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Realignment Subtalar Joint Arthrodesis

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ABSTRACT

Subtalar joint arthrodesis is a commonly performed procedure for the correction of hindfoot deformity and/or the relief of pain related to osteoarthritis. The purpose of the present study was to provide preoperative and intraoperative objective radiographic parameters to improve the accuracy and long-term success of realignment arthrodesis of the subtalar joint. We retrospectively reviewed the data from 16 patients, 11 male (57.9%) and 8 female (42.1%) feet, who had undergone realignment subtalar joint arthrodesis. A total of 19 fusions were performed in 9 (47.4%) right and 10 (52.6%) left feet, with a mean follow-up period of 2 (range 1 to 4.8) years. The mean age at surgery was 54.5 (range 14 to 77) years. Statistically significant improvement in radiographic alignment was found in the anteroposterior talo–first metatarsal angle ($p = .002$), lateral talo–first metatarsal angle ($p < .001$), tibial–calcaneal angle ($p < .001$), and tibial–calcaneal distance ($p < .001$). A positive correlation was observed between the tibial–calcaneal angle and tibial–calcaneal distance ($r = 0.825$, $p < .001$). The statistically significant improvement in tibial–calcaneal alignment, in both angulation and distance, support our conclusions that proper realignment of the calcaneus to vertical and central under the tibia will lead to short-term success and, likely, long-term success of subtalar joint arthrodesis.

Malalignment and deformity of the hindfoot can lead to debilitating pain and dysfunction of the lower extremity. Hindfoot arthrodesis has been shown to be effective in relieving pain and increasing function (1–3). Proper hindfoot realignment is important to minimize stress on the adjacent joints and maintain normal ankle mechanics (Fig. 1). The loss of normal ankle mechanics will result in osteoarthritis, which is disabling both physically and mentally, and has been noted to be as severely disabling as end-stage hip arthrosis (4,5).

To obtain accurate realignment of the hindfoot, the foot and ankle surgeon must correctly analyze the deformity in all planes. Preoperative planning should include obtaining proper multiplanar weight-bearing radiographs of the foot and ankle. In particular, frontal plane radiographs (hindfoot alignment view and long leg calcaneal axial view) provide essential information regarding the relationship of the hindfoot to the lower leg. Both axial views are critical for evaluation for deformities about the hindfoot and ankle (6). This radiographic projection can also be used to evaluate for translational deformities between the tibia and calcaneus (Fig. 2).

We present a simple and reproducible surgical technique to establish proper alignment when performing realignment subtalar joint arthrodesis. Additionally, we outline the deformity correction principles for accurate realignment of the hindfoot when performing subtalar joint arthrodesis. Finally, we review the radiographic effects of this surgical technique, with emphasis on frontal plane realignment, in a series of patients. To our knowledge, this is the first investigation evaluating the effect of frontal plane realignment after subtalar joint arthrodesis.

Patients and Methods

Our institutional review board approved the present retrospective radiographic review. A retrospective review of the medical records from January 2009 to December 2013 identified 65 patients with a longstanding history of pain and deformity unresolved by conservative treatment who had undergone realignment subtalar joint arthrodesis by the senior author (B.M.L.). The patients who had previously or were simultaneously undergoing ankle arthrodesis and those with Charcot neuroarthropathy were excluded from the present review, yielding 19 procedures in 16

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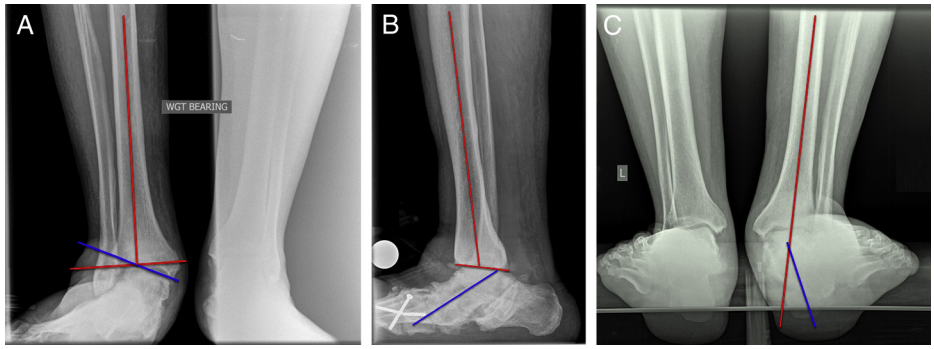

Fig. 1. (*A* to *C*) Malaligned hindfoot fusion resulting in right ankle valgus, ankle instability, and painful ankle osteoarthritis. (Reprinted with permission from the Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore.)

patients who met the criteria for inclusion. All surgical procedures were performed from January 2009 to December 2013.

The senior author (B.M.L.) used a standard lateral approach to access the subtalar joint. The joint cartilage was resected using either the saw or curettage method. Deformity correction was performed through wedge resection or bone graft wedge addition and realignment of the subtalar joint. In some cases, the anterior process of the calcaneus was resected, allowing for additional translation of the calcaneus under the talus, when needed. The realignment goal was to create a vertical heel axis in line with the tibial anatomic axis. Alignment was verified using intraoperative fluoroscopic axial views (Fig. 3). The joint was fixated with 2 large-diameter cannulated screws.

