

DISTRACTIONS

The Newsletter of
The Limb Lengthening and Reconstruction Society: ASAMI-North America

Volume 12, Number 1 January/February 2006

LLRS Specialty Day Saturday, March 25, 2006 Chicago, IL

Program Chairs: David S. Feldman, MD & David W. Lowenberg, MD	12:00–1:00 p.m.	Lunch On Your Own
8:00–8:10 a.m. Welcome & Introduction	Joint Distraction 1:00–1:20 p.m.	Moderator: David S. Feldman, MD Hip Distraction Shawn C. Standard, MD
8:10–8:30 a.m. Treatment of Failed Tibial Plateau Fractures – John K. Sontich, MD	1:20–1:40 p.m.	Knee Distraction – Dror Paley, MD
8:30–8:50 a.m. Use of OP-1 in the Treatment of Long Bone Nonunions Mark T. Dahl, MD	1:40–2:00 p.m.	Upper Extremity and Elbow Distraction Robert N. Hotchkiss, MD Peter M. Waters, MD
8:50–9:10 a.m. Circular Fixation vs. Intramedullary Rodding in the Treatment of Tibial Shaft Fractures Christopher Andrews, MD	2:00–2:20 p.m.	Foot and Ankle Douglas Beaman, MD
9:10–9:25 a.m. Discussion	2:20–2:40 p.m.	Discussion
9:25–9:40 a.m. Distal Tibial Metaphyseal–Diaphyseal Junction Nonunions: Treatment with Internal Fixation <i>Speaker TBD</i>	2:40–3:00 p.m.	Break
9:40–9:55 a.m. Distal Tibial Metaphyseal–Diaphyseal Junction Nonunions: Treatment with External Fixation <i>Speaker TBD</i>	Early Experience: Pearls and Pitfalls Moderator: David S. Feldman, MD 3:00–3:15 p.m.	Intramedullary Skeletal Kinetic Distraction (ISKD) Dror Paley, MD
9:55–10:05 a.m. Discussion	3:15–3:30 p.m.	Metaphyseal Arc Gail S. Chorney, MD
10:05–10:30 a.m. Break	3:30–3:45 p.m.	MultiAxial Correcting (MAC) S. Robert Rozbruch, MD
10:30–10:45 a.m. Treatment Strategies for Failed Supracondylar Femur Fractures James J. Hutson, Jr., MD	3:45–4:00 p.m.	Discussion
10:45–11:00 a.m. <i>Title and Speaker TBD</i>	Congenital Pseudoarthrosis of the Tibia Moderator: John G. Birch, MD 4:00–4:15 p.m.	OP-1/Iliac Crest Bone Graft Williams Rod Reggie C. Hamdy, MD
11:00–11:10 a.m. Discussion	4:15–4:30 p.m.	External Fixator/Ilizarov/Bone Graft Mark T. Dahl, MD
11:10–11:30 a.m. Combined Bone & Soft Tissue Management in the Multiply Injured Limb–Acute & Chronic David W. Lowenberg, MD	4:30–4:45 p.m.	Free Fibula – Roger Widmann, MD
11:30–11:50 a.m. Reconstruction of Malunions with External Fixation J. Charles Taylor, MD	4:45–5:00 p.m.	Amputation – Wallace Lehman, MD
11:50 a.m.–12:00 p.m. Discussion	5:00–5:20 p.m.	Discussion
	5:20–5:30 p.m.	Announcements, Evaluation, Adjourn

Register at www.aaos.org

Letter from the President

Dear LLRS Members,

The LLRS 16th Annual Scientific Meeting will be in San Diego, California, July 21–23, 2006. The schedule will follow the same format used in New York to provide participants and guests time to enjoy the City of San Diego. On the second day of the meeting, there will be a reception combined with lunch which will allow the membership to socialize and make new friends. Scientific abstracts are due **March 15, 2006**. The abstract submission form will be mailed and posted on the website shortly.

At the meeting in San Diego, the winning abstract of a resident and fellow competition for a Best Paper Award will be presented. The prize is \$500.00 and the deadline has been extended to **February 10, 2006**. Please encourage your residents and fellows to enter the competition. These individuals represent new members for our Society. Visit the website for the official form.

As you know, Specialty Day will be held in Chicago, IL, on Saturday, March 25, 2006. Drs. Lowenberg and Feldman have put together and excellent agenda and I encourage all of the membership to attend.

Jim Binski and I attended the COMSS/BOC meeting in Williamsburg, Virginia, October 27–30, 2005. COMSS has decided to change the name of the organization to the Board of Specialties BOS. The interaction of the Specialty Society with the AAOS was the major topic of the meeting. Symposia and Annual Meeting courses will become a joint effort of the AAOS and the Societies. Our Society will have the opportunity to present topics for consideration to be held as symposia or courses. The membership should consider topics for these and prepare a synopsis of proposed courses.

Also, as many of us are asked to speak at numerous meetings and conference throughout North America, the executive board asks that everyone help promote membership in LLRS. Please download the membership slide from the website, www.llrs.org, and attach it to the end of your presentations. Your assistance is appreciated.

I look forward to seeing you at Specialty Day, March 25, 2006, in Chicago!

Sincerely,



James J. Hutson, Jr., MD

Abstracts in A Minute

The purpose of Abstracts in A Minute is to facilitate members' self-study. Because of the brevity, these abstracts are not intended to be an authoritative or critical review.

Deformity Correction

Eidelman M, Chezar A. [**Principles of deformity correction using the Taylor Spatial Frame**]. *Harefuah* 2005; 144:115–118,149. This review presents an overview of the theoretical foundation and methods of using the TSF, with an emphasis on the advantages of this system and the capabilities in the correction of skeletal deformities.

Kessler AC, Pugh LL, Stasikelis PJ. **Length changes in tibial osteotomy with angular correction**. *J Pediatr Orthop B* 2005; 14:337–339. Twelve boys, aged 11–17 years, underwent percutaneous tibial osteotomies, application of an external fixator, and acute angular correction for unilateral Blount disease. Angular correction increased the overall limb length by a mean of 1.4 (range –0.4 to 3.2) cm. This increase was a mean 0.7 cm less than predicted by adding the preoperative tibial and femoral lengths. This failure to achieve the predicted limb length is due to shortening of the tibia and should be considered when planning an osteotomy.

Merian M, Schafer D, Hintermann B. [**Proximal tibial valgus osteotomy with callus distraction**]. *Oper Orthop Traumatol* 2005; 17:313–325. Thirty-four proximal tibial osteotomies were performed in 24 patients, ages 24–64 years. Indications included symptomatic genu varum following medial meniscectomy, medial compartment osteoarthritis, articular cartilage lesion of the medial compartment, avascular necrosis of the medial femoral condyle, osteochondritis dissecans of the medial femoral condyle, posterolateral and/or anteromedial rotatory instability. A monolateral external fixator was applied as proximal as possible, with an osteotomy just distal to the tibial tubercle. Distraction was begun 5 days after surgery. Median correction was 6 (3–12) degrees. Complications occurred in 15 of 34 tibiae, 8 needing a surgical revision. 20 of 24 patients would have the procedure again.

Sakurakichi K, Tsuchiya H, Kabata T, Yamashiro T, Watanabe K, Tomita K. **Correction of juxtaarticular deformities in children using the Ilizarov apparatus**. *J Orthop Sci* 2005; 10:360–366. Juxtaarticular deformities of 10 femurs and 17 tibias in 10 boys and 8 girls were corrected using the Ilizarov apparatus. Transverse osteotomies were performed in 16 segments and focal dome osteotomies in 11 segments. Mean age at operation was 12 (range 5–18) years. Acute correction was done in 14 segments; gradual correction was done in 13 segments. Accurate limb alignment was achieved in all cases, but the focal dome osteotomies with acute correction healed more rapidly than transverse osteotomies, attributed to better contact area.

