

Lateral Ligament Reconstruction for Ball-and-Socket Ankle Accompanying Lateral Ankle Instability: A Case Report and Literature Review

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ABSTRACT

The ball-and-socket ankle joint is a rare deformity characterized by the loss of concavity in the trochlear surface of the talus with rounding of the articular surfaces of the distal fibula and tibia. Frequently, tarsal coalitions, fibular hypoplasia, and shortening of the limb accompany this deformity. To date, no data have been reported on surgical treatment of lateral ankle joint instability and peroneal tendon dislocation concomitant with a ball-and-socket ankle joint. In the present study, we report the case of a 43-year-old male patient with right lateral ankle joint instability and peroneal tendon dislocation in a ball-and-socket ankle joint, with accompanying tarsal coalition. This was surgically treated by lateral ankle joint ligament reconstruction and tenodesis.

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A ball-and-socket ankle joint is known to occur from the loss of concavity in the trochlear surface of the talus, with rounding of the distal tibial and fibular articular surfaces (1). This condition was described by Politzer (2) in a German study in 1931 and Lamb (3) in an English study in 1958. The ball-and-socket ankle joint is an extremely rare condition, and the exact incidence is unknown (4). The etiology of the deformity is controversial but it has been reported to result from primary germplasm malformation or be secondary to an adaptive response to abnormal subtalar joint structure and function (1,5–7).

Poor development of the lateral malleolus, shortening of the limb, and tarsal coalitions can accompany the deformity (8–10). Patients are usually asymptomatic; however, increased ankle mobility, recurrent ankle sprains, persistent lateral pain, and decreased motion in the subtalar and mid-tarsal joints has been observed (11,12). Rarely, arthrosis of the ankle and/or subtalar joints will occur (13).

The treatment strategies depend on the patient's complaints. Asymptomatic patients might be observed without any treatment and/or treated conservatively with orthosis (14,15). Different approaches are available for surgical treatment, including debridement of the impinging osteophytes, subtalar arthrodesis, corrective osteotomy, and ankle joint arthroplasty, for symptomatic cases (6,11,13,16).

We present the case of a 43-year-old male patient who underwent treatment with lateral ligament reconstruction and peroneal tenodesis for lateral ankle joint instability and peroneal tendon dislocation accompanying a ball-and-socket ankle joint. To the best of our knowledge, the present report is the first of a case of a ball-and-socket ankle joint treated with lateral ligament reconstruction of the ankle joint.

Case Report

A 43-year-old male patient reported localized pain on the lateral aspect of the right ankle and recurrent spraining. The patient complained of intermittent pain after a sports injury that occurred when he was 20 years old. The patient had been treated with several analgesic medications and ankle splints for 20 years. He reported that he had no close relatives with any type of bone deformity.

On physical examination, he had minimal tenderness on the lateral aspect of his right ankle joint. The lateral malleolus was more prominent on the right side than on the contralateral side. The longitudinal length (between the back of the heel and the longest toe) of the right foot was 3 cm less than that of the left foot. The right ankle dorsiflexion was 15° and plantarflexion was 45°. The alignment of the hindfoot was normal. The length of the lower extremity was measured from the anterior superior iliac spine to the medial malleolus of the tibia. The right lower extremity was 2 cm shorter than the left side. Peroneal tendon dislocation was demonstrated when dorsiflexion and eversion against resistance was performed. However, he had no ligamentous laxity, and the neurologic examination revealed normal results.

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A ball-and-socket ankle joint and concomitant tarsal coalition was diagnosed from the posteroanterior and lateral radiographic images (Fig. 1). Synostosis was present between the fourth and fifth metatarsal bones. The right proximal fibula was hypoplastic. The contralateral foot and ankle joint images were normal. A talocalcaneonavicular coalition was confirmed by computed tomography (Fig. 2). On the magnetic resonance imaging scan, the anterior talofibular and calcaneofibular ligaments were not seen, and synovitis was present in the ankle joint. The patient underwent surgery for ankle joint instability and peroneal tendon dislocation.

Synovectomy using ankle arthroscopy was performed. No cartilage irregularities were seen during the arthroscopic evaluation. Tunnels were created through the talus, fibula, and calcaneus for reconstruction of the anterior talofibular and calcaneofibular ligaments. Lateral ligament reconstruction was performed using a fresh-frozen fascia lata allograft (17). Next, peroneal tenodesis was performed.

A short leg splint was applied for 3 weeks in the early postoperative period. The patient was allowed partial weightbearing with crutches. At the sixth postoperative week, he was mobilized with full weightbearing. At the 2-year follow-up examination, his daily

activities, such as climbing stairs, were well tolerated by the patient. He had not experienced further ankle joint sprains after the operation.

