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Case Reports and Series

Stabilization of the Fourth Metatarsal–Cuboid Lateral Lisfranc Injury: Early Results of an Innovative Technique Using Suture Anchors

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ABSTRACT

This report presents an innovative surgical technique for the correction of cuboid–metatarsal subluxation at the level of the lateral Lisfranc joint. This stabilization technique reinforces the dorsal fourth tarsometatarsal ligament by incorporating sutures and anchors, establishing a more stable joint. The data from 5 female patients undergoing stabilization using a suture anchor construct were reviewed. All 5 patients were able to resume their activities, including the adolescent athletes. Anatomic reconstruction of the dorsal fourth tarsometatarsal ligament complex can lead to full mechanical and functional stability, which ultimately allows for a return to activity, even in highly demanding sports and athletes.

The outcomes associated with the treatment of lateral column injuries involving the cuboid are infrequently reported. Some of these injuries involve the proximal articulation of the cuboid with the calcaneus and others involve distal structures, with the lateral 2 metatarsals constituting Lisfranc articulation with the tarsal. Cuboid pain is thought to be a common source of lateral midfoot symptoms in athletes (1). Newell and Woodle (2) reported a 4% incidence of cuboid pain after reviewing 3600 athletes with foot injuries. A greater incidence of cuboid-related symptoms has been documented for certain sports, such as professional ballet dancers. Marshall and Hamilton (3) recorded 63 total foot and ankle injuries at the American Ballet Theater and found that 17% were due to cuboid subluxation. Jennings and Davies (4) reported that 6.7% of patients with plantarflexion inversion ankle sprains also displayed the cuboid syndrome.

To best understand the surgical technique that we used in the patients described in the present report, it is important to review the complex anatomy of the lateral portion of the Lisfranc joint complex. The cuboid is a tarsal bone located in the lateral column of the midfoot. It articulates anteriorly with the fourth and fifth metatarsal bases, a complex known as the lateral tarsometatarsal joint (TMTJ), and a portion of the Lisfranc joint complex. Medially, the cuboid articulates with the lateral cuneiform and navicular bones. Posteriorly, it articulates with the calcaneus at the midtarsal, or Chopart, joint. The ligaments are the dorsal and plantar cubometatarsal, cuneocuboid, cubonavicular, and calcaneocuboid ligaments. The bifurcate ligament is a strong, Y-shaped ligament that extends from the anterior aspect of the superior surface of the calcaneus and attaches to the cuboid and navicular bones. It is composed of the confluence of the calcaneocuboid and calcaneonavicular ligaments. Additionally, the long and short plantar ligaments attach plantarly, which help to maintain the lateral, longitudinal arch of the foot. The long plantar ligament extends distally beyond the cuboid to the lateral metatarsals. A deepening groove is present along the plantar aspect of the cuboid, which allows the peroneus longus tendon to course through the midfoot in an anteromedial direction. These plantar structures outnumber the dorsal tarsometatarsal ligaments, in both number and thickness (2,5,6).

Dislocation of the metatarsal–cuboid joint, or cuboid subluxation, results from various predisposing factors and mechanisms of injury. The most common cause is thought to be secondary to plantarflexion and inversion ankle injuries, followed by overuse syndrome (2–6). Several factors might increase the likelihood of injury, including excessive body weight, ill-fitting or poorly constructed orthoses or shoes, exercise (intense, prolonged, frequent), inadequate exercise recovery, training on uneven surfaces, and sprain of the foot and/or ankle (1–7).

Subluxation is defined as a partial dislocation of a joint produced by motion that is contrary to the plane of motion or that exceeds the range of motion for the particular joint. In regard to cuboid subluxation, radiographically, at the distal portion of the articulation, the fourth metatarsal base is displaced medially on the weightbearing anteroposterior view (John F. Grady, DPM, personal communication; Poster International Post-Graduate Conference, Chicago, IL, 2015, submitted for publication) (8).

