Orthopaedics & Traumatology: Surgery & Research 100S (2014) S395–S399

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Original article

Reducible valgus flat-foot: Assessment of posterior subtalar joint surface displacement by posterior arthroscopy during sinus tarsi expansion screwing

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ARTICLE INFO

Article history:
Accepted 17 September 2014

Keywords:
Flat-foot
Subtalar joint
Arthroscopy
Anatomy

ABSTRACT

Introduction: Subtalar arthroereisis corrects childhood and adult reducible valgus flat-foot in certain indications. Inserting an expansion screw in the sinus tarsi simultaneously corrects the calcaneal valgus of the talocalcaneal divergence and first-ray pronation if these are reducible. The displacement induced in the posterior subtalar joint (decoaptation, translation, rotation) is, however, poorly known. The present study involved arthroscopic assessment of posterior subtalar joint surface displacement during insertion of a talocalcaneal arthroereisis screw, with the hypothesis that displacement varies in three dimensions according to screw size.
Material and method: Eight specimens were used for the study. All ankles were supple, taken from adult subjects. A 4.5-mm arthroscope was used and measurements were taken with a graduated palpator in the posterior subtalar joint. Three sinus tarsi expansion screws of incremental diameter were assessed. Before and after insertion measurements were made of posterolateral and posteromedial talar exposure on the calcaneus, anteroposterior and lateromedial translation, and talocalcaneal joint-line opening.
Results: Medial rotation, varization and anterior translation of the calcaneus were comparable in all cases. Mean lateral opening of the posterior subtalar joint was 0.88 mm with 8-mm screws and 1.25 mm with 16-mm screws. Significant differences between 8 and 16 mm screws were found for lateral subtalar joint opening ($P = 0.028$) and for lateromedial translation ($P = 0.004$).
Conclusion: Sinus tarsi expansion screwing corrects hindfoot valgus and talocalcaneal divergence by inducing medial translation of the calcaneus under the talus and talar medial rotation and varization, proportional to screw size (medial translation and lateral opening of the subtalar joint).
Level of evidence: III.

1. Introduction

Reducible flat-foot in children or in adults may require surgery. Various correction procedures have been described, including subtalar arthroereisis [1–9]. The objective (Fig. 1) is to reduce calcaneal valgus and talocalcaneal divergence [10–12]. The actual 3D displacements induced in the posterior subtalar joint, however, are poorly known:

- is there valgus correction by lateral opening of the talocalcaneal joint?
- what mechanism underlies talocalcaneal divergence correction?

To the best of our knowledge, only Husain et al. [13] and Arangio et al. [14] have studied these relationships. The present study sought to make an arthroscopic assessment of posterior subtalar joint relations following insertion of a sinus tarsi expansion screw by studying the displacement of predefined landmarks. The study hypothesis was that displacements varied in 3 dimensions according to screw size.

2. Material and method

Eight specimens from adult subjects were studied: 4 right and 4 left lower limbs, amputated at the knee. All ankles were supple: reducible calcaneal valgus, absence of equinus, dorsiflexion > 15°, plantar flexion > 30°. The limb was held in a vise in ventral decubitus. A 4-mm arthroscope and 4-mm shaver were

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http://dx.doi.org/10.1016/j.otsr.2014.09.004
1877-0568/

Fig. 1. Intra-operative view of expansion screw positioning in the sinus tarsi.

Fig. 2. Posterior ankle arthroscopy with medial and lateral para-Achilles instrumentation.

used. Measurements were taken using a palpation hook with 0.5-mm graduations, with the foot in neutral flexion-extension.

The posterior subtalar joint was approached by posterior arthroscopy following van Dijk et al. [15], with a posterolateral Achilles and posteromedial instrumental approach (Fig. 2). After subtalar joint exposure and debridement by shaver, posterior talar and calcaneal landmarking was performed by lancet (Fig. 3).

