Fibrin Glue as Interposition Graft for Tarsal Coalition

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Abstract

We describe a surgical technique and report outcomes for fibrin glue interposition after resection of a tarsal coalition.

An institutional review board–approved retrospective review of all pediatric patients with a tarsal coalition managed with resection was conducted between January 2002 and July 2010 by a single surgeon. All coalitions were resected with interposition of fibrin glue. Patients were evaluated for postoperative complications, pain, weight-bearing status, return to sports, and ankle and subtalar range of motion. Six feet without a coalition were used as a control group.

Nine patients (12 feet) were identified with mean follow-up of 2.1 years (range, 7-72 months). Preoperative complaints were predominately foot and ankle pain. Patients also reported flatfeet and recurrent ankle sprains. There were no reported postoperative complications. All 9 patients were weight-bearing as tolerated and returned to sports by 6 months.

Fibrin glue is a safe and reliable alternative to tissue grafts for interposition after resection of a tarsal coalition.

A tarsal coalition is a fibrous, cartilaginous, bony connection, or a combination thereof, between 2 or more of the tarsal bones in the foot. Tarsal coalitions occur from a congenital failure of differentiation and segmentation of the primitive mesenchyme. Clinically, many patients present between ages 8 and 16 years with a painful flatfoot, which coincides with ossification of a cartilaginous coalition, and they often have pain located in the region of the sinus tarsi.[1-3] Patients may also report recurrent ankle sprains.[4] On examination, there may be decreased subtalar motion. Epidemiologic studies have estimated that isolated tarsal coalitions occur in less than 1% of the population.[5] Radiographic evaluation begins with plain radiographs of the foot.[6] Improved visualization of the coalition can be obtained with computed tomography (CT).[7,8] When a fibrous coalition is expected, then magnetic resonance imaging (MRI) is preferred (**Figure 1**).[9]

Figure 1. Magnetic resonance imaging of bony calcaneonavicular coalition with anteater sign.

The goal of treatment is to relieve pain. Surgery is indicated once nonoperative treatment has failed. Nonoperative treatment includes use of anti-inflammatory medication, use of shoe inserts, and cast immobilization. Approximately 30% of patients remain pain-free after 6 weeks of cast treatment.[10] Surgical options include resection with interposition of the extensor digitorum brevis (EDB) or local or buttock fat.[11-13] Calcaneal osteotomy is considered with a severe planovalgus hindfoot. Triple arthrodesis is indicated when degenerative arthrosis is present.[14]

Success rates for resection and interposition of EDB have been as high as 89% in cases with 10-year follow-up, but lower success rates have been documented.[11,12,15] In a case series reported in 2009, Mubarak and colleagues[13] reviewed the results of managing calcaneonavicular coalitions with resection and interposition of gluteal fat. They found that 87% of patients had returned to sports or prior activities by 1 year after surgery,

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and 5% had symptomatic regrowth of their coalition. Fibrin glue (ie, fibrin sealant) is composed of thrombin and fibrinogen; when these 2 compounds are mixed, the enzyme, thrombin, converts the fibrinogen to fibrin, and a fibrin clot is formed.[16,17] Clinically, fibrin glue has been used to provide tissue adhesive for skin grafts, to repair dural or brachial plexus tears or bronchial fistulas, and to achieve hemostasis in liver and spleen surgery.[18-22]

To our knowledge, this is the first report of use of fibrin glue/sealant instead of fat or muscle for interposition after resection of a calcaneonavicular coalition. We describe our surgical technique and the outcomes for fibrin glue interposition after resection of a tarsal coalition.

Materials and Methods

Institutional review board approval was obtained before initiation of this study. We retrospectively reviewed the clinical records of all of the senior author's (AEP) patients with a tarsal coalition managed with resection and interposition of fibrin sealant (Tisseel; Baxter Healthcare Corp, Deerfield, Illinois) between January 2002 and December 2010. Patient charts were reviewed for information on preoperative symptoms, postoperative functional level and range of motion (ROM) of the ankle and subtalar joints, details of the surgical procedure, postoperative pain, and scores on the Foot and Ankle Outcomes Instrument (FAOI) and the 36-item Short Form Health Survey (SF-36). Postoperative pain and FAOI and SF-36 scores were assessed at final follow-up. Postoperative pain was rated on a scale of 0 (no pain) to 10 (worst pain). The FAOI is a validated outcome measure[23] with a scale ranging from 0 to 100 (with higher scores indicate better outcomes).

