Osteopathic Manipulative Treatment in Tarsal Somatic Dysfunction: A Case Study

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The authors present a case of a 24-year-old woman with left foot pain that began after an inversion injury obtained while running. The pain minimally improved with nonsteroidal anti-inflammatory medications. Clinical examination revealed a relatively normal foot with palpable changes in the bony structures at the midfoot consistent with a tarsal subluxation. Cuboid reduction was performed using high-velocity, low-amplitude manipulation, after which the patient reported immediate and near-complete pain relief. The authors also review mechanisms of injury, clinical findings, and treatment modalities for patients with tarsal subluxation.

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The tarsal bones (*Figure 1*) act as keystones to the pedal plantar arches, namely, the longitudinal and transverse arches. They play an important role in maintaining a high-efficiency spring in pedal mechanics, whereby energy is conserved and anatomic cushioning is optimized.[2] The longitudinal and transverse arches are used during motion kinetics (eg, walking, sprinting) or while holding static positions (eg, standing). However, these motions or positions may be affected after acute alteration of the related tissues.

The bony pedal arches are supported by a number of muscles, ligaments, and fascia that protect arch integrity while providing elasticity and maneuverability for storing and releasing energy. The longitudinal arch is supported by the tibialis posterior muscle, which has tendinous attachments to the navicular; first cuneiform; and second, third, and fourth metatarsal bones. This arch has 2 divisions: lateral and medial. Osseous structures in the lateral division of the arch include the calcaneus, cuboid, and fourth and fifth metatarsal bones, and structures in the medial division include the talus, navicular, 3 cuneiform, and first 3 metatarsal bones. The transverse arch receives soft tissue support from the long peroneal muscle laterally and from the anterior tibial muscle medially, with tendinous insertions to the first cuneiform bone.[3] Ligamentous and fascial reinforcements are provided inferiorly by the calcaneonavicular and plantar aponeuroses, respectively.

Excessive forces on soft tissues may cause strain patterns or tissue remodeling, depending on the chronicity of the resulting injury. Injuries are not limited to the foot and may occur distal to the knee, as in the case of medial tibial stress syndrome (MTSS). Deleterious changes in pedal structures have been associated with MTSS: one study[4] revealed that compared with healthy individuals, patients with MTSS

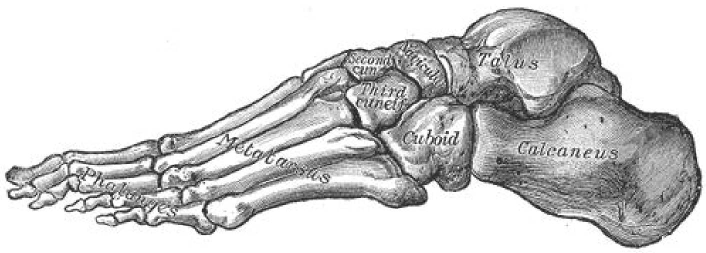

Figure 1.
Lithograph demonstrating anatomic relationships in proximity to the cuboid bone. Reprinted from *Anatomy of the Human Body*.[1] Public domain.

had an increase in navicular drop and longitudinal arch deformation during static postures and ambulation. The contiguous link of musculature and fascia between distal leg segments ultimately impacts the bony structures of the foot. In a like manner, acute trauma to the foot can result in somatic dysfunctions.

Patients with structural changes of the foot typically present to medical personnel when they begin showing symptoms, which often include pain and reduced ability to perform weight-bearing activities. Numerous factors can incite somatic changes, including age, obesity, occupation, shoe design, pregnancy, and soft or hard tissue damage—one of the most common of which is an ankle inversion injury.[5] The resulting deformation of the longitudinal pedal arch may cause inferiorly displaced tarsal bones (ie, tarsal subluxation) that induce strain patterns within the local tissues. Tarsal subluxation is a type of somatic dysfunction that can be managed with osteopathic manipulative treatment (OMT). In the present article, we describe the case of a young woman with tarsal subluxation that was resolved with OMT.

Report of Case

Presentation

A 24-year-old woman presented with a chief complaint of left foot pain, with tenderness on the plantar surface. The patient indicated that she had "rolled" her ankle while running 3 days earlier and that since then she had been experiencing discomfort each time she bore weight on her left foot. The patient described her pain as achy and constant and rated its severity as 4 on a 10-point scale. The severity of the pain remained unchanged throughout the day. She experienced mild pain relief after using a nonsteroidal anti-inflammatory medication, but she ultimately preferred avoiding medication when possible. She reported minimal swelling or discomfort at the ankle joint and denied difficulty with lower extremity movements. When questioned about her normal level of activity, she reported being actively involved in yoga, figure skating, running, and dancing. The pain was interfering with these activities.