Deformity Correction

Shin EK, Jones NF. **Temporary fixation with the Agee–Wristjack during correctional osteotomies for malunions and nonunions of the distal radius.** *Tech Hand Up Extrem Surg* 2005; 9:21–28. Authors describe a technique for providing provisional stabilization of a distal radial osteotomy site for treatment of malunions and nonunions using the Agee–Wristjack. Advantages include stable distraction and facilitation of distal fragment positioning due to its gear mechanism. Placement of the distal fixator pins into the index metacarpal instead of the distal radius facilitates radial plate application. The fixator may be maintained following surgery to supplement internal fixation.

Song HR, Myrboh V, Lee SH. **Unstable slipped capital femoral epiphysis: reduction by gradual distraction with external fixator. A case report.** *J Pediatr Orthop B* 2005; 14:426–428. Authors report a case of an 11-year-old girl who had a slipped capital femoral epiphysis, treated with an external fixator across the hip joint for gradual reduction of the femur over an 18-day period. At 38 months followup, there was excellent function and no radiographic sign of avascular necrosis or chondrolysis.

Song HR, Myrboh V, Oh CW, Lee ST, Lee SH. **Tibial lengthening and concomitant foot deformity correction in 14 patients with permanent deformity after poliomyelitis.** *Acta Orthop* 2005; 76:261–269. Fourteen patients with foot deformities after poliomyelitis were treated with tibial lengthening and gradual distraction of the foot deformity and arthrodesis. Tibial lengthening over a nail was performed in 3 and lengthening without a nail in 11. Mean external fixation time was 6 (3.6–10) months without a nail, 1.6 (1.5–1.7) months with a nail. The healing index was 1.8 (0.8–3.1) months/cm without the nail, 2 (1.8–2.3) months/cm with the nail. Concomitant foot procedures included triple arthrodeses (7), pantalar arthrodeses (2), and gradual foot distraction without bony foot procedures (5). Because of recurrent foot deformities, joint luxation, and arthritis, authors recommend triple arthrodesis as a concomitant procedure during tibial lengthening.

Wang JC, Riley BM. **A new fixation technique for the Lapidus bunionectomy.** *J Am Podiatr Med Assoc* 2005; 95:405–409. Authors performed 102 first metatarsocuneiform arthrodeses with external fixation for the correction of hallux valgus. Advantages include early weight bearing, predictable fusion, and removal of all hardware postoperatively. Average time to unassisted full weightbearing was 13.1 weeks. Average time to fusion was 5.3 weeks. Average time to fixator removal was 5.5 weeks. There were no nonunions or delayed unions. There was one pin tract irritation, which resolved with local care and a short course of oral antibiotics.

Wright JM, Crockett HC, Slawski DP, et al. **High tibial osteotomy.** *J Am Acad Orthop Surg* 2005; 13:279–289. Review article reporting the indications, contraindications, techniques, results, and complications of high tibial osteotomies. Goal is to unload diseased articular surfaces and to correct angular deformities of the tibiofemoral joint.

Infection

Baumgart R, Hinterwimmer S, Kettler M, et al. **[Central bone transport system optimizes reconstruction of bone defects Results of 40 treatments].** *Unfallchirurg* 2005; 108:1011–1021. Authors treated 40 patients (30 tibias and 10 femurs) with bony defects with either a single rope transport system (36) or a fully implantable distraction nail (4). There were 30 post-traumatic (12 aseptic, 18 post-septic) defects and 10 defects after tumor resection (2 benign, 8 malignant). Mean defect size was 10.1 cm. All defects were totally bridged. Mean distraction time was 131 (range 57–208) days. The mean external fixation time was 283 (126–326) days. Healing index was 47 (33.1–60.4) days/cm. Thirty-four patients underwent autologous bone grafting at the docking site. In 30 patients, the external fixator was replaced by internal stabilization. Mean LLD was 43mm. There were 1.8 complications/patient (15 pin tract infections, 2 premature consolidations). Patient comfort is improved and immobilization is reduced compared to other techniques.

El–Mowafi H, Elalfi B, Wasfi K. **Functional outcome following treatment of segmental skeletal defects of the forearm bones by Ilizarov application.** *Acta Orthop Belg* 2005; 71:157–162. Sixteen patients with forearm bone defects due to infection were treated with the Ilizarov technique. Mean time from injury was 11.7 months. Mean length of defect was 6.4 cm. The mean external fixation index, distraction index, and maturation index were 41.5 days/cm, 19.8 days/cm, and 21.7 days/cm, respectively. The mean time in the frame was 8.9 months. Eleven patients had 14 complications (pin site infection, premature consolidation, delayed union at the docking site, and refracture). The Ilizarov technique is an ideal solution for a large skeletal defect in spite of associated complications.

Patzakis MJ, Zalavras CG. **Chronic posttraumatic osteomyelitis and infected nonunion of the tibia: current management concepts.** *J Am Acad Orthop Surg* 2005; 13:417–427. Review article about posttraumatic osteomyelitis and infected nonunions of the tibia. Authors discuss pathogenesis, classification, diagnoses, and management. Algorithm for removing or retaining implants in the presence of infection is given.

Joints

Grass R, Rammelt S, Endres T, Zwipp H. **[Reorientational arthrodesis of the ankle joint using four screws].** *Orthopade* 2005; 34:1209–1215. Authors report on ankle arthrodeses using 4–5 lag screws. External fixation is preferred in case of osteitis, osteonecrosis, osteoporosis, and poor soft-tissue condition.

**Plan to attend the
16th Annual Scientific Meeting
July 21–23, 2006
San Diego, CA**

Joints

Inan M, Harma A, Ertem K, et al. **Successful treatment of high congenital dislocated hips in older children by open reduction, pelvic and femoral osteotomy with external fixator stabilization (average 8.2 years of age).** *J Pediatr Orthop B* 2005; 14:405–409. Twelve hips (11 patients) at a mean age of 8.2 (range 4–11) years underwent one-stage open reduction, capsulorrhaphy, femoral and pelvic (5 Salter, 7 triple) osteotomies, and application of a hinged external fixator on the ilium and femur. The pelvic osteotomies were internally fixed independent of the hinged fixator. Partial weightbearing began on the third day; full weightbearing on the fourteenth day. The hinge was unlocked to allow hip flexion from 15 to 60° twice daily. Functional and radiographic results are described. Five hips had 7 complications: one redislocation on the first postoperative day, when the hinge broke, followed by a successful closed reduction and excellent results. Other complications include AVN (2), positive Trendelenburg sign (1), limb length discrepancy (1), and pin tract infection (1). Authors conclude results are better than following spica casts.

Johannsen HG, Skov O, Weeth ER. **[Knee arthrodesis with external ring fixator after infected knee arthroplasty].** *Ugeskr Laeger* 2005; 167:3295–3296. Knee arthrodesis was performed in 8 patients, using an Ilizarov ring fixator. Median age was 63 (range 51–84) years. Mean follow up after removal was 10 months. Six arthrodeses healed without further surgery. One patient had an AK amputation due to chronic infection.