Discussion

A ball-and-socket ankle joint is an extremely rare condition. Unilateral involvement is frequent; however, the presence of a bilateral deformity has been reported to be 6% to 40% in different case series (5,6,18,19). Although the underlying etiology is controversial, a defect during the early embryogenesis or adaptive alterations has been postulated for the occurrence (1). Germplasm malformations during early embryogenesis were reported as the cause of congenital occurrence of this rare deformity (6,13). In contrast, a ball-and-socket deformity has also been reported as a secondary response to increased mobility of the ankle joint resulting from movement limitation in the subtalar and mid-tarsal joints owing to an accompanying tarsal coalition (1,5,19,20).

The occurrence of some uncommon anomalies accompanying the ball-and-socket ankle joint deformity have been reported in published studies (1,3–16,18–24) (Table). A ball-and-socket ankle joint is usually



Fig. 1. (A) Ball-and-socket ankle deformity of the right ankle in a 43-year-old male patient. (B) Anteroposterior and (C) lateral images of the ankle joint. (D) Synostosis seen between the fourth and fifth metatarsal bones on the anteroposterior image.

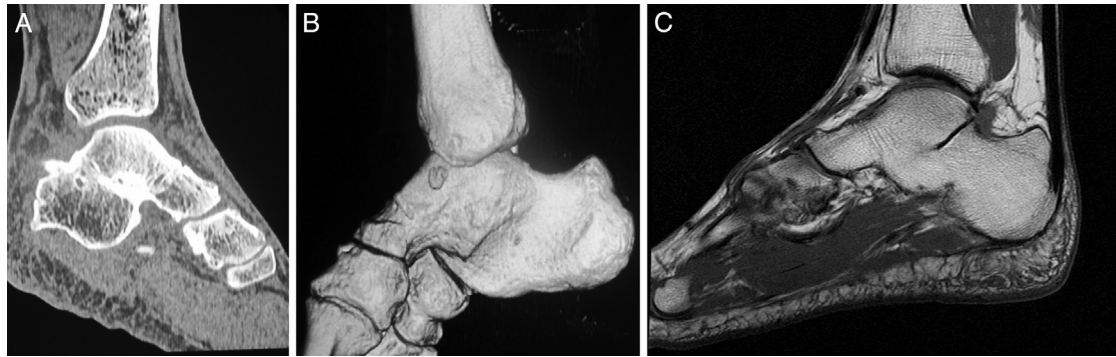


Fig. 2. Talocalcaneonavicular coalition seen on (A) computed tomography scan, (B) 3-dimensional computed tomography scan, and (C) magnetic resonance imaging scan.

accompanied by tarsal coalitions (1,4,12). According to the published data, the most common types of tarsal coalitions are talocalcaneal and talonavicular fusions (1,5,12). The presence of a talocalcaneonavicular coalition, such as occurred in the present case, was reported to be an extremely rare condition (1,5,10). Achterman and Kalamchi (25) reported the presence of a ball-and-socket ankle joint deformity in 38 of 46 patients with fibular hemimelia. Lloyd-Roberts and Clark (21) reported 3 cases of a ball-and-socket ankle joint associated with metatarsus adductus. Channon and Brotherton (1), in their series of 15 patients with a ball-and-socket ankle joint, reported the presence of a

short and high-arched foot in contrast to the contralateral foot, syndactyly, absence of the 12th rib, and shortening of the lower limb. Takakura et al (22) reported that patients had an absent or fused ray, pes planovalgus, and club foot concomitant with a ball-and-socket ankle joint. Flatfoot, vertical talus, clinodactyly, symphalangism, acetabular dysplasia, absence of the portal vein, block vertebra, genu valgum, and absent cruciate ligaments are other rarely encountered anomalies (12,13,23,24). No additional anomaly, other than the synostosis between the fourth and fifth metatarsal bone and fibular hypoplasia, were present in our patient.