Patient History

The patient's past medical history included nonrecent sinus and ear infections and occasional muscle soreness after strenuous exercise. She denied any past surgical interventions. Regular medication included birth control and daily vitamins. The patient reported having a mild milk allergy, stating that she had headaches after consuming large amounts of dairy products. She denied the use of tobacco products and indicated that she consumed alcohol rarely. Family medical history included a mother who had fibromyalgia and a father who died of lymphoma.

Examination

On examination, the patient had a blood pressure of 118/76 mm Hg, a heart rate of 68 beats per minute, and a respiratory rate of 18 breaths per minute. A focused examination of the lower extremities revealed somatic dysfunction: point tenderness to the plantar surface of the left foot was found anterior to the calcaneus and inferior to the medial aspect of the cuboid bone. The cuboid bone was found to be everted about its anteroposterior axis, as evidenced by a palpable fullness. Examination revealed no signs of infection, foreign bodies, or cutaneous tissue damage. Pedal pulse, sensation, and passive and active range of motion were found to be intact bilaterally. Leg lengths were equal while the patient was supine, without evidence of internal or external rotation of the proximal or distal leg segments. During standing postural examination, the patient described mild discomfort with weight-bearing on her left foot. Iliac crest heights were equal, with no evidence of genu valgus or varus. Pedal architecture was negative for pes cavus, pes planus, rotations that would cause toeing-in or toeing-out, and metatarsus adductus. Aside from the previously noted lesion, no somatic dysfunctions were identified at the knee, fibular head, ankle mortise, or forefoot, bilaterally.

Diagnosis and Treatment

On the basis of patient history and clinical examination findings, tarsal subluxation of the lateral midfoot was suspected. The patient was treated using a high-velocity, low-amplitude (HVLA) thrust manipulation (*Figure 2*). With the patient in the prone position, the ipsilateral knee was flexed 70° to 90° to disengage the gastrocnemius muscle and then hung over the edge of the table or positioned on the table. The physician (J.B.) cradled the dorsum of the dysfunctional foot with interlaced fingers and placed his thumbs on the plantar surface of the

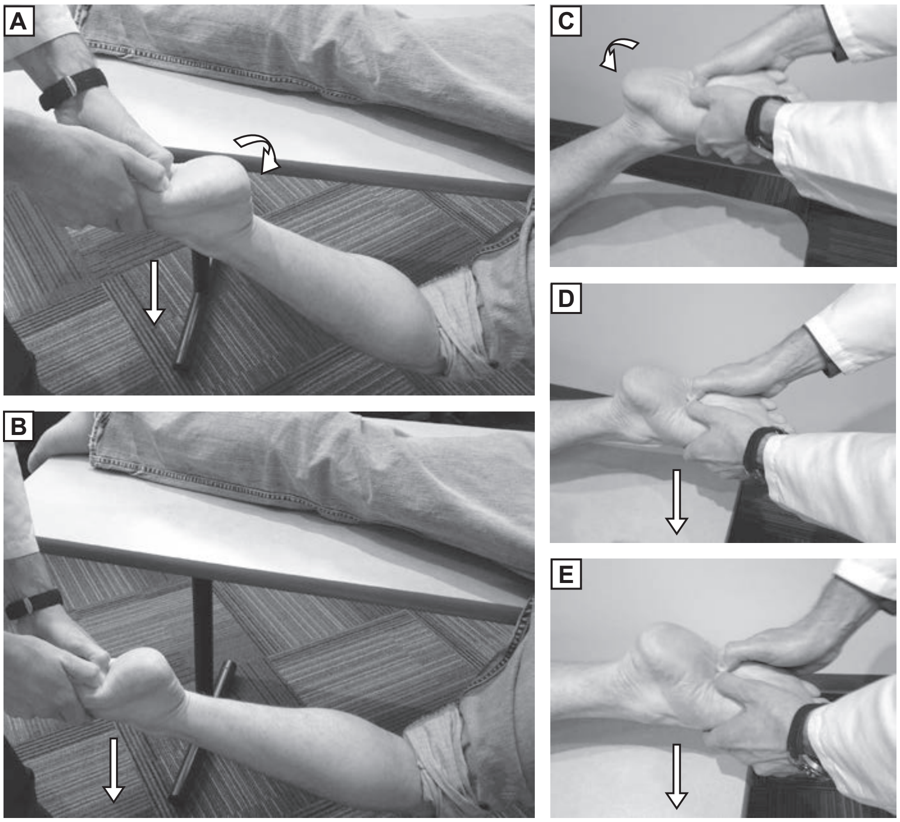

Figure 2.
Manipulation of the cuboid bone. With the patient in a prone position, the patient's knee is flexed 70° to 90°, and then his or her leg is hung over the side of the table (A, B). Alternatively, the patient's knee can be positioned on the table (C-E). The knee is flexed, and in 1 smooth movement the knee is passively extended while the ankle is plantar flexed with mild supination of the forefoot (B, D, E). The operator's thumbs are directed toward the medial border of the cuboid bone, and the operator applies a high-velocity, low-amplitude thrust at the end of the range of motion.

