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Medial Double Arthrodesis With Lateral Column Sparing and Arthrodiastasis: A Radiographic and Medical Record Review

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ABSTRACT

Correction of valgus hindfoot deformity can be successfully achieved with arthrodesis of the subtalar and talonavicular joints through a single medial based incision. The advantages of medial double arthrodesis compared with the standard triple arthrodesis 2-incision approach include the absence of a lateral incision and a few degrees of residual mobility through the unfused calcaneocuboid joint (CCJ). The CCJ has often been noted to distract and decompress with the abduction correction achieved through medial double fusion. The primary goal of the present retrospective study was to identify the frequency of CCJ decompression, measure the radiographic changes at the CCJ, and evaluate the flatfoot correction using this operative approach. A total of 46 patients (47 feet) were identified as possible subjects. Twenty patients (20 feet) with a mean follow-up period of 9.2 ± 4.1 (range 6 to 21) months met our inclusion criteria. Distraction of the CCJ using medial double fusion resulted in increased joint space and improvement of at least 1 grade of arthritis in 50% of the patients. In the patients with severe CCJ arthrosis, the improvement was less predictable, with only 20% showing radiographic improvement. Correction of flatfoot as measured on standard radiographs showed excellent results. Subchondral bone changes as measured by the CCJ arthrosis scale improved in patients with mild to moderate arthritis after distraction arthrodiastasis. However, those with severe preoperative CCJ had less predictable improvement. Medial double arthrodesis for severe flatfoot deformity provides predictable correction of the deformity and improvement in the CCJ arthritis scale when the preoperative arthritis of the CCJ is mild to moderate.

In recent years, an isolated medial approach (the medial double) to hindfoot fusion has been popularized owing to concerns regarding the lateral soft tissue and bone healing associated with the standard triple arthrodesis approach. The medial double approach has been shown to allow for adequate joint preparation, provide excellent deformity correction, decrease the operative time, and provide good rates of fusion with fewer soft tissue complications (1–4). Critical to the success of operative correction of advanced flatfoot and arthritic deformity is the realignment of the hindfoot joints before fusion. Although only a few degrees of motion will remain at the calcaneocuboid joint (CCJ), this has been theorized to decrease the incidence of lateral column pain and allow for better accommodation to uneven ground. The goal of the present retrospective study was to investigate the radiographic changes in the CCJ after fusion of the subtalar joint (STJ) and talonavicular joint (TNJ) and identify the frequency of CCJ distraction as a result of the medial double approach.

Patients and Methods

A radiographic review of consecutive patients who had undergone medial double hindfoot arthrodesis with a minimum of 6 months of follow-up data was performed. The institutional review board approved the present retrospective clinical medical record and radiograph review. Identification of potential consecutive subjects was done using Current Procedural Terminology (American Medical Association, Chicago, IL) codes (STJ arthrodesis, code 28725, TNJ arthrodesis, code 28740) through our billing and clinical departments from January 2009 to December 2011.

Medical Record Review

The patients' medical records were reviewed to determine whether they met the inclusion criteria. The patients were excluded if the clinical follow-up period was <6 months, if medical documentation was incomplete, if the surgery had been a revision at the given joints, if external fixation had been used concurrently, and if the patients had undergone surgery for Charcot osteoarthropathy, because that has been documented to affect the foot and ankle position (5). All study materials were de-identified of personal

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markers per institutional review board approval. General patient parameters were collected and included age (years), sex (male/female), weight (pounds), height (inches), and the calculated body mass index. Additionally comorbidities and conditions that affect bone healing were also collected, including present and former tobacco usage, diabetes mellitus, liver disease, kidney disease, rheumatoid arthritis, immunocompromised state, chronic steroid use, and preoperatively documented osteopenia or osteoporosis.

Pre- and Postoperative Radiologic Review

Two fellowship-trained foot and ankle surgeons who were unaware of the clinical data reviewed all the radiographs. The talonavicular coverage and calcaneocuboid angle were measured on standing anteroposterior radiographs (Fig. 1). On the standing lateral view, the talar-first metatarsal angle (Meary's angle) was examined. Ankle varus and valgus was also noted and measured on the anteroposterior view of the ankle. A numeric grading system previously used in published hindfoot arthrodesis studies (6) was used to assess the degenerative state of the CCJ and the surrounding nonoperative joints. Grading was determined by consensus of both surgeons considering all views with joint visualization: 0 represented no arthritic changes noted; 1, narrowing of the joint space with no other radiographic findings; 2, moderate sclerosis with the formation of osteophytes; and 3, severe sclerosis of the joint with narrowing and significant osteophytic formation. Not applicable was used for the inability to assess owing to the patient position and radiographic exposure. All statistical pre- to postoperative comparisons were completed using the Wilcoxon rank sum (Mann-Whitney *U*) test, with a statistical significance of $p \leq .05$. Radiographic union, defined as bridging across 3 cortices, of the operative site was identified on the final radiograph. Radiographic projection was standardized according to the magnification, the distance from the radiographic tube to the plate, and peak kilovoltage.

