment of intra-articular proximal tibial fractures with double osteosynthesis.

Singh S, Patel PR, Joshi AK, Naik RN, Nagaraj C, Kumar S.

All India Institute of Medical Sciences, New Delhi, India.

The treatment of intra-articular proximal tibial fractures is associated with complications, and much conflicting literature exists concerning the treatment of choice. In our study, an attempt has been made to develop an ideal and adequate treatment protocol for these intra-articular fractures. The principle of double osteosynthesis, i.e., lateral minimally invasive plate osteosynthesis (MIPO), was combined with a medial external fixator to treat 22 intra-articular proximal tibial fractures with soft tissue injury with a mean follow-up of 25 months. Superficial pin track infection was observed in one case, and no soft tissue breakdown was noted. Loss of articular reconstruction was reported in one case. Bridging callus was seen at 12 weeks (8 weeks-7 months). The principle of substitution or double osteosynthesis, i.e., lateral MIPO, was combined with a medial external fixator and proved to be a fairly good method of fixation in terms of results and complications.

Arch Orthop Trauma Surg. 2007 Nov 6 [Epub ahead of print]

Bone transport over an intramedullary nail for reconstruction of long bone defects in tibia.

Oh CW, Song HR, Roh JY, Oh JK, Min WK, Kyung HS, Kim JW, Kim PT, Ihn JC.

Department of Orthopedic Surgery, Kyungpook National University Hospital, 50, Samdok, Chung-gu, Daegu, 700-721, South Korea, cwoh@knu.ac.kr.

BACKGROUND: Although long bone defects may be treated by callus distraction, frequent complications arise from the long duration of external fixation. To reduce such complications, bone transport over an intramedullary nail (BTON) has been done for tibial bone defect. METHODS: In 12 patients (mean age, 46.1 years) of chronic osteomyelitis or bone defect, segmental transport was done using external fixator over an intramedullary nail. Prior to the index procedure, all patients had had serial debridements and five required myocutaneous or free flaps for covering of soft tissue defects. Using Mekhail's criteria, functional results were evaluated. RESULTS: The mean transported amount was 5.9 (range, 3.5-12) cm. The mean external fixation index was 26 days/cm, and healing index was 62.6 days/cm. The primary union of distraction and docking site was achieved in all, except for one failure in union at the docking site, which required another bone graft. Except for one patient with associated ankle injury, all had excellent or good functions. There was one recurrence of osteomyelitis and one procurvatum of the proximal tibia of 10 degrees. CONCLUSION: BTON may be a successful method in tibial reconstruction and allows patients to return to daily life earlier with relatively few complications.

Acta Ortop Mex. 2007 Nov-Dec;21(6):318-22.

[Treatment of the tibial bone defects by traumatic sequels with the Ilizarov method in children]

Zamora-Muñoz PM, Orellana-Reta C.

Hospital Shriners's México. paolazamoram@yahoo.com.mx

INTRODUCTION: Tibial bone defects are usually results of: high energy trauma, infections, bone tumors, and are associated to soft tissue lesion. The most

successful way to fill bone defects is the use of autologous bone grafting with adequate blood supply and soft tissue coverage. **PURPOSE:** To evaluate the clinical and functional outcome of post-traumatic bone defects treated with vascularized bone allograft, fibular tibialization, and bone transport with Ilizarov method. **MATERIAL AND METHODS:** Retrospective longitudinal study with 12 patients, from October 2000 to November 2005, with a 33.6 months follow up average. **RESULTS:** Seven male and five female, all of them treated previously in other institutions were included in the study. We found excellent clinical and functional results in five patients, good results in five and bad in two, with an average of surgical procedures of three. **COMPLICATIONS:** Pseudoarthrosis, fibular fusion and non union. **DISCUSSION:** Posttraumatic bone defects can be treated successfully using different techniques: Vascularized bone graft, tibialization, end bone transport with Ilizarov method. Bone transport allows filling of bone defect with adequate soft tissue coverage and length discrepancy management. **CONCLUSIONS:** These choices of treatment are different solutions with post-traumatic bone defects in patients candidate for amputation.

Am J Vet Res. 2007 Nov;68(11):1160-6.

Comparison of insertion characteristics of two types of hydroxyapatite-coated and uncoated positive profile transfixation pins in the third metacarpal bone of horses.

Zacharias JR, Lescun TB, Moore GE, Van Sickle DC.

Department of Veterinary Clinical Science, School of Veterinary Medicine, Purdue University, West Lafayette, IN 47906, USA.

OBJECTIVE: To determine the effect of 2 hydroxyapatite pin coatings on heat generated at the bone-pin interface and torque required for insertion of transfixation pins into cadaveric equine third metacarpal bone. **SAMPLE POPULATION:** Third metacarpal bone pairs from 27 cadavers of adult horses. **PROCEDURES:** Peak temperature of the bone at the cis-cortex and the hardware and pin at the trans-cortex was measured during insertion of a plasma-sprayed hydroxyapatite (PSHA)-coated, biomimetic hydroxyapatite (BMHA)-coated, or uncoated large animal transfixation pin. End-insertional torque was measured for each pin. The bone-pin interface was examined grossly and histologically for damage to the bone and coating. **RESULTS:** The BMHA-coated transfixation pins had similar insertion characteristics to uncoated pins. The PSHA-coated pins had greater mean peak bone temperature at the cis-cortex and greater peak temperature at the trans-cortex (70.9 +/- 6.4(o)C) than the uncoated pins (38.7 +/- 8.4(o)C). The PSHA-coated pins required more insertional torque (10,380 +/- 5,387.8 Nmm) than the BMHA-coated pins (5,123.3 +/- 2,296.9 Nmm). Four of the PSHA-coated pins became immovable after full insertion, and 1 gross fracture occurred during insertion of this type of pin. **CONCLUSIONS AND CLINICAL RELEVANCE:** The PSHA coating was not feasible for use without modification of presently available pin hardware. The BMHA-coated pins performed similarly to uncoated pins. Further testing is required in an in vivo model to determine the extent of osteointegration associated with the BMHA-coated pins in equine bone.

Clin Orthop Relat Res. 2007 Nov;464:238-41.

Juvenile dermatomyositis with bilateral progressive knee flexion contracture.

Güven M, Gholve PA, Blyakher A, Widmann RF.

Goztepe Education and Training Hospital, 2nd Orthopaedic and Traumatology Clinic, Goztepe, Istanbul, Turkey.

Juvenile dermatomyositis is a multisystem, inflammatory vasculopathy that primarily affects muscles and skin. Calcinosis is one of the most debilitating complications affecting patients with juvenile dermatomyositis. Calcifications resulting from calcinosis frequently are located on the elbows, knees, and other joints and can cause considerable disability with severe pain, joint

contractures, skin ulcers, and muscle atrophy. Many therapies for calcinosis have been reported including diltiazem, probenecid, and alendronate. We report a patient surgically treated for bilateral knee flexion contractures with the Ilizarov technique. At 2.5 years' followup, the patient had full extension of both knees with 0 degree to 50 degrees flexion and was walking independently. The Ilizarov technique provides an important option for correcting knee flexion contractures secondary to calcinosis in juvenile dermatomyositis.

Hand Clin. 2007 Nov;23(4):437-48, vi.

The operative treatment of diaphyseal humeral shaft fractures.

Cole PA, Wijdicks CA.

Department of Orthopaedic Surgery, University of Minnesota, Regions Hospital, Saint Paul, MN 55101, USA. peter.a.cole@healthpartners.com

Fractures of the humeral shaft comprise 1% to 3% of all fractures. Incidence rates reveal a bimodal distribution in which there is one small peak during adolescence, followed by a larger spike during the fifth and sixth decades of life. Most humeral diaphysis fractures are simple patterns of the mid-diaphysis. This article emphasizes surgical approaches to humeral fractures, providing a review of the surgical spectrum of treatment inclusive of intramedullary nailing and plating, but also includes a brief discussion of the conservative approach.

Hand Clin. 2007 Nov;23(4):397-414, v.

Two-part fractures and fracture dislocations.

Court-Brown CM, McQueen MM.

Royal Infirmary of Edinburgh, Old Dalkeith Road, Edinburgh, Scotland. courtbrown@aol.com

Proximal humeral fractures are common and are usually osteopenic or osteoporotic and about 85% occur in patients older than 50. Two-part fractures account for approximately 28% of proximal humeral fractures, with most being surgical neck fractures. This article discusses the management of two-part fractures and analyzes the use of nonoperative treatment, conventional plating, locked plating, antegrade intramedullary nailing, retrograde pinning, and Kirschner wires in their treatment. The literature indicates that nonoperative treatment is as effective as conventional plating, antegrade nailing, and Kirschner wiring in treating two-part surgical neck fractures in older patients. The early results of locked plating may be better, but more studies are required to prove this. This article gives the results of nonoperative treatment of all types of two-part fractures and fracture dislocations.

J Bone Joint Surg Br. 2007 Nov;89(11):1509-14.

Reconstruction with callus distraction for nonunion with bone loss and leg shortening caused by suppurative osteomyelitis of the femur.

Zhang X, Liu T, Li Z, Peng W.

Department of Orthopaedics, Second Xiangya Hospital, Changsha, Hunan 410011, People's Republic of China.

We present a retrospective study of 27 patients treated by callus distraction using a unilateral external fixator of our own design for nonunion with bone loss and shortening of the femur caused by suppurative osteomyelitis. The unilateral external fixator was used either alone or in combination with an intramedullary nail. The mean age of the patients was 13.6 years (8 to 18). The fixator was used alone in 13 patients and with an intramedullary nail in 14. The bone results at a mean follow-up of 88 months (37 to 144) were excellent in 16 patients and good in 11. The functional results were excellent in 18 patients and good in nine.

However, four patients still had draining sinuses at the latest follow-up. A residual deformity greater than 7 degrees was present in seven femora, but this did not adversely affect function or require further treatment.

J Hand Surg [Am]. 2007 Nov;32(9):1402-7.

Distraction lengthening of the ulna in children with radial longitudinal deficiency.

Peterson BM, McCarroll HR Jr, James MA.

Department of Orthopaedic Surgery, University of California, Davis, Sacramento, CA, USA.

PURPOSE: Children with radial longitudinal deficiency have very short forearms. The Ilizarov method of distraction osteogenesis has been used to increase extremity length, but results differ with the underlying condition and the limb being lengthened. The purpose of this study is to examine retrospectively the outcomes of Ilizarov lengthening of the ulna in children with radial longitudinal deficiency. **METHODS:** Nine children with radial longitudinal deficiency had 13 ulnar lengthenings using the Ilizarov method; 8 with unilateral deficiency had 9 lengthenings to improve appearance, and 1 child with bilateral radial longitudinal deficiency had 4 lengthenings to improve function. All had previous wrist centralization surgery, and all but 1 had a carpal osteotomy at the time of lengthening to reduce residual wrist angulation. **RESULTS:** The average gain for each lengthening was 4.4 cm (range 1.8-8.0 cm) with an average lengthening index of 9 weeks per cm (range 4-24 weeks per cm). All patients at each lengthening experienced at least 1 pin site infection that required antibiotic treatment. Other complications included delayed union requiring internal fixation and bone grafting in 3 lengthenings and recurrence of radial deviation requiring shortening and wrist arthrodesis in 1 case. **CONCLUSIONS:** The Ilizarov technique is an effective method for lengthening the ulna in children with radial longitudinal deficiency. The process of lengthening is prolonged and arduous with frequent complications. In successful cases, however, patients are pleased with the function and appearance of their lengthened forearms.

J Trauma. 2007 Nov;63(5):1043-53.

Treatment strategies for complex fractures of the tibial plateau with external circular fixation and limited internal fixation.

Catagni MA, Ottaviani G, Maggioni M.

Association for the Study and Application of the Method of Ilizarov (ASAMI), Department of Orthopedics and Ilizarov Unit, Alessandro Manzoni Hospital, Lecco, Italy. maurizio@catagni.it

BACKGROUND: We intended to evaluate the technique of treatment of complex fractures of the tibial plateau using external circular fixation combined with limited internal fixation, and to evaluate the treatment outcomes. **METHODS:** From 1992 to 2002, we treated 59 patients (40 men, 19 women) ranging in age from 23 to 63 years with the external circular fixation. All the cases were classified preoperatively as Schatzker types V, VI/Orthopedic Trauma Association 41-C1.3, C2.3, C3.1, C3.3. Five fractures were open. Three different strategies of treatment were used: (1) the frame is confined to the tibia when the external fixation is stable enough to allow knee bending; (2) the frame is extended onto the distal femur, with the proximal tibial ring located at the level of the tibial plateau when the joint surface is severely unstable; and (3) the frame is extended onto the distal femur, with the proximal tibial ring located more distally, bypassing the fracture, when the skin and soft tissue are compromised and within the fracture there is no bone suitable to place wires and pins for the external fixation construct. **RESULTS:** The results were evaluated as excellent in 30 patients (50.85%), good in 27 patients (45.76%), fair in 1 patient (1.695%), and poor in another 1 (1.695%). The patients' satisfaction was significantly related with the functional results. **CONCLUSIONS:** Our hybrid Ilizarov method combined with minimal internal fixation enables excellent to good results in most cases of complex tibial plateau fractures.

Proc Inst Mech Eng [H]. 2007 Nov;221(8):863-71.

Finite element modelling of the Ilizarov external fixation system.

Watson M, Mathias KJ, Maffulli N, Hukins DW, Shepherd DE.

Department of Bio-Medical Physics and Bio-Engineering, University of Aberdeen, UK.

This study describes a computational method for predicting the mechanical response of any configuration of the Ilizarov external fixation system. Mechanical testing of each of the individual components (ring, threaded rod, and wire) of the Ilizarov system was used to determine the stiffness of each component. Finite element (FE) analysis was then used to model each of the individual components. Each model was tuned to match the mechanical testing. A modular FE modelling system, using a master input file, was then developed where the tuned FE models of the individual components could be generated, positioned, and interconnected to replicate a range of fixator configurations. The results showed that the stiffness predications from the FE modelling of the fixator configurations were consistently 10 per cent higher than the stiffness values obtained from the mechanical testing. The FE modelling system can be used to predict the characteristic response of the fixator configurations and clearly shows the relative changes in that response for variations in the number of components used.

Acta Orthop. 2007 Oct;78(5):654-60.

Rapid pre-tension loss in the Ilizarov external fixator: an in vitro study.

Aquarius R, Van Kampen A, Verdonschot N.

Orthopedic Research Laboratory, University Medical Center Nijmegen, Nijmegen, the Netherlands.

BACKGROUND AND PURPOSE: Wire pre-tension in the Ilizarov frame is considered to be important in order to reduce movements that can impair fracture healing. Wires will eventually lose part of their pre-tension, however. In order to gain more insight into the need for wire pre-tension, we investigated: (1) the amount of pre-tension loss, (2) the relationship between pre-tension loss and bolt-tightening torque, (3) the cause of a possible loss of pre-tension, and (4) the effect of pre-tension on cyclic micromotions and total displacement of the bone segments. METHODS: 3 Ilizarov configurations, with various wire pre-tensions and bolt-tightening torques, were tested 3 times with an MTS machine. For each wire, slippage and tensions were measured for the duration of the whole experiment. RESULTS: A loss of wire pre-tension (up to 75%) due to slippage was found. Higher bolt-tightening torques significantly reduced the amount of pre-tension loss. Furthermore, a higher wire pre-tension reduced the maximal axial displacement of the bone fragment. There was, however, least cyclic axial micromotion when no wire pre-tension was present -- probably due to the lack of wire recoil. INTERPRETATION: Wires in an experimental Ilizarov external fixator lose pre-tension within a limited period of time, and probably also in the clinical setting. This does not seem to lead to increased cyclic axial micromotions of the bone fragments. However, the question remains as to how excessive axial displacement of the bone fragment and other loading configurations will affect the process of fracture healing in a patient.

Acta Orthop. 2007 Oct;78(5):648-53.

External fixation of the pelvic ring: an experimental study on the role of pin diameter, pin position, and parasymphseal fixator pins.

Ponsen KJ, Joosse P, Van Dijke GA, Snijders CJ.

Trauma Unit, Department of Surgery, Academic Medical Centre, University of Amsterdam, Amsterdam. K.J.Ponsen@amc.uva.nl

BACKGROUND: The mechanical properties of current external fixator systems for

unstable (type C) pelvic ring fractures are inferior to internal fixation, and are not optimal for definitive treatment. We explored methods to increase stability of external fixator constructs. **METHODS:** An experimental model was used for load tests. The same pelvic fixator was used while different pin diameters, pin positions, and modes of pubic symphysis fixation were tested. **RESULTS:** Changing of the pin diameter of the unthreaded part from 6 to 8 mm resulted in an increase in stiffness of 20%. An increase in stiffness by a factor of 1.9 was found by placing a pin on the iliac crest and one supra-acetabular. An additional increase by a factor of 3.6 was obtained by adding pubic symphysis plate fixation. Parasymphyseal pin fixation instead reduced stiffness, but not so much as when parasymphyseal pins were connected to the external fixator of the pelvic ring. The final configuration was at least 6 times stiffer than the initial configuration. **INTERPRETATION:** The new concept of parasymphyseal pin fixation connected to an external fixator of the pelvic ring produces a considerable increase in stability for the treatment of type C pelvic ring injuries, as does an increase in pin diameter and alternative pin positioning.

Acta Orthop Belg. 2007 Oct;73(5):630-4.

Treatment of delayed union or non-union of the tibial shaft with partial fibulectomy and an Ilizarov frame.

Dujardyn J, Lammens J.

University Hospital Pellenberg, Lubbeek, Belgium.

We reviewed 28 patients treated with partial fibulectomy combined with an Ilizarov compression frame for a non-infected tibial delayed union or non-union. Patient data, time to referral, type of fracture (open or closed), type of non-union (atrophic or hypertrophic) and period of treatment were recorded. Neither time to referral, type of fracture or type of non-union did adversely affect the duration of treatment. Only smoking was found to have a negative influence on the healing time. There were no major complications associated with the treatment and all fractures united except one. We conclude that partial fibulectomy combined with an Ilizarov frame is a reliable method for the treatment of tibial delayed and non-union.

Arch Orthop Trauma Surg. 2007 Oct;127(8):617-23. Epub 2007 May 3.

Treatment of type IIIA open fractures of tibial shaft with Ilizarov external fixator versus unreamed tibial nailing.

Inan M, Halici M, Ayan I, Tuncel M, Karaoglu S.

Orthopedic Department, Medical Faculty, Yeditepe University, Istanbul, Turkey.

minan@yeditepe.edu.tr

INTRODUCTION: The aim of this study was to compare the radiographic results and clinical outcome of unreamed tibial nailing (UTN) and Ilizarov external fixation (IEF) for the treatment of type IIIA open fractures of the tibia. **MATERIALS AND METHODS:** Sixty-one patients with open type IIIA tibial shaft fractures were treated with an IEF (n = 32) or UTN (n = 29). Both groups were compared for union time, secondary outcomes of nonunion, infections, mechanical failure of the implant, and malunion. **RESULTS:** The average time-to-bone healing was 19 weeks (range 14-23 weeks) for IEF and 21 weeks (range 16-36 weeks) for UTN; it was significantly shorter in the IEF group (P = 0.039). One patient had refracture in the IEF group. Malunion occurred in four patients for each group. Posttraumatic osteomyelitis occurred in two patients in the IEF group and in three patients in the UTN group. In the IEF group, additional surgical procedures were indicated in three cases including sequestrectomy (n = 1), and pin replacement (n = 2). In the UTN group, seven patients needed additional surgery including bone grafting (n = 3), nail exchanged (n = 1), and posttraumatic osteomyelitis (n = 3). **CONCLUSION:** The results of the current study showed that IEF technique had a notable incidence of pin-tract infection, joint contracture, and shortening related to

treatment of the delayed union. The UTN technique had the disadvantage of a posttraumatic osteomyelitis and delayed union requiring additional surgery. We believe that the decision to use IEF or UTN should be made on a case-by-case basis.

Arch Orthop Trauma Surg. 2007 Oct;127(8):625-31. Epub 2007 Apr 5.

Open grade III "floating ankle" injuries: a report of eight cases with review of Literature

Debnath UK, Maripuri SN, Guha AR, Parfitt D, Fournier C, Hariharan K. University Hospital of Wales, Cardiff, CF14 4XW, UK.

INTRODUCTION: "Floating ankle" injuries result from high-energy trauma and are usually associated with extensive soft tissue damage. Such rare and complex injuries in the acute phase pose therapeutic dilemma to the treating surgeon. When salvage instead of amputation is preferred, a variety of treatment options are available ranging from open reduction along with minimal internal fixation to external fixation. In this retrospective case series study we report eight patients with open "floating ankle" injuries who had been treated with external fixation with or without internal fixation. MATERIALS AND METHODS: Eight consecutive patients (7M: 1F) with mean age of 28 years (range 18-35 years) were treated. All had Grade III open fractures of the distal tibia with foot fractures and various degrees of soft tissue injuries. ISS and MESS were used to assess injury severity. Immediate radical wound debridement; skeletal stabilization and early soft tissue coverage were done by combined trauma and plastic surgical services followed by standard post-operative rehabilitation. All the patients were assessed with SF-36 questionnaire at mean follow-up of 2.5 years (range 2-4 years). RESULTS: Three patients were treated primarily with Ilizarov ring fixators, one had hybrid fixation and the other four had Hoffman frames. Four patients needed further surgeries. One patient developed metatarsal osteomyelitis, which was debrided and treated with antibiotics. The SF-36 results were compared with age matched UK norms for men and women in all categories. Only two patients returned to their previous employment. Six suffered varying degrees of disability out of which one underwent amputation. CONCLUSIONS: External fixation with or without internal fixation is an option when salvaging rare injuries like open grade III "floating ankle" injuries. Salvaged patients do suffer a cocktail of crippling disease characterized by psycho-socio-economic and physical disability and result in increased hospital costs. We recommend more prospective studies with long-term follow-up of such complex injuries to identify the indications for salvage and also the criteria for a successful salvage.

Int Orthop. 2007 Oct;31(5):587-91. Epub 2006 Oct 12.

Complications of Ilizarov leg lengthening: a comparative study between patients with leg length discrepancy and short stature.

Vargas Barreto B, Caton J, Merabet Z, Panisset JC, Pracros JP.

Department of Orthopaedics and Traumatology, Hôpital Saint Joseph, Lyon, France.

The Ilizarov technique has been used to treat severe limb length discrepancy and short stature. However, complications of this treatment are frequent. Between 1984 and 2001, 57 patients (94 tibias) had an Ilizarov procedure for limb lengthening. Twenty patients had limb discrepancy and 37 had short stature. Their mean age was 20.2 years (range 15-34). The average limb lengthening was 8.37 cm (range 3.2-14.7), which was equivalent to 26% (range 9.2-60%) average tibial lengthening. A total of 90 complications were observed. Thirty-three unplanned procedures were required during the lengthening programme. Two patients stopped the lengthening programme. There was no difference in the complications in leg lengthening using Ilizarov technique between the group of patients with leg length discrepancy and the group with short stature. A good knowledge of the Ilizarov technique is necessary to perform a lengthening programme with a low

rate of complications.

J Orthop Trauma. 2007 Oct;21(9):634-42.

Outcomes of tibial nonunion in older adults following treatment using the Ilizarov method.

Brinker MR, O'Connor DP.

Center for Problem Fractures and Limb Restoration, Fondren Orthopedic Group, Texas Orthopedic Hospital, Houston 77030-4509, TX. mbrinker@houston.rr.com

OBJECTIVES: To describe the functional outcomes of treatment using the Ilizarov method for tibial nonunions in older patients (>60 years of age). DESIGN:

Prospective case series. SETTING: Tertiary referral center. PATIENTS:

Twenty-three consecutive patients with an average age of 72 years (61 to 92) who had tibial nonunions for an average duration of 13 months (3 to 46). Fourteen patients had an associated deformity and eight patients had infection.

INTERVENTION: Ilizarov deformity correction, compression, or bone transport. MAIN OUTCOME MEASUREMENTS: Brief Pain Inventory, American Academy of Orthopaedic Surgeons (AAOS) Lower Limb Core Scale, Short Form (SF)-12, quality-adjusted life years. RESULTS: Three patients did not complete treatment: two patients died of cardiovascular disease during the treatment period and one patient demanded early removal of the Ilizarov device against medical advice. All 20 patients who completed treatment achieved bony union. Two of the 20 patients died before final follow-up, one patient was unable to participate in follow-up, and one patient was lost. At an average follow-up of 38 months (18 to 61), all of the remaining 16 patients were bearing full weight. AAOS Lower Limb Core Scale scores improved from 39 to 78 points ($P < 0.001$), pain intensity decreased from 3.6 to 0.9 ($P = 0.001$), SF-12 Physical Component Summary scores improved from 26.5 points to 35.3 points ($P = 0.030$), and SF-12 Mental Component Summary scores improved from 41.6 points to 48.7 points ($P = 0.011$). The improvement in quality of life is equivalent to 5.3 quality-adjusted life years per patient, which was larger than the average improvement in quality of life following total hip arthroplasty reported in published series. CONCLUSIONS: Treatment using the Ilizarov method restored function and had a profoundly positive effect on quality of life in these elderly patients with tibial nonunions.

Orthopedics. 2007 Oct;30(10):848-52.

Complications of high tibial osteotomy with external fixation in adolescent Blount's disease.

Wilson NA, Scherl SA, Cramer KE.

Rehabilitation Institute of Chicago, Lombard, Ill, USA.

Reported complication rates for tibial osteotomies have been widely variable and no study has focused on a single deformity etiology, surgical technique, or stabilization method. A review of 38 high tibial osteotomies with external fixation in adolescent Blount's disease patients was performed at two institutions. Results showed an overall complication rate of 153% and an elevated (97%) prevalence of morbid obesity in the patients in this series. This study highlights the potential association between comorbidities and elevated complication rates. Recognition of comorbidities will allow more effective risk stratification and preoperative counseling stressing the importance of compliance, wound, and pin care.

Trials. 2007 Sep 28;8:27.

Safety and efficacy of botox injection in alleviating post-operative pain and improving quality of life in lower extremity limb lengthening and deformity correction.

Hamdy RC, Montpetit K, Ruck-Gibis J, Thorstad K, Raney E, Aiona M, Platt R, Finley A, Mackenzie W, McCarthy J, Narayanan U.

Orthopaedics, Shriners Hospital for Children, 1529 Cedar Avenue, Montreal H3G 1A6, Canada. rhamdy@shriners.mcgill.ca.

ABSTRACT: BACKGROUND: Distraction osteogenesis is the standard treatment for the management of lower limb length discrepancy of more than 3 cm and bone loss secondary to congenital anomalies, trauma or infection. This technique consists of an osteotomy of the bone to be lengthened, application of an external fixator, followed by gradual and controlled distraction of the bone ends. Although limb lengthening using the Ilizarov distraction osteogenesis principle yields excellent results in most cases, the technique has numerous problems and is not well tolerated by many children. The objective of the current study is to determine if Botulinum Toxin A (BTX-A), which is known to possess both analgesic and paralytic actions, can be used to alleviate post-operative pain and improve the functional outcome of children undergoing distraction osteogenesis.

METHODS/DESIGN: The study design consists of a multi centre, randomized, double-blinded, placebo-controlled trial. Patients between ages 5-21 years requiring limb lengthening or deformity correction using distraction will be recruited from 6 different sites (Shriners Hospital for Children in Montreal, Honolulu, Philadelphia and Portland as well as DuPont Hospital for Children in Wilmington, Delaware and Hospital for Sick Children in Toronto, Ont). Approximately 150 subjects will be recruited over 2 years and will be randomized to either receive 10 units per Kg of BTX-A or normal saline (control group) intraoperatively following the surgery. Functional outcome effects will be assessed using pain scores, medication dosages, range of motion, flexibility, strength, mobility function and quality of life of the patient. IRB approval was obtained from all sites and adverse reactions will be monitored vigorously and reported to IRB, FDA and Health Canada. **DISCUSSION:** BTX-A injection has been widely used world wide with no major side effects reported. However, to the best of our knowledge, this is the first time BTX-A is being used under the context of limb lengthening and deformity correction. **TRIAL REGISTRATION:** NCT00412035.

