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Original Research

Arthroscopic Subtalar Arthrodesis: Does the Type of Fixation Modify Outcomes?

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ABSTRACT

The goal of the present study was to analyze a modified American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot scale score, time to union, and the incidence of fusion after isolated arthroscopic posterior subtalar arthrodesis using either 1 or 2 screws of different diameters. We reviewed a consecutive series of 65 patients, mean age 50.0 ± 15.6 years, including 38 males (58.5%) and 27 females (41.5%), who had undergone arthrodesis from May 2004 to February 2011. The mean follow-up duration was 57.5 (range 24 to 105) months. The patients were divided into 3 groups according to the fixation method used: group 1 (n = 12; 18.5%) underwent fixation with one 6.5-mm screw; group 2 (n = 40; 61.5%) with one 7.3-mm screw; and group 3 (n = 13; 20%) with two 7.3-mm screws. An overall statistically significant ($p < .0001$) improvement was seen in the modified AOFAS scale score for all 3 fixation groups; however, the difference was not statistically significant ($p = .79$) among the fixation groups. Fusion was achieved in 62 patients (95.4%) after a mean of 12.1 (range 9 to 16) weeks. The difference in the time to union was not statistically significant ($p = .781$) among the fixation groups. Nine patients (13.8%) experienced complications, and nonunion was significantly ($p = .005$) more prevalent in the single 6.5-mm screw group. In conclusion, all 3 screw configurations led to improved modified AOFAS scale scores, although nonunion was more common among patients fixed with a single 6.5-mm screw.

Subtalar arthrodesis is fusion of the posterior talocalcaneal joint. This procedure is performed to alleviate pain of subtalar origin in cases of primary osteoarthritis, posttraumatic arthritis after fractures of the talus or calcaneus, adult acquired flatfoot disorder due to posterior tibial tendon dysfunction, inflammatory joint diseases, and congenital disorders such as tarsal coalition, among others. Originally described by van Stockum (1) in 1912, Gallie (2) later popularized it for the treatment of calcaneal fractures. Although most experience has come from open arthrodesis with use of a supplemental bone graft, several investigators have reported their results using arthroscopic techniques to achieve joint fusion in an attempt to reduce postoperative morbidity and promote fusion.

Several methods of fixation have been described for subtalar arthrodesis. These include percutaneous Steinmann pins (Smith & Nephew, London, UK) (3), staples (4,5), and specifically designed implants such as the VIRA® device (Zimmer Biomet, Fair Lawn, NJ) (6), although percutaneous fixation with screws has been most popular (7–13). Accurate position of the fusion site is imperative because improper positioning of the joint surfaces can lead to poor outcomes; therefore, stable fixation is critical. The debate regarding the optimal configuration for screw fixation and the type, number, and size of the screws remains unresolved, with most evidence limited to biomechanical studies in cadaveric specimens (14–21) or bone models (18,20,22). Several variables can affect the stiffness and strength of the fixation construct, such as the number, type, direction, and trajectory of screws and the bone quality. Furthermore, it remains unclear whether more stable constructs will correlate with greater or quicker union rates in the clinical setting.

The goal of the present study was to analyze our results of arthroscopic posterior subtalar arthrodesis, in particular, regarding the number and size of screws used for fixation of the joint surfaces, to ascertain whether the union rates, time to union, modified American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot scale scores, and complication rates differed significantly between constructs.

Patients and Methods

Four of us (B.B.-G., V.J.-D., M.A.M.-R., C.O.-T.) reviewed the data from all patients who had undergone arthroscopic subtalar arthrodesis from May 2004 to February 2011. Patients were included if (1) arthroscopic arthrodesis had been performed through a

