METATARSAL BONES LENGTHENING WITH LAKI MINI EXTERNAL FIXATOR

Kirienko Alexander
Peccati Andrea, Portinaro Nicola

Istituto Clinico Humanitas, Milano, Italy
alexander@kirienko.com
Alexander KIRIENKO, MD
Istituto Clinico Humanitas
Italy

FINANCIAL DISCLOSURE

ORTHOFIX - Consultant
Brachymetatarsia is defined as one metatarsal ending 5 mm or more proximal to the parabolic arch of the other adjacent metatarsals. The fourth ray is most frequently affected.
CAUSES

Most common causes of brachymetatarsia are:
- congenital,
- post traumatic,
- post surgical,
- linked to diseases such as:
  - Down Syndrom,
  - Apert Syndrom,
  - Albrights Osteodystrophy,
  - Sickle Cell Anemia,
  - Diastrophic Dwarfism,
  - Turner Syndrom,
  - and Poliomyelitis.
INDICATION

Primary in the form of metatarsal lengthening lies in:
- cosmetic defects or
- complaints of pain
ILIZAROV MINIFIXATOR FOR SHORT TUBULAR BONES

Fixation Module

3/4 Threaded rod

Nuts

Washers

K. wires

Bolts
METHOD

Proximal metaphyseal osteotomy for lengthening the 4° metatarsal.

Simultaneous lengthening of the 3° and 4° metatarsals. A stable half-ring replaces the proximal module with crossed wires in the base of the metatarsals or in the cuboid and cuneiform bones.
Methods

- Bone extremities fixation with 2 modules
- Percutaneous osteotomy
- Distraction after 5 days of surgery
- Early weight bearing
- Initial rate of lengthening of 0.75 mm per day, slowed to 0.5 mm after 2 weeks.
Project of new frame for the hand and foot

- Multiplan Fixation
- More stable
- Small
- Possibility of correction and lengthening
Metal Execution Of The New Minifixator
Different Measures Of The New Minifixator
- semicircular crossed wires fixation
Minimal distance between the wires is 0,3mm
NEW SEMISIRCULAR MINI-FIXATOR
Biomechanical tests Of The New Minifixator
## Result of the Tests Of The New Minifixator

### Axial load

<table>
<thead>
<tr>
<th>Device</th>
<th>Length (mm)</th>
<th>Mean load to failure (N)</th>
<th>Mean final deformity (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>semicircular</td>
<td>16</td>
<td>95,3</td>
<td>0,3</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>90,0</td>
<td>0,4</td>
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<tr>
<td>axial</td>
<td>15</td>
<td>91,0</td>
<td>0,5</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>86,3</td>
<td>1,3</td>
</tr>
</tbody>
</table>

### Flexion load

<table>
<thead>
<tr>
<th>Device</th>
<th>Length (mm)</th>
<th>Mean load to failure (N)</th>
<th>Mean final deformity (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>semicircular</td>
<td>16</td>
<td>30,0</td>
<td>0,2</td>
</tr>
<tr>
<td>axial</td>
<td>14</td>
<td>21,3</td>
<td>1,2</td>
</tr>
</tbody>
</table>
OSTEOSYNTESIS OF THE 2º METACARPAL
SYSTEM FOR LENGTHENING
METHOD

- Introduction of the wires at a moderately oblique angle with respect to the vertical plane.
- The wire tail is folded back on itself in order to make the wires parallel to each other.
- The obliquity of the wires prevents their removal from the bone during distraction.
Axial deviation during lengthening. Correction is obtained by straightening the threaded rod at the end of the lengthening process. Simultaneously, the modules are brought together to avoid undesired distraction on the opposite side of the regenerated bone.
Method

1° METATARSAL LENGTHENING

Stability of the proximal module is achieved by introducing a wire into the medial cuneiform. Then metatarsal-phalangeal joint pinning with a K-wire is performed in order to avoid medial or lateral metatarsal-phalangeal subluxation.
METHOD

- Start of lengthening after waiting period 5-7 days
- Rhythm of lengthening 0.75-0.25 mm per day
- Until the metatarsal heads were lined
ADVANTAGES OF CALLUS DISTRACTION METHOD

No bone grafting
Early weight bearing
Surgical scar is incospicuous
Without compromise the neurovascular structures
Weight bearing with fixator
LIMITATION OF COSMETIC DEFECTS DURING TREATMENT
16 patients (25 metatarsals)
6 male and 10 female
Mean age 19 years (range from 13 to 36)

11 Congenital brachymetatarsia (5 bilateral)
1 Turner syndrome with bilateral shortening of 3°, 4° MT
1 Congenital shortening of 1°
3 Post traumatic shortening of 1°
A 17-YEAR-OLD FEMALE WITH CONGENITAL BILATERAL SHORTENING OF THE FOURTH METATARSAL.

Radiograph before treatment

Clinical photograph before treatment
Radiograph taken during lengthening of the fourth metatarsal on the left foot with the apparatus *in situ*.
Radiograph taken during lengthening of the fourth metatarsal on the right foot. Photos of apparatus.
Radiograph showing the bilateral result of lengthening

Clinical photograph of the result of bilateral lengthening
Female 19 y.o.. Congenital Shortening Of The 2\textsuperscript{nd} Metatarsal Of The Right Foot
A 13-year-old Female With Turner Syndrom And Bilateral Shortening Of The Fourth And Fifth Metatarsal.
Radiograph taken during lengthening of the fourth metatarsal on the left foot
Radiograph taken during lengthening of the fourth metatarsal on the right foot
Radiograph showing the bilateral result of lengthening of 4° and 5° metatarsals

Clinical photograph of the result of bilateral lengthening
12 Y.O. BOY WITH POSTTRAUMATIC DEFECT OF METATARSO PHALANGEAL JOINT
10 DAYS OF DISTRACTION
A 32-year-old male with post traumatic shortening of the first ray of the foot defect of distal part of 1° metatarsal and proximal part of proximal phalax.
Radiograph taken during lengthening of the first metatarsal on the left foot
Radiograph showing the result of lengthening of 1° ray.

Clinical photograph of the result of lengthening.
A woman 40 years. Lengthening of 4° metatarsal of the left foot. Primary diastasis of the bones fragments during surgery.
COMPLICATIONS

Bifocal osteosintesis to solve bone defect of 4° metatarsal. Good proximal lengthening.
Good distal contact and completion of
COMPICATIONS

Osteosynthesis with mini plate
RESULT

Average lengthening 17.5 (range 12-25 mm)
Increase of 36% (range 25-46%)
Healing index 60 days/cm (range 32-101)
THE COMPLICATIONS

- Slight deformity of lengthened metatarsal: 6
- Restriction of sagittal motion at MTP joint: 8
- Subluxation of MTP: 2
- Temporally toe deformity in all patients were observed: 5
- Pin track infection: 5
- Delayed consolidation and pseudoartrosis: 1
- No nerve or vascular damage was seen
CONCLUSIONS

The technique of gradual distraction gives sufficient precision lengthening for forming physiological arch of metatarsals heads and soft tissue modification.

Bone lengthening is effective in patients with short metatarsals not only for cosmetic, but also to relieve pain and callosities on the plantar of the second and third metatarsal heads and prevent secondary deformity of neighbours toes.

Subluxation of metatarsal joint may be prevented by pitting of the toe with longitudinal K-wire.

This method could be recommended as the way of choice for solving the problem of metatarsal shortening.
THANK YOU