Am J Orthop. 2007 Sep;36(9):473-6.

Effect of wire tension on stiffness of tensioned fine wires in external fixation: a mechanical study.

Antoci V, Voor MJ, Antoci V Jr, Roberts CS.

Department of Orthopaedic Surgery, University of Louisville School of Medicine, Louisville, KY 40202, USA.

To determine the effect of changes in magnitude of transfixion wire tension on stiffness of fine-wire external-fixation load deformation, we compared results obtained with different wire tensions (50-140 kg) under identical conditions of central axial compression, medial compression-bending, posterior compression-bending, posteromedial compression-bending, and torsion. Stiffness values were calculated from the load-deformation and torque-angle curves. Tension of 140 kg provided the most stiffness, and there was a trend toward increasing overall stiffness with increasing wire tension. The 1.8-mm wires should be tensioned to at least 110 kg in most cases of fine-wire external fixation; compared with all tensions less than 110 kg, this tension provides significantly more mechanical stability in all loading modes.

Chang Gung Med J. 2007 Sep-Oct;30(5):414-22.

Conditions affecting treatment of pertrochanteric osteomyelitis.

Wu CH, Yuan LJ, Chan YS, Chen AC, Lee MS, Ueng SW.

Department of Orthopaedics, Chang Gung Memorial Hospital, Taipei, Chang Gung University College of Medicine, Taoyuan, Taiwan.

BACKGROUND: Although osteomyelitis following treatment of pertrochanteric fractures is rare, management can be difficult and often results in several physical and economic difficulties. Data regarding treatment of patients with

perthrochanteric osteomyelitis is currently limited. This retrospective study evaluates the management of pertrochanteric osteomyelitis and presents our experience using a two-stage treatment protocol. **METHODS:** From 1984 to 1998, twenty-three pertrochanteric osteomyelitis cases were treated with a two-stage protocol comprising of an external skeletal fixator or Buck traction after radical debridement in the first stage and reconstruction in the second stage. The study included sixteen males and seven females with a mean age of 48.3 years (range 16-82 years). Patients were categorized as "successful" or "difficult" according to the number of operations they had undergone. Conditions including patient age, compromised host, interval before treatment, fracture severity, nonunion, hip joint involvement, multiple organisms and the presence of oxacillin-resistant *Staphylococcus aureus* were recorded for analysis. **RESULTS:** Only twelve of the twenty-three (52%) cases were successfully managed and infection recurred in four (17.4%) cases at final follow-up. Difficult cases managed by the two-stage protocol were more likely to be characterized by younger age ($p = 0.03$), unstable fractures ($p = 0.003$) and nonunions ($p = 0.027$). **CONCLUSION:** The use of external skeletal fixation is not recommended for managing pertrochanteric osteomyelitis. Success using a two-stage protocol was difficult to achieve. Initial fracture severity should be carefully assessed when devising a treatment protocol for pertrochanteric osteomyelitis.

Clin Exp Rheumatol. 2007 Sep-Oct;25(5):763-5.

Treatment of Achilles tendon calcinosis in juvenile dermatomyositis with external ilizarov fixator.

Bilavsky E, Horesh Z, Amir J, Bar-On E, Harel L.

Department of Pediatrics C, Schneider Children's Medical Center of Israel, Petah Tiqwa, and Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel.

Calcinosis is a devastating complication of juvenile dermatomyositis and a challenging therapeutic problem. We report the use of an external Ilizarov fixator for the treatment of Achilles tendon calcinosis causing severe disability in a young girl with juvenile dermatomyositis.

J Bone Joint Surg Am. 2007 Sep;89 Suppl 2 Pt.2:183-95.

Republished from:

J Bone Joint Surg Am. 2006 Oct;88(10):2137-45.

Reconstruction of segmental bone defects due to chronic osteomyelitis with use of an external fixator and an intramedullary nail. Surgical technique.

Eralp L, Kocaoglu M, Rashid H.

Department of Orthopaedics and Traumatology, Istanbul Medical School, Istanbul University, Capa, 34390, Istanbul, Turkey. yeralp@superonline.com

BACKGROUND: Callus distraction over an intramedullary nail is a rarely used technique for the reconstruction of intercalary defects of the femur and tibia after radical débridement of chronic osteomyelitic foci. The aim of this study was to summarize our experience with distraction osteogenesis performed with an external fixator combined with an intramedullary nail for the treatment of bone defects and limb-shortening resulting from radical débridement of chronic osteomyelitis. **METHODS:** Thirteen patients who ranged in age from eighteen to sixty-three years underwent radical débridement to treat a nonunion associated with chronic osteomyelitis of the tibia (seven patients) and femur (six patients). The lesions were classified, according to the Cierny-Mader classification system, as type IVA (nine) and type IVB (four). The resulting segmental defects and any limb-length discrepancy were then reconstructed with use of distraction osteogenesis over an intramedullary nail. Two patients required a local gastrocnemius flap. Free nonvascularized fibular grafts were added to the distraction site for augmentation of a femoral defect at the time of external fixator removal and locking of the nail in two patients. At the time of

the latest follow-up, functional and radiographic results were evaluated with use of the criteria of Paley et al. RESULTS: The mean size of the defect was 10 cm (range, 6 to 13 cm) in the femur and 7 cm (range, 5 to 10 cm) in the tibia. The mean external fixator index was 13.5 days/cm, the consolidation index was 31.7 days/cm, and the mean time to union at the docking site was nine months (range, five to sixteen months). At a mean follow-up of 47.3 months, eleven of the thirteen patients had an excellent result in terms of both bone and functional assessment. There were two recurrences of infection necessitating nail removal. These patients underwent revision with an Ilizarov fixator. Subsequently, the infection was controlled and the nonunions healed. CONCLUSIONS: This combined method may prove to be an improvement on the classic techniques for the treatment of a nonunion of a long bone associated with chronic osteomyelitis, in terms of external fixation period and consolidation index. The earlier removal of the external fixator is associated with increased patient comfort, a decreased complication rate, and a convenient and rapid rehabilitation.

J Foot Ankle Surg. 2007 Sep-Oct;46(5):372-5.

Predictors of postoperative complications of Ilizarov external ring fixators in the foot and ankle.

Rogers LC, Bevilacqua NJ, Frykberg RG, Armstrong DG.

Amputation Prevention Center at Broadlawns Medical Center, 1801 Hickman Road, Des Moines, IA 50315, USA. Lee.C.Rogers@gmail.com

Our objective was to determine factors associated with complications of Ilizarov external ring fixator surgery for foot and ankle disorders in persons with diabetes mellitus. We reviewed the records of patients who underwent Charcot foot reconstruction or soft tissue offloading surgery over 1 year at a single institution. We compared the association of serious pin tract infection, pin fracture, and surgical wound dehiscence with the patient age, weight, duration device was used, preoperative glucose, preoperative hemoglobin, tourniquet time, and total operating time. Fifteen patients (16 limbs) underwent reconstructive surgery. Younger age, elevated preoperative glucose, and lengthy tourniquet times were associated with complications ($P = .03$). These data demonstrate that 2 modifiable factors (preoperative hyperglycemia and tourniquet time) predict complications and should be mitigated to lower risk.

J Orthop Sci. 2007 Sep;12(5):471-5. Epub 2007 Sep 28.

Treatment of lower limb deformities and limb-length discrepancies with the external fixator in Ollier's disease.

Watanabe K, Tsuchiya H, Sakurakichi K, Yamashiro T, Matsubara H, Tomita K.

Department of Orthopaedic Surgery, Graduate School of Medical Science, Kanazawa University, 13-1 Takara-machi, Kanazawa, 920-8641, Japan.

BACKGROUND: In this study, we addressed two questions on the treatment for Ollier's disease: (1) how much callus formation occurs when an osteotomy is performed intralesionally and (2) how is the stability of the wires and half-pins that are inserted intralesionally. METHODS: Four children with Ollier's disease underwent treatment of 12 lower limb segments using distraction osteogenesis until completion of their growth. All osteotomies were performed at the centers of the deformities, resulting in a total of seven osteotomies performed intralesionally. RESULTS: Full correction of the deformity and full restoration of length were achieved in all cases, but a residual limb-length discrepancy of <10 mm remained. The mean external fixation index in the intralesional distraction osteogenesis group was 39.7 days/cm versus 30.8 days/cm in the extralesional distraction osteogenesis group. Conversion from abnormal cartilage to normal regenerate bone was seen in only one segment. Although approximately two-thirds of the wires and half-pins were inserted intralesionally, in all but one case (in which an iatrogenic fracture occurred) the wires and half-pins were

well stabilized throughout the external fixation period. **CONCLUSIONS:** Although deformity and limb-length discrepancies due to Ollier's disease were successfully resolved by distraction osteogenesis, enchondroma may arise in distracted calluses when osteotomized intralesionally. However, the stability of the external fixator was sufficient to lengthen limbs and correct deformities even when wires and half-pins were inserted intralesionally.

J Orthop Sci. 2007 Sep;12(5):430-6. Epub 2007 Sep 28.

Cross-sectional anatomy in postdistraction osteogenesis tibia.

Giannikas KA, Bayam L, Naraen A, Buckley J, Maganaris C, Wilkes RA, Hutchinson CE.

Hope Hospital, Salford, UK.

BACKGROUND: Although the early period of distraction osteogenesis has been extensively investigated, there are few data describing the appearance of medium-term bone regeneration. **METHOD:** We investigated 10 adults with magnetic resonance imaging scans. Seven of them underwent bone transport, and three had tibial lengthening. The mean follow-up was 28 months after removal of the external fixator. The values were compared with those of the contralateral tibia, which acted as a control. **RESULTS:** All of the cases with bone transport had an increase in the volume of the whole tibia of 15.3%-50.8%. The diameters of the regenerated segments increased significantly ($P < 0.0001$) in all cases. The mean signal intensity in the regenerate decreased significantly in seven cases ($P < 0.0001$), which suggested a rise in the content of unhydrated tissue, such as bone and collagen. The cross-sectional area of the transported segment increased in all cases ($P < 0.01$). Finally, in the patients who underwent bone transport, the docking site was seen to be obstructed by unhydrated tissue. **CONCLUSIONS:** Contrary to previous claims, the postdistraction osteogenesis of tibia consists of areas with potentially different biomechanical properties. Recognition of these changes is essential not only for appropriate preoperative counseling but also for considering treatment modalities in case of fracture.

J Orthop Trauma. 2007 Sep;21(8):549-56.

Ilizarov frame fixation without bone graft for atrophic humeral shaft nonunion: 28 patients with a minimum 2-year follow-up.

Tomi S, Bumbasirevi M, Lesi A, Mitkovi M, Atkinson HD.
Institute for Orthopaedic Surgery Banjica, Belgrade, Serbia.

OBJECTIVES: To evaluate the outcomes of patients with atrophic humeral shaft nonunion (HSNU) treated by Ilizarov frame fixation without the use of bone graft. **DESIGN:** A retrospective review of 28 consecutive patients treated in 1 center between 1996 and 2002. **SETTING:** Tertiary referral center. **PATIENTS AND METHODS:** We studied 28 consecutive patients: 12 male and 16 female. Of the patients, 21 had been previously operated (15 by internal fixation using compression plates, 3 by intramedullary nailing, and 3 by external fixation), and 9 of those 21 patients also had failed revision procedures; 7 patients had been treated nonoperatively from the time of injury to the time of the index procedure for HSNU. Mean age at the time of the index operation was 44 years (16-73 years). **INTERVENTION:** Removal of the previous fixation device, excision of fibrous tissue at the HSNU site, opening of the intramedullary canal, excision of avascular bony ends, and stabilization fixation and compression of the humerus with an Ilizarov circular frame (proximal semicircular ring) using smooth 1.8-mm K-wires. No bone graft was used. The mean postoperative follow-up was 76 months (24-174 months). **MAIN OUTCOME MEASUREMENTS:** Radiologic union using plain radiographs. Clinical and functional outcome using the Lammens system, which evaluates pain, range of shoulder and elbow movements (and their limitations), and humeral alignment and union. Patient subjective outcomes were assessed using a 4-point patient satisfaction questionnaire. **RESULTS:** Bony union was achieved in all 28 cases

after a mean of 4.1 months (3.4-5.7 months). There were 6 superficial pin tract infections (which resolved with antibiotics) and 1 transient radial nerve palsy (which resolved at 2.5 months). One patient refractured his humeral shaft following a fall, but the fracture successfully united 5.7 months later after a further Ilizarov frame application. All patients had good or excellent functional outcomes and range of shoulder and elbow movements as rated by the Lammens scoring system. CONCLUSIONS: Ilizarov circular frame fixation without bone graft is a reliable method for the treatment of atrophic nonunion of the humerus, even after failed previous surgery.

J Pediatr Orthop. 2007 Sep;27(6):611-7.

Does leg lengthening pose a threat to a child's mental health?: An interim report one year after surgery.

Niemelä BJ, Tjernström B, Andersson G, Wahlsten VS.

Department of Neuroscience, Child and Adolescent Psychiatry, Uppsala University, Sweden. birgitta.johansson.niemela@akademiska.se

Previous studies suggest that children react with functional and psychological disturbances after leg lengthening (LL). Long-term effects are not known, and there is a lack of prospective studies. The aim of this interim prospective study was to investigate the psychological impact of the Ilizarov technique on a sample of children 1 year after surgery. METHODS:: The subjects were 27 patients aged 6 to 16 years treated using the Ilizarov technique at the Pediatric Orthopaedic Department, Uppsala University Hospital, between 1997 and 2005. A control group of healthy children matched for age and sex were also included. Semistructured interviews and psychometric measures (anxiety, depression, self-esteem, behavior) were administered to patients and parents before surgery and 1 year after. Psychological measures were correlated with medical records (days of hospitalization, gained length, etc). The control group was examined at initial assessment only. RESULTS:: Before reconstructive surgery, the LL group had a significantly lower self-esteem compared with the control group. Aggressive behavior, attention and externalization problems, anxiety, and depression were significantly reduced after LL. Parents' state anxiety was also reduced. There were no differences in trait anxiety between the parents of patients and the parents of the control children. CONCLUSIONS:: Patients reported pain, psychological discomfort, complications, and restrained function during LL. However, there were no adverse psychological effects at 1-year follow-up; rather, there were signs of improved mental health. No single psychological parameter could predict the outcome after LL.

J Pediatr Orthop B. 2007 Sep;16(5):305-11.

The radiographic classification of the bone-screw interface in paediatric tibial lengthening.

McAndrew AR, Saleh M, Rigby AS, Donnan LT.

Portsmouth Hospitals NHS Trust, UK. aandj.mcandrew@btinternet.com

Bone-screw loosening in monolateral external fixators is a significant problem. This study classifies the radiographic appearance of the bone-screw interface and predicts which screws will become loose and those that will remain solidly fixed to bone. Five radiographic features were identified at the bone-screw interface. The classification of these features was validated using interobserver and intraobserver studies. The reliability of the classification was improved by image enhancement with simple filters. Some radiographic features predicted which screws would eventually become loose, allowing the clinician to make earlier management decisions regarding the adjustment of screws.

Acta Orthop Belg. 2007 Aug;73(4):437-42.

Mini-external fixation of two- and three-part proximal humerus fractures.

Ebraheim NA, Patil V, Husain A.

Department of Orthopaedic Surgery, Medical University of Ohio, Toledo, Ohio 43614, USA.

A retrospective review of 64 patients (M 36, F 28, average age 55 years) with 29 two-part fractures and 35 three-part fractures of the proximal humerus was conducted at a Level 1 Trauma Center. All fractures were managed with the mini external fixator. Open reduction was performed in 11 cases, closed reduction in 53. The average follow-up was 21 months (range, 12-39). The final outcome, evaluated according to Neer's scoring system, was excellent in 63.4% of patients, good in 18.8%, fair in 12.7%, and poor in 5.1%. By 9 weeks, 85% of the fractures were healed and 97% by 12 weeks. Complications included nonunion, superficial infection and deep infection, in two cases for each. Bicipital tendonitis occurred in five cases and secondary displacement of the fragments in four others. The small diameter of the pins used in the mini external fixator has the advantage of allowing the orthopaedic surgeon to fix the fracture in more than one plane and achieve an early acceptable range of motion. This technique appears attractive especially in polytrauma patients, as the procedure can be performed in the supine position and causes no additional blood loss.

Acta Orthop Traumatol Turc. 2007 Aug-Oct;41(4):302-6.

[The effect of surgical washers used with olive K-wires on bone surface kinetics in external fixation: a biomechanical study]

Kocao lu M, Eralp L, Bilsel K, Bozda E, Sünbülo lu E.

Istanbul Universitesi Istanbul Tıp Fakültesi Ortopedi ve Travmatoloji Anabilim Dalı, Istanbul.

OBJECTIVES: In external fixation, the type and configuration of K-wires have a considerable effect on fixation stability. Indications for external fixation have recently increased in the treatment of various musculoskeletal pathologies in osteoporotic patients. This biomechanical study was designed to determine the effect of surgical washers used with olive wires on surface kinetics of the cortical bone. **METHODS:** The study included 32 tibiae obtained from one-year-old sheep. Samples were prepared from the proximal parts of the tibiae which were then divided into four groups equal in number. A 1.8-mm olive K-wire was inserted into the proximal metaphyseal regions of the tibiae. Except for the control group, surgical washers were used with olive K-wires in the three study groups, with diameters of 5 mm, 7 mm, and 10 mm, respectively. The samples were then placed in a specially designed servo-hydraulic universal testing machine for static tensile test at 10 mm/min. **RESULTS:** The mean failure load was 806.9 N in the control group, compared to 1285.9 N, 1317.9 N, and 1345.9 N in the three groups in which 5-mm, 7-mm, and 10-mm surgical washers were used, respectively. While there were significant differences between the control and study groups ($p < 0.0001$), failure loads did not differ significantly between the three study groups ($p = 0.574$). **CONCLUSION:** The use of surgical washers in combination with olive K-wires offers a significant advantage to increase stability and to decrease surface pressure. We recommend utilization of washers for external fixation surgery in osteoporotic patients and osteoporotic bone segments.

Foot Ankle Int. 2007 Aug;28(8):873-9.

Outcome of Ilizarov ankle arthrodesis.

Eylon S, Porat S, Bor N, Leibner ED.

Hadassah-Hebrew University Medical Center, Orthopedic Surgery, Ein Karem, Jerusalem, Israel.

BACKGROUND: Many operative techniques have been described for ankle arthrodesis, with varying fusion rates. In revisions, the fusion rate is lower than in primary arthrodesis. Recent reports have described good results after Ilizarov ankle arthrodesis. However, descriptions were qualitative, with none using an accepted

score. We describe our experience with this technique and functional outcomes in our patients. **METHODS:** Seventeen patients (average age 48 years) had primary or revision unilateral ankle arthrodesis using the Ilizarov technique at two centers. Diagnoses included post-traumatic arthritis and Charcot arthropathy. Three patients had talar osteonecrosis. Time in the frame averaged 15 weeks and in a cast 4 weeks. Followup averaged 6 years. Outcome was assessed using the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale. **RESULTS:** All ankles achieved solid fusion. The average AOFAS score was 65 out of 86 possible. Based on this, results were defined as excellent in three patients, good in eight, fair in four, and poor in two. Minor complications were common, all resolving with local treatment. No deep infection developed. One fusion malunited in 8 degrees of varus. **CONCLUSIONS:** The Ilizarov external fixator has numerous advantages applicable to ankle fusion, including: stable fixation, respect for soft tissues, and the possibility of postoperative alignment 'fine-tuning'. Additionally, the ability to direct forces through or around skeletal elements allows varying of the load through the skeletal elements, allowing early weightbearing. The Ilizarov technique, with its high union rate, may be considered for any ankle arthrodesis but is especially useful in complex cases such as revisions, talar osteonecrosis, soft-tissue compromise, and infection. Early weightbearing is an added benefit.

J Bone Joint Surg Br. 2007 Aug;89(8):1077-83.

Treatment of benign bone tumours using external fixation.

Tsuchiya H, Morsy AF, Matsubara H, Watanabe K, Abdel-Wanis ME, Tomita K. Department of Orthopaedic Surgery, Graduate School of Medical Science, Kanazawa University, 13-1 Takara-Machi, Kanazawa, Japan. tsuchi@med.kanazawa-u.ac.jp

We present a retrospective study of patients suffering from a variety of benign tumours in whom external fixators were used to treat deformity and limb-length discrepancy, and for the reconstruction of bone defects. A total of 43 limbs in 31 patients (12 male and 19 female) with a mean age of 14 years (2 to 54) were treated. The diagnosis was Ollier's disease in 12 limbs, fibrous dysplasia in 11, osteochondroma in eight, giant cell tumour in five, osteofibrous dysplasia in five and non-ossifying fibroma in two. The lesions were treated in the tibia in 19 limbs, in the femur in 16, and in the forearm in eight. The Ilizarov frame was used in 25 limbs, the Taylor Spatial Frame in seven, the Orthofix fixator in six, the Monotube in four and the Heidelberg fixator in one. The mean follow-up was 72 months (22 to 221). The mean external fixation period was 168 days (71 to 352). The mean external fixation index was 42 days/cm (22.2 to 102.0) in the 22 patients who required limb lengthening. The mean correction angle for those with angular deformity was 23 degrees (7 degrees to 45 degrees). At final follow-up all patients had returned to normal activities. Four patients required a second operation for recurrent deformity of further limb lengthening. Local recurrence occurred in one patient, requiring further surgery.

J Orthop Surg (Hong Kong). 2007 Aug;15(2):207-10.

A combined use of a free vascularised flap and an external fixator for reconstruction of lower extremity defects in children.

Segev E, Wientroub S, Kollender Y, Meller I, Amir A, Gur E. The Department of Pediatric Orthopaedics, Dana Children's Hospital, Tel Aviv Sourasky Medical Center, The Sackler Faculty of Medicine, Tel-Aviv University, Tel Aviv, Israel. esegev@tasmc.health.gov.il

PURPOSE: To describe a combined use of a free vascularised flap and an external fixator for reconstruction of lower extremity defects in children, and correction of equinus contracture developed after removal of the external fixator using a circular dynamic frame. **METHODS:** Seven children (4 males) aged 4 to 12 (mean, 8) years were treated with 9 free vascularised flaps for 8 limbs (bilaterally in one

patient and for a failed flap in another). Patient pathologies included: 3 soft tissue degloving injuries, one soft tissue and bone avulsion, one severe burn contracture, one resurfacing of soft tissue and bone necrosis, and one osteosarcoma resection defect. Free flap reconstruction was delayed in 6 patients (range, 3 weeks to 4 years). Static external fixators were used to stabilise the free vascularised flaps at the time of reconstruction, with the ankle in a neutral position. RESULTS: The mean follow-up was 5 (1-10) years. All flaps but one survived; the failed one was immediately reconstructed with a contralateral, latissimus dorsi flap. One anastomosis following a Kirschner-wire injury was successfully revised. Six patients had pin tract infections and were treated with oral antibiotics. Two patients developed equinus contracture 6 and 3 years later, after removal of the external fixator, and were corrected by distraction, using a dynamic Ilizarov frame. CONCLUSION: The combined use of a free flap and an external fixator for salvage of lower extremities is useful in children. Late development of equinus contracture can be safely corrected by distraction, without compromising flap viability.

:Int Orthop. 2007 Jul 17 [Epub ahead of print]

Calcaneisation of tibia using Ilizarov fixator in crush injuries of hindfoot: a new method.

Wardak M, Wardak E, Goel A.

Orthopaedics & Traumatology, Wardak Hospital, Kabul, Afghanistan, drmmwardak@rediffmail.com.

Crush injuries of the foot are one of the most difficult and challenging tasks for a trauma surgeon to manage in terms of limb salvage and provision of a painless functional foot. Injuries to the foot, especially the hindfoot, account for almost 24.6% of all the warfare injuries in Afghanistan, of which more than 70% end in amputation for various reasons. We devised a method using the principles of Ilizarov's distraction osteosynthesis to salvage limbs with bony defects in the hindfoot which otherwise were candidates for amputation. The procedure is done in two stages. Initially, the ring fixator is applied for the soft tissue reconstruction and infection control, and the next stage consists of percutaneous "inverted L"-shaped osteotomy in the posterior half of the lower tibia. The study included 32 patients with hindfoot crush injuries involving talus, calcaneum, a combination of both, or even involving the adjacent tarsal bones. All these crush injuries were classified using the Gustilo and Anderson classification. The postoperative functional assessment of the feet was done using the Maryland Foot Score system with a minimum follow-up of four years. We had good results in 53%, fair in 34% and failure in 13% of our cases. The complications of this procedure were the same as with the use of the ring fixator elsewhere in the body. This method provides a technique to salvage the foot and produce a painless, stable, fused foot in one of the most difficult settings of a hindfoot crush injury.

J Orthop Trauma. 2007 Jul;21(6):404-6.

Chipping and lengthening technique for delayed unions and nonunions with shortening or bone loss.

Matsushita T, Watanabe Y.

Department of Orthopaedic Surgery, Teikyo University School of Medicine, Tokyo, Japan. takashi@matsushita.net

Autologous bone graft is usually necessary for reconstruction of nonunions with shortening or bone loss. We developed a new technique to reconstruct such nonunions or delayed unions without bone grafting by chipping and lengthening of bone at the original fracture site. Five in six nonunions with shortening or bone loss could be successfully united without bone graft by using our method. The chipping and lengthening technique, which requires neither bone grafting nor

change in the anatomy of muscles, is a useful technique for delayed unions and nonunions accompanied by shortening or bone loss.

Ortop Traumatol Rehabil. 2007 Jul-Aug;9(4):366-76.

The results of treatment of bone defects and non-union within the femoral shaft with shortening of femur using Ilizarov method.

Morasiewicz L, Orzechowski W, Kulej M, Stepniewski M.

Katedra i Klinika Ortopedii i Traumatologii Narządów Ruchu Akademii Medycznej we Wrocławiu, Poland. lморas@o2.pl

BACKGROUND: The non-union within the femur with shortening of the limb as a consequence of trauma is an indication to choose external stabilisation as a method of treatment for that reason, that healing of the bone and surrounded soft tissues is disordered. **MATERIALS AND METHODS:** Authors discuss the results of treatment of 16 patients with post-traumatic bone defect and pseudarthroses with femur shortening. The injury was located in femur shaft in 8 cases, distal epiphysis in 5 cases and proximal epiphysis in 3 cases. 11 patients were treated in one stage, 4 patients were treated in two stages and 1 was held in three stages. First operation was made for achievement of union in place of bone loss or pseudarthrosis- the second and third- for elongation and correction of the axis of the femur. The follow-up consisted of 10 patients. In most cases subjective and objective improvement was achieved. **RESULTS:** The bone union was reached in 15 patients and in 1 case pseudarthrosis was observed. Patients who were considered to have next procedures due to remaining femur shortening or other limb deformity didn't see necessity of following treatment. **CONCLUSION:** The results of the current study indicated that Ilizarov's method can be successfully used in most patients with post-traumatic bone defect and pseudarthrosis with femur shortening. The method allows to reach the bone union, correct the deformity and lengthen the limb as well, what need mostly multi-stage treatment.

Ortop Traumatol Rehabil. 2007 Jul-Aug;9(4):357-65.

Treatment of non-union of the forearm using distraction-compression osteogenesis.

Orzechowski W, Morasiewicz L, Dragan S, Krawczyk A, Kulej M, Mazur T.