Standard anteroposterior, lateral, and oblique radiographs were obtained for all patients before surgery; available preoperative CT or MRI scans were reviewed. At each postoperative visit, patients were assessed for pain, complications, and return to prior functional level. The surgical indication for resection was continued pain or disability after a trial of nonoperative treatment.

Figure 2. Radiograph of resected calcaneonavicular coalition with interposition of fibrin glue.

Figure 3. Insertion of fibrin glue.

Figure 4. After insertion of fibrin glue.

All procedures were performed by the senior author (AEP). For each coalition, a standard surgical approach was used. After an osteotome was used to completely resect the coalition, bone wax was placed over the bony ends of the resection. Next, fibrin glue (approximately 5 mL) was injected into the site of the resected coalition (**Figures 2-4**). The wound was gently irrigated and closed using the usual layered technique. After surgery, the patient was placed in a well-molded plaster splint for approximately 2 weeks. Physical therapy was initiated at the 2-week postoperative visit. Aggressive physical therapy was continued until calf circumference was symmetrical. Patients were followed until they had returned to full activities.

Results

Over the 8-year study period, surgical resection with interposition of fibrin glue was performed on 9 patients (12 feet) by the senior author (AEP). For the 5 men and 4 women patients, mean age at time of surgery was 14.6 years (range, 11-23 years). Follow-up ranged from 7 months to 6 years (mean, 25 months). Of the 9 patients, 5 were treated for an isolated calcaneonavicular coalition, 3 had bilateral calcaneonavicular coalitions, and 1 had a fibrous calcaneonavicular and middle facet talonavicular coalition in the same foot. Of the 12 resected coalitions, 7 were bony and 5 were fibrous. All the fibrous coalitions were diagnosed with MRI. All the coalitions were resected and treated with interposition of fibrin glue. For controls, we evaluated the uninvolved feet of those with unilateral coalitions (**Table I**).

Foot pain was the primary concern in 5 patients; the other 4 patients also reported ankle pain or recurrent ankle sprains. One patient with foot pain also reported having a flatfoot. All patients reported activity limitations secondary to symptoms. On examination, all patients had decreased ROM of the subtalar joint.

No patient had a postoperative wound complication or an unexpected return to the operating room. At final follow-up, 8 of the 9 patients rated their pain 0 (no pain); 1 patient rated it 1. Postoperative radiographs showed no recurrence of any of the coalitions. All 9 patients had returned to sports by

6 months. On the operated feet, mean ankle dorsiflexion was 21.5° (range, 10°-34°), mean ankle plantarflexion was 50.9° (range, 35°-70°), mean subtalar inversion was 21.5° (range, 10°-40°), and mean subtalar eversion was 4.6° (range, 0°-10°). Mean FAOI score was 93.22 (range, 89-100), and mean SF-36 score was 95.1 (range, 91.1-98.8). For the 6 feet without a coalition, mean ankle dorsiflexion was 20.5° (range, 12°-38°), mean plantar flexion was 55.0° (range, 45°-70°), mean subtalar inversion was 18.0° (range, 8°-30°), and mean subtalar eversion was 5.8° (range, 3°-10°) (**Table II**).

Discussion

Many techniques for managing tarsal coalitions have been described. Most physicians perform a resection of the coalition with interposition of an autologous tissue graft. The most commonly used tissue grafts are buttock fat, local fat, and muscle (eg, EDB). Each technique has the potential for increased patient morbidity related to obtaining the graft. The advantages of using fibrin glue for interposition are elimination of the increased morbidity associated with tissue graft harvest, decreased operative time, and potential reduction in the coalition recurrence rate.