Table

Associated hindfoot coalitions and other pathologic entities reported

Investigator	Year	Cases/Feet (n)	Associated Hindfoot Fusions (Coalitions)	Other Pathologic Entities
Lamb (3)	1958	5/5	Talocalcaneonavicular (n = 4)	Absent ray and cuneiform; fibular hypoplasia; fused metatarsal bases; limb length discrepancy
Weston (24)	1962	1/1	Talonavicular (n = 1)	Absent ray; congenital block vertebra in cervical spine
Schreiber (20)	1965	3/3	Talonavicular and talocalcaneal (n = 1)	Absent ray; limb length discrepancy; syndactyly
Lloyd-Roberts et al (21)	1973	3/5	Not well-defined (n = 1)	Absent ray; limb length discrepancy; metatarsus adductus varus
Channon et al (1)	1979	15/15	Talonavicular (n = 2); talocalcaneal (n = 4); talonavicular and talocalcaneal (n = 4)	Absent ray; absent rib and transverse process; sacralization of fifth lumbar vertebra; absent toe; club foot; fibular hypoplasia; high arched short foot; limb length discrepancy; scoliosis; spina bifida occulta; syndactyly
Pappas et al (19)	1982	51/55	Not well defined (n = 30)	Absent ray; club foot; fused ray; limb length discrepancy; syndactyly
Takakura et al (22)	1986	7/10	Not well-defined (n = 6)	Absent fibula; absent ray; congenital club foot; fibular hypoplasia; fused ray; oligodactyly; symphalangia
Pistoia et al (18)	1987	14/16	Talonavicular (n = 6); talonavicular and calcaneocuboid (n = 2)	Absent cuneiform; absent ray; fused metatarsal bases; hypoplastic metatarsal; hypoplastic mid-phalanx; limb length discrepancy; myelomeningocele; short fibula; talipes equinovarus
Steingard et al (15)	1995	1/1	Talocalcaneal (n = 1)	Limb length discrepancy
Scranton et al (14)	1997	4/4	Talocalcaneal (n = 4)	Ligament laxity
Takakura et al (5)	1999	10/14	Talocalcaneal (n = 2); talocalcaneal and talonavicular (n = 2); talocalcaneal and calcaneocuboid (n = 3); talonavicular and calcaneocuboid (n = 3); talocalcaneal, talonavicular, and calcaneocuboid (n = 3); gross coalition of all tarsal bones (n = 1)	Congenital longitudinal deficiency of fibula; os subtibiale
Kumar et al (4)	2002	1/1	None	None
Ruiz Santiago et al (7)	2002	1/1	None	Hypoplastic sustentaculum tali; shortening of tibia
Cetinus et al (9)	2003	1/1	Talocalcaneal and talonavicular (n = 1)	Fused metatarsal bases; limb length discrepancy; pes cavovarus
Stevens et al (6)	2006	16/17	Not well-defined (n = 3)	Limb length discrepancy; skew foot
Baek et al (10)	2008	12/12	Talocalcaneal and talonavicular (n = 2); talocalcaneal (n = 2); calcaneocuboid (n = 2); talocalcaneal and calcaneocuboid (n = 2)	Fibular hypoplasia; limb length discrepancy; terminal hemimelia
Zandieh et al (23)	2008	1/2	Talonavicular (n = 2)	Portal vein atresia
Fernandes (8)	2011	1/1	Talocalcaneal (n = 1)	Absent ray; fused phalanges; limb length discrepancy
Colin et al (11)	2013	1/2	Not well-defined (n = 2)	None
Ellington et al (12)	2013	13/13	Talonavicular (n = 11); talonavicular and calcaneocuboid (n = 1); talonavicular and talocalcaneal (n = 1)	Absent ray; brachymetatarsia; clinodactyly; fibular hypoplasia; short hallux
Fan et al (16)	2014	1/2	None	Subtalar synovitis
Lewis et al (13)	2015	4/5	Talocalcaneal (n = 1)	Hindfoot valgus

Limited published data related to the treatment of a ball-and-socket ankle joint are available. Observation was suggested for asymptomatic patients, and orthosis was the choice for preventing the advancement of progressive valgus deformity (1,21). The main purposes of surgical treatment are reorientation of the ankle alignment, prevention of osteoarthritis, and symptom relief (12). The accompanying hindfoot coalitions, ankle misalignment, and ankle instability must be considered during treatment planning (12). Corrective osteotomies for the valgus deformity of the hindfoot, arthrodesis, medial malleolar epiphysiodesis, and total ankle joint arthroplasty are optional surgical strategies for this deformity (6,12,13). Lateral ligament reconstruction and peroneal tenodesis were our choice for the surgical procedure owing to the absence of cartilage damage and/or hindfoot malalignment in the present case.

Increased loading presses the ankle to the valgus position in the ball-and-socket ankle joint owing to fibular shortness and the spherical shape of the plafond (6). This condition is important in the development of ankle joint instability. Two surgical procedures have been reported for the treatment of chronic ankle instability: direct repair and lateral ligament reconstruction. The functional results for patients with ankle instability treated by lateral ligament reconstruction have been promising. Jung et al (26) reported an increased American Orthopaedic Foot and Ankle Society scale score from 63 before surgery to 91 at 19 postoperative months in their series, including 27 patients who had undergone lateral ligament reconstruction. Furthermore, similar results were obtained by Hua et al (27) and Vega et al (28) in their series. Lateral ankle joint instability concomitant with a ball-and-socket ankle joint was previously reported in only 2 cases (1,3). Both of these patients were treated conservatively. Surgical treatment was chosen for our patient because the conservative approach had been unsuccessful. To the best of our knowledge, surgical treatment of talocalcaneonavicular fusion and lateral ankle joint instability accompanying a ball-and-socket ankle joint, such as in the present case, has not been previously reported.

In conclusion, in the present case, lateral ankle ligament reconstruction and peroneal tenodesis resulted in functional improvement in the ankle joint of a patient with lateral ankle instability that had developed secondary to a ball-and-socket ankle joint deformity. Lateral ligament reconstruction without hindfoot osteotomies might be sufficient for patients with normal hindfoot alignment.

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