Department of Orthopaedics and Musculoskeletal Traumatology, Medical University in Wrocław, Poland. viktor2000@o2.pl

BACKGROUND: The goal of the study is presentation broad abilities like gives Ilizarov method in the treatment of posttraumatic nonunion the of forearm with concomitant shortening and axis deformity, in minimally invasive technique, with contemporary axis correction and lengthening. **MATERIAL AND METHODS:** . Authors present 6 patient operated on with the use of Ilizarov method, in years 2001-2005, suffer from vital nonunion of the forearm - 6 cases radius; 1 case ulna and radius. In all cases with nonunion concomitant shortening of the radius from 2 to 3 cm and valgosity of radius with deformity in sagittal plane in 4 patients (2ante-curvature, 2 retro-curvature). All patients had restricted rotation ROM of forearm and restriction of wrist motion. Author's modification of Ilizarov apparatus (with mini-Schanz's half-pins, which permitted rotation of forearm) was used in most of patients. In 3 cases monofocal slow correction with lengthening within nonunion was performed. In 2 cases bifocal, one-step slow correction of deformity and compression within nonunion with lengthening was performed. In 1 remaining case compression of ulna nonunion and compression with deformity correction of radius nonunion were performed. Distraction and correction start in 7 postoperative day in rate from 0,25 to 1 mm/day and correspondingly from 1 to 2o/day. **RESULTS:** Time of correction and distraction was average 63,3 days (40 - 90 days). Total time of stabilization was average 25,4 weeks (20 - 35 weeks). Bone union was obtained in all patients. In all cases considerable recovery of limb function was achieved. All patients had superficial pin-tract infection. One patient had staphylococcal pin-tract infection of soft tissues, which retreat

after 3-weeks guided antibiotic therapy. **CONCLUSION:** The Ilizarov method permit for contemporary axis correction and/or distraction or compression. There is the method of choice in the treatment of nonunion of forearm with concomitant shortening and axis deformity.

Yonsei Med J. 2007 Jun 30;48(3):502-10.

Treatment of osteofibrous dysplasia and associated lesions.

Hahn SB, Kim SH, Cho NH, Choi CJ, Kim BS, Kang HJ.

Department of Orthopedic Surgery, Yonsei University College of Medicine, 250 Seongsanno, Seodaemun-gu, Seoul 120-752, Korea. sbhahn@yumc.yonsei.ac.kr

PURPOSE: To report long term treatment outcomes of osteofibrous dysplasia and association with adamantinoma. **PATIENTS AND METHODS:** From January 1984 to July 2001, 14 patients with osteofibrous dysplasia were followed for an average of 108 months (78 to 260 months). Our patient group consisted of 6 men and 8 women, with a mean age of 13.9 years (2 to 65 years). We reviewed the clinical and pathological features of all 14 patients. **RESULTS:** Thirteen patients had a lesion in the tibia, while one patient had lesions in both the tibia and the fibula. Initial treatments were observation after biopsy (6 patients), curettage with or without a bone graft (3 patients), resection followed by a free vascularized fibular bone graft (4 patients), or resection and regeneration with the Ilizarov external fixation (1 patient). Curettage was performed on 6 patients due to recurrence or progression after the initial treatment. Among these patients, one was diagnosed with AD from the biopsy of the recurrent lesion. This patient was further treated by segmental resection and pasteurization. After the initial pathology slides of the 13 patients were reviewed with immunohistochemical cytokeratin staining, one patient diagnosis was changed from osteofibrous dysplasia to osteofibrous dysplasia-like adamantinoma. **CONCLUSION:** Some patients with osteofibrous dysplasia require close observation because of the high association risk between osteofibrous dysplasia and adamantinoma, Immunohistochemical staining may be helpful in differentiating these two diagnoses.

Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2007 Jun;151(1):137-41.

Evaluation of bone healing in femurs lengthened via the gradual distraction method.

Jochymek J, Gal P.

Department of Pediatric Surgery, Orthopedics, and Traumatology of the Children's Medical Center, Faculty Hospital in Brno, and Medical Faculty of the Masaryk University in Brno. jjochymek@seznam.cz

BACKGROUND: Treatment of leg length inequality via lengthening of the shorter extremity is an infrequent orthopedic procedure due to the requirement of special distraction devices and possible serious complications. Essential qualitative changes in operative technique development are associated with the name of G. A. Ilizarov, who paved the way for the autoregenerate gradual distraction method in the 1950s. **MATERIAL AND METHODS:** In the years 1990 through 2006 a total of 57 patients underwent femur lengthening via gradual distraction using various types of external fixators at the Department of Pediatric Surgery, Orthopedics, and Traumatology, Faculty Hospital in Brno. The quality of bone healing was monitored and a number of parameters followed and statistically evaluated using regularly scheduled X-ray examinations. **RESULTS:** In 11 cases we had to remove the external fixator following the distraction phase, perform an osteosynthesis via a splint and fill the distraction gap via spongioplasty. The bone healing was satisfactory in the remaining 46 patients and the lengthened bone required no other fixation method. The analysis showed statistically significant deceleration in bone healing following distraction in female patients over 12 years of age, and in boys over 14 years of age. Lack of periosteal callus five weeks after surgery

always signified serious problems in further healing. Severe complications were recorded in 11 cases during the distraction phase, and in 9 cases after the removal of the distraction apparatus. **CONCLUSIONS:** The aim of this report was to present the results of our study of distraction gap bone healing using the gradual lengthening approach.

J Arthroplasty. 2007 Jun;22(4):617-20. Epub 2006 Jun 21.

Treatment of periprosthetic femoral fracture after cementless total hip arthroplasty with Ilizarov external fixation.

Sakai T, Ohzono K, Nakase T, Lee SB, Manaka T, Nishihara S.

Department of Orthopaedic Surgery, Osaka National Hospital, Osaka, Japan.

A 72-year-old woman with periprosthetic femoral fracture after cementless total hip arthroplasty (THA) underwent external fixation using the Ilizarov method. Although open reduction and internal fixation with a condylar plate system were initially attempted, deep infection with methicillin-resistant *Staphylococcus aureus* at the fracture site occurred 2 weeks postoperatively. Six weeks after removal of the plating system, the fracture was stabilized with external fixation using the Ilizarov method and went on to successful fusion at 3 months. To our knowledge, this is the first report in which Ilizarov external fixation has been used for periprosthetic femoral fracture after THA. Although this is a rare situation, where periprosthetic fracture and infection coexist, Ilizarov external fixation is a safe and reliable method for periprosthetic femoral fracture with infection.

J Pediatr Orthop. 2007 Jun;27(4):467-71.

Bisphosphonate rescue in distraction osteogenesis: a case series.

Kiely P, Ward K, Bellemore C M, Briody J, Cowell CT, Little DG.

Department of Orthopaedics, the Children's Hospital at Westmead, Sydney, Australia.

Distraction osteogenesis is a powerful stimulus for new bone (and tissue) generation (anabolism). Biomechanical stimulation by distraction of the regenerate region results in a high rate of tissue and bone production. However, catabolism (bone resorption) can also occur, the process potentially accentuated in a stress-shielded environment of an external fixator. Regenerate insufficiency can result in regenerate bending or fracture after frame removal. Experimental evidence has demonstrated that bisphosphonates may mediate improved local limb bone mineral density (BMD) and regenerate strength in animal models. Seven patients who had undergone limb lengthening using an Ilizarov device were found to have regenerate insufficiency. Poor regenerate quality led to consideration for intervention. With informed consent, patients received a therapeutic regime of intravenous pamidronate (n = 3) or zoledronic acid (n = 4). The mean age was 13.8 years (SD, +/-3.6 years), with a minimum follow-up period of 4 months after fixator removal. The sites of regenerate insufficiency were the proximal tibia (n = 6) and the distal femur (n = 1). The mean time interval in the fixator before bisphosphonate treatment was 170 days (range, 124-252 days), with an average length increase of 4.8 cm (SD, +/-1.1 cm). At time of intravenous bisphosphonate treatment, dual-energy x-ray absorptiometry measurements demonstrated a reduced BMD (mean, 62.1%; SD, +/-12.6%) in the bone adjacent to the lengthening site of the nonoperated side. Mean healing index was high at 79.6 days/cm (range, 64.4-108.0 days/cm), reflecting the observed regenerate insufficiency. No significant systemic complications were encountered. Six of the patient's fixators were removed without requirement for other intervention, demonstrating a rapid and sustained improvement in local BMD, increasing to a mean of 85.6% (SD, +/-13.3%) of the healthy side. One patient did not respond and subsequently healed after percutaneous osteogenic protein 1 (bone morphogenetic protein 7) and bone marrow injection. Most failed regenerate cases maintain some underlying

anabolic activity and can be treated successfully with bisphosphonate therapy, which reduces catabolism. Only 1 case required percutaneous administration of an anabolic therapy to achieve union. These minimally invasive approaches may lessen the need for surgery in a group where significant surgical reintervention could otherwise be required.

J Pediatr Orthop. 2007 Jun;27(4):402-7.

Joint distraction and reconstruction in complex knee contractures.

Devalia KL, Fernandes JA, Moras P, Pagdin J, Jones S, Bell MJ. Paediatric Limb Reconstruction Service, Sheffield Children's NHS Foundation Trust, Sheffield, UK.

We retrospectively reviewed the results of joint distraction and reconstruction in complex knee contractures in 6 patients with 9 knees. The circular Ilizarov fixator was used in all cases. Extensor mechanism alignment with frame in situ was performed in 4 cases and alignment of mechanical axis of the lower limb was done in 2. All patients had a mean total arc of movement of 79 degrees before operation; however, this was nonfunctional because of the degree of flexion contracture. Three of the 6 patients were nonambulant before surgery. After joint distraction and reconstruction, mean total arc of movement remained unchanged, but this was more functional with improvement in the mobility status. At an average follow-up of 53 months, the mean flexion contracture was 100 degrees (range, 0-70 degrees), with further flexion possible up to 90 degrees (range, 60-120 degrees). Four patients had no recurrence. All 6 patients were ambulant with or without orthosis. Rebound phenomenon with loss of achieved correction was observed in 2 patients. Four patients were quite satisfied with results of surgery. Realignment of the extensor mechanism and mechanical axis is an important part that needs to be addressed in flexion contractures of the knee. Proper preoperative planning and staged procedures reduce the risk of recurrence. A treatment protocol is proposed to help in planning and further management.

PMID: 17513960 [PubMed - indexed for MEDLINE]

114: Plast Reconstr Surg. 2007 Jun;119(7):2127-36.

Comment in:

Plast Reconstr Surg. 2008 Feb;121(2):689-90; author reply 690. Plast Reconstr Surg. 2008 Mar;121(3):1069; author reply 1069-70.

The distally based sural musculoneurocutaneous flap for treatment of distal tibial osteomyelitis.

Fodor L, Horesh Z, Lerner A, Ramon Y, Peled IJ, Ullmann Y.

Department of Plastic and Reconstructive Surgery, Rambam Medical Center, Haifa, Israel.

BACKGROUND: The treatment of distal tibial osteomyelitis represents a challenge for orthopedic and plastic surgeons. The affected tissues should be debrided and good vascularized tissue should cover the defect, but the option of a muscle flap covering the area is limited. Free flaps are used but require longer operating time and experience with microsurgery, may result in donor-site morbidity, and sometimes add bulky tissue to the area. The authors present their experience with a sural musculoneurocutaneous flap for the treatment of chronic osteomyelitis of the distal tibia. **METHODS:** Over a 2-year period, nine distally based sural musculoneurocutaneous flaps were used in the treatment of chronic osteomyelitis of the distal tibia. Four patients had comorbid conditions (smoking, diabetes

mellitus, venous insufficiency, or obesity). The clinical aspect was represented by drainage sinuses located in the distal part of the tibia. Five patients had postsurgical scars on the lateral malleolar region and one had medial and lateral malleolar scarring. Three patients had an Ilizarov device at the time of wound coverage. **RESULTS:** All wounds were closed successfully. Dehiscence surrounding the flap was encountered in a single case that was attributable to inadequate bone debridement; this flap was raised to allow extending the debridement, and a local medial fasciocutaneous flap completed wound coverage. Distal tip necrosis of the flap was encountered in two cases. **CONCLUSIONS:** The sural musculoneurocutaneous sural flap was successfully used for treatment of distal tibia osteomyelitis. Although it is believed that lateral malleolar scars might compromise the flap, the flaps in the authors' series survived. This flap can also be applied to patients with external fixators without removing the apparatus.

Publication Types:

Case Reports

PMID: 17519711 [PubMed - indexed for MEDLINE]

115: West Indian Med J. 2007 Jun;56(3):294-9.

Treatment of congenital pseudarthrosis of the tibia with the Ilizarov technique. Case report and review of the literature.

Rose RE, Wright DE.

Division of Orthopaedics, Department of Surgery, Radiology, Anaesthesia and Intensive Care, The University of the West Indies, Kingston 7, Jamaica, West Indies. recrose@hotmail.com

Congenital pseudarthrosis of the tibia continues to pose one of the most difficult problems in paediatric orthopaedic surgery. The surgical procedures most used for treating congenital pseudarthrosis of the tibia are intramedullary nailing associated with bone grafting, vascularized fibular graft and the Ilizarov external circular fixator. Even when union is achieved, the residual deformities in the affected limb often result in significant disability. These deformities include leg-length discrepancy, angular tibial deformities, ankle mortise valgus and fibular non-union. The Ilizarov method allows simultaneous excision of the pseudarthrosis site, correction of the deformity and lengthening. However, refractures, ankle joint stiffness, fibular non-union with progressive ankle valgus are frequent sequelae with the Ilizarov technique. The surgeon should know when to abandon reconstructive procedures and create a more functional patient with an amputation. The authors discuss the indications and results of the Ilizarov external fixator in two patients with this complex problem. In addition, a critical review of the current literature is undertaken.

Int Orthop. 2007 May 11 [Epub ahead of print]

Speeded gradual lengthening and secondary angled blade plate stabilisation for proximal tibial shaft non-union with shortening.

Wu CC, Lee ZL, Wu CC, Lee ZL.

Department of Orthopedics, Chang Gung Memorial Hospital, Chang Gung University, 5 Fu-Hsin St., 333, Kweishan, Taoyuan, Taiwan, ccwu@mail.cgu.edu.tw.

Eighteen patients with proximal tibial shaft non-union and shortening were treated. In each patient, the non-union area was débrided, realigned and stabilised with an Ilizarov lengthening frame. The tibia was gradually lengthened

by 1-1.5 mm per day. After achieving the desired length, external fixation was converted to an angled blade plate and packed with cancellous bone graft. Follow-up of 16 patients for a median of 2.4 (1.2-4.5) years revealed satisfactory outcomes in all. No wound infections were noted. The described technique has a high success rate, a short treatment course and reduces patient discomfort. This method may be considered preferential treatment for all patients with the specified indications.

Foot Ankle Int. 2007 May;28(5):557-68.

Correction of severe recurrent clubfoot using a simplified setting of the Ilizarov device.

Ferreira RC, Costa MT, Frizzo GG, Santin RA.

Department of Orthopaedics, Santa Casa School of Medicine and Hospitals of São Paulo, Brazil, Rua Mirando Guerra, 876-casa 2, Parque Petrópolis, Sao Paulo, SP 04640-001, Brazil. ceckley@unisys.com.br

BACKGROUND: Severe recurrent clubfoot deformities are challenging to treat. The Ilizarov method offers a safer alternative; however, the management of the device is complex. **METHODS:** A simplified standard setting of the Ilizarov device was used to treat 29 patients (35 feet) with a mean age of 14 years with severely stiff recurrent clubfoot deformities and large scars caused by one or more previous surgeries. This simplification involved a correction in two stages: first a gradual correction of the equinus, varus, cavus, and adduction deformities and later an acute correction of the supination deformity. All feet underwent percutaneous Achilles tenotomy and plantar fasciotomy; 11 feet required an additional midfoot osteotomy. The final outcome was scored as good (complete correction and no pain); fair (partial correction with plantigrade foot and occasional pain); or poor (nonplantigrade foot and continuous pain during walking). **RESULTS:** After a mean followup of 56 months, the results were good in 27 feet (77%), fair in five feet (14%), and poor in three feet (9%). Early complications were complete dislocation of the first metatarsophalangeal joint in two feet and partial dislocation of the distal tibial epiphysis in two feet. Late complications were recurrence of the deformity (11 feet), spontaneous ankylosis (16 feet), and symptomatic foot and ankle arthritis (7 feet). Arthrodesis was performed in 13 feet at an average of 21 months after the index surgery to treat symptomatic arthritis or correct disabling residual deformities. **CONCLUSIONS:** The Ilizarov device allowed correction of all the complex deformities of severe recurrent clubfoot with minimal operative intervention. Complications were numerous but manageable and for the most part did not compromise overall patient satisfaction in this very difficult to treat clinical condition.

Injury. 2007 May;38 Suppl 2:S77-84.

The health economics of the treatment of long-bone non-unions.

Kanakaris NK, Giannoudis PV.

Academic Department of Trauma & Orthopaedic Surgery, School of Medicine, University of Leeds, UK.

A review of the existing evidence on economic costs of treatment of long-bone fracture non-unions has retrieved 9 papers. Mostly the tibial shaft non-unions have been utilised as models for these economic analyses. Novel treatment strategies like BMP-7 grafting, Ilizarov ring external fixation or supplementary use of therapeutic ultrasound devices have been compared with standard methods of treatment focusing on direct and indirect costs and expenses. A cost-identification query was conducted and revealed costs of pound 15,566, pound 17,200 and pound 16,330 for humeral, femoral, and tibial non-unions respectively on a "best-case scenario". The existing scientific evidence can only imply the extent of the economic burden of long-bone non-unions. Further systematic studies are needed to assess the direct medical, direct non-medical, indirect, and

monetised quality of life and psychosocial costs of non-unions.

Injury. 2007 May;38 Suppl 2:S55-63.

Femoral diaphyseal aseptic non-unions: is there an ideal method of treatment?

Crowley DJ, Kanakaris NK, Giannoudis PV.

Academic Department of Trauma & Orthopaedics, School of Medicine, University of Leeds, Leeds, UK.

Femoral non-unions represent a formidable challenge for the orthopaedic surgeon. Their successful treatment is frequently time consuming, and requires utilisation of numerous resources. Three main methods of treatment have been described: intramedullary nailing (IMN), plating and external fixation. A systematic review of the existing English literature of femoral diaphyseal non-union treatment methods has been conducted. The gold standard remains exchange nailing despite the fact that plating has reached near equivocal rates of success. In cases where exchange nailing fails, the use of plates and external fixators has been shown to provide useful adjuncts to the nail. Most surgeons have preserved bone grafting as an option at a secondary or tertiary stage, after the initial revision procedure has failed.

Injury. 2007 May;38 Suppl 2:S39-49.

Humeral diaphyseal aseptic non-unions: an Algorithm of management.

Kontakis GM, Tosounidis T, Paskalos J.

Department of Orthopaedics - Traumatology, University of Crete, Greece.

kontak@med.uoc.gr

Successful operative treatment of a humeral shaft non-union may be a challenge for the surgeon. Several treatment options have been reported over the years. A systematic review of the literature was performed. Twenty-three retrieved articles (level of evidence IV) fulfilled our inclusion criteria and dealt with aseptic diaphyseal humeral non-union managed by plating, intramedullary nailing and external fixation based on Ilizarov's principles. Despite an obvious superiority of plating in the treatment of humeral shaft non-unions, there is no doubt that intramedullary nailing as well as external fixation devices have a role. An algorithm of management of the humeral shaft non-unions following a rational approach is suggested.

Ortop Traumatol Rehabil. 2007 May-Jun;9(3):310-8.

Penetration of a selected antibiotic and antiseptic into a biofilm formed on orthopedic steel implants.

Bartoszewicz M, Rygiel A, Krzemiński M, Przondo-Mordarska A.

Katedra Mikrobiologii AM, Wrocław. marzbp@mbio.am.wroc.pl

BACKGROUND: The aim of the study was to determine the impact of octenidine hydrochloride and gentamicin on bacterial survival and reduction of biofilms formed on orthopaedic metal implants. **MATERIAL AND METHODS:** We studied metal orthopaedic components (screws, nails, fragments of wires used in Ilizarov devices) and a bone sequester. The presence and intensity of biofilm formation on the medical biomaterials was determined using the method of Richards et al. by visual evaluation of 2,3,5-triphenyl tetrazolium chloride (TTC) reduction by viable bacteria. The presence and structure of the biofilm on the components of the Ilizarov device, screws and bone sequester was also studied by electron microscopy. Bacterial survival in the biofilm following exposure to the antibiotic and antiseptic was studied by CLSI microdilution method in microtitre plates using TTC. **Results.** Most of the 16 strains (*S. aureus*, *S. epidermidis*, *E. coli*, *Enterobacter*) isolated from orthopaedic implants were able to form a biofilm. Established biofilms were resistant to gentamicin and octenidine hydrochloride but demonstrated greater susceptibility to octenidine. **CONCLUSIONS:** The results of the study indicate that octenidine hydrochloride is more effective

than gentamicin in the treatment of infections associated with the formation of a biofilm on orthopaedic implants.

Ortop Traumatol Rehabil. 2007 May-Jun;9(3):254-8.

Nine-years experience with the use of shock waves for treatment of bone union disturbances.

Bara T, Synder M.

*Katedra i Klinika Ortopedii i Ortopedii Dziecięcej Uniwersytetu Medycznego, _ód_.
tomasz.bara@neostrada.pl*

BACKGROUND: Stimulation of bony union by means of various physical modalities has not been widely used in clinical practice. Extracorporeal shock wave therapy (ESWT) offers the most promise. ESWT was first used to crush kidney stones (lithotripsy) in 1980. It is based on a sound rationale. Shock waves penetrate soft tissues and to release mechanical energy at the surface of bone, producing microfractures in sclerotic bone ends and triggering physiologic fracture healing, or "healing of fracture without a fracture". **MATERIAL AND METHODS:** Since 1998 we have treated more than 150 patients with delayed and non-unions of fractures using a standard lithotripter. Between 1,500 and 3,000 pulses were generated during one procedure depending on fracture size. Treatment effects were typically seen in the first follow-up radiographs at 6-12 weeks. **RESULTS:** Fracture union was achieved in 83% of the patients after 3-6 months. No complications were noted. The method arguably represents a useful adjunct to the treatment of bone union disturbances. It is a method of choice for patients with non-dislocated bony fragments. It can be used with metal implants or immobilisation in a cast or brace. In patients with dislocated bony fragments, we used the Ilizarov apparatus for correction and compression and shock waves for stimulation of healing. The best results were observed in delayed unions and vital nonunions. Atrophic nonunions did not respond well. Large bone defects did not fill. **CONCLUSIONS:** Shock wave therapy is a very effective treatment for delayed union or non-union of bone. It is a safe and complication-free method. ESWT should be considered in every case of delayed union. It may help avoid surgery under favourable conditions.

Tissue Eng. 2007 May;13(5):947-55.

Stem cells associated with macroporous bioceramics for long bone repair: 6- to 7-year outcome of a pilot clinical study.

Marcacci M, Kon E, Moukhachev V, Lavroukov A, Kutepov S, Quarto R, Mastrogiacomo M, Cancedda R.

Laboratorio di Biomeccanica, Istituti Ortopedici Rizzoli, Bologna, Italy.

Extensive bone loss is still a major problem in orthopedics. A number of different therapeutic approaches have been developed and proposed, but so far none have proven to be fully satisfactory. We used a new tissue engineering approach to treat four patients with large bone diaphysis defects and poor therapeutic alternatives. To obtain implantable three-dimensional (3D) living constructs, cells isolated from the patients' bone marrow stroma were expanded in culture and seeded onto porous hydroxyapatite (HA) ceramic scaffolds designed to match the bone deficit in terms of size and shape. During the surgical session, an Ilizarov apparatus or a monoaxial external fixator was positioned on the patient's affected limb and the ceramic cylinder seeded with cells was placed in the bone defect. Patients were evaluated at different postsurgery time intervals by conventional radiographs and computed tomography (CT) scans. In one patient, an angiographic evaluation was performed at 6.5 years follow-up. In this study we analyze the long-term outcome of these patients following therapy. No major complications occurred in the early or late postoperative periods, nor were major complaints reported by the patients. No signs of pain, swelling, or infection were observed at the implantation site. Complete fusion between the implant and

the host bone occurred 5 to 7 months after surgery. In all patients at the last follow-up (6 to 7 years postsurgery in patients 1 to 3), a good integration of the implants was maintained. No late fractures in the implant zone were observed. The present study shows the long-term durability of bone regeneration achieved by a bone engineering approach. We consider the obtained results very promising and propose the use of culture-expanded osteoprogenitor cells in conjunction with porous bioceramics as a real and significant improvement in the repair of critical-sized long bone defects.

Ann Acad Med Singapore. 2007 Apr;36(4):267-71.

Spiral and oblique fractures of distal one-third of tibia-fibula: treatment results with circular external fixator.

Demiralp B, Atesalp AS, Bozkurt M, Bek D, Tasatan E, Ozturk C, Basbozkurt M. Faculty of Medicine, Department of Orthopaedics and Traumatology, Gülhane Military Medical Academy, Ankara, Turkey. bahtidemiralp@yahoo.com

INTRODUCTION: Spiral and oblique fractures of distal 1/3 of tibia-fibula are relatively common fractures of long bones. Due to their types, aetiology, limited coverage and blood supply, these fractures often lead to union and soft tissue problems. MATERIALS AND METHODS: Twenty-seven patients with spiral and oblique fractures of distal 1/3 of tibia-fibula were treated with circular external fixator (CEF) between January 1997 and August 2000. All the fractures were closed. The type of fractures based on AO classification were A1 (n = 8), A2 (n = 6), B1 (n = 11) and C1 (n = 2). RESULTS: The mean framing time was 14.1 +/- 1.8 weeks (range, 12 to 19 weeks), and the mean treatment time was 18.8 +/- 2.2 weeks (range, 15 to 24 weeks). The patients were followed up for 36 to 78 months (mean follow-up time: 51.9 +/- 10.4 months). The results were evaluated for shortness, angulation, rotation, ankle stiffness, pain and infection. After removal of the frames, 11 patients had ankle pain and stiffness, and 3 patients had loss of range of motion in the ankle even after rehabilitation. None of the patients suffered any complications such as shortness, angulation, rotational deformity and infection, and none had loss of motion in the knee. CONCLUSIONS: CEF might be a preferable alternative treatment for distal tibia-fibula fractures due to its easy application, fewer major complications such as shortness and angulation, early mobilisation and shorter treatment time.

Arch Orthop Trauma Surg. 2007 Apr;127(3):161-5. Epub 2006 Dec 30.

Surgical outcomes after treatment of fractures in femur and tibia in pycnodysostosis.

Nakase T, Yasui N, Hiroshima K, Ohzono K, Higuchi C, Shimizu N, Yoshikawa H. Department of Orthopedic Surgery, Hoshigaokakouseinenkin Hospital, 4-8-1, Hoshigaoka, Hirakata, 573-8511, Osaka, Japan. tnakase@ff.ij4u.or.jp

Pycnodysostosis is a rare hereditary disease, characterized by systemic bone sclerosis. The most important orthopedic problem in this condition is the recurrent pathological fracture of long bones. In this paper, the surgical results for fractures of six limbs (three femurs and three tibias) in five cases of pycnodysostosis are reported. Five limbs achieved fracture union and union is developing in one tibia after intramedullary nail (IM) nailing or Ilizarov external fixation (IEF), although fracture line tends to persist for longer periods of time. One femoral fracture was treated by IM nailing, and one femoral and one tibial fracture were treated by IEF leading to final bone union. One femoral and one tibial fracture were initially treated by IEF, and were treated by IM nailing after re-fracture. One tibial fracture was initially treated by IEF leading to a failure of union, and was converted to IM nailing. All cases are able to walk; one case requires a single crutch. Infection was noted in two limbs after IM nailing following IEF. Fixation with IM nail was effective in preventing re-fracture as well as in alignment correction. Although the surgical technique

is more difficult, IM nailing in the initial surgery may be a better choice for achieving successful union while reducing the risk of re-fracture or infection.

