Shortening of first metatarsalia after ReveL procedure depends on the osteotomy angle

AF Viehöfer, P Fürnstahl, SH Wirth

University Hospital Balgrist, Zurich, Switzerland
DISCLOSURE

NO CONFLICT TO DISCLOSE

Shortening of first metatarsalia after ReveL procedure depends on the osteotomy angle

AF Viehöfer
P Fünrstahl
SH Wirth
Hallux valgus deformity can lead to transfermetatarsalgia due to an impairment and relative shortening of the first ray. During hallux valgus operation (e.g. ReveL operation) the first metatarsalia (MT I) is osteomized perpendicular to the second ray to shift the distal part laterally. However, this procedure does not correct the relative shortening of the MT I (Figure 1).

Furthermore, an accidentally posterior deviation of the osteotomy angle results in additional iatrogenic shortening of the MT I and might favor postoperative transfermetatarsalgia.
Figure 1: left: shortening ($x_1$) of MT I after ReveL osteotomy perpendicular to second Metatarsalia (MT II), black: MT I with normal intermetatarsal angle (IMA), grey: MT I position in hallux valgus disease (increased IMA), green MT I after ReveL osteotomy
Right: additional shortening ($x_2(\varphi)$) if osteotomy points posterior ($\varphi > 0$)
The aims of this study were to determine the change in length of the MT I after ReveL operation and to investigate the influence of the osteotomy angle on the shortening of the MT I.
A 3-dimensional model of a foot was obtained from CT scans of a cadaveric foot. To simulate double-limbed standing stance the specimen was axially loaded with 350 N in a custom made clamping system during the scan. The MT I of the 3-dimensional model was then pivoted medially (Figure 2) to simulate a severe hallux valgus deformity of an intermetatarsal angle (IMA) of 18° and an intermediate hallux valgus deformity of an IMA of 13°.
MATERIAL AND METHODS

In a second step a ReveL operation was simulated to correct the IMA to 8° for the severe and the intermediate Hallux valgus. Therefore the osteotomy angle in the coronal plane (φ=0) was chosen perpendicular to the axis of the second metatarsalia. Afterwards the length of the MT I was measured. This procedure was repeated for an posterior altered osteotomy angle (φ = 5°, 10°, 15° and 20°).
MATERIAL AND METHODS

Figure 2: model of right MT I (grey), blue cylinder with green axis: axis for rotation to simulate hallux valgus, green head of MT I: displacement after simulated ReveL procedure (osteotomy plane is shown)
RESULTS

The change in MT I length resulting from an osteotomy perpendicular to the axis of MT II was 0.6 mm for a severe hallux valgus (IMA correction from 18° to IMA 8°) and 0.3 mm for a moderate hallux valgus (IMA 13° to IMA 8°).

A posterior deviation of the osteotomy angle led to additional shortening (max. 2.9 mm) with a total shortening of up to 3.5 mm (Figure 3).

To avoid any shortening of MT I an osteotomy slightly pointing anterior (negative φ) of 3.5° (IMA change of 10°) and 3° (IMA change of 5°) was found.
Figure 3: MT I length shortening after ReveL operation for different osteotomy angles $\varphi$. First row: moderate hallux valgus correction: IMA correction of $5^\circ$ (13° to 8°). Second row: severe hallux valgus correction: IMA correction of $10^\circ$ (18° to 8°).
CONCLUSION

ReveL procedure can to a relevant shortening of MT I

To avoid shortening the osteotomy angle should be slightly anterior (3°)

Further studies are needed to investigate the clinical impact of our findings.