Koczewski P, Shadi M. **[Plasty of knee extension apparatus in the treatment of “extension contracture” after femoral lengthening].** *Chir Narzadow Ruchu Ortop Pol* 2005; 70:91–96. Authors review 4 patients with a mean age of 19 (range 14–22) years, who underwent soft tissue releases for extension contractures following Ilizarov femoral lengthenings. Two patients’ fixators spanned the knee. Mean lengthening was 7.5 (range 5–12) cm. Preoperative knee flexion before lengthening was 90 to 150 (mean 135) degrees. After lengthening, mean flexion was 41 (range 20–75) degrees. Plasty was done 16 months after fixator removal. Procedures consisted of subcutaneous and fascial releases around knee (4), patellar retinaculum and iliotibial tract release (4), lengthening of vastus lateralis (4), vastus medialis (2), vastus intermedius (1), mobilization of patellofemoral joint (3), and intramuscular lengthening of rectus (2). Intraoperatively, 90 (range 80–100) degrees of flexion was achieved. At followup 10–47 (mean 36) months after surgery, mean flexion was 114 (range 105–120) degrees. All joints were stable in the sagittal and coronal planes.

Tan V, Daluiski A, Capo J, Hotchkiss R. **Hinged elbow external fixators: indications and uses.** *J Am Acad Orthop Surg* 2005; 13:503–514. Four currently available hinged elbow external fixators are described. A treatment algorithm for complex elbow instability and potential use of a hinged fixator is presented. The fixators are based on the normal ulnohumeral kinematics, which approximate a simple hinge; most critical step in application is correct placement of the axis pin. Indications include complex elbow dislocations with fractures and/or collateral ligament disruption, persistent instability that is present either acutely or in the early postoperative period, chronic dislocation, distraction interposition arthroplasty, and protection of elbow motion and/or repair in the obese patient. It is also indicated in the uncommon case of acute elbow instability when concentric reduction cannot be achieved by splinting or in a patient who cannot tolerate a prolonged surgical procedure.

Lengthening

Catagni MA, Lovisetti L, Guerreschi F, et al. **Cosmetic bilateral leg lengthening: Experience of 54 cases.** *J Bone Joint Surg Br* 2005; 87-B:1402–1405. Authors report leg lengthening for cosmetic reasons in 54 patients with constitutional short stature. A mean lengthening of 7 cm with a low complication rate was achieved. All results were excellent or good, including improvement in psychological disturbances related to short stature.

Hosny GA. **Unilateral humeral lengthening in children and adolescents.** *J Pediatr Orthop B* 2005; 14:439–443. Sixteen unilateral humeral lengthenings were performed for shortening from 5.5 to 15 cm. Average age was 13 (range 8.5–17) years. Etiologies were Erb’s palsy (8), epiphyseal injury (5), and infection (3). Mid-third osteotomies were performed. Hybrid fixators using pins and wires were used. There were 10 excellent and 6 good results. Average healing index was 28 days/cm. Complications included pin tract infection, a radial nerve palsy that resolved, and two fractured regenerates.

Lee FY, Schoeb JS, Yu J, Christiansen BD, Dick HM. **Operative lengthening of the humerus: indications, benefits, and complications.** *J Pediatr Orthop* 2005; 25:613–616. Nineteen humeral lengthenings in 16 patients with a mean age of 8.7 (range 2–21) years were reviewed. Etiologies included infection (6), congenital anomaly (6), unicameral bone cyst (5), and sequelae of trauma to the physes (2). Average lengthening was 5cm. Benefits included increased performance in daily activities, improved sports performance, and better self-image. Complications included temporary radial nerve palsy (3), pin site drainage (2), elbow flexion contracture (3), and late humeral fracture (2). All complications resolved and did not affect the outcome.

Register for the Annual AAOS Meeting

at

www.aaos.org.

Lengthening

Schmickal T, Recum JV, Wentzensen A. **Stiffness measurement of the neocallus with the Fraktometer FM 100®.** *Arch Orthop Trauma Surg* 2005; 125:653–659. Authors tested stiffness of the healing callus in 11 cases of lower extremity callotaxis with the Fraktometer FM 100 stiffness measuring system. In 10 cases, regular healing could be followed by a signal decrease; one case revealed a persistent signal with no decrease in a case of callotaxis failure. One case of late axis deformation after fixator removal occurred because of disregarding the delayed bending signal decrease. Authors concluded that measurements of the external fixator's stiffness after callotaxis can provide useful information for further treatment strategies.

Song HR, Oh CW, Mattoo R, et al. **Femoral lengthening over an intramedullary nail using the external fixator: risk of infection and knee problems in 22 patients with a follow-up of 2 years or more.** *Acta Orthop* 2005; 76:245–252. Twenty-two patients underwent femoral lengthening over an intramedullary nail. Mean age was 22 (13–35) years. Mean lengthening was 5 (2.7–8.1) cm. Mean external fixation index was 24 (11–35) days/cm. Mean consolidation index was 43 (26–65) days/cm of lengthening. Three patients who had a past history of infection or open trauma developed osteomyelitis, requiring nail removal. There were 4 knee complications (posterior knee subluxation and patellar subluxation). In one patient, the regenerate collapsed with breakage of the locking screws. Although lengthening over a nail can reduce the duration of external fixation, caution is required to prevent complications.

Tesiorowski M, Kacki W, Jasiewicz B, et al. **[Methods of bone regenerate evaluation during distraction osteogenesis].** *Chir Narzadow Ruchu Ortop Pol* 2005; 70:127–130. Methods to evaluate the bony regenerate during lengthening can be divided into those that involve radiography and those that do not. Methods can also be divided into descriptive and quantitative. Radiologic examination remains the basic evaluation method, with others being supplementary. The future is in quantitative radiography. Classic x-ray pictures made in reproducible conditions may be subjected to digital quantitative image analysis for more precise evaluation of new bone formation in distraction osteogenesis.

Unal VS, Ozlu K, Demirel M, Girgin O. **Lengthening procedures of small bones of foot and foot stump.** *Acta Orthop Belg* 2005; 71:321–327. Twelve cases of lengthening of the small bones of the foot were performed to improve push off and foot resilience. Foot length discrepancies were proximal to the metatarsals. Results were satisfactory.

Watanabe K, Tsuchiya H, Sakurakichi K, Yamamoto N, Kabata T, Tomita K. **Tibial lengthening over an intramedullary nail.** *J Orthop Sci* 2005; 10:480–485. Thirteen tibial lengthenings (8 patients) over a nail were compared to 17 standard tibial lengthenings (16 patients) using an external fixator alone. Patients with previous bone infections, open fractures, immature bones, or severe angular deformity were excluded. The mean external fixation time differed significantly between the two groups, but the consolidation index did not. Callus formation was satisfactory in both groups, but complications related to the external fixator were far fewer in the lengthening over nail group.

Yamada N, Yasuda Y, Hashimoto N, et al. **Use of internal callus distraction in the treatment of congenital brachymetatarsia.** *Br J Plast Surg* 2005; 58:1014–1019. Authors present a case report of bilateral congenital brachymetatarsia treated with osteotomy and bone lengthening using the internal distraction technique.

Nonunions

Baumgart R, Hinterwimmer S, Kettler M, et al. **[Central bone transport system optimizes reconstruction of bone defects Results of 40 treatments].** *Unfallchirurg* 2005; 108:1011–1021. See “Infections.”