Clin Orthop Relat Res. 2007 Apr;457:242-6.

Lengthening of a free fibular graft after sarcoma resection of the humerus.

Ilizarov S, Blyakher A, Rozbruch SR.

Hospital for Special Surgery, New York, NY, USA. ilizarovs@hss.edu

We report a patient who had resection of the humerus for osteosarcoma, initial reconstruction with a free fibular graft of the humerus, and subsequent lengthening of the graft. A 9-cm (100% of free fibula length) lengthening was achieved to equalize the humerus length. A complication of regenerate fracture was treated successfully with plating. Four years after the initial surgery for lengthening, the patient presented with a new radial neuropathy.

Int Orthop. 2007 Apr;31(2):165-70. Epub 2006 Jul 4.

Treatment of traumatic forearm bone loss with Ilizarov ring fixation and bone transport.

Smith WR, Elbatrawy YA, Andreassen GS, Philips GC, Guerreschi F, Lovisetti L, Catagni MA.

Department of Orthopaedic Surgery, Denver Health Medical Center, University of Colorado School of Medicine, Denver, CO 80204, USA.

Bone loss in the forearm results from high-energy trauma or follows non-union with infection. Ilizarov methodology provides stable fixation without implantation of permanent foreign bodies while permitting wrist and elbow movement. We are reporting our experience using distraction osteogenesis in the treatment of traumatic bone loss in the forearm. From 1991 to 2000, 11 consecutive patients with traumatic forearm bone loss were treated with Ilizarov ring fixation. Records were reviewed retrospectively. All patients were contacted 2-10 years after surgery at the Ilizarov Clinic in Lecco, Italy. Eleven atrophic non-unions with bone loss were treated. The time from injury to Ilizarov treatment averaged 2.1 years. Follow-up averaged 6.2 years. The union rate with Ilizarov treatment alone was 64%. Thirty-six percent of the patients were converted to a hypertrophic non-union and underwent compression plating. The overall rate of union was 100%. There were four unplanned reoperations and no refractures, neurovascular injuries or deep infections. Three patients had significant limitations of wrist function. Nine patients described their function as excellent. Ilizarov fixation with bone transport is a viable treatment option for atrophic forearm non-unions with bone loss. Treatment resulted in ablation of infection, healing of atrophic non-unions with minimal complications and early extremity use.

Orthopedics. 2007 Apr;30(4):304-7.

Mechanical performance of hybrid Ilizarov frames containing full-threaded Schanz screws.

Togrul E, Golsen M, Sarpel Y, Ozkan C, Capa M, Herdem M.

Dept of Orthopedics and Traumatology, Cukurova University Faculty of Medicine, 01330 Balcali Adana, Turkey.

Modification of circular Ilizarov frames is necessary to overcome the difficulties in pin positioning due to unfavorable anatomic site or local soft-tissue conditions. Hybrid frame configurations consisting of half pins or full-threaded schanz screws are widely used in clinical practice. This study compared the mechanical performance of hybrid frames and a standard system. One standard and five modified hybrid systems were tested under axial compression, four-point bending, and torsional forces. Systems modified with full-threaded schanz screws showed a higher stiffness than half pin modifications and exhibited a similar mechanical performance of a standard system.

Rev Med Chir Soc Med Nat Iasi. 2007 Apr-Jun;111(2):428-34.

[Results of external fixation in pelvic ring fractures]

Alexa O, Iancu C, Veliceasa B, Puha B, Georgescu N.

Facultatea de Medicin_, Disciplina de Ortopedie-Traumatologie, Universitatea de Medicin_ si Farmacie "Gr. T. Popa" Ia_i.

Pelvic ring fractures are severe injuries, with high mortality and morbidity rates. In the past orthopedic treatment was preferred, but after 1960 external fixation started to be used in the treatment of these fractures. External fixation is preferred in fractures with moderate displacement and incomplete posterior injuries of pelvic ring. There are lots of types of external fixators: uniplane--easy to apply, but unstable; multiplane--with complex geometry witch offers a more solid fixation, but needs a more complex technique to be applied. MATERIAL AND METHOD: We studied a series of 24 cases of unstable pelvic ring injuries in a four year period. Primarily, the injuries were classified as follows: 21 type B and 3 type C. RESULTS: All patients were treated with external fixation. Good clinical and radiological results were noted in 20 cases. The main intraoperative complications were the impossibility to insert all the Schanz screw between the two cortices of the iliac wing (6 cases) and insufficient reduction (4 cases). Postoperative complications were seen in 7 patients: pin tract infections (2 cases), secondary displacement or insufficient reduction (4 cases), screw fixation loosening (1 case). CONCLUSIONS: Treatment of type B of the pelvic ring with external fixation is a highly effective yet relatively simple and minimally invasive treatment method. Surgical time and blood loss are minimal, and patients can be effectively and rapidly mobilized. Clinical outcome is often unsatisfying because the posterior pelvic ring fracture is underdiagnosed and this type of fixation is sometimes used in patients with type C fractures.

Int Orthop. 2007 Mar 27 [Epub ahead of print]

Acute peg in hole docking in the management of infected non-union of long bones.

Dhar SA, Mir MR, Ahmed MS, Afzal S, Butt MF, Badoo AR, Dar IT, Hussain A.

The Bone and Joint Surgery Hospital, Barzullah, Srinagar, 190005, Kashmir, India, shabirdhar@yahoo.co.in.

The Ilizarov method has been studied extensively in the management of non-union of long bones. In most cases this involves filling of defects present primarily or after débridement by bone transport. Acute docking over gaps longer than 2 cm has not been adequately studied, however. The purpose of this paper is to report the efficacy of acute peg in hole docking as a bone graft-sparing modality in the management of infected non-union of long bones.

Int Orthop. 2007 Mar 15 [Epub ahead of print]

Application of external fixation for management of hand syndactyly.

Shevtsov VI, Danilkin MY.

Russian Ilizarov Scientific Center for Restorative Traumatology and Orthopaedics, 6, M. Ulianova street, Kurgan, 640014, Russia, gip@rncvto.kurgan.ru.

We present the method for management of syndactyly based on guided gradual and coordinated separation of finger phalanges and metacarpal bones by means of an original external fixator in order to grow soft tissue stock in the interdigital web spaces for their subsequent Z-plasty. Unlike traditional methods of treatment, the interdigital soft tissue bulk is grown by distraction only at the expense of local tissues. Cutaneous fascial grafting is avoided as it damages the donor site and causes ugly scarring.

Int Orthop. 2007 Mar 1 [Epub ahead of print]

Functional outcome after lengthening with and without deformity correction in

polio patients.

Emara KM, Khames A.

Department of Orthopaedic Surgery, Ain Shams University, Cairo, Egypt.

Poliomyelitis is one of the causes of limb length discrepancy. The aim of lengthening and deformity correction in such patients is to improve the functional mobility of the patient. This study aims to find out whether or not improvement of limb length inequality with or without deformity correction affects or improves ambulation. This prospective study included 32 skeletally mature patients managed using the Ilizarov technique and external fixation for limb lengthening with or without deformity correction. Functional Mobility Scale scoring was used for assessment of ambulation before lengthening and at the final follow-up. The average duration of follow-up was 2 years and 9 months. Lengthening alone did not change the Functional Mobility Scale score. While lengthening associated with deformity correction improved the mobility scale at 5 m only (in the house), it had no effect on the 50 and 500 m score.

J Bone Joint Surg Br. 2007 Mar;89(3):398-400.

Patellar tendon lengthening for patella infera using the Ilizarov technique.

In Y, Kim SJ, Kwon YJ.

Department of Orthopaedic Surgery, Uijongbu St. Mary's Hospital, The Catholic University of Korea School of Medicine, 65-1 Kumoh-dong, Uijeonbu-si, Gyeonggi-do, Republic of Korea.

Patella infera can cause knee pain and lead to patellofemoral osteoarthritis. Treatment is usually unsatisfactory. We describe a case of severe patella infera after operative treatment for fracture of the patella. We used Ilizarov external fixation and gradual lengthening of the patellar tendon. The patellar height was restored and the patient's symptoms were much improved.

J Formos Med Assoc. 2007 Mar;106(3 Suppl):S44-9.

Successful treatment of congenital pseudarthrosis of the tibia with long segment fibular allografting in a young child.

Su YP, Wang MN, Chang WN.

Department of Orthopedics and Traumatology, Taipei Veterans General Hospital, Taipei, Taiwan.

Congenital pseudarthrosis of the tibia (CPT) in young children with large bone defect after surgical resection can be difficult to reconstruct. Structural allograft may be a useful alternative in such cases but data are limited. We report a girl 1 year and 10 months of age with CPT successfully treated with en bloc resection of there current extensive pseudarthrosis, intramedullary rod placement, and long-segment intercalary allografting with supplemental autograft of the bony defect. At 6 years of follow-up, radiographs showed equal leg lengths, with good incorporation into the host bone. This method is technically simple and less time-consuming. It may be considered as an alternative method to the other more complicated procedures, such as microvascular fibula graft or the Ilizarov technique, in such a young child.

: J Orthop Trauma. 2007 Mar;21(3):178-84.

Ilizarov treatment of infected nonunions of the distal humerus after failure of internal fixation: an outcomes study.

Brinker MR, O'Connor DP, Crouch CC, Mehlhoff TL, Bennett JB.

Center for Problem Fractures and Limb Restoration, Houston, TX 77030-4509, USA. mb53@fondren.com

OBJECTIVE: To report the functional outcomes of Ilizarov treatment of infected nonunion of the distal humerus. DESIGN: Prospective case series. SETTING: Tertiary referral center. PATIENTS: Between July 1998 and August 2003, 6 consecutive patients (age 33 to 73 years) were referred to us with an infected

nonunion of the distal humerus following failure of open reduction and internal fixation. The average time from initial injury to presentation with the nonunion was 27 months (range, 6 to 99 months). The average number of prior surgeries was 2.8 (range, 1 to 4). INTERVENTION: Hardware removal, ulnar nerve neurolysis, 1 stage debridement, autogenous bone grafting, and application of an Ilizarov external fixator with acute compression in the operating room followed by slow gradual compression (0.25-0.50 mm per day) for several weeks postoperatively. MEASUREMENTS: Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire; SF-12 Physical Component Scale (PCS); Brief Pain Inventory; quality-adjusted life years. RESULTS: All patients attained bony union. One patient refractured 3 weeks after removal of the external fixator following a fall and ultimately underwent total elbow arthroplasty. At an average follow-up of 4.1 years (range, 2 to 7 years), none of the remaining 5 patients had undergone any additional surgery on their arm and all were free of infection. For these 5 patients, significant improvements were seen in standardized DASH scores (42% initially to 78% at follow-up, $P = 0.017$), worst pain intensity ratings (5.4 initially to 0.8 at follow-up, $P = 0.007$), and SF-12 PCS scores (37 initially to 44 at follow-up, $P = 0.041$). On average, the pretreatment to posttreatment improvement was equivalent to 3.8 quality-adjusted life years. CONCLUSIONS: Ilizarov treatment of infected distal humeral nonunions that have failed internal fixation restores function, decreases pain, and improves quality of life. The Ilizarov method should be considered a primary treatment option for this disabling and difficult clinical problem.

J Pediatr Orthop. 2007 Mar;27(2):220-4.

Soft tissue Ilizarov correction of congenital talipes equinovarus--5 to 10 years postsurgery.

Prem H, Zenios M, Farrell R, Day JB.

Royal Orthopaedic Hospital, Birmingham, United Kingdom.

The aim of this study was to address concerns regarding maintenance of correction of foot deformity after soft tissue Ilizarov distraction in relapsed clubfeet. We retrospectively reviewed the results of Ilizarov surgery of 19 rigid clubfeet in 14 children. The postoperative follow-up was at least 5 years (range, 5-10 years). All patients were assessed using the International Clubfoot Study Group score. This is a comprehensive scoring system published in 2003, incorporating morphological, functional, and radiological assessments. Patient and parent satisfaction was also assessed. Using the International Clubfoot Study Group score, 14 of the 19 feet managed by the Ilizarov soft tissue distraction technique were graded good or excellent. Only 1 patient experienced recurrence of the deformity. Subjectively, 13 of the 14 children in the study were satisfied with the result of the treatment. The study confirms that the short-term good results reported previously are maintained at least 5 years after the operation. There are no other similar studies with a minimum 5-year follow-up.

J Pediatr Orthop B. 2007 Mar;16(2):125-8.

High recurrence after calf lengthening with the Ilizarov apparatus for treatment of spastic equinus foot deformity.

Biedermann R, Kaufmann G, Lair J, Bach C, Wachter R, Donnan L.

Department of Orthopaedics, Innsbruck Medical University, Anichstrasse 35, A-6020 Innsbruck, Austria. rainer.biedermann@uibk.ac.at

Both gastrocnemius recession and Achilles tendon lengthening lead to scarring in the calf and have high reported recurrence rates when performed under the age of 8 years. Triceps surae lengthening by external fixation seemed to be a valuable alternative. Twelve calf lengthenings have been performed with an Ilizarov device with a mean correction of 27 degrees. No calcaneal gait was observed, but there was a slow continuous loss of dorsiflexion over the observation period. The

Ilizarov technique has a higher recurrence rate than most operative procedures for calf lengthening, but carries virtually no risk in producing calcaneus. The technique cannot be recommended for routine clinical use and may only be an alternative for selected cases.

J Pediatr Orthop B. 2007 Mar;16(2):113-9.

Acute correction of proximal tibial deformities in adolescents using Ilizarov external fixator: focal-dome versus straight-cut osteotomy.

El-Rosasy M, Ayoub M.

Department of Orthopaedic Surgery and Traumatology, Faculty of Medicine, University of Tanta, Tanta, Egypt. elrosasym@yahoo.com

Straight-cut osteotomy was compared with focal-dome osteotomy in two similar groups of patients with proximal tibial deformities. Acute correction of deformity was carried out for 27 patients with a total of 36 bone segments. Ilizarov external fixator was used in all cases. No significant difference was found between the two groups in terms of bone healing, external fixation time and stability of osteotomy. The follow-up ranged from 24 to 63 months. In this study, the focal-dome osteotomy was not found to be superior to straight-cut osteotomy, which is simpler to perform and more versatile for deformity correction.

Acta Orthop Belg. 2007 Feb;73(1):77-82.

The Ilizarov technique in joint contractures and dislocations.

Ullmann Y, Fodor L, Soudry M, Lerner A.

Department of Plastic and Reconstructive Surgery, Rambam Medical Center & Bruce Rapaport Faculty of Medicine, Haifa, Israel. y_ullmann@rambam.health.gov.il

This study was designed to evaluate the results of treatment of joint contractures (6 patients) and dislocations (2 cases) with an Ilizarov device. Six patients with restricting joint contractures were successfully treated and after gradual scar expansion they achieved a significant improvement in their range of motion. One patient with elbow instability after closed dislocation achieved 5 degrees to 130 degrees of motion, while one patient with an open dislocation achieved a range of motion from 15 degrees to 100 degrees. These results suggest that a hinged Ilizarov external fixation frame can be a useful tool to restore function in such complex problems.

Knee Surg Sports Traumatol Arthrosc. 2007 Feb;15(2):192-8. Epub 2006 Aug 9.

Tibial slope and high tibial osteotomy using the circular external fixator.

Gunes T, Sen C, Erdem M.

School of Medicine, Gaziosmanpasa University, Tokat, Turkey. drtgunes@gmail.com

Alteration of tibial slope is one of the important anatomical changes of the proximal tibia after high tibial osteotomy. Increased or decreased tibial slope can effect further total knee prosthesis procedure. In this retrospective study, 18 knees of 17 patients (17 female, mean age 51 range 43-61, mean BMI is 33.6 +/- 4.6 kg/m²) who were applied high tibial osteotomy using circular external fixator due to medial compartment arthrosis of the knee were evaluated in terms of tibial slope changes. While mean correction about 12.3 degrees in mechanical femoro-tibial angle was obtained in frontal plan (P = 0.0001), significant change in tibial slope was not determined in sagittal plan (P = 0.127). The mean posterior proximal femoral angle values were measured as 79.5 +/- 2.1 degrees preoperatively and as 80.3 +/- 2.7 degrees postoperatively and found to fall into the normal range (80.4 +/- 1.6 degrees). As there is no significant alteration in tibial slope after high tibial osteotomy performed with the Ilizarov system, complications due to alteration in tibial slope will not be experienced in follow-up or in further total knee prosthesis procedure.

Acta Chir Jugosl. 2007;54(2):83-9.

[Treatment of unstable closed tibial shaft fractures by external fixation]

Golubovi_ZS, Stojiljkovi_PM, Mitkovi_MB, Macukanovi_-Golubovi_LD, Bumbasirevi_MZ, Lesi_AR, Milenkovi_SS, Najman SR, Visni_AM, Karalei_SS, Matovi_ZM, Jovanovi_VR.

Klinika za Ortopediju i Traumatologiju, Kliniski centar Nis.

The fracture of tibia shaft is one of the most common fracture of long bones. The authors bring out the results of the treatment of 90 patients with unstable closed tibial shaft fractures treated by the use of Mitkovic external fixation systems. Within the analyzed group there were 66 (73%) male and 24 (27%) female. The average patients age was 43.9 years (range 15 to 82). Excellent result in treatment of unstable closed tibial shaft fractures with external fixation were achieved in 15 (16,7%) patients, very good in 38 (42,2%) patients, good in 24 (26,7%), poor in 9 (10%) and bad in 4 (4,4%) patients. With 4 (4,4%) patients pseudoarthrosis was formed. Additional treatment of patients with pseudoarthrosis (spongioplastic and placing of CD device) led to pseudoarthrosis healing. Within the analyzed group in all patients treated with external fixation there were no registered cases of postoperative osteitis. External fixation by the use of Mitkovic external fixation is one of the method of choose in the treatment of unstable closed tibial fractures, providing dynamic and balanced biomechanical conditions for fracture healing.

Biomed Tech (Berl). 2007;52(6):383-90.

An easily reproducible and biomechanically standardized model to investigate bone healing in rats, using external fixation.

Kaspar K, Schell H, Toben D, Matziolis G, Bail HJ.

Musculoskeletal Research Center Berlin, Center for Musculoskeletal Surgery, Charité-Universitätsmedizin Berlin, Free and Humboldt University of Berlin, Berlin, Germany. katharina.kaspar@charite.de

Abstract We have established a new small animal model to investigate the process of bone regeneration. A total of 42 male Sprague-Dawley rats received an osteotomy of the left femur, stabilized with a custom-made external fixator. The fixation method was chosen to create an easily reproducible, biomechanically well-defined model with minimized interference of the implant with the healing zone. At 14 or 56 days post-operation, the animals were sacrificed and examined biomechanically, histologically and radiologically. Radiologically, the femurs of all animals were anatomically positioned directly post-operation and remained in that position throughout the examination period. At 14 days post-operation, a typical periosteal callus formation could be observed both histologically and radiologically. At 56 days post-operation, the osteotomy was almost completely bridged by periosteal callus and the biomechanical competence of the bones was fully restored. Relative to the intact contralateral femur, the torsional stiffness median was 130.3% (interquartile range 118.9-157.7%) and the maximum torsional failure moment median was 135.6% (interquartile range 69.5-208.7%). As this model provides standardized conditions, it is suitable for a wide range of investigations and is particularly valuable for investigations of locally applied therapies, such as osteoconductive materials or osteoinductive factors.

Bull NYU Hosp Jt Dis. 2007;65(4):294-9.

Biomechanics of external fixation: a review of the literature.

Moss DP, Tejwani NC.

Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, New York, NY, USA.

External fixation for the purpose of bony realignment has been in practice since the early 1900s and is widely used today. External fixators are primarily used for trauma but may also be used for deformity correction and arthrodesis, among other applications. The advantages of external fixation over open reduction and

internal fixation and intramedullary nailing include simplicity of application, adjustability of the construct, and increased access for wound care and wound monitoring after fixation is achieved. Frame design requires a combination of pins, wires, clamps, rings, and rods to ultimately form a stable construct that can apply compressive, distractive, or neutral forces on bone.

Endokrynol Diabetol Chor Przemiany Materii Wieku Rozw. 2007;13(3):143-6.

[Surgical treatment of short stature of different etiology by the Ilizarov method]

Koczewski P, Shadi M.

Katedra i Klinika Ortopedii Dziecięcej i Traumatologii UM im K. Marcinkowskiego w Poznaniu. koczewski@orto.med.pl

THE AIM OF THE STUDY: To evaluate the results of surgical short stature treatment with distraction osteogenesis using Ilizarov apparatus. MATERIAL AND METHODS: Since 1996 sixteen patients were treated surgically because of short stature (11 male and 5 female) at the age of 9 to 29 years (mean 15.2). The cause of short stature in 6 patients was achondroplasia, 2 - Ellis van Creveld, 2 - Ollier disease, 1 - spondylometaphyseal dysplasia, 1 - hypothyroidism, 1 - pseudoachondroplasia and constitutional short stature - in other 3 patients. The pre-operative height ranged between 103 cm to 155 cm (mean 125). 12 patients were treated by the crossing method, means in one stage lengthening of the femur and the tibia of the contralateral limb. In 4 cases lengthening and improvement of body proportion was achieved by lower leg lengthening only (one of them lengthened twice). In 9 cases treated with the crossing method complete procedure was finished, in other 3 - only the first stage. Results In all patients the planned segmental lengthening was achieved except one tibial segment in the most older patient. Achieved height increase ranged from 8 to 20 cm (mean 13.8), on femur level 6 to 10 cm (mean 8.3) while on tibia level 2 to 10.5 cm (mean 7.3). The lengthening index for the single segment ranged from 0.6 to 4.7 months/cm (mean 1.5). COMPLICATIONS: Severe limitation of knee joint range of motion (up to 50 degrees) needs quadriceps plasty in one case. Residual valgus deformity of the tibia in one case with Ellis van Creveld needs corrective osteotomy. Abnormal bony re-generate of the tibia in the oldest patient did not allows achieving the planned lengthening and leads to increasing the lengthening index up to 3 times. CONCLUSION: Increasing the height with Ilizarov method is effective however the treatment time is long, requiring strict patients cooperation. The risk of complications should makes the qualification to this treatment careful and precise.

Endokrynol Diabetol Chor Przemiany Materii Wieku Rozw. 2007;13(3):121-4.

[Humeral lengthening with a monolateral external fixator in achondroplasia]

Shadi M, Koczewski P.

Katedra i Klinika Ortopedii Dziecięcej i Traumatologii UM im K. Marcinkowskiego w Poznaniu.

INTRODUCTION: In achondroplasia patients the shortening of upper limb (mainly the arms) is an important part of pathology in addition to low stature. Not all patients who are treated for increasing their height decided to have humeral lengthening and the indication for treatment is not only for cosmetic, psychological aspects but also limitation of upper limb function like self-services and personal hygiene. MATERIAL AND METHODS: 5 patients were evaluated (4 girls and 1 boy) at age of 14 to 18 years (mean 15.7) in whom 10 humeral lengthening were done using monolateral external fixator "Pumed". All patients have lower limb lengthening with the Ilizarov method 4-5 years before humeral lengthening. Observation time was 6 to 34 months (mean 20). In all cases the Pumed external fixator was fixed to humerus by 4 Schanz screws, open humeral distraction osteotomy was done below the insertion of deltoid muscle. In one case

15 degrees anteflexion correction was done intraoperatively. Distraction began at 5-6th day postoperatively with rate of 1 mm/day. Because of hypertrophic bone regenerate the distraction rate was often increased up to 1.5 mm/day. RESULTS: 8 to 9 cm lengthening was achieved (mean 8.5) which represents more than 50% of the primary segmental length. The average time of fixator application was 7 months and the lengthening index ranged from 0.8 to 1.1 months/cm (average 0.85). No shoulder and elbow joint range of motion deterioration was observed. At the follow-up transient radial nerve palsy was observed in one case after acute limb axis correction. CONCLUSIONS: Humerus lengthening, in achondroplasia patients with the use of monolateral external fixator is an effective and reliable method of treatment, with relatively low lengthening index. Monolateral External Fixator are well tolerated by patients.

J Craniofac Surg. 2007 Jan;18(1):29-38.

Mandible distraction using internal device: mathematical analysis of the results.

Freitas Rda S, Alonso N, Busato L, D'oro U, Ferreira MC.

Department of Plastic Surgery, Federal University of Paraná, Curitiba, Brazil.

dr.renato.freitas@gmail.com

For many years, surgeons have sought a method to treat severe facial deformities without using bone grafts and extensive surgery. Distraction osteogenesis offers this promise. The technique used in mandibular hypoplasia follows the basic principles proposed by Ilizarov which states that the device must be elongated 1 mm per day to create optimal bone production. Despite the widespread implementation of this recommendation to include the 1-mm/day separation, doubt still exists as to whether this is the optimal treatment regimen. Intraoral devices with percutaneous activator pins were used in 16 patients with hypoplastic mandibles. The results of distraction were documented by panorex and cephalogram of the mandible. The length of the ramus as well as multiple mandible dimensions and facial angles were measured. The panorex and cephalogram of the mandible were effective in demonstrating the significant increase in length of the mandible and ramus, as well as the entire mandible, but there was no correlation between the stretching obtained by the distraction device and that measured by the radiographic studies. The S-N-B angle was the only facial angle in which there is a statistically significant increase measured and this appeared to be related to a mandible rotation. It is concluded that the mandible distraction (using an intraoral device and an external activator pin) was effective in increasing the ramus length and both the panorex and the cephalogram were effective in demonstrating this morphologic change. There was no correlation between the clinical result and the radiographic studies demonstrating that the clinical judgment still has a significant role in controlling mandible distraction.

J Pediatr Orthop. 2007 Jan-Feb;27(1):41-5.

The deep fascia in response to leg lengthening with particular reference to the tension-stress principle.

Wang HQ, Li MQ, Wu ZX, Zhao L.

Department of Orthopaedics, Xi-Jing Hospital, Fourth Military Medical University, Xi'an, PR China.

OBJECTIVE: To investigate the morphological changes of deep fascia subjected to distraction in a rabbit model of leg lengthening. METHODS: The animal model of leg lengthening was established in 20 New Zealand white rabbits using a unilateral external fixator with 4 half pins medially fixed to the tibia, and osteotomy was performed between the second and the third pins. The distraction was initiated 7 days after the osteotomy procedure, with the rate of 1 and 2 mm/d in 2 steps, and proceeded until 10% and 20% increases in the initial length of the tibia had been achieved. The deep fascia samples were studied by the

hematoxylin-eosin stain, the Masson-trichrome staining, and the JEM2000EX electron microscopy. RESULTS: Under light, the cross section of normal deep fascia without distraction consisted of 3 layers. Whereas in the longitudinal sections, the deep fascia consisted of wavy collagen fibers. The normal deep fascia consisted of fibrocyte and collagenous fibrils under electron microscopy. After leg lengthening, the morphology of the fascia distracted at each rate changed. Under light, the fascia distracted at each rate kept the normal 3 layers in the cross sections. The fascia subjected to distraction at a rate of 2 mm/d showed injuries of collagen fibers. Under electron microscopy, the fascia distracted at a rate of 2 mm/d showed active metabolism to repair the necrotic collagenous fibrils. Whereas the fascia subjected to distraction at a rate of 1 mm/d showed regenerative changes. The endotheliocyte of capillaries within the deep fascia subjected to distraction at a rate of 1mm/d with 20% lengthening of tibia was metabolically active. CONCLUSIONS: The tension stress, which is applied in leg lengthening and deformity correction as described by Ilizarov, has a great effect upon the fascia, which is always related to the function of the involved limb. The appropriate regimen of distraction at the rate of 1 mm/d with 20% lengthening of tibia leads to the regenerative changes in deep fascia, ultimately close to the morphological structure of normal under the condition of this investigation.