One author (M.J.H) measured all pre- and postoperative angles and positions on the weightbearing anteroposterior, lateral, and axial radiographs. A calibrated picture archiving and communication system measuring tool was used to obtain all measurements. The postoperative measurements were completed at the last recorded follow-up visit. The measurements were recorded as absolute values at the preoperative radiographic measurement and as negative values at the postoperative radiographic measurement only when a plane shift had occurred (i.e., varus to valgus or medial to lateral). Using the anteroposterior foot radiograph, the talo–first metatarsal angle, talo–calcaneal angle, lateral distal tibial angle, and joint line congruence angle of the ankle were measured. On the lateral foot radiograph, the talo–first metatarsal angle, talar declination, calcaneal inclination angle, anterior distal tibial angle, navicular height, and mid-tibia to lateral talar process distance were measured. The hindfoot alignment radiograph was reviewed to measure the tibial–calcaneal distance and tibial–calcaneal angle.

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp, Armonk, NY). The results are expressed as the mean ± standard deviation. The paired samples *t* test was used to compare the pre- and postoperative absolute radiographic angles and measurements. Pearson's correlation coefficient was used to compare the postoperative radiographic angle measurements. The results were considered statistically significant at $p < .05$.

Results

A total of 19 realignment subtalar joint arthrodesis procedures in 11 male (57.9%) and 8 female (42.1%) feet were included in the present analysis. Of the 19 fusions performed, 9 were in the right (47.4%) and 10 in the left (52.6%) feet, with a mean follow-up period of 2 (range 1 to 4.8) years. The mean age at surgery was 54.5 (range 14 to 77) years. Subtalar joint arthrodesis was performed for multiple etiologies: 10 cases of pes planus (53%), 4 of pes cavus (20%), 2 of isolated subtalar joint arthritis (11%), 2 of calcaneal fracture malunion (11%), and 1 case of Charcot-Marie-Tooth disease (5%) (Table 1).

Using the preoperative tibial–calcaneal angle, 9 feet were initially varus, 7 valgus, and 3 were neutral. The mean anteroposterior talo–first metatarsal angle was 20° preoperatively and had decreased to 11° postoperatively ($p = .002$). The lateral talo–first metatarsal angle was 19° preoperatively and had decreased to 6° postoperatively ($p < .001$). The mean tibial–calcaneal angle had decreased from a mean of 18° to 6° ($p < .001$). The tibial–calcaneal distance had

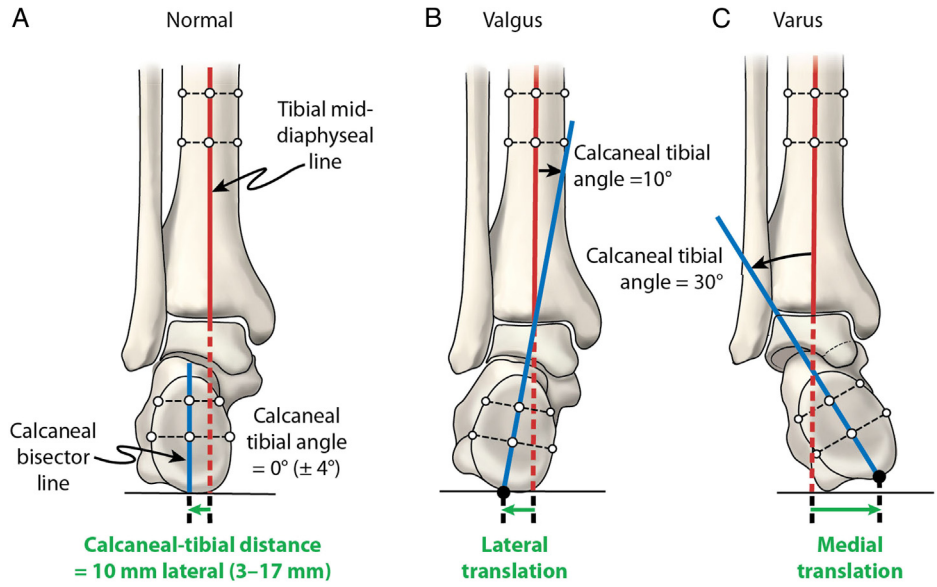

Fig. 2. Calcaneal translation showing how to measure the angles and reference points on the hindfoot alignment view. (*A*) Normal measurements include the calcaneal–tibial distance and calcaneal–tibial angle. (*B*) Valgus deformity of the hindfoot will result in a lateral translational deformity of the calcaneal axis at the weightbearing surface of the calcaneus. (*C*) Varus deformity of the hindfoot will result in a medial translational deformity of the calcaneal axis at the weightbearing surface of the calcaneus. (Reprinted with permission from the Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore.)