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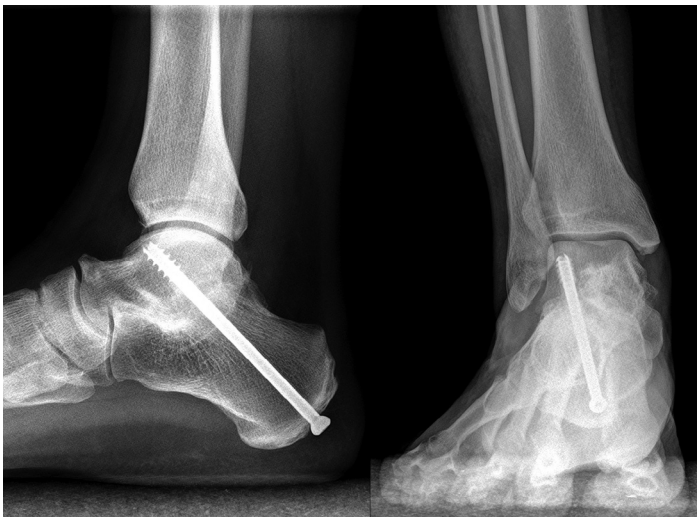

Fig. 1. Standard lateral and anteroposterior radiographs after subtalar arthrodesis in a patient with primary subtalar osteoarthritis, using a single 7.3-mm-diameter cannulated screw (DePuy Synthes).

posterior approach, with fixation using one or two 6.5-mm or 7.3-mm cannulated screws; (2) clinical and radiologic follow-up data were available for ≥24 months, and (3) no other associated surgeries had been performed with subtalar fusion (i.e., calcaneal osteotomy, posterior tibial tendon procedures). The same surgeon (J.V.R.) performed all the procedures, and the data were prospectively collected using a standardized form.

Surgery was performed with the patient in the prone position under spinal anesthesia in all cases. A pneumatic tourniquet was applied at the thigh, and arthroscopy was performed through 2 posterior portals using a 4.5-mm 30° arthroscope. The joint surfaces were debrided using a 3.5-mm shaver and burr until subchondral bone was exposed throughout the joint and the structures of the sinus tarsi could be identified. If necessary, a third portal was performed as described by Beimers et al (23) to improve the view of the anterior margin of the posterior subtalar joint. The joint was fused using 1 or 2 parallel 6.5-mm or 7.3-mm cannulated partially threaded screws (DePuy Synthes, Paoli, PA) that crossed the most anterior part of the posterior subtalar joint in a calcaneotalar direction (Fig. 1). The type and number of screws were determined by the surgeon and was dependent on the screw purchase during placement and the bone quality. A bone graft was not used in any patient. After surgery, the joint was immobilized in a posterior ankle splint for 3 weeks, followed by progressive partial weightbearing protected by crutches and a walker type ankle-foot orthosis, with complete and unprotected weightbearing allowed after 8 to 12 weeks.

The postoperative clinical and radiographic evaluation was performed by 4 of us (J.V.-R., B.B.-G., V.J.-D., M.A.M.-R.) and included the union rate, time to union, occurrence of postoperative complications, and modified AOFAS ankle-hindfoot scale scores. At baseline, the full 100-point AOFAS ankle-hindfoot scale score was used. The 6 points for the subtalar motion were not assigned in the follow-up evaluations; thus, the maximum score at the final follow-up examination was 94 points. The criteria for clinical union included the absence of pain and crepitation with ambulation and a lack of subtalar motion on examination. The radiographic follow-up protocol included lateral, oblique, and axial views of the hindfoot. Fusion was defined as the appearance of osseous trabeculae across the subtalar arthrodesis area. A computed tomography (CT) scan was performed to assess for union or the lack thereof in patients with persistent pain and a lack of radiographic evidence of union after a minimum of 6 months. The patients underwent repeat surgery if nonunion was confirmed by CT and the symptoms persisted (Fig. 2).

Descriptive statistics were used to depict the demographics, clinical characteristics, and functional and radiographic outcomes. Normality was tested using the Kolmogorov-Smirnov test with Lilliefors correction and the Shapiro-Wilk test, with nonparametric statistics used for bivariate comparisons. The 1-way analysis of variance or Kruskal-Wallis test was used for continuous variables that did or did not fulfill the criteria for normality, respectively. Fisher's exact test was used to compare proportions. The paired Student *t* tests were used to compare the pre- and postoperative modified AOFAS ankle-hindfoot scale scores. To detect differences among the fixation groups, a survival analysis was performed using the Mantel-Cox test, with the time to union as the time-dependent variable (C.O.-T.). Statistical significance was set at an α error of 5% ($p \leq .05$).