J Trauma. 2007 Jan;62(1):174-83.

Two-ring hybrid external fixation of distal tibial fractures: a review of 47 cases.

Ristiniemi J, Flinkkilä T, Hyvönen P, Lakovaara M, Pakarinen H, Biancari F, Jalovaara P.

From the Department of Orthopaedic and Trauma Surgery, University Hospital of Oulu, Oulu, Finland. jukka.ristiniemi@oulu.fi

BACKGROUND: The healing of a metaphyseal fracture line is a major problem in cases of distal tibial fracture treated with external fixation. METHODS: Forty-seven distal tibial fractures treated with two-ring Ilizarov hybrid external fixation (16 AO/OTA type A and 31 type C, 10 open) were followed up. Fracture reduction and union time was evaluated and IOWA and RAND 36-Item Health Survey scores were used to assess functional outcome. RESULTS: Thirty-five fractures united uneventfully in a median time of 20 weeks, but 12 fractures needed additional procedures because of delayed union. According to univariate analysis, the risk factors for a longer time needed for fracture union were translational displacement and current smoking, and the risk factors for reoperation because of delayed union translational displacement fibular fracture fixation, and the number of cigarettes smoked per day. In multivariate analysis, translational displacement was a risk factor for both longer time to fracture union and reoperation and fibular fracture fixation was a risk factor for reoperation. If the translational displacement was less than 3 mm, the reoperation rate was 6%, whereas if the displacement was more than 3 mm, it was 83%. Reoperation was performed on 50% of the patients who underwent fibular fixation and on 15% of the patients who did not undergo fibular fixation. There were only marginal decreases in the range of motion and arthritis scores in the AO/OTA fracture types other than type C3. There were no significant differences in RAND 36 scores between the general Finnish population aged 18 to 64 years and our patients. CONCLUSIONS: Hybrid external fixation of distal tibial fractures is associated with delayed union, which is closely related to the degree of residual translational displacement after reduction. Fixation of an associated fibular fracture does not help to achieve better contact in the tibial fracture and increases the risk of delayed union.

J Trauma. 2007 Jan;62(1):166-73.

Reconstruction of juxta-articular huge defects of distal femur with vascularized

fibular bone graft and Ilizarov's distraction osteogenesis.

Lai D, Chen CM, Chiu FY, Chang MC, Chen TH.

Department of Orthopedics and Traumatology, Taipei Veterans General Hospital, and Division of Orthopedics, Department of Surgery, Chang Bing Show Chwan Memorial Hospital, Changhua County, Taiwan. davyilai2002@yahoo.com.tw

BACKGROUND: We evaluate the effect of reconstructing huge defects (mean, 15.8 cm) of the distal femur with Ilizarov's distraction osteogenesis and free twin-barreled vascularized fibular bone graft (TVFG). **METHODS:** We retrospectively reviewed a consecutive series of five patients who had cases of distal femoral fractures with huge defects and infection that were treated by the Ilizarov's distraction osteogenesis. After radical debridement, two of the five cases had free TVFG and monolocal distraction osteogenesis, and another two cases had multilocal distraction osteogenesis with knee fusion because of loss of the joint congruity. The other case with floating knee injury had bilocal distraction osteogenesis and a preserved knee joint. The mean defect of distal femur was 15.8 cm (range, 14-18 cm) in length. **RESULTS:** The mean length of distraction osteogenesis by Ilizarov's apparatus was 8.2 cm. The mean length of TVFG was 8 cm. The average duration from application of Ilizarov's apparatus to achievement of bony union was 10.2 months (range, 8-13 months). At the end of the follow-up, ranges of motion of three knees were 0 to 45 degrees, 0 to 60 degrees, and 0 to 90 degrees. Two cases had knee arthrodesis with bony fusion because of loss of the joint congruity. There were no leg length discrepancies in all five patients. In addition, three patients had pin tract infections and one case had a 10 degree varus deformity of the femur. **CONCLUSIONS:** Juxta-articular huge defect (>10 cm) of distal femur remains a challenge to orthopedic surgeons. Ilizarov's technique provides the capability to maintain stability, eradicate infection, restore leg length, and to perform adjuvant reconstructive procedure easily. In this study, we found that combining Ilizarov's distraction osteogenesis with TVFG results in improved patient outcome for patients with injuries such as supracondylar or intercondylar infected fractures or nonunion of distal femur with huge bone defect.

Khirurgiia (Mosk). 2007;(3):30-4.

[Functional state of lower extremities muscles at the patients with shin congenital defects before and after treatment with Ilizarov device]

Shevtsov VI, Dolganova TI, Sa futdinov MS, Dolganov DV, Borzunov DIu.

Results of examination (dynamometry, electromyography, ultrasonography) of 34 patients aged 6 to 23 years before and after treatment with Ilizarov's method are analyzed. Decrease of dynamometry and electromyography parameters, ultrasonic data are evidence of hard structural and functional disorders of motor system of these patients. Decrease of force and activation characteristics of tested muscles of operated extremity after removal of external fixator relates to high level of central protective inhibition and prolonged afferentation dysbalance at somatosensory system. Degree of recovery is limited and depends on patient age: recovery resources are presented at children before 8 years, but at juveniles they are depleted during the growth.

Med Image Comput Assist Interv Int Conf Med Image Comput Assist Interv. 2007;10(Pt 2):935-42.

Proof of concept of a simple computer-assisted technique for correcting bone deformities.

Ma B, Simpson AL, Ellis RE.

Human Mobility Research Centre, Kingston General Hospital, Kingston, Ontario, Canada. mab@cs.queensu.ca

We propose a computer-assisted technique for correcting bone deformities using the Ilizarov method. Our technique is an improvement over prior art in that it

does not require a tracking system, navigation hardware and software, or intraoperative registration. Instead, we rely on a postoperative CT scan to obtain all of the information necessary to plan the correction and compute a correction schedule for the patient. Our laboratory experiments using plastic phantoms produced deformity corrections accurate to within 3.0 degrees of rotation and 1 mm of lengthening.

Pol J Vet Sci. 2007;10(4):217-31.

Treatment of radius-ulna and tibia fractures with circular external skeletal fixator in 19 dogs.

Bilgili H, Kurum B, Captug O.

Department of Surgery, Faculty of Veterinary Medicine, Ankara University, 06110 Diskapi, Ankara, Turkey. hbilgilitr@yahoo.com

This study was carried out on 19 dogs of different breed, age and sex. 10 different types of radius-ulna and 9 tibia fractures were treated by circular external skeletal fixator. The cases were followed by clinical and radiological controls in the postoperative period. It was observed that the cases tolerated the apparatus well. There was no looseness of fixator stability and configuration during the 15-day interval examination. Complications like pin track, serous drainage and pin loosening were observed postoperatively. It was concluded that radiographic, clinical and anatomical data together with good preoperative planning, the Ilizarov Method and circular external skeletal fixator was successful for the treatment of open or closed fragmented radius-ulna and tibia fractures in dogs.

Pol J Vet Sci. 2007;10(3):153-7.

Comminuted long bone fractures in cats caused by pneumatic gun shot and repaired using the external fixator "tie-in" technique.

Adamiak Z, Aleksiewicz R, Kostrzewski M, Mederski J.

Division of Surgery and Roentgenology, Department of Clinical Sciences, Faculty of Veterinary Medicine, University of Warmia and Mazury in Olsztyn, Oczapowskiego 14, 10-957 Olsztyn, Poland. zbigniew.adamiak@wp.pl

Five cats with femoral fractures caused by pneumatic gun shot wounds were treated using intramedullary pin/external skeletal fixation "tie-in" (IM/ESF tie-in) technique between 1997 and 2005. Clinical and radiographical examinations were used to assess bone healing, limb function recovery and complications. Clinical results as well as fracture healing were excellent in all five cats. The study showed that the IM/ESF tie-in technique can be used in cats for the treatment of comminuted femoral fractures caused by pneumatic bullets.

Vestn Ross Akad Med Nauk. 2007;(5):37-41.

[Hemodynamic steal syndrome in the distal limb segments in patients treated by Ilizarov method]

Complex physiological examination of 149 patients with lower limb bone defects was performed using Doppler ultrasonography, rheovasography, percutaneous measurement of oxygen and carbon dioxide during treatment with Ilizarov apparatus. Within the process of treatment with Ilizarov apparatus, with marked collateral circulation, steal syndrome is noted in the distal parts of limb due to the effect of "functional shunting" in the zone of distraction regenerate bone. Steal syndrome during treatment by Ilizarov technique is registered, according to rheovasography and Doppler data, in 57% of patients with a defect in the femoral bone, in 24% of patients with post-traumatic defects in shin bones, and in 85% of patients with congenital defects in shin bones. In the compensated form of steal syndrome in the distal segment, according to polarography data, normoxia combined with hypocapnia is registered; oxygen requirements at rest are met by its more complete utilization, and activation of anaerobic processes.

Vet Comp Orthop Traumatol. 2007;20(4):264-8.

Stiffness of modified Type 1a linear external skeletal fixators.

Reaugh HF, Rochat MC, Bruce CW, Galloway DS, Payton ME.

Dallas Veterinary Surgical Center, Dallas, Texas, USA. hreaugh@sbcglobal.net

Modifications of a Type 1a external skeletal fixator (ESF) frame were evaluated by alternately placing transfixation pins on opposite sides of the connecting rod (Type 1a-MOD) or by placing additional connecting rods on either of the two inside (Type 1a-INSIDE) or two outside (Type 1a-OUTSIDE) transfixation pins. The objective of this study was to evaluate the stiffness of these modifications in terms of axial compression (AC), cranial-caudal bending (CCB), and medial-lateral bending (MLB). We hypothesized that these designs would allow significant increase in unilateral frame stiffness, over Type 1a, without proportional increase in frame complexity or technical difficulty of application. All of the ESF frames were constructed using large IMEX SKtrade mark clamps, 3.2 mm threaded fixation pins, 9.5 mm carbon fibre connecting rods and Delrin rods as bone models. Nine, eight pin frames of each design were constructed, and subjected to repetitive non-destructive loading forces (AC, CCB, MLB) using a materials testing machine. Frame construct stiffness for each force (AC, CCB, MLB) was derived from load-deformation curve analysis and displayed in N/mm. Data revealed the 1a-MOD and 1a-OUTSIDE constructs had significantly increased stiffness in CCB and AC as compared to the Type 1a constructs while all of the modified constructs were significantly stiffer in MLB than the Type 1a constructs.

J Orthop Surg. 2006 Dec 11;1:16.

Fatigue behavior of Ilizarov frame versus tibial interlocking nail in a comminuted tibial fracture model: a biomechanical study.

Hasenboehler E, Smith WR, Laudicina L, Philips GC, Stahel PF, Morgan SJ.

Department of Orthopaedic Surgery, Denver Health Medical Center, University of Colorado School of Medicine, 777 Bannock Street, Denver, CO 80204, USA.

erik.hasenboehler@dhha.org

BACKGROUND: Treatment options for comminuted tibial shaft fractures include plating, intramedullary nailing, and external fixation. No biomechanical comparison between an interlocking tibia nail with external fixation by an Ilizarov frame has been reported to date. In the present study, we compared the fatigue behaviour of Ilizarov frames to interlocking intramedullary nails in a comminuted tibial fracture model under a combined loading of axial compression, bending and torsion. Our goal was to determine the biomechanical characteristics, stability and durability for each device over a clinically relevant three month testing period. The study hypothesis was that differences in the mechanical properties may account for differing clinical results and provide information applicable to clinical decision making for comminuted tibia shaft fractures. **METHODS:** In this biomechanical study, 12 composite tibial bone models with a comminuted fracture and a 25 mm diaphyseal gap were investigated. Of these, six models were stabilized with a 180-mm four-ring Ilizarov frame, and six models were minimally reamed and stabilized with a 10 mm statically locked Russell-Taylor Delta tibial nail. After measuring the pre-fatigue axial compression bending and torsion stiffness, each model was loaded under a sinusoidal cyclic combined loading of axial compression (2.8/28 lbf; 12.46/124.6 N) and torque (1.7/17 lbf-in; 0.19/1.92 Nm) at a frequency of 3 Hz. The test was performed until failure (implant breakage or ≥ 5 degrees angulations and/or 2 cm shortening) occurred or until 252,000 cycles were completed, which corresponds to approximately three months testing period. **RESULTS:** In all 12 models, both the Ilizarov frame and the interlocking tibia nail were able to maintain fracture stability of the tibial defect and to complete the full 252,000 cycles during the entire study period of three months. A significantly higher stiffness to axial

compression and torsion was demonstrated by the tibial interlocking nail model, while the Ilizarov frame provided a significantly increased range of axial micromotion. **CONCLUSION:** This is the first study, to our knowledge, which compares the biomechanical properties of an intramedullary nail to an external Ilizarov frame to cyclic axial loading and torsion in a comminuted tibia shaft fracture model. Prospective, randomized trials comparing Ilizarov frames and interlocked tibial nails are needed to clarify the clinical impact of these biomechanical findings.

Acta Orthop Belg. 2006 Dec;72(6):765-8.

Distraction osteogenesis to improve limb function in congenital bilateral humeroradioulnar synostosis.

Kakarala G, Kavarthapu V, Lahoti O.

King's College Hospital, London, United Kingdom. kakaralagk@yahoo.com

Congenital bilateral humeroradioulnar fusion of the elbow is rare. Many patients tolerate unilateral elbow stiffness very well, but bilateral fixed elbows are very disabling. We report the management of a 13-year-old patient using the Ilizarov technique. The left elbow was ankylosed in 70 degrees flexion. It was gradually lengthened through an osteotomy across the fused elbow and flexed through the regenerate to 110 degrees. This has improved the function of the left arm.

Int Orthop. 2006 Dec;30(6):550-4. Epub 2006 May 12.

Deformity correction and lengthening of lower legs with an external fixator.

Matsubara H, Tsuchiya H, Sakurakichi K, Watanabe K, Tomita K.

Department of Orthopedic Surgery, School of Medicine, Kanazawa University, Kanazawa, Japan.

Deformities combined with shortening in 34 lower limb segments of 28 patients were treated with an Ilizarov external fixator or a Taylor spatial frame at the same level as the osteotomy. We compared an acute correction group (A) with a gradual correction group (G) in patients undergoing deformity correction followed by lengthening. We retrospectively examined the amount of deformity correction, length gained, distraction index, maturation index, and external fixation index in both groups. The mean age of subjects was 12.9 years for A, 17.9 years for G. The mean deformity correction was 17.8 degrees for A, 25.1 degrees for G. Mean lengthening was 5.5 cm for A, 5.0 cm for G. Mean distraction index was 16.4 days/cm for A, 10.6 days/cm for G ($P<0.05$). Mean maturation index was 40.5 days/cm for A, 29.5 days/cm for G ($P=0.081$). Mean external fixation index was 58.6 days/cm for A, 42.5 days/cm for G ($P<0.05$). The distraction index and external fixation index differences between the two groups were statistically significant. Gradual correction may represent a better approach than acute correction with the use of external fixators to treat deformity combined with shortening.

J J Bone Joint Surg Br. 2006 Dec;88(12):1642-6.

Limb salvage for osteosarcoma of the distal tibia with resection arthrodesis, autogenous fibular graft and Ilizarov external fixator.

Shalaby S, Shalaby H, Bassiony A.

Ains Shams University, Orthopaedic Department, El Demerdash Hospital, Ramses Street, El Abbassia, 11381, Cairo, Egypt.

We report the results of limb salvage for non-metastatic osteosarcoma of the distal tibia using resection arthrodesis, autogenous fibular graft and fixation by an Ilizarov external fixator. In six patients with primary osteosarcoma of the distal tibia who refused amputation, treatment with wide en bloc resection and tibiotalar arthrodesis was undertaken. The defect was reconstructed using non-vascularised free autogenous fibular strut graft in three patients and a

vascularised pedicular fibular graft in three, all supplemented with iliac cancellous graft at the graft-host junction. An Ilizarov external fixator was used for stabilisation of the reconstruction. In five patients sound fusion occurred at a mean of 13.2 months (8 to 20) with no evidence of local recurrence or deep infection at final follow-up. The mean post-operative functional score was 70% (63% to 73%) according to the Musculoskeletal Tumour Society scoring system. All five patients showed graft hypertrophy. Union of the graft was faster in cases reconstructed by vascularised fibular grafts. One patient who had a poor response to pre-operative chemotherapy developed local tumour recurrence at one year post-operatively and required subsequent amputation.

J Orthop Surg (Hong Kong). 2006 Dec;14(3):273-9.

Comment in:

J Orthop Surg (Hong Kong). 2007 Apr;15(1):122.

Acute compression and lengthening by the Ilizarov technique for infected nonunion of the tibia with large bone defects.

Magadum MP, Basavaraj Yadav CM, Phaneesha MS, Ramesh LJ.

Department of Orthopaedics, St John's Medical College Hospital, Bangalore, Karnataka, India. mahanteshmagadum@yahoo.co.in

PURPOSE. To assess the Ilizarov technique in treating large infected tibial defects by resection of the infected focus, its acute compression, and gradual distant site lengthening. **METHODS.** 27 men (mean age, 39 years) with infected nonunion and large bone defects of the tibia underwent complete resection of the nonunion site, debridement, sequestrectomy, lavage, and Ilizarov ring fixator application. Patients underwent acute compression of the defect site, followed by distant site metaphyseal corticotomy for simultaneous lengthening. The mean length of resection was 10 (range, 6-17) cm. The mean follow-up was 27 (range, 25-39) months. **RESULTS.** The mean lengthening achieved was 10 cm, mean union time 6.3 months, and mean duration of consolidation 10.2 months. Functional results were excellent in 19 patients and good in 5. The union time was longer in older patients. **CONCLUSION.** Acute compression and simultaneous lengthening can be used safely for treatment of large bone defects in the tibia. This avoids secondary operations at the docking site and reduces the duration of treatment.

J Orthop Surg (Hong Kong). 2006 Dec;14(3):265-72.

Modified Ilizarov technique for infected nonunion of the femur: the principle of distraction-compression osteogenesis.

Krishnan A, Pamecha C, Patwa JJ.

Department of Orthopaedics, Sheth KM School of PG Medicine and Research, Smt NHL Municipal Medical College, Ahmedabad, India.

PURPOSE. To evaluate the treatment outcome of the modified Ilizarov technique in infected nonunion of the femur. **METHODS.** Between 1989 and 2002, records of 20 patients with infected nonunion of the femur treated with the modified Ilizarov technique were retrospectively reviewed. The modified Ilizarov frame was fixed after necrectomy of the dead infected bone and tissues. A proximal or distal corticotomy was performed following biological principles. For regeneration of gap, segmental transport was performed in 11 patients with a gap of more than 5 cm; acute docking followed by lengthening at the corticotomy site was performed in 9 patients with a gap of smaller than 5 cm. Mobilisation was started early with active participation of the physical therapist and the patients. Bone and functional results were measured and complications were categorised according to the Association for the Study and Application of the Method of Ilizarov guidelines. **RESULTS.** The mean follow-up period was 62.8 months. Bony union and eradication of the infection was achieved in all patients except one who underwent amputation due to uncontrolled infection. Bone results were excellent in 13 patients, good in 4, fair in one, poor in one, and treatment failure

(amputation) in one. Functional results were excellent in 3 patients, good in 9, fair in 3, poor in 4, and failure in one. A total of 71 complications occurred: 35 problems, 6 obstacles, and 30 true complications. The mean healing index was 38.3 day/cm (standard deviation, 1.6 day/cm). **CONCLUSION.** The Ilizarov technique is a good salvage operation for infected nonunion of the femur. Limb salvage is preferable to prosthesis if the limb is viable, adequately innervated and the patient is mentally and financially committed to save the limb.

West Indian Med J. 2006 Dec;55(6):420-4.

Femoral lengthening using the Ilizarov technique.

Rose RE.

Division of Orthopaedics, Department of Surgery, Radiology, Anaesthesia and Intensive Care, The University of the West Indies, Kingston 7, Jamaica. recrose@hotmail.com

The Ilizarov method allows the surgeon to perform extended lengthening of both congenital and acquired short limbs. The technique can be difficult, time consuming and is associated with many complications. Generally, the number of complications and failures of lengthenings increases in proportion to the length of the distraction and the severity of the preoperative problems. The rate of major complications decreases substantially as the experience of the surgeon increases.

J Pediatr Orthop. 2006 Nov-Dec;26(6):788-93.

Bifocal tibial corrective osteotomy with lengthening in achondroplasia: an analysis of results and complications.

Vaidya SV, Song HR, Lee SH, Suh SW, Keny SM, Telang SS.

Department of Orthopaedics, Rare Diseases Institute, Korea University, Guro Hospital, Seoul, South Korea.

The results and complications of bifocal tibial osteotomies with gradual correction and lengthening by Ilizarov ring fixator performed in 47 tibiae in 24 achondroplastic patients were analyzed. Comparison was made between the parameters of angular and torsional deformities of the tibia preoperatively, at fixator removal, and at last follow-up. Of these parameters, statistically significant change was seen postoperatively in the values of medial proximal tibial angle, lateral distal tibial angle, mechanical axis deviation, and tibial torsion, which changed from 78.8 +/- 7.05 degrees, 103.2 +/- 11.8 degrees, 25.1 +/- 14.6 mm (medial), and 22.7 +/- 10 degrees (internal) preoperatively to 87.3 +/- 6.3 degrees, 90.9 +/- 5.4 degrees, 5.3 +/- 10 cm (medial), and 15.8 +/- 4.2 degrees (external), respectively, at the time of fixator removal; and this correction was maintained during the follow-up period. Mean total tibial lengthening was 6.84 +/- 1.3 cm. Average healing index was 26.06 days/cm. Complications observed were 15 pin tract infections, 1 residual varus, 1 overcorrection into valgus, 2 recurrence of varus, 22 equinus contractures, 2 premature consolidations, and 3 fibula malalignments. Recurrence of varus was observed in limbs with a residual abnormal medial mechanical axis deviation due to femoral deformity. A hundred percent incidence of equinus was observed in limbs with tibial lengthening of more than 40%, with distal tibial lengthening of more than 15%. To minimize the risk for occurrence of equinus, we recommend restriction of distal tibial lengthening in achondroplasia to less than 15%, although total tibial lengthening may exceed 40%. Fibula malalignment was not observed after double fibula osteotomy. This procedure is safe and efficacious if performed with strict adherence to prescribed technique.

J Trauma. 2006 Nov;61(5):1186-91.

External circular fixation: a comparison of infection rates between wires and conical half-pins with threads outside or inside the skin.

Catagni MA, Ottaviani G, Combi A, Elhence A.

Department of Orthopaedic and Ilizarov Unit, Alessandro Manzoni Hospital Lecco, Italy. maurizio@catagni.it

BACKGROUND: The purpose of this study was to evaluate if there is a difference in the rates of infection between Ilizarov wires and half-pins and between half-pins with threads outside and inside the skin in circular fixators modified by Catagni and Cattaneo. **METHODS:** Between May and December 2004, 218 patients with circular Ilizarov fixators for various orthopaedic indications who visited our Ilizarov clinic were subjected to a one-time evaluation of half-pins and wires. **RESULTS:** A total of 1,093 half-pins were checked and 34 (3.11%) of these were infected (50% with threads outside and 50% with threads inside the skin). Among a total number of 951 wires (1,092 pin tracts) checked, 45 (4.73%) were infected. **CONCLUSIONS:** We conclude that the circular Ilizarov fixation with conical half-pins and wires has similar rate of infection compared with conventional Ilizarov circular fixator. Moreover, there is no difference in infection rates between pins with threads inside the skin as compared to those with threads outside the skin.

Acta Orthop. 2006 Oct;77(5):772-7.

No difference in tibial lengthening index by use of Taylor spatial frame or Ilizarov external fixator.

Kristiansen LP, Steen H, Reikerås O.

Rikshospitalet-Radiumhospitalet Medical Center, Biomechanics Laboratory, Orthopaedic Department, University of Oslo, Oslo, NO-0027, Norway.

leif.pal.kristiansen@rikshospitalet.no

BACKGROUND: Different methods and devices are used to perform lengthening and deformity reconstruction in the tibia. Recently, the Taylor spatial frame (TSF) has been introduced as a computer-assisted and versatile external ring fixator. Lengthening index (LI) and complications are important result parameters, and the aim of this study was to review our first 20 tibial segments operated with the TSF and to compare the results with our experience of using the traditional Ilizarov external fixator (IEF). **PATIENTS AND METHODS:** We lengthened 20 tibial segments in 20 patients with the TSF. The results were compared with those of 27 tibial segments from 27 patients that were lengthened with the IEF. All segments were operated on with monofocal osteotomies. **RESULTS:** In the overlapping zone of comparable lengthening distances between 2.4 and 6.0 cm, the LI of 2.4 and 1.8 months/cm was not significantly different between the TSF and IEF groups, respectively ($p = 0.17$). This non-significant difference was confirmed after adjustment for age. **INTERPRETATION:** We found no difference between the TSF and IEF frames regarding LI and complication rate. However, rotational, translational, and residual deformity correction is easier to perform with the TSF.

Chirurg. 2006 Oct;77(10):943-61; quiz 962.

[Osteitis. Infections of the locomotive system]

Schmelz A, Kinzl L, Einsiedel T.

Abteilung für Unfall-, Hand-, Plastische und Wiederherstellungschirurgie, Universitätsklinikum Ulm, Steinhövelstrasse 9, 89075 Ulm.

andreas.schmelz@uniklinik-ulm.de

Infections of the locomotive system appear in many different forms such as acute inflammation of joints or bone following injury or surgical or chronic processes, often lasting for years. They demand an exact treatment plan not only to remove necrotic tissue but also for reconstruction of defects. A special problem is infection following alloplastic reconstruction of joints or spine. Multiple surgical procedures are required to hinder reinfection, restore function, and assure acceptable patient quality of life.

Clin Orthop Relat Res. 2006 Oct;451:113-20.

Hybrid external fixation for arthrodesis in knee sepsis.

Salem KH, Keppler P, Kinzl L, Schmelz A.

Department of Trauma, Hand, Plastic, and Reconstructive Surgery, University of Ulm, Ulm, Germany. khaled_hamedsalem@hotmail.com

Several techniques for knee fusion have been described with success rates ranging from 29% to 100%, with worse results occurring in patients with joint sepsis. We treated 21 patients with persistent infections using knee arthrodesis with a hybrid Ilizarov frame at our institution. There were 13 men and eight women ranging from 21 to 75 years (mean, 49.7 years). Sixteen patients had chronic osteomyelitis and five had previous fusion trials. Two patients required bone transport using the same arthrodesis frame. We corrected associated malalignment in three patients. Solid knee fusion was achieved in all but one patient after a mean external fixation time of 22.7 weeks (range, 11-47 weeks). Limb shortening averaged 2.8 cm (range, 1.5-5 cm). No patients required secondary bone grafting to achieve fusion. Nine patients had complications develop, three of whom required resection and frame application to treat persistent infection or delayed union. Our results emphasize the clinical success of using the Ilizarov fixator for knee arthrodesis after persistent sepsis.

Foot Ankle Int. 2006 Oct;27(10):764-70.

Ankle arthrodesis using Ilizarov ring fixators: a review of 22 cases.

Salem KH, Kinzl L, Schmelz A.