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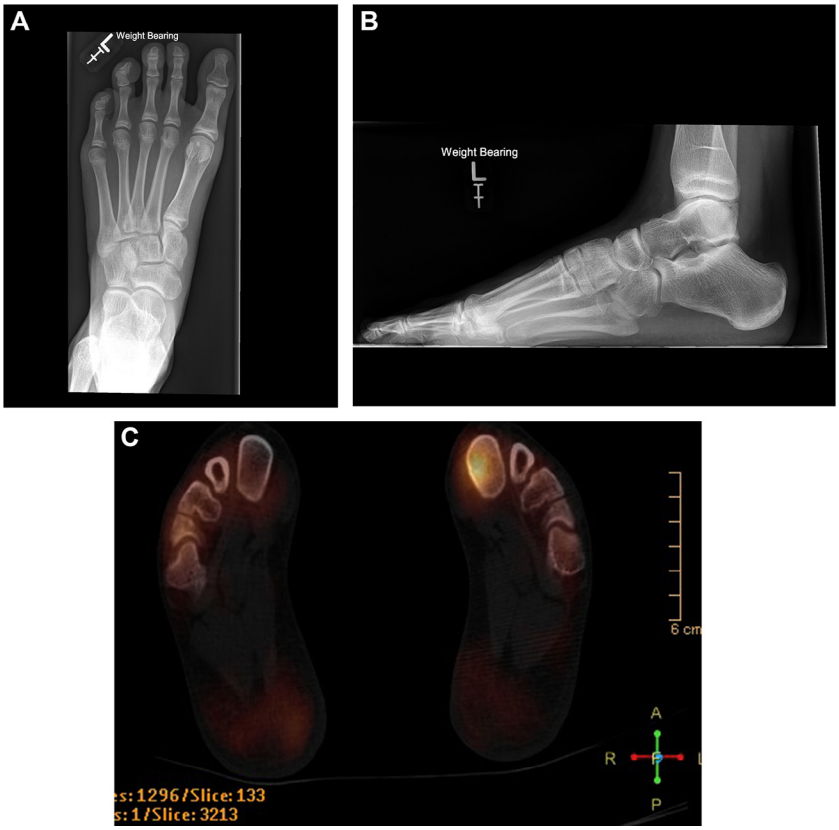

Fig. 1. *(A to C)* Preoperative radiographs and single photon emission computed tomography image showing fourth metatarsal subluxation medially from the cuboid.

The recommended treatment of cuboid subluxation includes therapeutic exercises, padding, low dye taping techniques or arch taping with a cuboid pad, rest, arch supports, and manual reduction (2–4,6). Additionally, low-intensity pulsed ultrasonography can be used to facilitate collagen synthesis and, when increased to continuous soundwave, can further promote healing of damaged tissues (4). If symptoms persist after initiation of treatment, ongoing treatment, including several manipulations of the subluxated joint, are warranted (4,7,9–12). Physical therapy exercises focusing on stretching tight peroneus longus and triceps surae muscles and tendons and strengthening the intrinsic and extrinsic muscles of the foot and proprioception exercises through the use of neuromuscular control exercises (6) were used. If conservative treatment is unsuccessful, surgical intervention is necessary to return athletes to their activity. Lohrer and Arentz (13) explained an operative technique for anatomic reconstruction of the calcaneocuboid joint in 2004 for a national top level gymnast. Their surgical technique involved reefing (tensioning) of the dorsal calcaneocuboid ligament, which was then augmented with a local periosteal flap. Their patient returned to full, high-level gymnastics activity 16 weeks after the surgery. In 2008, Punwar and Madhav (14) described a surgical technique that incorporated a harvested autogenous gracilis tendon to re-create the dorsal support of the cuboid portion of the bifurcate ligament and the dorsal calcaneocuboid ligament, and also reinforcing the plantar calcaneocuboid ligament. Understanding these previously reported methods, we propose an innovative suture anchor surgical procedure to address the subluxed cuboid–fourth metatarsal articulation, and we report our initial results in a small series of patients.

Patients and Methods

Consecutive patients who sustained a fourth metatarsal–cuboid joint, or lateral Lisfranc joint, injury were reviewed regarding their outcomes after undergoing surgical stabilization of the subluxated joint from January 2015 to June 2016. A search was performed using the term "Lisfranc," Current Procedural Terminology codes 28555 and 28615 (American Medical Association, Chicago, IL) and International Classification of Diseases, 9th revision, code 845.11 (World Health Organization, Geneva, Switzerland) by a clinical researcher. The patients' demographic data were recorded. To be included, a patient had to have had a minimum of 12 months of follow-up after surgery. Furthermore, to be included, the patients had to have standard foot radiographs available showing subluxation of the fourth metatarsal relative to the cuboid (Fig. 1), and computed tomography (CT), single photon emission CT, or magnetic resonance imaging scans were used, if needed, to ascertain the diagnosis. In equivocal cases, a diagnostic local anesthetic was injected into the fourth tarsometatarsal joint and, if this was followed by pain relief, during the therapeutic duration of the anesthetic to clinically ascertain the diagnosis. The etiology of the cuboid subluxation and treatments used before surgery were recorded. Furthermore, the duration of time required for the patient to return to activity was recorded, and patient-reported outcomes were procured using the Roles and Maudsley (RM) score (15). The data were abstracted from the medical records by a fellow (D.M.) not involved in the surgery. The surgeries were performed by the senior author (A.S.), and the data were analyzed by both of us (A.S., D.M.).

The surgical technique included stabilization of the fourth tarsometatarsal articulation through a dorsal, linear incision situated directly over the fourth TMTJ. Dissection was carried down to the extensor digitorum brevis muscle belly, with care taken to avoid the branches of the intermediate dorsal cutaneous nerve. Sharp and blunt dissection was used to dissect through the extensor digitorum brevis to the base of the fourth metatarsal. The cuboid–metatarsal articulation was opened, and the articular surfaces of the joint were inspected for any