Multiple retrospective studies have documented good results with coalition resection.[11,24-26] Mubarak and colleagues[13] recently examined clinical, functional, and radiographic evaluation to measure success with coalition resection and fat graft. They found that 87% of patients had returned to their prior level of function by 1 year. They also reported a 5% rate of symptomatic regrowth requiring repeat excision. Our study examined return to activities, postoperative subtalar ROM, postoperative complications, and outcomes questionnaire scores.

Mean age of our patients was 14.6 years, slightly older than the mean in other studies[11,13] but consistent with the theory that the patient becomes symptomatic after ossification of the coalition, which causes decreased subtalar motion and hindfoot stiffness. All 9 of our patients reported being unable to fully participate in their activities. Five patients had foot pain, and 4 had ankle pain and recurrent ankle sprains; sprains have been reported by other authors.[2,14,27]

None of our 9 patients developed a postoperative wound complication. Although our patient series was relatively small, there appeared to be no increased morbidity with use of fibrin glue. Fibrin glue has been successfully and safely used as a hemostatic agent and adhesive in other disciplines, with multiple studies showing few adverse reactions with use of fibrin glue.[28-33]

All 9 patients in our study returned to their usual sports, with a few as early as 4 months. Before surgery, all patients had a follow-up radiograph, which showed no evidence of coalition regrowth. Studies with larger series of patients have reported a symptomatic regrowth rate of 5%.[13] None of our patients had symptomatic regrowth of the coalition. Given the small number of patients in our study, we cannot conclude that fibrin glue is more effective in preventing coalition regrowth. In addition, as only 1 patient in our study had a middle facet coalition, we cannot conclusively say that this is an effective treatment option for middle facet coalitions.

Postoperative ROM for the 12 feet in our study was consistent with mean ROM for the 6 normal feet. Our postoperative ROM was also consistent with published norms.[34,35] Mean FAOI score was 93.22 (range, 89-100) and mean SF-36 score was 95.1 (range, 91.1-98.8), which indicate that all patients had excellent outcomes.

We chose fibrin glue as an alternative to interposition of tissue to decrease the risk for morbidity and increased operative time associated with harvesting fat through a separate incision or part of the EDB. We believe that fibrin glue forms a barrier between the bony edges of the resected coalition that prevents coalition recurrence or scar tissue from forming in the area that may subsequently limit hindfoot motion. The list price for 4 mL Tisseel fibrin sealant (Baxter Healthcare Corp) is $262.01. In our opinion, the higher cost of using this product is mitigated by the longer operating room time and higher morbidity associated with harvesting fat from a separate incision or the morbidity associated with using part of the EDB. Regenerative tissue matrix has also been used as an interposition graft.[36] GraftJacket

Table I. Demographics

Characteristics	N = 9
Males (n)	5
Females (n)	4
Mean age (range), years	14.6 (11-23)
Feet	**12**
Isolated calcaneonavicular coalitions	5
Bilateral calcaneonavicular coalitions	3
Multiple coalitions	1

Table II. Results

	Coalition Resection (9 feet)	Control (6 feet)
Ankle dorsiflexion	20.2° (P = .54)	19.8° (P = .54)
Ankle plantarflexion	44.5° (P = .81)	53.5° (P = .81)
Subtalar inversion	22.5° (P = .5)	18.3° (P = .5)
Subtalar eversion	4.3° (P = .5)	5.7° (P = .5)
Foot and ankle outcomes instrument score (range)	93.22 (89-100)	—
36-Item Short Form Health Survey score (range)	95.1 (91.1-98.8)	—

(Wright Medical Technology Inc, Arlington, Tennessee), a regenerative tissue matrix used in orthopedics, has a list price of approximately $1300.

One limitation of our study is that it was a small retrospective case series without a control group.

Fibrin glue is a safe and reliable alternative to tissue grafts for interposition after resection of a tarsal coalition. In this study, no postoperative complications were observed, and all patients reported excellent outcomes and were able to return to sports. We hope that this study prompts studies directly comparing fibrin glue with tissue interposition.

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