Department of Trauma, Hand, and Reconstructive Surgery, University of Ulm, Steinhoevelstrasse 9, 89075 Ulm, Germany. Khaled_hamedsalem@hotmail.com

BACKGROUND: Orthopaedic surgeons are being increasingly confronted with complex ankle problems that cannot be reliably treated by conventional arthrodesis procedures. The Ilizarov technique can be an alternative salvage method in such cases. **METHODS:** Twenty-two Ilizarov tibiotalar arthrodeses were retrospectively reviewed. There were 16 men and six women (mean age 49 years). The underlying pathology was infection after internal fixation of ankle or plafond fractures in 16 patients, posttraumatic ankle arthritis in five, and septic arthritis after an infected Achilles tendon repair in one. Five patients had at least one failed previous arthrodesis. Primary iliac crest bone grafting was done in two patients. Proximal tibial lengthening was done in six patients. **RESULTS:** Twenty-one patients were followed for an average of 29 months. A solid fusion was achieved in all patients by the end of treatment. The external fixation time averaged 27.7 (range 12 to 84) weeks. The mean time spent in a foot frame was 22.3 weeks. Complications occurred in 11 patients, including two nonunions that healed after revision and renewed frame application and four pin track infections. **CONCLUSIONS:** The use of the Ilizarov frame provides a successful salvage method that offers solid bony fusion, optimal leg length, and eradication of infection in complex ankle pathology or failed previous arthrodesis.

Injury. 2006 Oct;37(10):941-5.

Relationship between locking-bolt torque and load pre-tension in the Ilizarov frame.

Osei NA, Bradley BM, Culpan P, Mitchell JB, Barry M, Tanner KE.

Department of Orthopaedics and Trauma, The Royal London Hospital, Whitechapel, London E1 1BB, United Kingdom. nana_akoto@hotmail.com

The wire-bolt interface in an Ilizarov frame has been mechanically tested. The optimal torque to be applied to the frame locking-bolts during physiological loading has been defined. The set-up configuration was as is used clinically except a copper tube was used to simulate bone. The force-displacement curves of the Ilizarov wires are not altered by locking-bolt torque. The force in the bone model at which pre-tension is lost increases as the locking-bolts are tightened

to 14 Nm torque, but decreases if torque exceeds 14 Nm. Thus, 14 Nm is the optimal locking-bolt torque in frame. The relationship between pre-tension versus load for different locking-bolt torques arises because at low and high clamping torques poor wire holding and plastic deformation respectively occur. Wire damage was seen under light and electron microscopy. Clinically, over or under-tightening locking-bolts will cause loss of pre-tension, reduction in frame stiffness and excessive movement at the fracture site, which may be associated with delayed union.

J Am Acad Orthop Surg. 2006 Oct;14(10 Suppl):S90-3.

New developments in flap techniques.

Levin LS.

Limb reimplantation techniques using composite free-tissue transfer and microsurgical salvage of traumatized extremities have become standard reconstructive methods. Mechanisms for working with free-tissue transfers have advanced, specifically in regard to the use of thin-wire fixators: combining microsurgical techniques and thin-wire fixators helps in salvaging limbs that otherwise might be amputated. Also, combining the Ilizarov method with microsurgical techniques for limb salvage provides a new use for flaps. A further development in the use of flaps is the application of free-tissue transfers to preserve amputation levels in the war-injured. So-called fillet flaps serve as "spare parts" and can be customized for specific recipient sites. The so-called perforator flap makes use of feeder vessels, thus providing cutaneous and other composite flaps without sacrificing major vessels. Finally, the advent of the sural flap has made it possible to avoid microsurgical reconstruction but still provide adequate, well-vascularized cover, particularly in the distal third of the leg.

J Bone Joint Surg Am. 2006 Oct;88(10):2137-45.

Republished in:

J Bone Joint Surg Am. 2007 Sep;89 Suppl 2 Pt.2:183-95.

Reconstruction of segmental bone defects due to chronic osteomyelitis with use of an external fixator and an intramedullary nail.

Kocaoglu M, Eralp L, Rashid HU, Sen C, Bilsel K.

Department of Orthopaedics and Traumatology, Istanbul Medical School, Istanbul University, Capa, 34390, Istanbul, Turkey.

BACKGROUND: Callus distraction over an intramedullary nail is a rarely used technique for the reconstruction of intercalary defects of the femur and tibia after radical débridement of chronic osteomyelitic foci. The aim of this study was to summarize our experience with distraction osteogenesis performed with an external fixator combined with an intramedullary nail for the treatment of bone defects and limb-shortening resulting from radical débridement of chronic osteomyelitis. **METHODS:** Thirteen patients who ranged in age from eighteen to sixty-three years underwent radical débridement to treat a nonunion associated with chronic osteomyelitis of the tibia (seven patients) and femur (six patients). The lesions were classified, according to the Cierny-Mader classification system, as type IVA (nine) and type IVB (four). The resulting segmental defects and any limb-length discrepancy were then reconstructed with use of distraction osteogenesis over an intramedullary nail. Two patients required a local gastrocnemius flap. Free nonvascularized fibular grafts were added to the distraction site for augmentation of a femoral defect at the time of external fixator removal and locking of the nail in two patients. At the time of the latest follow-up, functional and radiographic results were evaluated with use of the criteria of Paley et al. **RESULTS:** The mean size of the defect was 10 cm (range, 6 to 13 cm) in the femur and 7 cm (range, 5 to 10 cm) in the tibia. The mean external fixator index was 13.5 days per centimeter, the consolidation index

was 31.7 days/cm, and the mean time to union at the docking site was nine months (range, five to sixteen months). At a mean follow-up of 47.3 months, eleven of the thirteen patients had an excellent result in terms of both bone and functional assessment. There were two recurrences of infection necessitating nail removal. These patients underwent revision with an Ilizarov fixator. Subsequently, the infection was controlled and the nonunions healed. **CONCLUSIONS:** This combined method may prove to be an improvement on the classic techniques for the treatment of a nonunion of a long bone associated with chronic osteomyelitis, in terms of external fixation period and consolidation index. The earlier removal of the external fixator is associated with increased patient comfort, a decreased complication rate, and a convenient and rapid rehabilitation.

Oper Orthop Traumatol. 2006 Oct;18(4):364-76.

The use of a nerve stimulator to allow safe placement of Ilizarov wires.

Shortt NL, Keenan GF, Muir AY, Simpson AH.

Edinburgh Orthopaedic Unit, Royal Infirmary of Edinburgh, Little France, UK.

OBJECTIVE: Avoidance of potential iatrogenic nerve injury during insertion of Ilizarov fine wires into areas of high anatomic risk by using a modified nerve stimulation technique. **INDICATIONS:** Application of the Ilizarov ring fixator to areas of high anatomic hazard, in situations where anatomic topography may be distorted by previous surgery, trauma, or congenital anomalies. **CONTRAINDICATIONS:** Use of systemic muscle relaxants. Caution in patient with cardiac pacemaker. **SURGICAL TECHNIQUE:** Preliminary experiments showed that a standard nerve-stimulating device can deliver a negatively charged, monophasic square pulse of current through Ilizarov wires. During the application of an Ilizarov frame to potentially hazardous anatomic regions, providing no systemic muscle relaxants are used, a voltage field sufficient to cause nerves in close proximity to the Ilizarov wire to depolarize is produced. Identification of a distal muscle twitch provoked by the stimulation may indicate a potential for iatrogenic nerve injury. **RESULTS:** Results show that with the nerve stimulator set at 2.5 mA (pulsed at a frequency of 2 Hz), peripheral nerves are stimulated if they lie within 5 mm of the wires. Should a distal muscle twitch occur, wires should be repositioned so that equivalent stimulation produces no twitch. The technique was used during Ilizarov frame application in ten patients, with only a single occurrence of distal muscle twitches in a lower-leg frame. Following repositioning of the Ilizarov wire in this case, no further twitches were observed, indicating that no Ilizarov wire was inserted close to peripheral nerves. No neurologic impairment was present postoperatively.

J Foot Ankle Surg. 2006 Sep-Oct;45(5):337-41.

Treatment of relapsed idiopathic clubfoot by complete subtalar release combined with the Ilizarov method.

Nakase T, Yasui N, Ohzono K, Shimizu N, Yoshikawa H.

Department of Orthopaedic Surgery, Osaka National Hospital, Osaka, Japan.

This study presents the clinical and radiographic outcomes of 6 feet (4 patients) with relapsed idiopathic clubfoot that were treated with a combination of subtalar release and the Ilizarov method. The mean patient age at the time of the surgery was 7.4 years (range, 4.5-10.5 years), and the mean follow-up was 5.1 years (range, 2.0-7.3 years). All cases achieved a plantigrade foot, better walking ability, and parental satisfaction with the result. Ankle joint range of motion increased from a mean of 17 degrees (range, 10-30 degrees) preoperatively to 45 degrees (range, 35-65 degrees) at final follow-up. The talocalcaneal angle improved from a mean of 26 degrees (range, 15-34 degrees) preoperatively to 55 degrees (range, 47-65 degrees) at follow-up. The mean tibiocalcaneal angle improved from 95 degrees (range, 87-115 degrees) preoperatively to 80 degrees (77-83 degrees) at follow-up, whereas the talometatarsal angle improved from a

preoperative mean of -19 degrees (range, -35 to -10 degrees) to 3.5 degrees (range, -5 to 7 degrees) at follow-up. Recurrence was observed in only 1 foot with forefoot adductus, caused by a pin tract infection and early fixator removal. These cases suggest the Ilizarov method combined with subtalar release are beneficial for the treatment of relapsed idiopathic clubfoot.

Orthop Nurs. 2006 Sep-Oct;25(5):300-8; quiz 309-10.

Impact of external fixation on adolescents: an integrative research review.

Patterson M.

University of Massachusetts Graduate School of Nursing, Department of Orthopedics, UMass Memorial Medical Center, Worcester, MA, USA.

PURPOSE: To define the state of nursing knowledge about the psychological impact of treating adolescents with external fixation devices (EFDs). **METHOD:** An integrated research review was conducted on literature available from CINAHL, MEDLINE, and PsycINFO. Keywords used were external fixation, fracture fixation, orthopaedic or orthopaedic, limb lengthening, Ilizarov, halo traction, Orthofix, EBI fixator, pelvic fixator, ring fixator, body image, self-concept, self-esteem, self-perception, adaptation, emotional, behavior, and outcome. Inclusion criteria for studies were (a) publication from 1990 to 2003, (b) focus on psychosocial and functional outcomes of treating adolescents with EFDs, and (c) publication in English. Studies were categorized by author, year, discipline(s), design, focus, sample, measurement, findings, and research recommendations. Findings and recommendations were compared across publications. **RESULTS:** All studies reported psychological and behavioral changes after EFD treatment. Pain and pin-site infections were the most problematic physical findings. Depression was universally evident to varying degrees, with some suicidal ideation and self-destructive behaviors, although mostly reported as transient. This predominantly retrospective cohort of studies reported social isolation as well as eating and sleep disturbances. Family and nursing support, a multiple disciplinary approach, and better preoperative preparation were crucial to adolescents psychological health after EFD treatment. **CONCLUSION:** Adolescents treated with EFDs require significant psychosocial support. The findings reveal major gaps in the knowledge on adolescents treated with external fixation for traumatic injury and none focused on EFD treatment in the acute period.

Arch Orthop Trauma Surg. 2006 Aug;126(6):401-5. Epub 2006 May 30.

Preliminary results of the use of Ilizarov fixation in clavicular non-union.

Demiralp B, Atesalp AS, Sehirlioglu A, Yurttas Y, Tasatan E.

Faculty of Medicine, Department of Orthopaedics and Traumatology, Gülhane Military Medical Academy, Ankara, Turkey. bahtidemiralp@yahoo.com

Although clavicular fractures are common, nonunion of clavicle is a rare complication. Clavicular nonunion that occurs due to insufficient stabilization is usually painful and necessitates operative treatment. Seven cases with oligotrophic clavicular nonunion that developed after a conservative process were treated with Ilizarov between January 2000 and December 2002. In all of them, the middle one-third of the clavicle was affected. Details of the cases regarding sex, age information, reason of fracture, previous treatment methods that were applied, nonunion area, nonunion, and duration of frame application were recorded. Two of the cases were female and five of them were male with age mean of 27.1 (19-32 years). Five of these cases had right clavicular injury and two of them had left clavicular injury. Mean nonunion duration was 18 months (range was 6-36 months). All nonunion were fixed and went through acute compression by means of Ilizarov's external fixators without grafting. The duration between the frame application and union was mean 2.7 months (range was 2.5-3.5 months). Mean follow-up period was 31 months (range was 22-48 months). Cases were evaluated in accordance with the Constant Scoring system. They were able to return to their

normal daily activities in 10-15 days. All of them regained full shoulder movement and extension ability. Patients have also been evaluated by using Dash-Score. Union existed for all patients and none of them had any complaints of pain after treatment. Since circular external fixator allows acute compression, early shoulder movements, and requires no such additional procedure as grafting, it is an alternative method which can be used in treating nonunion of clavicle.

Clin Orthop Relat Res. 2006 Jul;448:217-24.

Is staged external fixation a valuable strategy for war injuries to the limbs?

Lerner A, Fodor L, Soudry M.

Department of Orthopaedic Surgery A and Faculty of Medicine, Rambam Medical Center and Technion-Israel Institute of Technology, Haifa. alex_lerner@yahoo.com

High-energy weapons or blast injuries usually result in substantial tissue damage and are serious medical and public health problems. We report our experience with staged external fixation for war injuries to the extremities. Forty-seven patients with 64 high-energy limb fractures caused by war weapons were retrospectively reviewed. The fractures were associated with severe soft tissue damage. There were 14 Gustilo-Anderson Type IIIA fractures, 40 Type IIIB fractures, and 10 Type IIIC fractures. Soft tissue débridement followed by axial realignment of the fractured bones with immediate skeletal stabilization using the AO/ASIF unilateral tubular external fixator was performed on the day of admission. The primary tubular fixators were exchanged 5 to 7 days later for Ilizarov frames. Delayed primary closure, skin grafts, or flaps were used for soft tissue coverage. The mean followup was 40 months, and the Ilizarov/hybrid external fixator was the definitive treatment in all patients. Bone union was achieved at an average of 8 months in 58 (90.6%) fractures. Three patients had nonunions and one patient required an amputation. Two patients were lost to followup. Staged external fixation is a valuable strategy for treatment of war injuries to the extremities. LEVEL OF EVIDENCE: Therapeutic study, Level IV. See the Guidelines for Authors for a complete description of levels of evidence.

Clin Orthop Relat Res. 2006 Jul;448:208-16.

Medial fibula transport with the Ilizarov frame to treat massive tibial bone loss.

Catagni MA, Camagni M, Combi A, Ottaviani G.

Department of Orthopedics and Ilizarov Unit, Alessandro Manzoni Hospital, Lecco, Italy. maurizio@catagni.it

Massive segmental tibial bone loss from trauma, tumor, or infection is a limb-threatening situation. It is a considerable surgical challenge, especially when associated with extensive skin and soft tissue damage. Amputation was the only solution in the past, but current limb-salvage options include contralateral or ipsilateral microvascularized or free-fibular transfer. However, these methods are not without risks and disadvantages. We report seven patients with massive tibial bone loss treated by gradual medial transport of the ipsilateral fibula using an Ilizarov traction apparatus with olive wires after proximal and distal fibular osteotomies. This method has the advantages of avoiding surgery on the contralateral limb while allowing early weightbearing because of the stability of the Ilizarov frame. Hypertrophy of the transported fibula accompanied by full weightbearing and satisfactory joint motion occurred in all patients. All patients were satisfied with the results, and none thought amputation would have been a better treatment. The minimum followup was 5 years. We think the Ilizarov frame for ipsilateral fibular gradual transport is a reasonable alternative for limb salvage in patients with massive tibial bone loss. LEVEL OF EVIDENCE: Therapeutic Study, Level IV (case series). See the Guidelines for Authors for a complete description of levels of evidence.

Foot Ankle Int. 2006 Jul;27(7):494-9.

Calcaneal fractures: indirect reduction and external fixation.

McGarvey WC, Burris MW, Clanton TO, Melissinos EG.

Michael.W.Burris@uth.tmc.edu

BACKGROUND: The current treatment of displaced intra-articular calcaneal fractures has been surgical fixation. The objective of this study was to evaluate the use of indirect reduction with Ilizarov external fixation as a viable alternative in the surgical treatment of certain calcaneal fractures. **METHODS:** Thirty-one patients with 33 fractures of the calcaneus (Sanders types II, III, and IV) were treated using small wire circular external fixation. A limited percutaneous plantar skin incision was used to improve reduction of the posterior facet. Fractures were evaluated by preoperative CT scans and classified by an independent observer. Patients were evaluated by physical examination as well as by the AOFAS hindfoot score questionnaire. Followup ranged from 6 months to 4 years. **RESULTS:** The average AOFAS score for 18 patients available for examination was 66 (42 to 92). The average score increased to 74 for patients with more than 10 months followup and to 77 for patients with isolated calcaneal fractures. Open fractures also had early debridement and soft-tissue coverage; no deep infections were seen in this subgroup. There were 11 complications, including nine superficial pin track infections, one superficial skin necrosis under an area of fracture blister, and one deep infection in a diabetic smoker with severe hemorrhagic fracture blisters. All superficial infections responded to local pin or wound care and oral antibiotics. No secondary reconstructive procedures, including osteotomies, subtalar fusions, or amputations, have been done. All open fractures healed and maintained soft-tissue coverage. **CONCLUSIONS:** Indirect reduction and external fixation is a viable surgical alternative for intra-articular calcaneal fractures. Particularly favorable results were obtained in open fractures when soft-tissue reconstruction also was done. Advantages include shorter time to surgery, immediate weightbearing, minimal invasiveness, few serious wound problems, and no residual hardware. Disadvantages include technical difficulty, incomplete reduction of fracture fragments, and the need for secondary surgery (fixator removal).

J Bone Joint Surg Br. 2006 Jul;88(7):928-32.

Management of complex tibial and femoral nonunion using the Ilizarov technique, and its cost implications.

Patil S, Montgomery R.

Department of Orthopaedics James Cook University Hospital, Marton Road, Middlesbrough, TS4 3BW, UK. sunitpatil@doctors.org.uk

We reviewed 78 femoral and tibial nonunions treated between January 1992 and December 2003. Of these, we classified 41 in 40 patients as complex cases because of infection (22), bone loss (6) or failed previous surgery (13). The complex cases were all treated with Ilizarov frames. At a mean time of 14.1 months (4 to 38), 39 had healed successfully. Using the Association for the Study and Application of the Methods of Ilizarov scoring system we obtained 17 excellent, 14 good, four fair and six poor bone results. The functional results were excellent in 14 patients, good in 14, fair in two and poor in two. A total of six patients were lost to follow-up and two had amputations so were not evaluated for final functional assessment. All but two patients were very satisfied with the results. The average cost of treatment to the treating hospital was approximately pound 30,000 per patient. We suggest that early referral to a tertiary centre could reduce the morbidity and prolonged time off work for these patients. The results justify the expense, but the National Health Service needs to make financial provision for the reconstruction of this type of complex nonunion.

J Burn Care Res. 2006 Jul-Aug;27(4):529-34.

Combined Ilizarov and free flap for severe recurrent flexion-contracture release.

*Bar-Meir E, Yaffe B, Winkler E, Sher N, Berenstein M, Schindler A.
Department of Plastic and Reconstructive Surgery, Chaim Sheba Medical Center,
Israel.*

This article discusses the treatment of recurrent flexion-contracture of the knee after circumferential burns involving the entire limb. A two-team approach to surgery is used: the orthopedic team widely excises the scar tissue and releases tendons, muscles, and adjacent soft tissue that limit joint movement. The microsurgery team covers the exposed popliteal neurovascular elements with a latissimus dorsi free flap. However, full range of the knee is still limited by the short neurovascular bundle. Therefore, the orthopedic team applies a circular hinged Ilizarov external-fixator-frame to achieve gradual correction, until full range of the knee is achieved. Intensive physiotherapy and continuing use of extension splints for additional 6 months until the scars are deemed stable compliment the treatment regimen and prevent the recurrence of contractures. Between the years 2002 and 2003, we treated four patients (totaling five knee joints) with recurrent severe flexion-contractures after circumferential burns of the entire lower extremity. A significant limitation was caused by the abnormal scarring, which left the patients confined to a wheelchair. In all our patients, previous attempts to release the flexion-contracture failed. With the aforementioned technique, within 3 months after the procedure, all patients were able to walk. We encountered one major complication (ie, drop foot). At follow-up, all patients enjoyed a full range of motion and were able to walk. The strength of our approach comes from combining a free muscle flap with an Ilizarov external fixation and a detailed postoperative rehabilitation plan.

: J Orthop Trauma. 2006 Jul;20(6):419-24.

Temporary intentional leg shortening and deformation to facilitate wound closure using the Ilizarov/Taylor spatial frame.

*Nho SJ, Helfet DL, Rozbruch SR.
Limb Lengthening and Deformity Service, Orthopaedic Trauma Service, The Hospital for Special Surgery, Weill Medical College of Cornell University, 535 East 70th Street, New York, NY 10021, USA.*

Infected tibial nonunions with bone loss pose an extremely challenging problem for the orthopaedic surgeon. A comprehensive approach that addresses the infection, bone quality, and overlying soft-tissue integrity must be considered for a successful outcome. Acute shortening with an Ilizarov frame has been shown to be helpful in the treatment of open tibia fractures with simultaneous bone and soft-tissue loss. Cases in which the soft-tissue defect considerably exceeds bone loss may require an Ilizarov frame along with a concomitant soft-tissue procedure; however, there are a number of potential difficulties with vascularized pedicle flaps and free tissue flaps, including anastomotic complications, partial flap necrosis, and flap failure. The technique described in this report involves acute shortening and temporary bony deformation with the Ilizarov apparatus to facilitate wound closure and does not require a concomitant soft-tissue reconstructive procedure. Once the wound is healed, osseous deformity and length are gradually corrected by distraction osteogenesis with the Ilizarov/Taylor Spatial frame.

J Pediatr Orthop. 2006 Jul-Aug;26(4):449-54.

Isolated congenital pseudarthrosis of the fibula: clinical course and optimal treatment.

*Cho TJ, Choi IH, Chung CY, Yoo WJ, Lee SH, Lee SH, Suh SW.
Department of Orthopaedic Surgery, Seoul National University College of Medicine,
Seoul, Korea.*

The purposes of this study were to determine the clinical course of isolated congenital pseudarthrosis of the fibula (ICPF) and to establish optimal treatment guidelines for this disease. Thirteen fibulae in 12 patients with ICPF were followed for an average of 6.2 years. Twelve of the 13 fibulae were regarded to originally have had a pre-pseudarthrotic condition. Five fibulae remained intact during follow-up, but 8 developed pseudarthrosis. Two cases with established pseudarthrosis were observed for ankle alignment change without intervention, and in 4 cases successful fibular osteosynthesis maintained the ankle alignment. The remaining 2 adolescent cases presenting with ankle valgus were treated using the Ilizarov technique and distal tibiofibular synostosis. ICPF follows a unique clinical course, which should be taken into consideration along with fibular status, ankle alignment, and patient age when planning treatment.

J Pediatr Orthop. 2006 Jul-Aug;26(4):432-7.

The Ilizarov method for the treatment of resistant clubfoot: is it an effective solution?

Freedman JA, Watts H, Otsuka NY.

Department of Orthopaedic Surgery, David Geffen School of Medicine at UCLA, Los Angeles, CA 90095, USA. jfreedman@mednet.ucla.edu

The resistant clubfoot deformity presents a significant challenge. Several corrective procedures have been described, with the goal to provide a pain-free, plantigrade foot. The Ilizarov method of external fixation and gradual distraction has been reported as an alternative to conventional techniques. Previous reviews have concluded that this method can provide satisfactory correction and outcome. This study presents a review of 21 resistant clubfeet in 17 patients, who had undergone previous surgery, treated with Ilizarov external fixation and gradual distraction by 1 of 2 surgeons. Outcome measures were graded based on function and presence of residual deformity: (a) excellent (painless, plantigrade foot, with no functional limitations); (b) good (plantigrade foot in a patient able to ambulate long distances with mild pain); (c) fair (mild residual deformity, required bracing, and/or had some functional limitations but an active life); and (d) poor (significant residual deformity, pain, and activity limitations). Radiographic measures of the talocalcaneal and talo-first metatarsal angles were compared preoperatively and postoperatively. At an average follow-up of 6.64 years (range, 2.25-10.50 years), 9.5% (2) achieved an excellent result; 4.8% (1), good; 33.3% (7), fair; and 52.4% (11), poor. All 11 of the feet graded poor required revision surgery at an average of 5.63 years postoperatively (range, 2.67-10.2 years). Only the talo-first metatarsal angle displayed a clinically and statistically significant correction. We conclude that the Ilizarov method for treatment of resistant clubfoot deformities results in poor outcome associated with residual or recurrent deformity, often requiring revision surgery.

J Pediatr Orthop B. 2006 Jul;15(4):278-84.

Patient-based outcomes after Ilizarov surgery in resistant clubfeet.

Utukuri MM, Ramachandran M, Hartley J, Hill RA.

Hospital for Sick Children, Great Ormond Street, London, UK.

We present the results of clinical evaluation and patient-based outcomes after Ilizarov surgery in resistant clubfeet (grade D clubfeet, Dimeglio-Bensahel system). This is a retrospective study of 26 resistant clubfeet in 23 children who were managed by the Ilizarov technique. The average age of the patients at the time of the operation was 9 years and the average follow-up period was 47 months. A calcaneal or mid-foot osteotomy followed by bony distraction was undertaken in nine feet and a soft-tissue distraction, with or without soft-tissue release, was undertaken in 17 feet. Clinical evaluation of the degree of correction of the deformity and functional evaluation, using patient-based

questionnaires, were used in assessing the outcome in these patients. Patient-based outcomes give useful information about the functional status following surgery, complementing the objective assessment by the surgeon. Clinical evaluation revealed stiff, plantigrade feet in nine patients and a recurrent deformity after initial correction in the remaining 14 patients. The patient-based outcomes were good to excellent in 52% for satisfaction, 57% for cosmesis, 48% for walking and 73% for teasing (made fun of because of the shape of foot), showing that the functional results were better in these patients in spite of a poor surgical outcome.

Acta Orthop Belg. 2006 Jun;72(3):332-6.

Treatment of Gustilo grade III B supracondylar fractures of the femur with Ilizarov external fixation.

Kumar P, Singh GK, Singh M, Bajraacharya S.

Department of Orthopedics, BP Koirala Institute of Health Sciences, Dharan, Nepal. drpankaj06@yahoo.co.in

Twenty patients who had been treated with Ilizarov external fixation for a Gustilo grade IIIB supracondylar fracture of the femur were functionally assessed 12 to 52 months after treatment. Fourteen fractures were type C3 and 6 were type C2 according to the AO classification. Fractures were united at an average of 39 +/- 9 weeks. There was a final knee extension deficit of 5 degrees to 10 degrees (12.2 degrees +/- 3.5 degrees) and flexion reached 110 degrees +/- 10 degrees in type C2 and 73 degrees +/- 36 degrees in C3 supracondylar fractures. Forty percent of the supracondylar fractures had 4cm shortening and 40% had 1.5 cm. Pin-track infection occurred in 21%. Half of the C3 fracture cases had problems with pain on walking, needed support and had pain at rest, whereas no patients had difficulty getting out of a chair, going up and down stairs. However, all C2 type fractures had problems with all types of function.

Rev Chir Orthop Reparatrice Appar Mot. 2006 Jun;92(4):364-70.

[Ilizarov reconstruction of the distal radius after resection of a giant-cell tumor: a case report]

Tomi S, Krajinovi O, Krajinovi J.

Institut d'Orthopédie et Traumatologie Banjica, M. Avramovica 28, 11000 Belgrade, Serbie et Monténégro. stomic@iohbb.edu.yu

We present a case of Ilizarov reconstruction after en bloc resection of the distal radius. An 8-cm resection was required to remove a giant-cell tumor. Reconstruction was based on the ascension technique using an Ilizarov external fixator after corticotomy of the proximal fragment of the radius. Satisfactory reconstruction with formation of a neoarticulation between the radius and the carpus was achieved. Satisfactory wrist function was achieved and the patient was recurrence free at five years. The arguments leading to this therapeutic option are discussed.

J Pediatr Orthop B. 2006 May;15(3):220-1.