Borus TA, Yian EH, Karunakar MA. **A case series and review of salvage surgery for refractory humeral shaft nonunion following two or more prior surgical procedures.** *Iowa Orthop J* 2005; 25:194–199. Authors report use of a rigid 4.5 mm compression plating with a minimum of 8 cortices of fixation proximal and distal to the nonunion site and autologous bone grafting for refractory humeral nonunions following one or more initial failed nonunion interventions in seven patients. All healed within six months. Although Ilizarov treatment and allograft cortical strut augmentation have been described, authors' protocol is less complex and can result in successful salvage of resistant humeral nonunions.

Giannoudis PV, Tzioupis C. **Clinical applications of BMP-7. The UK perspective.** *Injury* 2005; 36 Suppl 3:S47–50. The efficacy of BMP-7 was evaluated in persistent nonunions, augmentation of periprosthetic fracture treatment and osteotomies, enhancement of fracture healing following acetabular reconstruction, distraction osteogenesis, free fibular graft, and joint arthrodesis. Overall success rate in 535 cases was 82% with no local or systemic adverse effects.

Research

Eckardt H, Lind M, Christensen KS, Hansen ES, Hvid I. **Mid-tibial distraction osteogenesis redistributes bone blood flow: a microsphere study in rabbits.** *Acta Orthop* 2005; 76:459–464. The tibiae of 8 rabbits were lengthened 10 mm by mid-tibial distraction osteogenesis, and the regional blood flow of the tibia was quantified with radioactive microspheres. The absolute blood flow of the distracted tibiae was 4% lower than the non-distracted side. There was decreased blood flow to the metaphyseal and epiphyseal region but an increase in the diaphysis. Mid-tibial distraction osteogenesis redistributed the blood flow to the distracted tibia, but the absolute tibial blood flow did not increase.

Filipiak J, Morasiewicz L. **[Biomechanical properties of external Ilizarov fixator with hybrid implants system].** *Chir Narzadow Ruchu Ortop Pol* 2005; 70:49–56. Authors measured stability of an Ilizarov frame with Kirschner wires or Schanz screws mounted on a pipe section to simulate a femur. The Ilizarov fixator's rigidity (particularly transverse rigidity) can be considerably increased by replacing the Kirschner wires with the Schanz screws or using hybrid systems of these implants.

Research

Fitzpatrick DC, Sommers MB, Kam BC, et al. **Knee stability after articulated external fixation.** *Am J Sports Med* 2005; 33:1735–1741. Monolateral and bilateral articulated external fixators were applied to 7 cadaveric knee specimens. Instrumented forces were applied to the tibias to measure displacement in the intact and the cruciate-deficient knees with and without external fixation. Application of the monolateral fixator significantly reduced cruciate ligament forces, and, in the cruciate-deficient knee, significantly reduced tibiofemoral translation. There was no significant difference between monolateral and bilateral fixation. Articulated external fixators can reduce stress in the cruciate ligaments after multiligament reconstructions and can decrease anteroposterior translation on the cruciate-deficient knee.

Jones KB, Inoue N, Tis JE, McCarthy EF, McHale KA, Chao EY. **Quantification of the microstructural anisotropy of distraction osteogenesis in the rabbit tibia.** *Iowa Orthop J* 2005; 25:118–122. Sixteen rabbits underwent mid-tibia lengthening. Fast Fourier Transform analysis of digitized micrographs of 12 regions of the regenerate was performed. The microstructure of the regenerate callus demonstrated an angle of orientation that uniformly matched the cortical bone in all regions of the callus and an intensity of orientation which approached that of cortical bone.

Kajiwara R, Ishida O, Kawasaki K, Adachi N, Yasunaga Y, Ochi M. **Effective repair of a fresh osteochondral defect in the rabbit knee joint by articulated joint distraction following subchondral drilling.** *J Orthop Res* 2005; 23:909–915. Full thickness osteochondral defects were created in the weightbearing region of the medial femoral condyles in adult rabbits. Experimental group was treated with a pair of articulated external fixators and 1.5 mm distraction; controls had no apparatus. A combination of subchondral drilling, joint motion and distraction by an articulated external fixator promoted repair of a fresh osteochondral defect in the weightbearing area. Although distraction for four weeks was not a long enough period to repair the defect, distraction for 8 and 12 weeks resulted in a good outcome.

Kessler P, Neukam FW, Wiltfang J. **Effects of distraction forces and frequency of distraction on bony regeneration.** *Br J Oral Maxillofac Surg* 2005; 43:392–398. Mandibles of pigs were lengthened by either continuous or intermittent distraction after osteotomies. Continuous distraction resulted in intramembranous regeneration of bone, whereas intermittent distraction caused chondroid ossification. Continuous osteodistraction caused speedier regeneration, and distraction forces were lower than with intermittent distraction.

Koo TK, Chao EY, Mak AF. **Development and validation of a new approach for computer-aided long bone fracture reduction using unilateral external fixator.** *J Biomech* 2005; Epub July 25. Authors developed a unilateral external fixator to perform fracture reduction based on the residual translations, displacements, and angulations. The reliability and accuracy were validated on plastic tibial models. Fracture reduction can be performed off-site, minimizing disruption of periosteum and soft tissue and reducing radiation exposure.

Korkmaz M, Ozturk H, Bulut O, et al. **[The effect of definitive continuous distraction employed with the Ilizarov type external fixation system on fracture healing: an experimental rabbit model].** *Acta Orthop Traumatol Turc* 2005; 39:247–257. Fifteen mature rabbits underwent tibial osteotomies and fixation with an Ilizarov external fixator. Controls underwent no distraction; experimental groups underwent definitive continuous distraction (DCD) amounting to 10% and 30% of body weight via a spring system. Radiographic and histologic analyses showed the best fracture healing in the group undergoing DCD of 10% body weight, with poorer healing in the group undergoing DCD of 30% of body weight when compared to the controls.

Mark H, Rydevik B. **Torsional stiffness in healing fractures: influence of ossification: an experimental study in rats.** *Acta Orthop* 2005; 76:428–433. Stiffness of rat femur fractures was measured. One group had 0 mm fracture gap, corresponding to an axial stiffness of 265 N/mm. The other group had a 2 mm gap, corresponding to an axial stiffness of 30 N/mm. The group with no fracture gap had greater torsional stiffness during healing. The contralateral unfractured femur in the rats with delayed healing (group 2) had increased torsional stiffness, possibly indicating a response to loading conditions or a systemic stimulation of bone mass.

Muhonen A, Saamanen AM, Peltomaki T, Happonen RP. **The effect of irradiation and hyperbaric oxygenation (HBO) on extracellular matrix of the condylar cartilage after mandibular distraction osteogenesis in the rabbit.** *Int J Oral Maxillofac Surg* 2005; 35:79–87. The effects of irradiation and hyperbaric oxygen (HBO) on the articular cartilage after mandibular distraction was investigated. Groups included control, high and low dose irradiation with HBO, and high and low dose irradiation without HBO. Proteoglycan distribution, collagen I and II, and fibrillar network structure were evaluated. Irradiation in conjunction with the pressure applied by distraction causes severe damage to extracellular matrix of condylar cartilage in the high and low dose irradiation subject, not prevented by HBO.

Neuhoff D, Thompson RE, Frauchiger VM, Ganser A, Steiner A, Ito K. **Anodic Plasma Chemical treatment of titanium Schanz screws reduces pin loosening.** *J Orthop Trauma* 2005; 19:543–550. Adult sheep tibia osteotomies were stabilized with an external fixator and 4 Schanz screws. Group 1 was treated with Schanz screws treated with Anodic Plasma Chemical calcium-phosphate (APC-CaP) titanium (Ti) pins; group 2 with anodized Ti pins. There was a trend for fewer infections in group 1 at 6 weeks ($p = 0.056$), but the difference diminished with time. Extraction torque was greater in group 1. There was no difference in tibial healing.

