

FUSION OF THE FOURTH AND FIFTH METATARSOCUBOID JOINTS

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FUNCTIONAL ANATOMY

The lateral arch of the foot is comprised of three bones: the fifth metatarsal, the cuboid, and the calcaneus. Although some authors believe the lateral column to be made up only of the fourth and fifth metatarsals and the cuboid, as well as the intervening joints,¹ for the purposes of this discussion the lateral column is made up of the fourth and fifth metatarsals, the cuboid and the calcaneus plus the joints that connect these bones together longitudinally. The mobility of the lateral column is fundamental to the efficient functioning of the foot. It plays a central role in shock absorption, mobile adaptation, and as a rigid lever for toe-off.

Understanding the functional characteristics of the lateral column is important when faced with the need to lengthen, stabilize or fuse the joints along this anatomical path. During the stance phase of gait the heel strikes the floor slightly inverted causing the fifth metatarsal to contact the supporting surface shortly after the heel, becoming fully loaded during the middle third of this phase and peaking at about two-thirds of the way through. The weight then shifts medially across the forefoot in preparation for propulsion. The cuboid bone is temporarily suspended just before the central midstance phase when it contacts the ground to help transmit the body weight forward along the lateral column.

Ouzounian and Shereff found the fourth and fifth metatarsocuboid joints to have arcs of motion of approximately 10° in both plantarflexion-dorsiflexion and supination-pronation,² consistent with the observations of Hicks³ and Gellman.⁴ The same authors found the calcaneocuboid motion to be only about 2° for dorsiflexion-plantarflexion and about 7° for supination-pronation. Relative to dorsiflexion-plantarflexion total motion is greatest for the fourth and fifth metatarsocuboid joints, followed by the talonavicular, medial and middle naviculocuneiform joints through the midfoot. Supination-pronation motion is greatest through the talonavicular joint, then the fourth and fifth metatarsocuboid

joints, followed by the calcaneocuboid joint and the medial naviculocuneiform joint. In summary, the fourth and fifth metatarsocuboid joints provide the lion's share of motion through the midfoot, especially through the lateral column.

CLINICAL APPLICATION

Midfoot pain, deformity and dysfunction can result from traumatic arthritis, degenerative joint disease, functional breakdown and Charcot neuroarthropathy as well as mechanical disorders such as cuboid syndrome. When they do not respond to conservative care, arthrodesis of the midfoot alone or with reconstructive osteotomies has become the accepted standard method for salvaging these difficult foot problems.⁵⁻¹⁰ However, other than a case report, only one study has addressed arthrodesing the fourth and fifth metatarsocuboid joints and its effect on the lateral column.

In 2003 Raikin and Schon retrospectively reviewed the records of 23 patients (28 feet) who had undergone midfoot arthrodeses, including the fourth and fifth metatarsocuboid joints.¹ Although most of these surgeries were part of the correction of neuroarthropathic deformities, six arthrodeses were of the fourth and fifth metatarsocuboid joints in normosenate feet with painful localized arthritis. The etiologies for these six feet included two with post-traumatic degeneration, one with rheumatoid arthritis, two with non-traumatic degenerative arthritis, and one with chronic cavus foot deformity. Using the AOFAS midfoot scale,¹¹ the average pain scores for this small arthritic group diminished from 8.2 points preoperatively to 2.4 points postoperatively, a 70.7% decrease in lateral column pain which was statistically significant. The results of the isolated fusions of these two mobile joints allayed some of the concerns that such permanent immobilization could lead to lateral column overload and result in local bone pain, nonunion, stress fractures, and pain in neighboring joints. However, none of these patients had concurrent fusion of the calcaneocuboid joint.

CASE HISTORY

A 45-year-old female former podiatry assistant, referred from a distance, presented with a painful calcaneonavicular bar tarsal coalition that had not responded to extensive conservative care. She consented to surgery and the bar was resected. She returned home and after several months became frustrated with the pain that persisted at the surgical site. In order to avoid traveling to the original surgeon, she sought an opinion from a geographically closer surgeon who felt that her pain had transferred to the calcaneocuboid joint. Shortly thereafter, this surgeon attempted to fuse this joint.

The arthrodesis went on to a painful nonunion and she returned to the original surgeon. The failed arthrodesis was subsequently repaired with an autogenous bone graft, external fixator and electrical bone growth stimulator.

She did well until she returned to work and

dramatically increased her weight-bearing activity level. Pain began to emanate from the adjacent fourth and fifth metatarsocuboid joints due to the increased demand to transfer flexion and forces through these joints. After over two years of attempts to treat this persistent pain with changes in activity levels, castings, injections therapy, NSAIDs, and various orthotics the patient elected to have the fourth and fifth metatarsocuboid joints fused.

This provided good relief for one and a half years. When she increased her work load again, she started to overload the fourth metatarsal. The shaft became constantly tender and very sensitive. After another year of less than successful treatment, a dorsiflexory osteotomy was performed through the neck of the fourth metatarsal. This gave relief enough that she could walk fairly normally but limited her activity level. After a recognized threshold she experiences disabling pain. Below that threshold she can function to tolerance. (Figures 1-7)



Figure 1A. Calcaneonavicular fibro-osseous bar. Source of original pain.