Treatment of a congenital pseudarthrosis of the tibia by osteogenic protein-1 (bone morphogenetic protein-7): a case report.

Anticevic D, Jelic M, Vukicevic S.

Department of Orthopaedic Surgery, School of Medicine, University of Zagreb, Zagreb, Croatia.

Congenital pseudarthrosis of the tibia remains one of the most difficult orthopaedic problems to treat. Before the use of a recombinant bone morphogenetic protein (bone morphogenetic protein-7; osteogenic protein-1) the patient with congenital pseudarthrosis of the tibia in this report had had 12 unsuccessful surgeries. Five months after radical resection of sclerotic tibial segments, Ilizarov fixation and administration of osteogenic protein-1 osteogenic device,

the congenital pseudarthrosis of the tibia healed; at 45 months the tibia increased in size and the patient was fully weight bearing.

J Pediatr Orthop B. 2006 May;15(3):198-201.

Lengthening of congenital forearm stumps.

Jasiewicz B, Tesiorowski M, Kacki W, Kasprzyk M, Zarzycki D.

Department of Orthopaedics and Rehabilitation in Zakopane, Jagellonian University College of Medicine, Poland. basiaj@klinika.net.pl

The Ilizarov device and distraction osteogenesis method became very useful in correction and elongation of forearm defects. Two cases of forearm elongation with congenital transverse defect are described. The construction of the device is provided. During follow-up examination, 2 and 7 years after the treatment, good clinical results were achieved in both patients with the use of upper limb prosthesis employing the patient's own elbow joint. Presented application of the Ilizarov method can significantly improve possibilities for the use of prosthesis in patients with congenital upper limb defects and result in better cosmetic and functional outcome.

Med Tekh. 2006 May-Jun;(3):39-42.

[Use of hinge joints in devices for treatment of human locomotor system]

Shevtsov VI, Alatov DV, Burlakov EV.

An analytical review of hinge joints used in external osteosynthesis apparatuses is presented. The goal of this review was to help to optimize the construction of new external osteosynthesis apparatuses based on hinge joints and to improve the procedure of their installation. Several variants of hinge joint construction are considered. The review points out the specific properties of these joints that have to be taken into account in development of medical equipment.

Acta Orthop Belg. 2006 Apr;72(2):214-8.

Management of a large post-traumatic skin and bone defect using an Ilizarov frame.

D'Hooghe P, Defoort K, Lammens J, Stuyck J.

Department of Orthopaedics, University Hospital Pellenberg, Weligerveld 1, B-3212 Pellenberg, Belgium. pieter@medscape.com

The authors report the case of a 28-year old male who presented with a compound diaphyseal fracture of the tibia, which was treated with intramedullary nailing. Postoperatively he required an extensive fasciotomy for an acute compartment syndrome. The fracture evolved towards post-traumatic osteomyelitis, growing methicillin-resistant *Staphylococcus aureus* (MRSA), combined with a large overlying soft tissue gap. An Ilizarov frame was used to treat both the bone and the skin defect. The infected fracture was treated by resection and longitudinal bone transport. Meanwhile, the skin was gradually closed using extra rods on the frame, allowing for a transverse 'skin transport'. Both the bone and the soft tissues healed without further complications.

Clin Podiatr Med Surg. 2006 Apr;23(2):455-65, viii.

Current concepts and techniques in posttraumatic arthritis.

Polyzois VD, Papakostas I, Zgonis T, Polyzois DG, Soucacos PN.

KAT Hospital, 2 Nikis str, 14561, Kifisia, Athens, Greece. bpolyzois@yahoo.com

Posttraumatic arthrosis is a commonly encountered clinical problem, but the pathoetiology of its development is not yet clarified. Many contributing mechanical biologic factors interplay with the traumatic event that necessarily precedes the posttraumatic syndrome. New biologic concepts involving the ability of the cartilage to repair and how such healing can be promoted are being realized in new modalities of treatment. The traumatic event as such and the resulting pathomechanical consequences require new ways of evaluation.

Clin Podiatr Med Surg. 2006 Apr;23(2):343-53, vi-vii.

The use of Ilizarov technique and other types of external fixation for the treatment of intra-articular calcaneal fractures.

Zgonis T, Roukis TS, Polyzois VD.

Division of Podiatry, Department of Orthopaedics, University of Texas Health Science Center at San Antonio, 7773 Floyd Curl Drive, San Antonio, TX 78229, USA.

zgonis@uthscsa.edu

Treatment of severely comminuted calcaneal fractures with soft tissue compromise is still a controversial issue among surgeons. Complications of open reduction internal fixation have been well reported in the literature with a fairly high incidence of posttraumatic osteoarthritis of the subtalar joint, symptomatic hindfoot stiffness (especially when fixed in varus), wound dehiscence, and potential for the development of osteomyelitis caused by the extensive soft tissue trauma inherent with these injuries. For these reasons, closed treatment techniques using minimally invasive reduction procedures with application of ring-type fine-wire external fixation have recently gained popularity.

Foot Ankle Int. 2006 Apr;27(4):266-73.

Correction of neglected clubfoot using the Ilizarov external fixator.

Ferreira RC, Costo MT, Frizzo GG, da Fonseca Filho FF.

ceckley@unisys.com.br

BACKGROUND: This study was conducted to evaluate the corrective capability of the Ilizarov external fixator in the treatment of neglected clubfoot. **METHODS:** Thirty patients (38 feet) with a mean age of 19 (5 to 39) years with severe deformities and stiff feet associated with neglected clubfoot were studied. A limited soft-tissue dissection, Achilles tenotomy, and plantar fasciotomy were done. Progressive correction of the deformities was achieved through a standard setting of the Ilizarov external fixator. The device was used for 16 weeks, on average, and after removal a short-leg walking cast was used for an additional 6 weeks, followed by an ankle-foot orthosis (AFO) for 6 months. **RESULTS:** The final outcome was scored as good (complete correction and no pain); fair (partial correction with plantigrade foot and occasional pain); or poor (nonplantigrade foot and continuous pain during walking). After a mean followup of 58 (range 12 to 107) months, the results were good in 30 feet (78.9%); fair in three feet (7.9%); and poor in five feet (13.2%). Early complications were a distal tibial fracture in one foot, dislocation of the first metatarsophalangeal joint in one foot, and arterial damage that resulted in amputation of the toes in one foot. Recurrence of the deformity was found in 19 feet (50%): 11 minor, three mild, and five severe. Spontaneous ankylosis developed in 28 feet (73.7%). Nine feet (23.7%) required arthrodesis for symptomatic arthritis of the ankle or midfoot and deformity that could not be treated with orthoses. **CONCLUSION:** The Ilizarov external fixator allows simultaneous correction of all the severe foot deformities associated with neglected clubfoot with minimal surgery, reducing risks of cutaneous or neurovascular complications and avoiding excessive shortening of the foot. Even in those patients in whom final corrective arthrodesis is necessary, this may be carried out with minimal bone resection, since the severe deformities of the foot and ankle have been corrected.

Injury. 2006 Apr;37 Suppl 1:S51-5. Epub 2006 Mar 29.

Management of nonunion with distraction osteogenesis.

Kanellopoulos AD, Soucacos PN.

1st Department of Orthopaedic Surgery, KAT Accident Hospital, University of Athens Medical School, Greece. adkanell@yahoo.com

Nonunions of long bone fractures represent a clinical entity that is commonly perpetuated by a high velocity injury. There are both bony and soft tissue

factors responsible for the nonunion. This paper is focused on the reported clinical and radiographic outcomes whenever treatment protocols pertaining to distraction osteogenesis are implemented.

Int Orthop. 2006 Apr;30(2):113-7. Epub 2006 Jan 25.

Ilizarov treatment of complex tibial pilon fractures.

Vidyadhara S, Rao SK.

Department of Orthopaedics, Kasturba Medical College, Manipal, 576 104, Karnataka, India. vidya007@gmail.com

We treated 21 consecutive patients between 1998 and 2002 with complex tibial pilon fractures, eight type B and 13 type C, using percutaneous reduction and fixation with the small diameter Ilizarov apparatus. The average patient age was 34+/-5.6 years (range 28-52 years). Nine of the patients had open fractures (two type I, four type II, and three type IIIA). The patients were followed up regularly at 6-month intervals for 2 years. All fractures united. The fixator was removed at an average of 26.6+/-4.2 weeks (range 20-34 weeks). The average American Orthopaedic Foot and Ankle Society ankle-hind foot score was excellent in 11 patients, good in five, fair in four, and poor in one. Thirteen patients were able to squat and climb stairs.

: J Knee Surg. 2006 Apr;19(2):99-104.

Circular external fixation in knee arthrodesis following septic trauma sequelae: preliminary report.

Salem KH, Kinzl L, Schmelz A.

Department of Trauma, Hand, and Reconstructive Surgery, University of Ulm, Germany.

Deep infection is one of the most devastating complications after knee fractures. It may be related to the initial fracture status or, more commonly, the surgical intervention. From 1991 to 2003, 12 patients underwent knee fusion to treat resistant infection after complex knee fractures or arthrodesis fractures using the Ilizarov method and frame. There were 9 men and 3 women (mean age, 39.7 years). Two-thirds of the patients had long-standing infection and 5 patients had undergone earlier attempts at knee arthrodesis. Correction of concurrent malalignment was achieved in 2 patients. Bone transport using the same arthrodesis frame was necessary in 2 patients to overcome large bony defects. Solid fusion was achieved in all patients by the end of treatment. The average duration of external fixation was 22 weeks (range: 11-44 weeks). No patients required secondary bone grafting to achieve union. Complications occurred in 6 (50%) patients. The most common problem seen was pin tract infection, but only 2 patients required surgical intervention for its treatment. The study emphasizes the clinical success of the Ilizarov method in knee arthrodesis after infected fractures.

: J Reconstr Microsurg. 2006 Apr;22(3):143-8.

Two-stage reconstruction in congenital pseudarthrosis of the forearm using the Ilizarov technique and vascularized osteoseptocutaneous fibula.

Mateev M, Imanaliev A.

Department of Plastic and Reconstructive Microsurgery and Hand Surgery, National Hospital of Kyrgyzstan, Bishkek, Kyrgyzstan.

The authors present nine patients with congenital pseudarthrosis of the forearm. The reconstruction was carried out in two stages. At the first stage, Ilizarov's device was applied to the forearm in order to lengthen the affected extremity and to eliminate deformity. At the second stage, the bone defect was replaced with free vascularized fibula osteoseptocutaneous graft. All patients had complete survival of the transferred fibula grafts. Bone consolidation was achieved in 4 to 6 months after the reconstruction.

J Bone Joint Surg Am. 2006 Mar;88 Suppl 1 Pt 1:119-34.

Treatment of malunion and nonunion at the site of an ankle fusion with the Ilizarov apparatus. Surgical technique.

Paley D, Lamm BM, Katsenis D, Bhave A, Herzenberg JE.

International Center for Limb Lengthening, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore, MD 21215, USA.dpaley@lifebridgehealth.org

BACKGROUND: Malunion and nonunion of an ankle fusion site are associated with pain, osteomyelitis, limb length discrepancy, and deformity. The Ilizarov reconstruction has been used to treat these challenging problems. METHODS: We reviewed the results in twenty-one ankles that had undergone a revision of a failed fusion, with simultaneous treatment of coexisting pathologic conditions, with use of the Ilizarov technique. Eight patients had undergone ankle fusion only, eleven had undergone ankle and subtalar fusion, and two had undergone pantalar fusion. Eighteen patients with an average limb-length discrepancy of 4 cm underwent limb lengthening simultaneously with the revision surgery. The average patient age was forty years. Indications for treatment were malunion (eleven patients), aseptic nonunion (eight patients), and infected nonunion (two patients). Clinical, subjective, objective, gait, and radiographic analyses were performed after an average duration of follow-up of 83.4 months. RESULTS: Solid union was achieved in all ankles. The functional result was excellent for fifteen patients, good for three, fair for two, and poor for one. The bone result was excellent for ten ankles, good for nine, fair for one, and poor for one. All eighteen patients who underwent gait analysis had a heel-to-toe progression gait, and twelve achieved normal walking velocity with their shoes on. A plantigrade foot was achieved in each case, and only two patients had >5 degrees of residual deformity. During the Ilizarov treatment, forty-one minor complications (treated conservatively) and twenty major complications (treated surgically) occurred. After removal of the circular frame, seven other complications, which required four additional operations, occurred. CONCLUSIONS: In patients with a failed ankle fusion, infection, limb-length discrepancy, and foot deformity can be addressed simultaneously with use of the Ilizarov apparatus to achieve a solid union and a plantigrade foot, usually with a clinically satisfactory result.

: J Orthop Trauma. 2006 Mar;20(3):197-205.

Simultaneous treatment of tibial bone and soft-tissue defects with the Ilizarov method.

Robert Rozbruch S, Weitzman AM, Tracey Watson J, Freudigman P, Katz HV, Ilizarov S. Hospital for Special Surgery, New York, NY 10021, USA. RozbruchSR@hss.edu

OBJECTIVES: To evaluate the potential for limb salvage using the Ilizarov method to simultaneously treat bone and soft-tissue defects of the leg without flap coverage. DESIGN: Retrospective study. SETTING: Level I trauma centers at 4 academic university medical centers. PATIENTS/PARTICIPANTS: Twenty-five patients with bone and soft-tissue defects associated with tibial fractures and nonunions. The average soft-tissue and bone defect after debridement was 10.1 (range, 2-25) cm and 6 (range, 2-14) cm respectively. Patients were not candidates for flap coverage and the treatment was a preamputation limb salvage undertaking in all cases. INTERVENTION: Ilizarov and Taylor Spatial Frames used to gradually close the bone and soft-tissue defects simultaneously by using monofocal shortening or bifocal or trifocal bone transport. MAIN OUTCOME MEASUREMENTS: Bone union, soft-tissue closure, resolution or prevention of infection, restoration of leg length equality, alignment, limb salvage. RESULTS: The average time of compression and distraction was 19.7 (range, 5-70) weeks, and time to soft-tissue closure was 14.7 (range, 3-41) weeks. Bony union occurred in 24 patients (96%). The average time in the frame was 43.2 (range, 10-82) weeks. Lengthening at another site was performed in 15 patients. The average amount of bone lengthening

was 5.6 (range, 2-11) cm. Final leg length discrepancy (LLD) averaged 1.2 (range, 0-5) cm. Use of the trifocal approach resulted in less time in the frame for treatment of large bone and soft-tissue defects. There were no recurrences of osteomyelitis at the nonunion site. All wounds were closed. There were no amputations. All limbs were salvaged. **CONCLUSIONS:** The Ilizarov method can be successfully used to reconstruct the leg with tibial bone loss and an accompanying soft-tissue defect. This limb salvage method can be used in patients who are not believed to be candidates for flap coverage. One also may consider using this technique to avoid the need for a flap. Gradual closure of the defect is accomplished resulting in bony union and soft-tissue closure. Lengthening can be performed at another site. A trifocal approach should be considered for large defects (>6 cm). Advances in technique and frame design should help prevent residual deformity.

J Pediatr Orthop. 2006 Mar-Apr;26(2):233-7.

A new double elevating osteotomy in management of severe neglected infantile tibia vara using the Ilizarov technique.

Hefny H, Shalaby H, El-Kawy S, Thakeb M, Elmoatasem E.

Ain Shams University, Limb Reconstruction Unit, Cairo, Egypt.

Neglected infantile Tibia Vara is a very challenging clinical problem with many technical problems including distorted joint line secondary to the medial tibial plateau depression, obesity leading to difficulty in exposure, performing osteotomies and difficulty in osteotomy fixation. The aim of this study is to evaluate the clinical and radiological results of treatment of severe neglected infantile Tibia Vara using a new osteotomy to elevate the depressed medial tibial plateau in conjunction with the Ilizarov technique. Seven tibias in five patients were included in this study. These were all Stage V and VI according to Langenskiold and Riska classification. The average age at surgery was 11.6 years (ranging from 8 to 15), and the average follow-up was 6.2 years (ranging from 3 to 10). A new double osteotomy technique was used to elevate the depressed medial tibial plateau and correct the varus deformity. Correction was done gradually using the Ilizarov Frame. The results were assessed clinically and radiologically. The femoral shaft -- tibial shaft angle improved from an average of 36 degrees of varus preoperatively to 4 degrees of varus. The femoral condyle-tibial shaft angle improved from an average of 58 degrees to 83 degrees. The angle of depressed medial tibial plateau improved from an average of 53 degrees to 10 degrees. We believe that our new double elevating osteotomy in conjunction with Ilizarov technique is an excellent modality for patients with stage V and VI according to the Langenskiold and Riska classification. The advantages of this technique include correction of the deformity with simultaneous correction of the joint architecture, immediate weight bearing, and avoidance of excessive dissection needed for internal fixation.

J Pediatr Orthop B. 2006 Mar;15(2):147-53.

Limb lengthening in fibular hemimelia type II: can it be an alternative to amputation?

Zarzycki D, Jasiewicz B, Kacki W, Koniarski A, Kasprzyk M, Zarzycka M, Tesiorowski M.

Department of Orthopaedics and Rehabilitation, Jagiellonian University College of Medicine, Zakopane, Poland.

The purpose of our study was to analyze limb lengthening in fibular hemimelia type II. Ten patients underwent 16 tibia lengthenings. The mean tibia shortening was 5.8 cm. We used the Ilizarov technique in all cases. The mean follow-up time was 7.2 years. The mean lengthening was 23% of the former length. The healing index was 50.8 days/cm. In the final examination six patients were skeletally mature, equal limb length and functional foot positioning were achieved in four

of them. Complications were observed during 14 lengthenings (87.5%). Although lengthening in fibular hemimelia is difficult, elongation with axis and foot correction may offer an alternative to amputation.

J Bone Joint Surg Br. 2006 Feb;88(2):232-7.

The use of the Ilizarov method as a salvage procedure in infected nonunion of the distal femur with bone loss.

Saridis A, Panagiotopoulos E, Tyllianakis M, Matzaroglou C, Vandoros N, Lambiris E. Department of Orthopaedics University of Patras, Rio Patras 26504, Greece.

We reviewed 13 patients with infected nonunion of the distal femur and bone loss, who had been treated by radical surgical debridement and the application of an Ilizarov external fixator. All had severely restricted movement of the knee and a mean of 3.1 previous operations. The mean length of the bony defect was 8.3 cm and no patient was able to bear weight. The mean external fixation time was 309.8 days. According to Paley's grading system, eight patients had an excellent clinical and radiological result and seven excellent and good functional results. Bony union, the ability to bear weight fully, and resolution of the infection were achieved in all the patients. The external fixation time was increased when the definitive treatment started six months or more after the initial trauma, the patient had been subjected to more than four previous operations and the initial operation had been open reduction and internal fixation.

J Orthop Trauma. 2006 Feb;20(2):138-42.

A technique for correction of equinus contracture using a wire fixator and elastic tension.

Melvin JS, Dahners LE.

Department of Orthopaedic Surgery, University of Pennsylvania, Philadelphia, PA, USA.

Equinus contracture often is a complication of trauma, burns, or neurologic deficit. Many patients with contractures secondary to trauma or burns have poor soft tissue, which makes invasive correction a less appealing option. The Ilizarov external fixator has been used as a less invasive attempt to correct equinus contracture. We describe our "dynamic" technique and present a clinical patient series using a variation of the unconstrained Ilizarov technique, which uses elastic bands rather than threaded rods to supply the corrective force.

J Orthop Trauma. 2006 Feb;20(2):122-8.

Modification of the Ilizarov external fixator for aseptic hypertrophic nonunion of the clavicle: an option for treatment.

Tomij S, Bumbasirevic M, Lesi A, Bumbasirevi V.

Institute for Orthopaedic Disease Banjica, Belgrade.

OBJECTIVE: To assess the results of treatment of aseptic hypertrophic nonunion of the clavicle by external fixation using a modified Ilizarov apparatus. DESIGN: Prospective study. SETTING: A consecutive series of 12 patients from 2 specialized orthopaedic institutions, treated by the 3 senior authors. PATIENTS: Twelve patients (5 females) with a mean age of 38.7 +/- 12.4 (range, 18-50) years with an aseptic hypertrophic nonunion of the clavicle were treated operatively during the period 1994 to 1998. Ten patients had previously been treated nonoperatively, whereas 2 had been treated surgically; the treatment in all had failed. All patients had pain with shoulder stiffness. INTERVENTION: Patients were treated using the Ilizarov external fixation technique. The operation was performed under general anesthesia and an Ilizarov external fixator was applied percutaneously under fluoroscopic control, without a skin incision or bone grafting. The patients were then monitored clinically and radiologically for 24 to 96 (mean, 45.4) months. MAIN OUTCOME MEASUREMENTS: Radiologic evaluation and clinical assessment by the Constant numerical score. RESULTS: The mean Constant

preoperative score was 30.4 +/- 9 (range, 18-44). Healing of the nonunion occurred in all patients treated by the Ilizarov technique. Nine patients had pain relief and gained unlimited range of motion, whereas 3 patients had mild pain during elevation of the arm. A mean period of 75.4 (range, 50-95) days was needed for gradual bone reduction and union. The mean Constant outcome score was 68.8 +/- 14.7 (range, 46-85). Complications: 2 patients had superficial pin infections that cleared with local therapy and antibiotics, and 1 patient had a reoperation for a nonunion after a fall onto the floor. CONCLUSIONS: Ilizarov fixation seems to be an effective method in the treatment of aseptic hypertrophic clavicle nonunions, even in patients where previous surgery has failed.

Acta Chir Jugosl. 2006;53(4):27-31.

[The treatment of infected diaphyseal femoral defects by lengthening one of the bone fragments by Ilizarov]

*Tomi_S, Krajinovi_O, Blagojevi_Z, Apostolovi_M, Lalosevi_V.
Institut za ortopedsko hirurske bolesti Banjica Beograd.*

We analyzed 30 patients with infected diaphyseal defect of femur, which have been treated by lengthening one of the bone fragments with Ilizarov apparatus. The mean length of the bone defect was 6 cm. Substitution of the defect, bone healing and elimination of the infection was achieved in 27 patients. The mean time of apparatus fixation was 10 months. According to Palley scoring system, 10 patients had excellent functional results.

Acta Orthop Traumatol Turc. 2006;40(3):193-8.

[Early results of medial opening wedge osteotomy in varus gonarthrosis]

*Orsel S, Altun M, Bekmezci T, Tonbul M, Yalaman O.
Department of Orthopedics and Traumatology (Ortopedi ve Travmatoloji Klini_i),
Okmeydani Training and Research Hospital, Istanbul, Turkey.*

OBJECTIVES: We evaluated the efficacy and short-term results of medial opening wedge high tibial osteotomy with the use of a Puddu plate in patients with medial compartment gonarthrosis. METHODS: The study included 15 knees of 12 female patients (mean age 50.6 years; range 45 to 63 years) who were treated with medial opening wedge high tibial osteotomy for varus knees with medial compartment gonarthrosis. The osteotomy sites were fixed with a Puddu plate followed by allograft application. The mean follow-up period was 30.7 months (range 19 to 40 months). RESULTS: The mean consolidation time was 7.1 weeks (range 6 to 9 weeks). The mean preoperative and postoperative Lysholm scores were 54.1 (range 30 to 60) and 82 (range 67 to 95), respectively. The mean preoperative femorotibial angle was 3.5 degrees in varus malalignment (range 3 degrees valgus to 9 degrees varus). It was 7.3 degrees valgus postoperatively. The mean correction of the mechanical axis was 10.7 degrees, with no loss of correction during the follow-up period. No adverse effects were observed associated with allograft use. The lateral cortex was broken in one patient (6.7%) who was then treated with an Ilizarov external fixator due to pseudoarthrosis. All but this patient were satisfied with the treatment. CONCLUSION: Compared with other osteotomy models, medial opening wedge osteotomy with the use of a Puddu plate offers advantages in terms of ease of application and maintenance of correction in the early follow-up period. With allograft application, consolidation is obtained without interfering with the rehabilitation period.

Conf Proc IEEE Eng Med Biol Soc. 2006;1:3811-4.

Semi-automated intra-operative fluoroscopy guidance for osteotomy and external-fixator.

*Lin H, Samchukov ML, Birch JG, Cherkashin A.
Texas Scottish Rite Hosp. for Children, Dallas, TX, USA.*

This paper outlines a semi-automated intra-operative fluoroscopy guidance and

monitoring approach for osteotomy and external-fixator application in orthopedic surgery. Intra-operative Guidance module is one component of the "LegPerfect Suite" developed for assisting the surgical correction of lower extremity angular deformity. The Intra-operative Guidance module utilizes information from the preoperative surgical planning module as a guideline to overlay (register) its bone outline semi-automatically with the bone edge from the real-time fluoroscopic C-Arm X-Ray image in the operating room. In the registration process, scaling factor is obtained automatically through matching a fiducial template in the fluoroscopic image and a marker in the module. A triangle metal plate, placed on the operating table is used as fiducial template. The area of template image within the viewing area of the fluoroscopy machine is obtained by the image processing techniques such as edge detection and Hough transformation to extract the template from other objects in the fluoroscopy image. The area of fiducial template from fluoroscopic image is then compared with the area of the marker from the planning so as to obtain the scaling factor. After the scaling factor is obtained, the user can use simple operations by mouse to shift and rotate the preoperative planning to overlay the bone outline from planning with the bone edge from fluoroscopy image. In this way osteotomy levels and external fixator positioning on the limb can be guided by the computerized preoperative plan.

Orthopedics. 2006 Jan;29(1):70-4.

Ilizarov bone transport for massive tibial bone defects.

Abdel-Aal AM.

Department of Orthopedics and Traumatology, Assiut University Hospital, Assiut, Egypt.

This article reports the treatment of massive tibial bone defects by bone transport using the Ilizarov external fixator. Fifteen patients were treated using this technique (3 females and 12 males). The defect size ranged between 7 and 22 cm (average: 10.6 cm). Etiology was infected nonunion in 9 patients, nonunion in 5 patients, and recurrent giant-cell tumor in 1 patient. The affected site was the tibial diaphysis in 10 patients, the lower tibial metaphysis in 4, and the upper tibial epiphysis in 1 patient. The external fixation time ranged from 9 months to 17 months (average: 12.27 months). External fixation index ranged from 21.8 to 42.5 day/cm (average: 35.7 day/cm). There was no recurrence of infection, no recurrence of the tumor, nor fractures after frame removal. We had to graft the docking site in 2 patients for delayed union and 2 patients developed equinus deformity and had tenoplasty for the Achilles tendon at the time of frame removal. Four patients had pin tract infection at ≥ 1 of the wires and this was successfully treated by antibiotic injection at the wire site. This study suggests that Ilizarov bone transport is a reliable method to fill massive bone defects.

Orthopedics. 2006 Jan;29(1):53-9.

Femoral lengthening after transfemoral amputation.

Walker JL, White H, Jenkins JO, Cottle W, VandenBrink KD.

Division of Orthopedic Surgery, University of Kentucky, 1900 Richmond Rd, Lexington, KY 40502, USA.

This retrospective study included four patients with transfemoral amputations who had undergone six lengthenings of their residual femurs. Initial femoral bone lengths averaged 15.5 cm with a mean final length of 21 cm. The average gain of limb length (ischium to end of soft tissue), however, was 2 cm (15%). Second lengthenings resulted in only 17% additional bone length, compared to 50% for first lengthenings. Treatment time was protracted and complications resulted from infection, bone healing, and pin migration. However, all patients reported substantial improvement in walking function and prosthetic use.

Vet Comp Orthop Traumatol. 2006;19(3):162-71.

Detailed preoperative planning for fracture treatment with Ilizarov method in three dogs.

Bilgili H, Dioszegi Z, Csebi P.