Nielsen JK, Saltzman CL, Brown TD. **Determination of ankle external fixation stiffness by expedited interactive finite element analysis.** *J Orthop Res* 2005; 23:1321–1328. Finite element analysis was used to investigate variables affecting an Ilizarov frame used for ankle distraction. Factors contributing most strongly to the stiffening of the construct included use of tibial half-pins instead of wires, placing the tibia closer to the fixator rings, and mounting the pins to the rings at the nearest circumferential location to the bone. Benchtop mechanical validation results were similar to the finite element computations.

Research

Nunotani Y, Abe M, Shirai H, Otsuka H. **Efficacy of rhBMP-2 during distraction osteogenesis.** *J Orthop Sci* 2005; 10:529–533. BMP-2 was inserted into femoral lengthening sites of rabbits via a polymer-coated gelatin sponge. Lengthening sites underwent histologic examination; femurs underwent biomechanical testing. The BMP-treated femora exhibited the highest values for both torsional strength and stiffness, thicker cortices, and better marrow cavity formation. The efficacy of BMP-2 in distraction osteogenesis was recognized radiographically, histologically, and by mechanical testing (torsional strength and stiffness).

Ohashi S, Ohnishi I, Kageyama T, Fukuda S, Tsuchiya A, et al. **Effect of vascularity on canine distracted tibial callus consolidation.** *Clin Orthop Relat Res* 2005; 438:253–259. Eight adult beagle dogs underwent tibial lengthening for 30 days and a consolidation period of 60 days. Just before euthanasia, blood vessels were perfused with BaSO₄. Bone mineral density correlated with higher blood vessel volume density.

Papadonikolakis A, Shen J, Garrett JP, et al. **The effect of increasing distraction on digital motion after external fixation of the wrist.** *J Hand Surg [Am]* 2005; 30:773–779. Authors investigated the hypothesis that wrist distraction, as may occur in external fixation of the wrist, is an etiology of digital stiffness. Cadaveric forearms were distracted sequentially and the flexor digitorum superficialis (FDS) was pulled until 90° flexion at the MCP joint was generated. Load cells recorded the force applied to the tendon. There was a significant difference in the effect of distraction of the individual fingers. For the index finger, the load required to the FDS to produce 90° of flexion at the MCP joint was increased linearly between 0 and 8 mm distraction with as little as 2mm of wrist distraction increasing the load for flexion at the MCP joint. For the other fingers, a significant increase in the load was noticed after 5 mm of wrist distraction.

Renard AJ, Schutte BG, Verdonschot N, van Kampen A. **The Ilizarov external fixator: What remains of the wire pretension after dynamic loading?** *Clin Biomech (Bristol, Avon)* 2005; 20:1126–1130. A single tensioned wire on a ring was loaded with different torques on the wire fixation bolt. A quick decrease in wire tension to a steady state situation was seen. In the most stable configuration (20 N mm wire fixation torque), 50% of the initial 90 K wire pretension remained after dynamic loading with 200 N. In the least stable configuration (10 N m wire fixation torque), considerable wire slippage occurred even without loading and no tension remained after loading. No plastic deformation of the wires occurred, so loss of wire tension was due entirely to wire slippage through the bolt. Further research should address the question whether preservation of a higher wire tension during long-term loading promotes faster fracture healing.

Sabharwal S, Harten RD, Sabatino C, et al. **Selective soft tissue release preserves growth plate architecture during limb lengthening.** *J Pediatr Orthop* 2005; 25:617–622. Authors studied growth inhibition of the tibia following tibial lengthening. Eight 21-week-old rabbits underwent 40% lengthening with the contralateral side as the control. The rabbits were divided into Achilles tendon release and non-release groups. Radiographs and histomorphometric analysis of the proximal tibial growth plate was performed 5 and 10 weeks after distraction. The corrected length of tibias without tenotomy was significantly shorter than the contralateral controls, whereas those with tenotomy were statistically equivalent to the contralateral controls. Histologically, the operated limbs without tenotomy showed a significant decrease and loss of cellular architecture of the proximal tibial physis, compared to the tenotomy group, which were near normal. In this model, concomitant Achilles tendon lengthening performed with 40% tibial lengthening preserves the proximal tibial physis.

Schleip R, Naylor IL, Ursu D, et al. **Passive muscle stiffness may be influenced by active contractility of intramuscular connective tissue.** *Med Hypotheses* 2005; 66:66–71. Authors hypothesize that intramuscular connective tissue (the perimysium) may be capable of active contraction and consequently influence passive muscle stiffness. Support for this hypothesis is partly based on the pronounced increase of the perimysium in muscle immobilization and in distraction osteogenesis, which adapts to mechanical stimulation and hence influences passive muscle stiffness. Methods for testing this concept are suggested.

Shao Z, Liu B, Liu Y, Liu W, Liu R, Peng Q, Liu L. **Distraction osteogenesis in the irradiated rabbit mandible.** *Br J Plast Surg* 2005; Epub Aug 3. Mandibular distraction in six rabbits was performed. One side was radiated; the contralateral side was not radiated and served as the control. After 8 days distraction and 6 weeks consolidation, the irradiated group had no significantly lower BMD than the controls. No difference was found between the percent area of new bone in both groups. New bone was more mature and organized in the controls. Larger chondroid islands were more numerous in the radiated group.

Thraikill KM, Liu L, Wahl EC, et al. **Bone formation is impaired in a model of type I diabetes.** *Diabetes* 2005; 54:2875–2881. Diabetic mice underwent tibial lengthening for 14 days. Diabetic mice received treatment with insulin, vehicle, or no treatment. Total new bone in the gap was reduced in the diabetic mice compared to the nondiabetic mice but preserved with insulin administration. Mechanical properties, cortical thickness, and endosteal perimeter was impaired in diabetic mice but normalized with insulin treatment.

Tsuchiya H, Sakurakichi K, Yamashiro T, Watanabe K, Inoue Y, Yamamoto N, Tomita K. **Bone transport with frozen devitalized bone: an experimental study using rabbits and a clinical application.** *J Orthop Sci* 2004; 9:619–624. Authors treated 1.5 cm segmental defect in adult rabbits. A transport segment was devitalized in liquid nitrogen and then reinserted for transport at 1 mm/day. Docking sites healed, and transport segments underwent revascularization. A case in a 13-year-old girl with osteofibrous dysplasia was treated in a similar manner.

Research

Vijayakumar V, Marks L, Bremmer-Smith A, Hardy J, Gardner T. **Load transmission through a healing tibial fracture.** *Clin Biomech (Bristol, Avon)* 2005; 21:49–53. Using computed tomography images, force plate data and recorded 3D interfragmentary micromovements, accurate 3D finite element models of a healing human tibial fracture were generated at 7, 10, and 16 weeks post fracture and used to calculate longitudinal tibial forces and external fixator load-sharing during bilateral stance and walking. Tibial load-sharing by the fixator decreased significantly as the fracture tissues developed even moderate stiffness, while tibial load increased steadily toward normal. Quantitative assessment of the contribution of the external fixator is important as overloading of the callus due to insufficient support has been implicated in the retardation of the healing process.