Operative Technique

Equinus contracture was addressed according to surgeon preference before fusion. A medial incision was made beginning just posterior and inferior to the medial malleolus and then extending along the course of the posterior tibial tendon to the navicular tuberosity. The dissection was carried deep to the sheath of the posterior tibial tendon, exposing the TNJ and STJ. Both joints were then prepared by removal of all cartilage to subchondral bone. The articular surfaces were then fenestrated to augment fusion potential. Fixation of the TNJ included crossing screws with and without locking plate technology. Fixation of the STJ was achieved with 6.5-mm cannulated screws. Standard postoperative protocols, including a period of non-weightbearing casting for 2 months and protected weightbearing in a fracture boot, were followed until radiographic evidence of bone bridging and clinical resolution of pain and swelling were noted. Radiographs were obtained at regular intervals during this observation period.

Statistical Analysis

The primary analysis point was the radiographic grade of arthrosis at the CCJ preoperatively and at the last postoperative radiographs. A secondary analysis was conducted to determine whether any additional patient factors had influenced the likelihood of significant change at the CCJ, using multiple logistic regression analyses. The patient data points are described using the mean, mode, standard deviation, and range for numeric variables and percentages for nominal variables.

Results

A total of 46 patients (47 feet) were identified by our billing department using the selected Current Procedural Terminology codes (STJ arthrodesis, code 28725; TNJ arthrodesis, code 28740). On radiographic and medical record review, 20 patients (20 feet) with a mean follow-up period of 9.2 ± 4.1 (range 6 to 21) months met the inclusion criteria. The mean patient age at surgery was 61.9 ± 11.2 (range 37 to 82) years, and this cohort included 5 males (25%) and 15 females (75%). The mean body mass index for the patient group was 35.06 ± 7.64 (range 23.05 to 49.91) kg/m^2. Additional demographic characteristics included 2 (10%) current, 2 (10%) former, and 16 (80%) never tobacco users; 6 (30%) with diabetes mellitus; and 3 (15%) patients with osteopenia or osteoporosis receiving active medical management. One patient (5%) had rheumatoid arthritis.

CCJ Results

A normal joint contour to a slightly distracted CCJ was seen in 10 patients (50%) postoperatively. The rate of CCJ arthrosis improvement by a decrease of ≥1 grades from a mean of 1.21 preoperatively to a mean of 0.65 postoperatively was 50% (Table). The number of patients with severe, grade 2 and 3, arthrosis, seen in 7 patients (35%) preoperatively, decreased and was only observed in 3 patients (15%) at the final follow-up visit. Although this approached statistical significance from preoperatively to the postoperative correction, significance was not attained (Z-score = 1.95; $p = .05$). Only 1 patient (5%) experienced progressive arthritic changes in the CCJ after undergoing medial double arthrodesis.

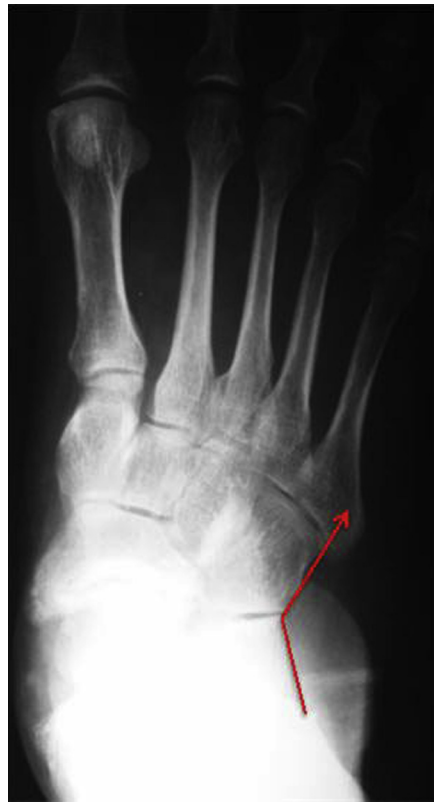

Fig. 1. Talonavicular coverage and the calcaneocuboid angle were measured on standing anteroposterior radiographs.

Overall Flatfoot Correction Results

Regarding overall flatfoot deformity correction, the mean abduction through the CCJ preoperatively was 150.3° ± 12.5° (range 126° to 172°), with a corrected postoperative position of 168.1° ± 9.2° (range 140° to 180°). This represented a mean and statistically significant (Z-score = −4.03; $p = 0$) correction of 17.8° in the transverse plane. Sagittal realignment exhibited a mean improvement of 10.5° from a talar-first metatarsal angle of 17.7° ± 14.8° (range 0° to 45°) to 7.2° ± 6.7° (range 0° to 30°), which was not statistically significant (Z-score = 1.89; $p = .06$). TNJ coverage increased from 56.3% ± 18.9% (range 20% to 90%) to 96.7% ± 8.4% (range 70% to 100%), an increase of 171%, which was statistically significant (Z-score = −4.74; $p = 0$). All but 1 patient (95%) had radiographic union of the STJ and TNJ at the last follow-up visit. Of the 40 joints, 39 had fused (incidence of fusion 97.5%) on radiographic evaluation within the study period. Additionally, no increase was found in adjacent joint arthritis postoperatively as summarized in the final line of the Table. Only 2 patients (10%) complained of lateral column pain after surgical correction.