Results

Sixty-five hindfoot fusions were performed in 65 consecutive patients (38 males [58.5%] and 27 females [41.5%]) and were included in the present study. The mean age of the patients was 50 (range 21 to 72) years. The median time elapsed from the onset of symptoms to surgery was 17 (range 9 to 43) months. Of the 65 fusions, 40 (61.5%) were on the right and 25 (38.5%) on the left hindfoot. Of these fusions, 37 (56.9%) were for treatment of arthritis after fracture of the calcaneus, 24 (36.9%) for adult acquired flatfoot disorder due to posterior tibial tendon dysfunction, and 4 (6.2%) for primary osteoarthritis of the subtalar joint. The mean follow-up period was 57.5 (range 24 to 105) months. No patients were lost to follow-up.

All the patients in our series showed significant improvement statistically, with a mean overall improvement in the modified AOFAS scale score from 51.5 ± 9.5 of a maximum of 100 points preoperatively to 81.9 ± 9.2 of a maximum of 96 points after surgery ($p < .0001$). Union was achieved in 62 patients (95.4%) after a mean of 12.1 ± 1.5 (range 9 to 16) weeks; all 3 nonunions achieved fusion after revision surgery. Revision surgery was performed using an open approach in 2 patients and an arthroscopic approach in the third patient. Of the 65 patients, 5 (7.7%) required hardware removal because of joint penetration or symptomatic screw heads, and 1 developed a superficial wound infection that resolved with oral antibiotics.

Of the 65 patients, 12 (18.5%) underwent fixation using a single 6.5-mm cannulated lag screw, 40 (61.5%) using a single 7.3-mm screw, and 13 (20.0%) with two 7.3-mm screws. The patient characteristics and results and the comparisons between groups are indicated in the Table. The preoperative AOFAS scale (maximum score 100 points) and postoperative modified AOFAS scale (maximum score 94 points) and the improvement in the modified AOFAS scale scores for each of the 3 groups are shown in Fig. 3. No statistically significant differences were found among the fixation groups regarding age, gender, side treated, preoperative diagnosis, or modified AOFAS scale score. The clinical improvement was similar among the 3 groups; however, all 3 cases of nonunion in our series had been fixed with a single 6.5-mm screw, and this difference was statistically significant ($p = .005$). Nonetheless, the mean time to union was similar among the fixation groups, as shown by the time-to-event analysis ($p = .781$; Fig. 4).

Discussion

Our study reports consistently satisfactory results after isolated arthroscopic subtalar arthrodesis, with a union rate of 95.4% after a mean

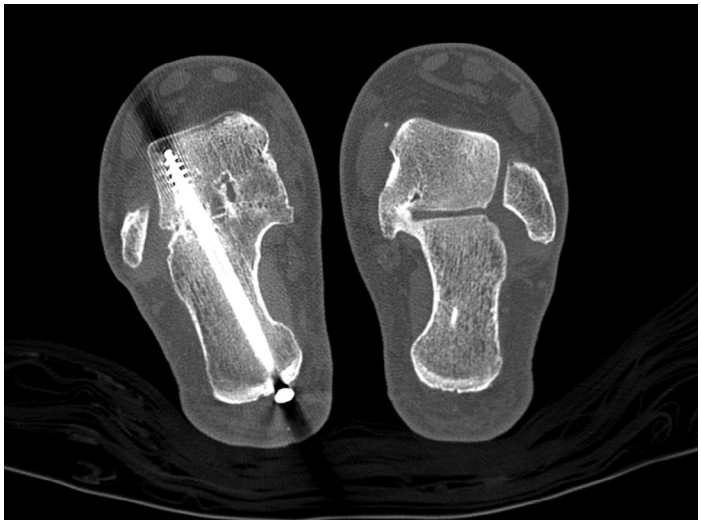

Fig. 2. Axial computed tomography scan of fusion achieved in the right subtalar joint using a single 7.3-mm-diameter cannulated screw.