Department of Orthopaedics and Traumatology, Faculty of Veterinary Medicine, University of Ankara, Ankara, Turkey. hbilgilitr@yahoo.com

The purpose of this study is to present preoperative planning with consideration of the anatomical variations of different dog breeds, gross anatomy, preoperative radiographs and computed tomography (CT) images, ring number, ring type and ring levels, rod positions and rod number for fracture treatment using the Ilizarov method in three dogs. In all cases, preoperative radiographs of affected limb and contralateral limb, intact extremity's CT views and anatomical atlases were used for preoperative frame planning. The frame is assembled preoperatively, rehearsed and then it is applied. Preoperative radiographs and clinical findings of affected limbs are beneficial for preoperative frame planning, whilst CT views are not as they do not provide any different vision of anatomical structures for all cases. Other colleagues' and our anatomical atlases, including cross-sectional views of limbs, are satisfactory for preoperative planning. In addition, functional and cosmetic results in all three cases were determined to be very good.

Acta Orthop Belg. 2005 Dec;71(6):686-91.

Outcome of pelvic support osteotomy with the Ilizarov method in the treatment of the unstable hip joint.

El-Mowafi H.

Mansoura University Hospital, Mansoura, Egypt. hanielmowafi@yahoo.com

Instability of the hip joint in the young adult is a difficult problem. Patients with an unstable hip secondary to any aetiology usually have loss of bone from the proximal femur or shortening of the limb or both. In this study we report our results in the treatment of the unstable hip joint in young adults by pelvic support osteotomy using the Ilizarov method. From 1997 to 2004, 25 patients (17 females and 8 males) with an unstable hip joint were treated in the Orthopaedic department of Mansoura University Hospital, Egypt. Their mean age was 22.4 years (range: 19 to 35). The main complaints were pain, leg length discrepancy, limping, and limited abduction of the hip. All patients underwent valgus extension osteotomy in the proximal femur and distal femoral osteotomy for lengthening. The average follow-up ranged from 2 to 7 years. All hips were pain free at follow-up. The Trendelenburg sign became negative in 20 patients. There was no limb length discrepancy and alignments of the extremity were re-established. Five patients had a lurch gait. Valgus extension osteotomy has provided stability of the hip joint and maintained some motion of the hip joint. By using the Ilizarov technique, we could prevent the valgus effects created by the valgus extension osteotomy while achieving lengthening of the femur through the distal osteotomy in the femur.

Chir Narzadow Ruchu Ortop Pol. 2005;70(4):243-7.

[Limb lengthening in children with osteogenesis imperfecta]

Su ko J, Rad o W.

Oddzia_ Ortopedyczno-Urazowy Katedry i Kliniki Chirurgii Pediatrycznej Uniwersyteckiego Szpitala Dzieciecego, Wydzia_ Lekarski Uniwersytetu Jagiello_skiego.

The authors operated on 7 children (5 girls, 2 boys) suffering from osteogenesis imperfecta (oi) type I according to Sillence classification, with lower limbs discrepancy. We elongated 10 segments (7 femurs and 3 tibias). Mean age at operation time was 14.7 years (13-17 years). The mean leg length discrepancy was 9.3 cm (4-18 cm), and shortening of one bone was 6.5 cm (4-9 cm). We used

Ilizarov technique twice in tibial lengthening. We used Wagner technique in one tibial elongation and in 7 femur elongation. Except for one tibia, in the remaining cases there was Rush rod inserted intramedullary in the bone being elongated. During tibial elongation we fixed lateral malleolus by screw. The osteotomy was performed in proximal metaphysis of the 5 femurs and 3 tibias, and in distal femurs in two cases. The elongation was 1 mm for day, with frequency 4 x 1/4 mm. The mean bone lengthening achieved was 5.5 cm (2-9 cm); the mean lengthening of the limb was 7.9 cm (2-18 cm). The mean time of elongation was 2.8 months (2-5 months). Elongation index was 26 days for 1 cm of lengthening. The mean time of fixator removal was 9.2 months (4-13 months). Healing index was 58 day/1 cm (overall number of days for 1 cm lengthening). The complications occurred in all the patients. Although the risk of numerous complication is high, lower limbs lengthening in children with type I osteogenesis imperfecta is possible to perform and allows equalizing discrepant limbs or, at least reducing the difference.

Chir Narzadow Ruchu Ortop Pol. 2005;70(4):235-41.

[The value of methods of bone regeneration evaluation in limb lengthening by the Wagner, Ilizarov methods and by physal distraction]

Tesiorowski M, Kacki W, Jasiewicz B, Rymarczyk A, Sebastianowicz P.

Katedra i Klinika Ortopedii i Rehabilitacji, Collegium Medicum Uniwersytetu Jagiello _skiego w Zakopanem.

Limb lengthening is a long-lasting process, and during new bone formation different complications may occur. Due to this, early diagnosis of disturbances of new bone formation leading to such complications is of importance. The goal of this study is to analyze already used methods of regenerate evaluation. Material consists of retrospective data of 237 patients, who underwent limb lengthening between 1983 and 2002 by one of three methods: Wagner method, Ilizarov method and physal distraction. During femoral lengthening by Wagner method appropriate shape of regenerate according to Hamanishi was observed in 9 cases (29.0%), and during tibia lengthening--only in 1 case (6.7%). During femoral lengthening by physal distraction appropriate shape of regenerate (A or B according to Hamanishi) was observed in 24 cases (77.4%), and during tibia lengthening--in 11 cases (78.6%). During femoral lengthening by Ilizarov method appropriate shape of regenerate was observed in 51 cases (72.9%), and during tibia lengthening--in 46 cases (66.7%). Only in Wagner method a correlation between abnormal regenerate shape and bone consolidation complications was noted. Methods of evaluation of bone regeneration during distraction osteogenesis give only descriptive assessment. So far parameters applied for evaluation of distraction osteogenesis in Ilizarov method and physal distraction do not allow for detailed assessment of bone regeneration process.

Med Image Comput Assist Interv Int Conf Med Image Comput Assist Interv. 2005;8(Pt 1):459-66.

Computer-assisted deformity correction using the ilizarov method.

Simpson AL, Ma B, Borschneck DP, Ellis RE.

School of Computing, Queen's University, Kingston, Ontario, Canada.

simpson@cs.queensu.ca

The Taylor spatial frame is a fixation device used to implement the Ilizarov method of bone deformity correction to gradually distract an osteotomized bone at regular intervals, according to a prescribed schedule. We improve the accuracy of Ilizarov's method of osteogenesis by preoperatively planning the correction, intraoperatively measuring the location of the frame relative to the patient, and computing the final shape of the frame. In four of five tibial phantom experiments, we were able to achieve correction errors of less than 2 degrees of total rotation. We also demonstrate how registration uncertainty can be

propagated through the planned transformation to visualize the range of possible correction outcomes. Our method is an improvement over an existing computer-assisted technique (Iyun et al.) in that the surgeon has the same flexibility as in the conventional technique when fixating the frame to the patient.

Morfologia. 2005;128(5):67-71.

[Experimental histological study of the articular cartilage of the external femoral condyle in tibial elongation in dogs]

Shchudlo MM, Stupina TA, Erofeev SA.

The tibia was elongated in 18 adult mongrel dogs with the rate of 1 mm per day produced with 60 increments (1st series, autodistraction) or 8 increments (2nd series, manual distraction). On completion of 28 days of distraction, followed by 30 days of fixation and 30 days without the fixator, the articular cartilage of the external femoral condyle was studied in the experimental and 3 intact animals using the methods of light and scanning electron microscopy, computer morphometry and stereometry. It was established that the structural changes in the cartilage during the experiment included destruction of the superficial area. The degree of destruction severity was directly related to the duration of the stage when the fixator was on. In a month after the fixator removal the return to the motor stereotype resulted in restoration of the cartilage surface in the 1st series, whereas in the second one the changes persisted. The studies performed revealed general features of the morpho-functional state of the articular cartilage in tibial lengthening in both experimental series, and showed that the autodistraction mode was less traumatic for the articular cartilage.

Ortop Traumatol Rehabil. 2004 Aug 30;6(4):423-32.

Assessment of Ilizarov's method in intraarticular calcaneal fractures.

Koprowski P, Kulej M, Romaszkiwicz P, Dragan S, Krawczyk A, Prastowski A.

Background. Hindfoot dysfunction after intrarticular fracture of calcaneus are evoked by disturbances of muscle balance caused by change of bone shape and disturbances of talo-calcaneal joint function caused by secondary arthrosis of the joint. Goal of fracture treatment is restoring joint surfaces and the shape of calcaneus. It allow restoring function of foot and a correct gait. Material and methods. In the years 1997-2002 in Department of Orthopedic and Traumatology of Wrocław Medical University 45 patients with intrarticular fractures of calcaneus were treated. Closed reduction as well as external stabilisation with the use of Ilizarov fixator was applied in 20 patients as method of choice, in accordance to our criteria. Observation period of the treated group extended from 6 months to 6 years. Results. To investigation answered 25 patients (21 men and 4 woman). In this group 11 patients with 14 fractures of calcaneal bone were treated with Ilizarov method. Restoration of anatomical conditions and secondary arthrosis were evaluated on the basis of x-ray examination and functional result of treatment simultaneously according to Olerud, Molander and Rowe evaluation form. Conclusions. In our analysis application of closed reduction and external fixation with Ilizarov device is a method of choice in cases when selected criteria are fulfilled.

Ortop Traumatol Rehabil. 2004 Feb 28;6(1):103-12.

External fixation in the treatment of severe tibial fractures complicated by soft tissue injury.

S_uza_ek M, Ga_dzik TS, Mrozek S, Ryba J.

Background. In recent years multiple injuries to the tibial shaft have become increasingly common. High-energy impacts cause comminuted fractures, often accompanied by damage to neural and vascular structures, muscle, and surface layers. The key to good healing is preserving normal blood supply. Serious damage

to the tibia should be treated by external stabilization. Material and methods. A group of 23 patients with severe tibial fractures accompanied by soft-tissue injuries were treated surgically, using Polfix, Ilizarov and Dynastab external stabilizers. Open fractures were classified according to the Gustillo-Anderson scale. Internal bone transport and the Ilizarov apparatus were used for the treatment of fractures with bone defect. Bone infections were treated with targeted antibiotic therapy and flush drainage. In cases with staphylococcus infection anti-vaccination was used. Plastic surgery was performed to cover soft tissue defects. Polfix stabilizers were removed after 35 weeks, Ilizarov after 45 weeks, and Dynastab after 18 weeks. The Sarmiento cast was applied in 6 cases. Results. In all patients treated with external fixation good results were observed. Conclusions. In the treatment of open tibial fractures complicated by significant bone defects and soft-tissue defects (type IIIB/C), the methods of choice are Ilizarov or Dynastab stabilizers. Polfix or Dynastab stabilizers are suitable for open fractures of types I-III A. Serious tibial injury necessitates the use of various kinds of skin grafts, so the best solution is regular cooperation with a plastic surgeon. Treatment with Sarmiento's functional plaster cast is a valuable supplement to external fixation.

Ortop Traumatol Rehabil. 2003 Dec 30;5(6):787-94.

Results of conservative treatment of "pilon" fractures.

Othman M, Strzelczyk P.

Katedra i Klinika Ortopedii i Traumatologii Narządu Ruchu, Akademia Medyczna, Warszawa.

Material and methods. From 1996 to 2002 30 cases of distal tibia epiphysis fractures (pilon fractures), including 4 cases of open fractures, were treated by conservative technique. According to the Rüedi-Allgöwer AO classification, there were 13 patients with type I fractures, 9 type II and 8 type III fractures. Follow up examinations were performed from 4 months to 4 years. Results. Long-term results (mean 3 years) have been assessed in 8 cases as good, 12 as fair and 10 as bad. In 23 cases osteoarthritis of talotibial joint has been found. In 16 cases there were deviations of bone axis (15 degree of varus). The range of movement of the joint was limited in all patients. In 18 cases there was no dorsiflexion. In one case shortening of the treated leg 2 cm has occurred. Conclusions. The conservative treatment is effective for pilon fractures type I and II. The majority of bad results was found in type III due to the severe destruction of the articular surfaces. In that cases we recommend treatment by external fixation with corrections of deformation.

Ortop Traumatol Rehabil. 2002 Oct 30;4(5):622-5.

Evaluation a range of the motion of knee during femoral lengthening by Ilizarov method.

Pasierbek M, Gazdzik TS, Ryba J, Barczy_ski A, Golonka J.

Background. Extensory contracture of the knee joint is a constant problem during thigh lengthening procedures. Its occurrence is dependent on such factors as rehabilitation, the construction of the Ilizarov apparatus, the extent of the lengthening, and the etiology of the shortening. Material and methods. Between 1998 and 2001, 34 children were treated for thigh shortening. Contracture occurred in all cases. Results. The dynamics of the lengthening process were strictly associated with the development and elimination of any contracture that appeared. If the indicated rules are followed, extensory contracture of the knee joints always resolved within several months after removal of the Ilizarov apparatus. Conclusions. The importance of the proper rehabilitation program is equal to that of the surgical procedure. Limiting the number of impulses and localizing them is helpful in later rehabilitation.

Ortop Traumatol Rehabil. 2002 Aug 30;4(4):473-6.

Psychological aspects of Ilizarov method treatment.

Napiontek M, Koczewski P, Shandi M.

Katedra i Klinika Ortopedii Dziecięcej, Akademia Medyczna im. K. Marcinkowskiego, Poznań

This article discusses the impact of certain factors on the psychological status of a patient treated by Ilizarov method. These include the etiology of the disease, the patient's age when treatment by the Ilizarov method is commenced, the attitudes of parents and caregivers, anesthetic methods, surgical technique, methods of rehabilitation and pain management, duration of hospitalization, and patient involvement.

Ortop Traumatol Rehabil. 2002 Aug 30;4(4):469-72.

Problems in the rehabilitation of patients treated with the Ilizarov method.

Wrzosek Z.

Katedra i Klinika Ortopedii i Traumatologii Narządu Ruchu, Akademia Medyczna, Wrocław

The implementation of the Ilizarov method in the treatment of diseases and post-traumatic injuries to the locomotor system has opened up new possibilities for the management of unequal limb length and limb deformity. The final treatment outcome depends on many factors, one of the most important of which is proper and systematic rehabilitation. Among the essential problems entailed in this process are spastic contractures, limitations in the range of mobility in joints adjacent to the lengthened segment, and the lack of patient cooperation. The solution of these problems in the course of rehabilitation improves limb function and esthetic appearance, thereby eliminating the feeling of being cut off from the environment.

Ortop Traumatol Rehabil. 2002 Aug 30;4(4):441-51.

The application of Ilizarov's "bone segment transport" method in the treatment of tumors and tumor-like changes in bone.

Dragan S, Krawczyk A, Orzechowski W, Wrzosek Z, Kulej M, Czaplinski J.

Katedra i Klinika Ortopedii i Traumatologii Narządu Ruchu, Akademia Medyczna im. Piastów Śląski, Wrocław

Background. The authors present their own experience in the application of the "bone segment transport" method developed by Ilizarov for filling post-resection bone deficits in the treatment of neoplastic tumors in long bones. Material and method. Our research involved 9 patients: 2 female patients with an average age of 14.5, and 7 male patients with an average age of 16.7. The follow-up time ranged from 2 to 8 years (average 3.4). Of these patients, 5 were treated for giant-cell tumors with varying degrees of malignancy. Among the remaining patients the bone transport method was used in 2 cases of osteogenic sarcoma, 1 case of chondrosarcoma, and 1 case of aneurismatic cyst. The choice of surgical treatment method was made on the basis of the surgical systems of evaluation and classification of tumors in the locomotor apparatus provided by the Musculoskeletal Tumor Society and described by Enneking. Results. The authors discuss the method and the results using the example of three cases: an osteogenic sarcoma, a giant-cell tumor, and an aneurismatic cyst. The outcome for bone tumors treated with the "bone segment transport" method are satisfactory. Conclusions. In our material there were no tumor relapses after the combined treatment program was completed. In addition, the preservation of the limb provides psychological comfort for the patient, for whom the potential loss of the limb is a source of stress, often undermining faith in the good effects of treatment.

Ortop Traumatol Rehabil. 2002 Aug 30;4(4):434-40.

The Ilizarov Method in the treatment of pseudoarthrosis of the humerus.*Zarek S, Macias J.*

Background. The aim of our study was to evaluate the effectiveness of the Ilizarov method in the treatment of pseudoarthrosis of the humerus. Material and methods. Twenty patients ranging in age from 9 to 69 were treated for humeral pseudoarthrosis (11 atrophic, 8 hypertrophic, 1 bone defect) using the Ilizarov technique. Eighteen of these patients had been treated previously using other surgical techniques. Two of them had radial nerve palsy. Twenty surgical procedures were performed (19 compression osteosyntheses, one distraction osteosynthesis). Resection of the pseudoarthrosis site and preparation of the fragment ends was necessary in 11 cases. Results. The mean time of treatment with the apparatus was 7.1 months. Bone union was achieved in 19 cases. Improvement of the range of motion of shoulder and elbow was observed in 14 cases. The main complication during treatment was superficial pin-tract infection (eight cases). Neuropraxia of the radial nerve occurred in two patients. Deviation of the humerus axis (without function disturbance) was observed in two cases. Conclusions. The Ilizarov method is a very effective and safe technique for use in the treatment of humeral pseudoarthrosis.

Ortop Traumatol Rehabil. 2002 Aug 30;4(4):427-33.

The Ilizarov method in the treatment of pilon fractures.*Zarek S, Othman M, Macias J.**Katedra i Klinika Ortopedii i Traumatologii Narzadu Ruchu, I Wydzia_Lekarski, Akademia Medyczna, Warszawa.*

Background. Comminuted fractures of the distal epiphysis and metaphysis of the tibia with penetration to the ankle joint, which occur rarely, are known as "pilon fractures". Material and methods. From 1996 to 2001, eight cases of distal tibia epiphysis fractures (pilon fractures), including four cases of open fractures, were treated by the Ilizarov technique. According to the Rüedi-Allgöwer classification, there were two patients with type I fractures, four patients with type II fractures, and two patients with type III fractures. Four patients were treated on an emergency basis, while two other patients underwent planned surgery 2 weeks after injury. In two patients previously treated by internal fixation the Ilizarov method was applied after 4 months due to pseudoarthrosis. Repositioning of the fractures was performed under x-ray control. The construction of the apparatus allows for weight bearing and early movement of the foot. The average period of treatment by this method was 5 months. Follow up examinations were performed from 2 months to 5 years after conclusion of treatment. Results. Bone consolidation was achieved in all cases. There were no deviations of bone axis, apart from one case of 10-degree varus deformity. A good range of motion was obtained in seven cases. Only in one case was the range of motion of the crurotalar joint reduced to 0 degrees dorsiflexion and 20 degrees plantar flexion. There were no cases of osteomyelitis or deep infections. Pin-tract infections occurred in three patients. Conclusions. The Ilizarov technique is a safe and very effective method for the treatment of pilon fractures.

Ortop Traumatol Rehabil. 2002 Aug 30;4(4):421-6.

The surgical treatment of short stature: management strategy and local experience.*Koczewski P, Shadi M, Napiontek M.**Katedra i Klinika Ortopedii Dzieciecej, Akademia Medyczna im. K. Marcinkowskiego, Pozna_*

Background. This article presents the indications and counterindications for the application of limb lengthening using distraction osteogenesis in the treatment of patients with short stature. Various treatment strategies are described. The

factors influencing the choice of strategy are discussed, the means used to determine the extent and level of lengthening, and the optimum age to begin treatment. Material and methods. On the basis of their own material the authors present the problems, obstacles, and complications occurring during treatment. During the period 1997-2000 a total of 5 patients were treated for short stature, averaging 18 years of age. In these cases the "crossed" technique of surgical treatment was applied, using an Ilizarov apparatus on the tibia and an Italian modification on the leg. Results. A total of 8 tibial segments (ave. 7 cm) and 8 femoral segments (ave. 7.5 cm) were lengthened. The average increase in stature was 14.8 cm (a 12% increase over the growth prior to treatment). Conclusions. The methods applied produced good results in patients with non-proportional dwarfism, while the majority of complications involved patients with constitutionally short stature. This confirms the necessity to make a strict selection of healthy persons undertaking to increase their stature for cosmetic reasons.

Ortop Traumatol Rehabil. 2002 Aug 30;4(4):413-20.

Leg lengthening in patients with congenital fibular hemimelia.

Jasiewicz B, Kacki W, Koniarski A, Kasprzyk M, Zarzycka M, Tesiorowski M. Uniwersytet Jagiello _ski, Collegium Medicum, Klinika Ortopedii i Rehabilitacji, Zakopane.

Background. Anisomelia in patients with congenital fibular deficiencies is a difficult orthopedic problem due to concomitant deformities of the ankle and knee. The goal of the present study was to analyze outcomes of tibia lengthening in these patients. Material and methods. In the period 1989-2001 we performed lengthening of 26 limbs in 21 patients with congenital fibular deficiency (11 female, 10 male, average age 10.1 years). Under the Achterman-Kalamchi classification, 8 tibiae were Type 1, 3 were Type 1b, and 10 were Type 2 (including one case with bilateral defect). The average baseline shortening was 4.6 cm, i.e. 15.3%. The Ilizarov method was used in 24 cases, chondrial lengthening in the others. We measured time of lengthening, time of stabilization, total healing time, amount of lengthening, and the lengthening index, as well as the range of ankle and knee movement, the positioning of the foot, and the axis of the tibia at each stage. Problems and complications were classified according to Paley. The average follow-up was 4.9 years Results. The mean time of lengthening was 101 days, stabilization time 177 days, total healing time 269 days, mean lengthening 5.6 cm (22.9%). As of the last examination only 7 patients did not require follow-up surgery, 6 with Type 1a and 1 with Type 1b. Conclusions. Tibia lengthening with axis correction constitutes an alternative to amputation in congenital fibular deficiency. It is a difficult procedure, however, encumbered by a significant risk of complications.

Ortop Traumatol Rehabil. 2002 Aug 30;4(4):403-12.

Limb lengthening in automatic mode.

Shetsov VI, Popkov AV.

Russian Ilizarov Scientific Centre for Restorative Taumatology and Orthopaedics General Director: V. I. Shevstov.

Background. More than 5000 lengthening procedures in the upper and lower limb bones were performed at the Russian Ilizarov Scientific Centre, including 406 segments that were lengthened in automatic mode. Distraction was continuous, 24 hours a day, at a rate of 1 mm over 60 operating cycles of the autodistractor. Material and methods. Lengthening in automatic mode was used in 171 patients between the ages of 5 and 43. Monosegmental and polysegmental osteosynthesis techniques were applied. The amount of lengthening ranged from 3 to 16 cm. The mean value of lengthening by the monosegmental type of osteosynthesis was 6.1 +/- 2.0 cm, and by polysegmental techniques, 7.2 +/- 1.5 cm. The distraction forces developed in the autodistractor were also measured. In order to develop an

objective opinion about the advantages of automatic distraction, we calculated the fixation index in the apparatus for one centimeter of lengthening. Results and conclusions. The fixation index was only 5-6 days/cm when using automatic distraction, but came to 22-24 days/cm by manual adjustment of lengthening. The biochemical study of bone metabolism during lengthening showed expressed activity of blood enzymes, such as alkaline and acid phosphatases, as well as large amounts of minerals in the distraction osteogenesis area.

Ortop Traumatol Rehabil. 2000 Sep 30;2(3):49-53.

Locking intramedullary nailing in failure of bone union.

Wójcik K, Gaździk TS, Baraska T, Nolewajka M.

Katedra i Oddział Kliniczny Ortopedii, Śląska Akademia Medyczna, Sosnowiec.

Treatment of long bone fractures carries a high risk of complications. Among them slow union, nonunion and implant breakage are most often. It is very important to choose a proper method of treatment of these patients. In 15 such cases we performed locked intramedullary nailing. In most cases patients with femur and tibia nonunion after Zespol, Polfix or plate osteosynthesis were operated on. One patient with open tibia fracture treated by Ilizarov method, one with plate breakage after humerus shaft osteosynthesis and one with nonunion which followed closed treatment of tibia fracture were treated. It is very important to pay attention to technical elements of the procedure as well as a traumatic operative technic.

Ortop Traumatol Rehabil. 2000 Sep 30;2(3):46-8.

The treatment of pseudarthrosis using the Ilizarov method.

Niedzielski K, Synder M.

Katedra i Klinika Ortopedii, Akademia Medyczna, ód

This paper presents a method for treating pseudarthrosis in the lower limbs using the Ilizarov method. 20 patients were treated, including 3 cases with infected false joints. Bone union was attained in cases with infected false joints. Bone union was attained in cases of pseudarthrosis without infection within an average time of 8 months. In cases of infected false joints the time required to achieve bone union was 12 months. On the basis of the authors' observations the method described here proved to be suitable for the treatment of disturbed bone union. The value of this method is further increased by the slow, steady correction of axial disorders in the limb accompanied by simultaneous equalization. Bone union was achieved in 94,2% of the cases studied.

Ortop Traumatol Rehabil. 2000 Sep 30;2(3):42-5.

External fracture fixation in terms of the capability to monitor and simulate bone union processes.

Deszczyński J, Jasińska-Choromańska D, Szczesny G.

Oddział Chirurgii Urazowo-Ortopedycznej, Szpital Czerniakowski, Warszawa.

This paper presents the possibilities offered by the application of Dynastab - T (shaft) external stabilizers in the treatment of diaphysis fractures. The measure system, which during fracture treatment records the changing values of stress on the stabilizer arm, makes it possible to use artificial intelligence techniques to monitor and predict the bone union process.

Ortop Traumatol Rehabil. 1999 Dec 30;1(1):67-70.

External fixation in treatment of false joints and bone losses using vascularized grafts.

Ozonek W.

Klinika Ortopedii CMKP, PSK Nr 2 im. Prof. Adama Grucy, Otwock.

Different kind of external fixator osteosynthesis in the treatment of pseudoarthroses and bone defects with vascularized bone grafts are presented.

Construction features of different external fixators are discussed based on clinical material of 48 patients, who have had different vascularized bone graft surgery. For tibia treatment mainly external plate fixator "Zespol" was used. Its advantages such as simplicity of construction, small size and weight and easy application are presented. The possibility of joining the external plates allows using this method in the treatment of bone defects of arbitrary length. Some restrictions of this method are also pointed out. Fixators of larger size were used for treatment of femoral pseudoarthroses and bone defects. Emphasis was put on advantages and disadvantages of multiplane static fixators and unilateral fixators. The importance of weight bearing and dynamization for bone healing process were discussed. It seems that external fixator whose construction allows to adjust the dynamization level at various stages of the healing process is the best method of treatment of complications of bone union.

Ortop Traumatol Rehabil. 1999 Dec 30;1(1):60-2.

Reposition and stabilization of long bones using external fixator CZ - II.

Czyrny S, Fryc D, Sterkowicz G.

Oddzia_Ortopedyczno-Urazowy Szpitala im. Sw. _ukasza, Tarnów.

The CZ - II apparatus is a further stage of development of experimental construction CZ - I. During 3 years at Orthopedic ND Traumatology Department in Tarnów 69 patients were treated using CZ - II device. The fixator was mainly used not only in treatment of open, comminuted and multifocal fractures but also in the case of multiorgan damages as well. Authors think than using CZ - II apparatus is a simple and effective way of fixation and it also enables correction of position of fragments during treatment.

Ortop Traumatol Rehabil. 1999 Dec 30;1(1):49-59.

External fixation in the treatment of pelvic fractures.

Caban A.

Samodzielny Publiczny Szpital Kliniczny; Klinika Chirurgii Urazowej Narzadu Ruchu, Warszawa.

External fixation with MONO-Tube was used 68 times for the treatment of unstable pelvic fractures. The device was efficient in stabilizing the fracture and controlling the shock. It can be used as far final treatment in type LC1, APC1, APC2 and partly APC3 fractures, what supports an earlier observation by Young-Burgess. Other fractures usually need to be operated and the external fixation should only be treated as an initial procedure before surgery.