Wahl EC, Perrien DS, Aronson J, et al. **Ethanol-induced inhibition of bone formation in a rat model of distraction osteogenesis: a role for the tumor necrosis factor signaling axis.** *Alcohol Clin Exp Res* 2005; 29:1466–1472. Chronic ethanol exposure inhibits rapid bone formation during distraction osteogenesis. The osteoinhibitory effects of ETOH exposure were partially blocked by antagonists to tumor necrosis factor alpha in rats undergoing tibial lengthening. Antagonists to cytokines interleukin-1 beta did not prevent ethanol-induced bone inhibition.

Watson MA, Mathias KJ, Ashcroft GP, et al. **Wire tension in the Ilizarov system: accuracy of the wire-tensioning device.** *Proc Inst Mech Eng [H]* 2005; 219:355–359. Five subjects tested three Ilizarov wire tensioners. There were significant differences between the results for different subjects and different instruments, but not for different settings or between two settings. Overall, mean measured tensions were 4.9% below intended value. Tensions obtained at the maximum edge (completely occluded) on the scale markings were significantly closer to the nominal values (mean discrepancy 3.6%) than those at the lower edge (mean discrepancy 17.6%). Tensioning devices are not identical, and results depend on the user. The discrepancy between the intended and actual tensions of around 5% is likely to be adequate for clinical practice since surgeons do not select the most suitable tension following quantitative data assessment but rather it is a subjective judgment.

Weiss S, Zimmermann G, Baumgart R, et al. **Systemic regulation of angiogenesis and matrix degradation in bone regeneration-distraction osteogenesis compared to a rigid fracture healing.** *Bone* 2005; 37:781–790. Serum samples from 10 patients undergoing lower limb lengthening were compared to 10 osteotomy patients undergoing elective axis correction to investigate systemic biochemical regulation mechanisms of bone regeneration by angiogenic and matrix-degrading enzymes. Bone regeneration in distraction osteogenesis and rigid osteotomy is accompanied by systemic increase of matrix-degrading and angiogenic factors in a certain time course and quantity. This may reflect biochemical regulation of local bone healing in the circulation. ProMMP-1, VEGF and TIMP-1 seem to be regulatory factors during distraction osteogenesis.

Trauma - Lower Extremity

Bardenheuer M, Philipp T, Obertacke U. **[Treatment results after primary management of severely dislocated ankle fractures with external fixation and subsequent internal osteosynthesis].** *Unfallchirurg* 2005; 108:728–736. Twenty-five patients (age 18–84) with severely displaced ankle fractures were treated with external fixation as the primary method. Between two and five operations were necessary 4–27 days after injury. There was an average loss of 12.4 degrees plantar flexion. When compared to other prospective studies and the authors' random series, initial external fixation seems to be justified and leads to acceptable results.

Burkhardt M, Culemann U, Seekamp A, Pohlemann T. **[Strategies for surgical treatment of multiple trauma including pelvic fracture Review of the literature].** *Unfallchirurg* 2005; 108:812–820. Authors review clinical trials in the literature and classify them into evidence levels and conclude that there is a consensus that emergency stabilization of the pelvic ring as the most important goal within the acute period to control bleeding, at least with extraperitoneal tamponade if necessary, utilizing external fixation or pelvic C-clamps. Once the hemorrhage has been stopped, the late and definitive internal fracture stabilization of the pelvis should be performed based on the fracture pattern.

Charalambous CP, Alvi F, Siddique I, et al. **Casting versus surgical fixation for grade IIIA open tibial diaphyseal fractures in children: effect on the rate of infection and the need for secondary surgical procedures to promote bone union.** *Int Orthop* 2005; 29:392–395. Authors review 39 grade IIIA open tibial fractures in children less than 13 years old to determine relationship between treatment method and the infection rate and the need for further surgery to promote union. Thirty had casting; nine underwent internal or external fixation. There were two infections in the casting group and two in the surgical stabilization group. None required further surgery to achieve union. Results suggest that manipulation and casting is a reliable treatment for open tibial fractures in children.

Clasper JC, Phillips SL. **Early failure of external fixation in the management of war injuries.** *J R Army Med Corps* 2005; 151:81–86. Fifteen external fixators were applied to 14 patients for war injuries during the 2003 Gulf Conflict. 87% required early revision or removal due to complications. Instability was a problem in 67%. There were 14 pin site infections in 3 fixators which failed to resolve despite IV antibiotics. Authors advise against the universal use of external fixation. If used, consideration must be given to the optimum time for frame application (at the initial debridement or later), the optimal frame design, and pin site care.

Distractions thanks Dan O'Connor, Ph.D., of the Joe W. King Orthopedic Institute for his assistance with obtaining these articles and abstracts.

Trauma – Lower Extremity

Dwyer AJ, Paul R, Mam MK, Kumar A, Gosselin RA. **Floating knee injuries: long-term results of four treatment methods.** *Int Orthop* 2005; 29:314–318. Sixty patients with floating knee injuries were reviewed at an average follow up of 7.2 years. Nonoperative, operative (external fixation and intramedullary nailing), and combined modalities were compared. Based on union rates, return to normal activities, and long-term functional results, authors recommend intramedullary nailing and combined treatments. External fixation of the fractured femur resulted in quadriceps fixation. Fractured tibia, treated by any method, did not interfere with patients' joint mobilization whereas associated injuries did.

Egol KA, Tejwani NC, Capla EL, et al. **Staged management of high-energy proximal tibia fractures (OTA types 41): the results of a prospective, standardized protocol.** *J Orthop Trauma* 2005; 19:448–455; discussion 456. Fifth–three patients with 57 high-energy tibial plateau fractures were treated with temporary knee spanning external fixation, followed by conversion to plate and screw constructs or to a ring fixator. Complications included deep wound infections (5%) and nonunions (4%). One downside may be residual knee stiffness, but benefits include osseous stabilization, access to soft tissues, and prevention of further articular damage. This study supports the practice of delayed internal fixation until the soft-tissue envelope allows for definitive fixation.

Emara KM, Allam MF. **Management of calcaneal fracture using the Ilizarov technique.** *Clin Orthop Relat Res* 2005; 439:215–220. Twelve patients with Sanders type 3 calcaneal fractures with poor skin conditions were unsuitable for ORIF. Instead, they were treated with open reduction of the subtalar and calcaneocuboid joint surfaces, direct bone grafting via the subtalar joint, and Ilizarov fixation of the calcaneal tuberosity. Results were compared to a control group that underwent ORIF. Both groups had similar functional and radiographic outcomes, but the internal fixation group had a higher complication rate. The Ilizarov method is a safe and effective alternative to ORIF in the presence of poor skin conditions.

Gansslen A, Pohlemann T, Krettek C. **[Supraacetabular external fixation for pelvic ring fractures].** *Oper Orthop Traumatol* 2005; 17:296–312. Retrospective review of 64 unstable type B and type C pelvic ring fractures treated with supraacetabular external fixation. There was one pseudarthrosis of the pubic and ischial rami but no pin infections or secondary displacement of the fractures.

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Gaston P, Will EM, Keating JF. **Recovery of knee function following fracture of the tibial plateau.** *J Bone Joint Surg Br* 2005; 87:1233–1236. Prospective study measured functional outcomes of tibial plateau fractures in 63 consecutive patients. The uninjured opposite knee was used as the control. Mean age was 45 (range 16–81) years. Fifty–one were treated with internal fixation, 5 by combined internal and external fixation, and 7 nonoperatively (hinged knee brace and non-weight bearing). At one year, 21% had a residual flexion contracture. Only 14% achieved normal quadriceps strength at one year, whereas 30% achieved normal hamstring strength. Recovery was slower in patients older than 40 years. Authors conclude there is significant impairment of movement and muscle function after fracture of the tibial plateau, and the majority of patients have not fully recovered one year after injury.