medial cuboid bone. The forefoot was brought into slight supination to open the lateral midfoot. Manipulation involved slight extension of the knee, plantar flexion of the ankle, and a dorsally directed HVLA thrust applied with the thumbs approximately 60° laterally through the medial cuboid bone.[3,5-8] The patient indicated mild discomfort when tissues were adjusted prior to the directed thrust and then relief shortly after the treatment session. Soft tissue OMT technique was performed for approximately 1 minute to encourage nociceptive dissipation.[5] Reevaluation of the foot revealed a decreased cuboid prominence on the plantar surface and minimal tenderness with palpation. The patient was advised to apply a cold compress to the area and use an over-the-counter nonsteroidal anti-inflammatory medication to minimize the pain and inflammation as needed until symptoms completely resolved.

The patient reported less discomfort with weight-bearing and ambulation immediately after treatment. Because of her active lifestyle, the patient was advised to initially modify her daily activities as necessary to permit the tissues to recover completely. She denied recurrence of discomfort at 1-month follow-up and reported no problems returning to her daily activities within 1 week of OMT.

Comment

Tarsal subluxation is described using a variety of names in the medical literature, including *cuboid syndrome*, *dropped cuboid*, *dropped navicular,* and *tarsal somatic dysfunction*; this inconsistency of terminology has made it a poorly understood condition among health care personnel and lay persons alike.[5,6] One type of tarsal subluxation, a subluxed cuboid, or cuboid syndrome, often presents with lateral foot pain that radiates to the plantar aspect of the medial foot, anterior ankle, or lateral metatarsal and is commonly secondary to traumatic ankle inversion injuries.[5,7] Swelling, ecchymosis, and calcaneonavicular tenderness may also be noted along the lateral foot.[6] Traumatic or genetic laxity of supporting ligaments and tendons contribute to the osseous displacement seen in cuboid syndrome, including lateral malleolar discomfort commonly associated with ankle inversion injuries. Diagnosis of this condition is often made from patient history and clinical findings, as radiographic findings may not reveal any abnormalities.[5,6] Palpation may reveal cuboid prominence on the lateral plantar surface of the midfoot, with a deeper than normal groove distal to the styloid process of the fifth metatarsal.[8] In severe cases, a shallow depression may be visible on the dorsal surface of the lateral foot above the medial surface of the cuboid bone.[7] Special evaluations and guidelines such as resisted inversion and eversion exercises,[5] heel and toe raises,[5] Ottawa ankle rules,[5] tarsometatarsal and midtarsal glide tests,[6] and radiologic tests,[5,6] offer only limited information and are not reliable indicators of cuboid syndrome, but they may be used in evaluating this condition and in the differential diagnosis.

Once an accurate diagnosis has been made, cuboid syndrome can be resolved with OMT. Reduction of the displaced bone is the initial step to relieving patient discomfort and is often performed through HVLA mobilization at the end of joint range.[5,7] This OMT technique can be performed with the patient either lying prone on a table or standing.[9] It is recommended that "whipping" of the leg be avoided so as not to introduce extemporaneous forces to the talocrural joint.[6,9] The patient may experience a substantial decrease in the severity of or a full resolution of symptoms immediately following the manipulation of the displaced cuboid bone, with minimal recurrence.[5,6,9] In refractory cases, multiple attempts at manipulation may need to be performed for adequate results.[5,6]

Other conservative methods have been described in the literature, including therapeutic exercise, low dye arch taping, and padding.[5,6] Despite its simplicity, manipulation is contraindicated when neoplasms or other bone disease, gout, inflammatory arthritis, or vascular abnormalities are identified.[6,7,9]

Although various manipulative techniques have been described in the management of cuboid syndrome—including *cuboid squeeze*,[6,9] *modified hiss plantar whip technique*,[3] *cuboid whip*,[6,9] *foot: cuboid, plantar rotation technique*,[8] and *black snake heel whip*[6]—the general principle remains the same for any treatment approach: cuboid bone reduction (or realignment) should be the first line of treatment.

Postmanipulative care varies by operator, but treatment guidelines generally recommend applying ice to the lateral foot for pain and inflammation control.[7] Some practitioners use massage, orthotics, ultrasonography, or taping as part of therapeutic modalities for cuboid syndrome with varied results.[5-7,9] As described earlier, the most important component of treatment is reduction of the displaced cuboid bone. Manipulation remains the conservative therapy of choice in patients with tarsal somatic dysfunction.

Conclusion

Ankle inversion injuries are common and often associated with cuboid syndrome. Notably, a tarsal somatic dysfunction can be diagnosed with palpatory examination findings. Because of the limited knowledge of cuboid syndrome, diagnosis and management of the condition are contingent on practitioner experience. Therefore, the condition should be considered in the differential diagnosis of lateral foot pain secondary to inversion ankle injuries. Osteopathic manipulative treatment techniques—particularly HVLA—readily play a role in the conservative care of patients with tarsal somatic dysfunction.

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