Figure 1B.



Figure 2A. Post surgical resection of C-N bar.

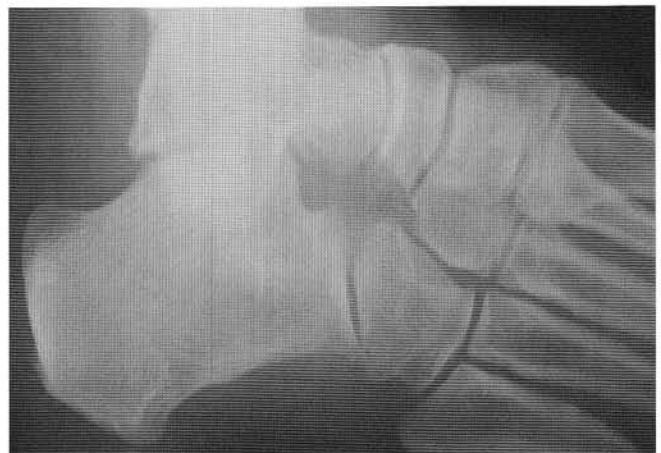


Figure 2B.



Figure 3. Nonunion after attempted fusion of calcaneocuboid joint.

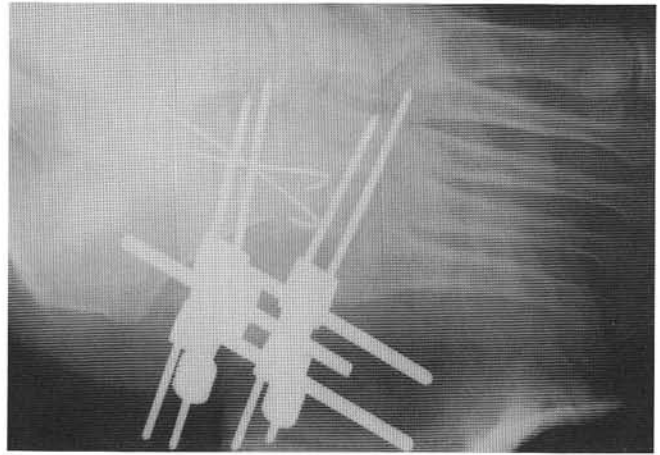


Figure 4. Repair of CCJ nonunion using external fixator and autogenous bone graft.



Figure 5. Healed calcaneocuboid arthrodesis after nonunion repair.



Figure 6A. Arthrodesis of fourth and fifth metatarsocuboid joint.



Figure 6B.



Figure 7A. Dorsiflexory osteotomy of fourth metatarsal to relieve overload.

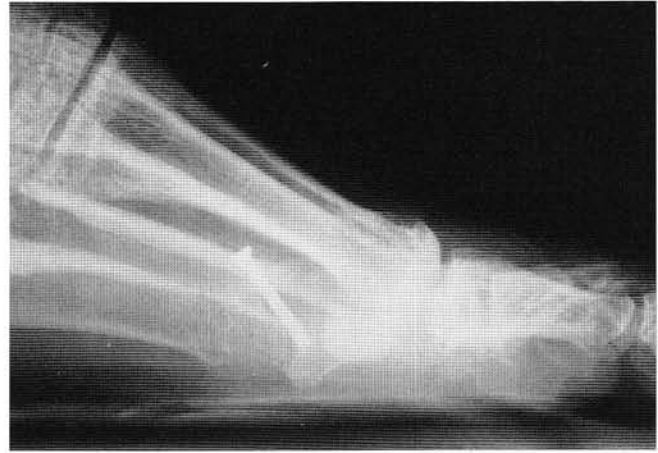


Figure 7B.

DISCUSSION

This case illustrates the critical importance of the lateral column mobility provided by the fourth and fifth metatarsocuboid joints. Once it is lost individually, it appears that the calcaneocuboid joint can supply enough motion to keep the lateral column comfortably functional. However, when both of these joint-connections are fused there is a definite overload problem as the lateral column becomes a rigid lever. Since the peak load during stance phase occurs in this area at heel-off as the foot prepares for propulsion, the forces concentrate in the distal fourth and fifth metatarsals.

Berlet et al described a procedure that resects the dysfunctional fourth and fifth metatarsocuboid joints and interposes a tendon graft in the resulting space.¹² The goal for this technique is to excise the damaged or arthritic joint and still allow motion at the articulation. The authors reported a 40% improvement in dysfunction and a 50% improvement in pain at an average of 24 months follow-up. The study by Raikin and Schon of arthrodesis of the fourth and fifth metatarsocuboid joints, after an average of 37 months of follow-up, observed an overall 74.5% improvement in pain and a 73.8% improvement in dysfunction.

CONCLUSION

Arthrodesis of the fourth and fifth metatarsocuboid joints, when done well, is an effective surgical technique for treating with predictable success for arthritis, pain and dysfunction of the involved joints. The neighboring joints seem to be able to compensate for the lost motion. However, when combined with fusion of the calcaneocuboid joint the resulting lateral column overload can be functionally painful and may be intolerable to the patient.

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