Kubiak EN, Egol KA, Scher D, Wasserman B, Feldman D, Koval KJ. **Operative treatment of tibial fractures in children: are elastic stable intramedullary nails an improvement over external fixation?** *J Bone Joint Surg Am* 2005; 87:1761–1768. Nonrandomized retrospective review, comparing 16 tibia fractures treated with elastic intramedullary nails to 15 tibia fractures treated with external fixation. All patients had open physes. Of the 16 fractures treated with EIN, 11 were closed, 5 were open. Of the 15 treated with external fixation, 7 were closed, 8 were open. Outcomes were evaluated with the PODCI and the occurrence of complications. Mean time to union was significantly shorter in the EIN group. Functional outcomes were significantly better, and complications (delayed union, malunion, nonunion) occurred in the external fixation group but not in the EIN group.

Mashru RP, Herman MJ, Pizzutillo PD. **Tibial shaft fractures in children and adolescents.** *J Am Acad Orthop Surg* 2005; 13:345–352. Treatment options, complications, and related clinical entities for tibial shaft fractures in children and adolescents are presented. External fixation is most commonly used to stabilize severely comminuted and unstable tibial fractures and those associated with severe soft tissue, head, or multisystem injuries. External fixation may be augmented with limited internal fixation.

Papagelopoulos PJ, Partsinevelow AA, Themistocleous GS, et al. **Complications after tibial plateau fracture surgery.** *Injury* 2005; Epub Aug 20. Treatment options include internal and external fixation, hybrid fixation, and arthroscopically assisted techniques. Serious complications, including knee stiffness, ankylosis, deep infection, post-traumatic arthritis, malunion, and nonunion, may occur.

Patzakis MJ, Zalavras CG. **Chronic posttraumatic osteomyelitis and infected nonunion of the tibia: current management concepts.** *J Am Acad Orthop Surg* 2005; 13:417–427. See “Infections.”

Trauma – Lower Extremity

Rammelt S, Biewener A, Grass R, Zwipp H. **[Foot injuries in the polytraumatized patient]**. *Unfallchirurg* 2005; 108:858–865. Foot injuries in the polytraumatized patient are not critical for survival but for the later quality of life. Emergent reduction of the fracture dislocations via direct approaches and temporary transfixation with K-wires should be attempted as the first step wherever possible. Additional external fixation facilitates wound care and prevents soft tissue contractures until definite internal fixation becomes feasible.

Rao H. **A complete dislocation of the calcaneus: a case report**. *J Foot Ankle Surg* 2005; 44:401–405. A 40-year-old man sustained an open dislocation of the calcaneus from the cuboid and talus with subluxation of the talonavicular joint. Immediate reduction with K-wires and an external fixator was performed. At two years, the functional result was satisfactory, with no evidence of infection or avascular necrosis. This case illustrated that the diagnosis of concomitant injuries in the adjacent column of the foot and compliance with the principles of management of multiple injuries in the midfoot are paramount in reducing morbidity in these injuries.

Sabharwal S. **Role of Ilizarov external fixator in the management of proximal/distal metadiaphyseal pediatric femur fractures**. *J Orthop Trauma* 2005; 19:563–569. Five proximal and 5 distal metadiaphyseal fractures of the femur were treated with a low profile Ilizarov fixator in 10 skeletally immature males. Ages ranged from 7+5 to 15+10 years. Time in the fixator averaged 138 (range 104–180) days. There were no cases of loss of reduction, refracture, or permanent loss of hip or knee mobility. At follow up, there was no significant mechanical axis deviation, knee joint malorientation, malrotation, or leg length discrepancy > 1 cm. One case of transient foot drop resolved; this case was the only patient whose femoral fixator extended to the tibia.

Xiao R, Tang Q, Cai C. **[Treatments of tibial pilon fractures with a combination of limited internal fixation and external fixation]**. *Zhongguo Xiu Fu Chong Jian Wai Ke Zu Zhi* 2005; 19:603–606. Authors compare 20 patients with tibial pilon fractures treated with external fixation and limited open reduction to 22 pilon fractures treated with other methods. The clinical outcomes and radiologic outcomes were slightly but insignificantly better in the external fixation and limited internal fixation group. There were significantly fewer complications in the external fixation and limited open reduction group, especially soft tissue complications and juxta-articular bone collapse.

Trauma – Upper Extremity

Arora J, Malik AC. **External fixation in comminuted, displaced intra-articular fractures of the distal radius: is it sufficient?** *Arch Orthop Trauma Surg* 2005; 125:536–540. External fixation was used to treat 27 patients with displaced intraarticular fractures of the distal radius. At 2-year follow up, there was a positive correlation between the restoration of normal anatomy (radiological results) and the functional outcome. Authors conclude that external fixation is inadequate in restoring articular congruity in many cases. Complications are frequent and may be serious.

Babu VL, Baskaran K, Kocalkowski A. **External fixation of finger fractures made simple**. *Acta Orthop Belg* 2005; 71:347–348. Authors present a simple method for treatment of comminuted and open phalangeal fractures of the hand, using readily available K-wires and needle sheaths.

Bindra RR. **Biomechanics and biology of external fixation of distal radius fractures**. *Hand Clin* 2005; 21:363–373. External fixation combined with ligamentotaxis can be used effectively to reduce difficult distal radius fractures. Overdistraction and prolonged traction can be harmful. Certain types of fractures do not respond to ligamentotaxis alone and require adjunctive treatment, such as limited internal fixation. A single K-wire significantly increases the stability of fixation and should be considered in all cases.

Blum J, Gercek E, Hansen M, Rommens PM. **[Operative strategies in the treatment of upper limb fractures in polytraumatized patients]**. *Unfallchirurg* 2005; 108:843–849. Authors recommend treatments for upper extremity fractures in polytraumatized patients. External fixation is recommended for distal radius multifragmentary fractures and grade III open fractures of the upper extremity long bones.

Gradl G, Jupiter JB, Gierer P, Mittlmeier T. **Fractures of the distal radius treated with a nonbridging external fixation technique using multiplanar K-wires**. *J Hand Surg [Am]* 2005; 30:960–968. Twenty-five consecutive patients with fractures of the distal radius were treated with nonbridging external fixation for 6 weeks. A preliminary joint-bridging construct was used for reduction purposes, followed by insertion of 3 or 4 K-wires in the distal fragment, assembling of wires to a bar, and lastly the removal of the joint bridging component. Follow up was performed 1 day, 7 days, 6 weeks, and 2 years after surgery. Palmar tilt and articular stepoff < 2mm was restored in all patients. Loss of radial length occurred in 4 patients with 3 K-wire fixation. All fractures united. Average extension = 55°; average flexion = 64°. Authors conclude nonbridging external fixation is a good treatment option for distal radius fractures. It permits wrist motion. Four K-wires should be used.

Grewal R, Perey B, Wilkink M, Stothers K. **A randomized prospective study on the treatment of intra-articular distal radius fractures: open reduction and internal fixation with dorsal plating versus mini open reduction, percutaneous fixation, and external fixation**. *J Hand Surg [Am]* 2005; 30:764–772. Randomized prospective study was done to compare ORIF with dorsal plating vs. mini open reduction, percutaneous K-wires, and external fixation. All patients had AO type C patterns and were 70 years or less in age. Minimum follow up was 6 months; average follow up was 18 months. Functional and radiographic outcomes, complications, and tourniquet times were compared. The dorsal plate group had significantly longer tourniquet times and higher pain levels at one year, equalized by plate removal. The external fixator group had greater grip strength when compared to the contralateral uninjured side. Because of these results, enrollment in the study was terminated. The authors cannot recommend dorsal plates for complex intraarticular distal radius fractures.