On each talar and calcaneal bone segment, 3 points were landmarked by the lancet tip (Fig. 4):

- most lateral posterior calcaneal (C lat) and talar (T lat) landmark;
- central posterior calcaneal (C cen) and talar (T cen) landmark;
- medial posterior calcaneal (C med) and talar (T med) landmark.

The tibiotalar joint space between the 3 landmarks was measured before screw insertion (Fig. 5).

Three expansion screws of length 16 mm and incremental diameter (8, 14 and 16 mm) were successively used to obtain maximal differential range of motion. A 20-mm skin incision was performed over the sinus tarsi and the screw was inserted into the sinus.

Before and after each screw insertion, the graduated hook (Fig. 6) was used to measure (in mm):

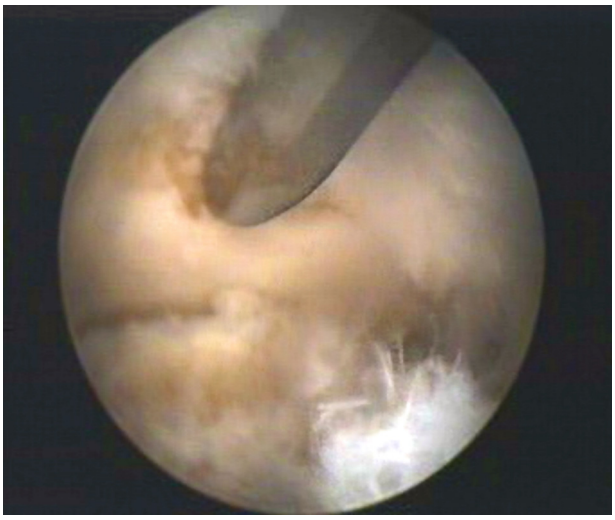

Fig. 3. Arthroscopic view of posterior subtalar joint. Posteromedial talar landmarking.

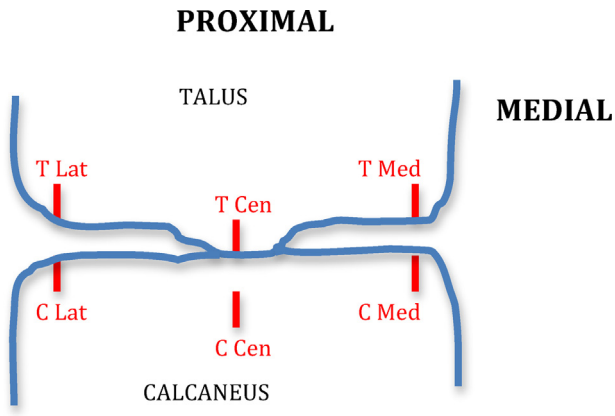

Fig. 4. Posterior arthroscopic view.

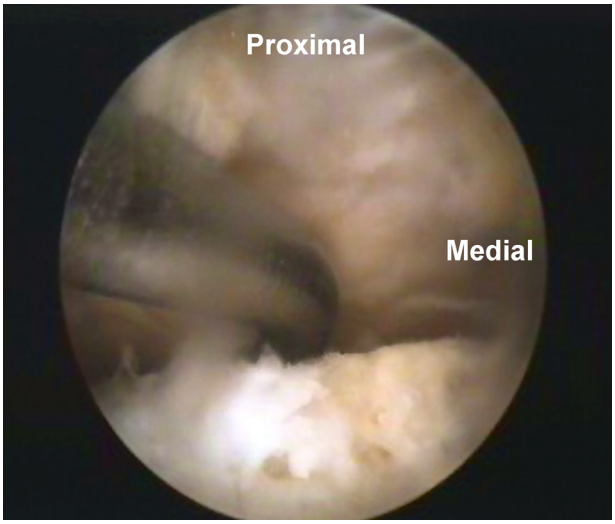

Fig. 5. Measurement of joint space between talus (above) and calcaneus (below).

- maximal posterolateral and posteromedial joint incongruence of the talus over the calcaneus: positive if the calcaneal joint surface extends beyond the talar joint surface and negative if the calcaneal joint surface no longer covers the talus;