Trauma – Upper Extremity

Guofen C, Doi K, Hattori Y, Kitajima I. **Arthroscopically assisted reduction and immobilization of intraarticular fracture of the distal end of the radius: several options of reduction and immobilization.** *Tech Hand Up Extrem Surg* 2005; 9:84–90. Ninety-one patients with intraarticular 2-, 3-, and 4-part fractures of the distal radius were treated with arthroscopy with the purpose of achieving < 1 mm reduction. Fixation methods included ORIF, external fixation combined with K-wire or plate combined with pullout wire or screw, or a single K-wire or screw.

Li ZZ, Hou SX, Wu KJ, Zhang WJ, Li WF, Shang WL, Wu WW. **Unilateral external fixator in the treatment of lower third humeral shaft fractures.** *Clin J Traumatol* 2005; 8:230–235. Thirty-three patients with a mean age of 31 (range 15–70) years underwent unilateral external fixation for fractures of the distal humerus. There were 9 spiral, 1 oblique, 3 transverse, and 20 comminuted (11 B1, 9 B2) fractures. Time to healing averaged 14 (range 11–22) weeks. Fifteen were treated with open reduction, limited internal fixation, and external fixation; 10 were treated with open reduction and external fixation; and 8 were treated with closed reduction and external fixation. All preoperative radial nerve palsy (9) and postoperative loss of elbow motion (2) resolved.

McAuliffe JA. **Combined internal and external fixation of distal radius fractures.** *Hand Clin* 2005; 21:395–406. Combined internal and external fixation of distal radius fractures is used most commonly to treat injuries with joint surface or metaphyseal comminution. External fixation aids reduction intraoperatively and facilitates arthroscopic, percutaneous, or open manipulation of the fracture. Internal fixation maintains precise reduction of critical anatomy, principally the contour and orientation of the articular surface. Postoperatively the fixator functions as a neutralization device, preventing fracture collapse and decreasing the biomechanical demands on the internal fixation hardware. The combined technique exploits the benefits of both forms of fixation, allowing each to be used to full advantage in the treatment of complex distal radius fractures.

McQueen MM. **Non-spanning external fixation of the distal radius.** *Hand Clin* 2005; 21:375–380. Non-spanning external fixation of the distal radius is a simple, reliable, and noninvasive technique to restore the anatomy in unstable extra-articular or minimal articular fractures of the distal radius. Rehabilitation is faster and more complete than with other comparable techniques. It is also a successful technique for stabilization of corrective osteotomy of the distal radius formal union.

Micic ID, Mitkovic MB, Mladenovic DS. **Unreduced chronic dislocation of the humeral head with ipsilateral humeral shaft fractures: a case report.** *J Orthop Trauma* 2005; 19:578–581. An 18-year-old female sustained multisystem trauma in a MVA. She sustained a humeral shaft fracture and an anterior subcoracoid humeral head dislocation. At 45 days a shoulder x-ray revealed the previously missed dislocation. The fracture and dislocation were reduced and stabilized with an external fixator, consisting of 2 pins above and 2 pins below the fracture and a pin through the humeral head into the glenoid. At 3 year follow up, reduction and ROM were normal.

Muzaffar AR, Chao JJ, Freidrich JB. **Posttraumatic thumb reconstruction.** *Plast Reconstr Surg* 2005; 116:103e–122e. Thumb reconstruction options are discussed. Distraction lengthening of the first metacarpal can provide up to 3 cm of length without complex microsurgical methods.

Ruch DS, Lumsden BC, Papadonikolakis A. **Distal radius fractures: a comparison of tension band wiring versus ulnar outrigger external fixation for the management of distal radioulnar instability.** *J Hand Surg [Am]* 2005; 30:969–977. This study compares two treatment techniques for 35 distal radius fractures, fracture of the base of the ulnar styloid, and unstable distal radioulnar joint. All patients had associated ulnar styloid displacement > 2 mm. Group 1 was treated with tension band wiring of the distal ulnar styloid. Group 2 was treated with external fixation with a supplemental outrigger from the external fixator to the ulnar styloid, locking the forearm in 60° supination. The functional outcomes measurements were similar in the two groups, but group 2 had lower rate of complications, fewer secondary procedures, and better supination.

Slutsky DJ. **Nonbridging external fixation of intra-articular distal radius fractures.** *Hand Clin* 2005; 21:381–394. Multicenter clinical trials are necessary to determine if the superior results obtained with nonbridging fixation of extra-articular distal radius fractures can be duplicated with nonbridging fixation of intraarticular fractures. With further study and new fixation designs, nonbridging fixation of intraarticular distal radius fractures may become another viable treatment options.

Westphal T, Piatek S, Schubert S, Winckler S. **Outcome after surgery of distal radius fractures: no differences between external fixation and ORIF.** *Arch Orthop Trauma Surg* 2005; 125:507–514. Retrospective review comparing external fixation, dorsal plating, and volar plating for 166 distal radius fractures. Functional and radiological outcomes were evaluated. ORIF, especially volar plating, demonstrated the best radiological and functional results. Subjective assessment of ORIF was better than that of external fixation.

Tumor

Baumgart R, Hinterwimmer S, Kettler M, et al. **[Central bone transport system optimizes reconstruction of bone defects Results of 40 treatments].** *Unfallchirurg* 2005; 108:1011–1021. See “Infections.”

Baumgart R, Hinterwimmer S, Krammer M, et al. **The bioexpandable prosthesis: a new perspective after resection of malalignment bone tumors in children.** *J Pediatr Hematol Oncol* 2005; 27:452–455. Authors describe a new concept for treatment of malignant bone tumors in children, combining an endoprosthesis with a fully implantable motorized distraction nail that can be activated in gradual steps to lengthen the remaining bone by callus distraction.

Tumor

Li D, Cui Q, Fan H. [Extendible replacement of the distal femur in the treatment of osteosarcoma in growing individuals]. *Zhongguo Xiu Fu Chong Jian Wai Ke Zu Zhi* 2005; 19:560–562. Two cases of osteosarcoma of the distal femur were treated with an extendible distal femur replacement. After tumor removal, the two femurs were 4–5cm short within 2–3 years. After the lengthening procedure, the affected extremities were equal to the contralateral limb. There was no aseptic lengthening. Joint function was fairly good.

Luna AR, Fahandez–Saddi H, Garcia AV, et al. **Aneurysmal bone cyst in children involving infrequent locations.** Report on two cases. *Chir Organi Mov* 2004; 89:347–352. Two case reports of aneurysmal bone cysts (ABC) in children. One ABC in the talus was successfully treated with curettage and an articulated Orthofix external fixator from the tibia to the calcaneus instead of a cast.

Shirai T, Tsuchiya H, Yamamoto N, Sakurakichi K, Karita M, Tomita K. **Successful management of complications from distraction osteogenesis after osteosarcoma resection: a case report.** *J Orthop Sci* 2004; 9:638–642. Case report of a 15-year-old boy with osteosarcoma of the proximal tibia, treated successfully with marginal excision, chemotherapy, and distraction osteogenesis. Two years later he developed an infection, treated with excision and shortening–distraction with an Ilizarov frame. Four years after the original procedure, he sustained a tibia fracture in a traffic accident and underwent correction of the residual deformity and leg length discrepancy with the Ilizarov technique.

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