CHAPTER 8

# Outcomes of Peroneus Brevis Tendon Repair Using Human Amniotic Allograft

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## INTRODUCTION

Peroneus brevis tendon tears often present as lateral ankle pain and instability caused by mechanical or anatomical factors. Since first reported by Myers in 1924, its incidence today is not always appreciated. Longitudinal peroneus brevis tears have been reported to be between 11 and 37% with significant lateral ankle injuries (1-4). Tears of the peroneus brevis tendon are frequently overlooked leading to misdiagnosis and mistreatment. Dombek et al, found that only 60% of peroneal tendon disorders were accurately diagnosed at first visit (5). Tears and ruptures are commonly associated with other disorders including chronic ankle instability, inversion ankle sprains, tenosynovitis, and ankle fractures (6, 7).

Proper treatment of these injuries requires an understanding of potential anatomic abnormalities that may contribute to this pathology. The anatomic position of the peroneus brevis tendon predisposes the tendon to shear stress due to its location between the fibula and the peroneus longus tendon (8). A convex or flat retromalleolar groove, low lying muscle belly, peroneus quartus, rearfoot varus, procurvatum ankle, posterior lateral fibular spurring, and superior peroneal retinaculum incompetence are additional anatomic abnormalities that can contribute to weakening of the peroneus brevis tendon (2, 5, 9-12).

Surgical treatment options for peroneus brevis tendon tears may include one or more of the following: primary repair of the tendon, debridement, excision of tendon with tubularization, tenodesis, tendon transfer, lateral ankle ligament reconstruction, repair using allograft, peroneal sulcus deepening, or superior peroneal retinaculum repair (2, 6, 13-17). More than one procedure is often performed to sufficiently address the tear and its concurrent anatomic abnormalities as mentioned above.

A thorough biomechanical evaluation will determine whether there is an osseous rearfoot component contributing to the peroneal tendon tear, such as a structural rearfoot varus, which has been found to contribute to peroneal tendon tears by causing increased friction and overloading to the lateral ankle (6). Understanding whether or not the rearfoot inversion is a structural deformity, or rather a compensatory position for a forefoot valgus/plantarflexed first ray, will determine what surgical approach is necessary to correct the deformity and alleviate the forces on the lateral ankle (18). This can be determined using a Coleman Block test in which a patient places the lateral aspect of their foot on a block in order to off-load the first ray. If the rearfoot inversion (supination) corrects itself to the perpendicular or past the perpendicular with the first ray off-loaded, then it confirms that the rearfoot inversion (supination) is forefoot driven and can be corrected with a forefoot procedure such as a first ray dorsiflexory osteotomy. If the rearfoot remains in an inverted position despite the first ray being off-loaded, then it is a structural hindfoot varus deformity that needs to be addressed directly with a calcaneal osteotomy. Another clinical test that can be used to assess the rearfoot inversion (supination), is a valgus wedge test. This can be done by placing a valgus wedge on the forefoot and observing the rearfoot to see if the rearfoot converts to or past the perpendicular. The results of this test can be interpreted in the same manner as the Coleman Block test to help guide your surgical approach.

Human amniotic allograft (HAA) is a commercially available product that is composed of human amniotic membrane, the innermost lining of the placenta. The use of human amniotic allograft in peroneal tendon repair has been minimally reported in the literature, however, it is well documented in its use for many other clinical procedures. Over the past 100 years, human amniotic allograft has been used in chronic wounds, burns, tendon repair, nerve repair, corneal repair, intra-oral reconstruction, hip arthroplasty, microvascular grafts, genital reconstruction, peritoneal reconstruction, dural defects, skin reconstruction, intra-abdominal adhesions, talar dome lesions, calcaneal osteotomies, and reconstruction of nasal lining and tympanic membranes (19-25). Several studies have shown that human amniotic allograft contains an array of growth factors, cytokines, and proteins that contribute to its analgesic, antimicrobial, and anti-inflammatory properties (19-23, 26-29). The primary glycosaminoglycan present in amniotic allograft is high molecular weight hyaluronic acid, which has been shown to decrease adhesions and fibrosis and therefore help with the reduction of scars (19-21, 26, 29-31). The risk for host rejections is eliminated due to

the fact that human amniotic allograft is immunologically inert. Every tissue specimen is procured from live, healthy donors at childbirth and terminally sterilized. The donors undergo a strict screening process and are pre-screened for relevant communicable diseases (32). All of these qualities of human amniotic allograft have made it a suitable product for a variety of foot and ankle pathologies.

There are currently no outcome studies on surgical treatment recommendations for peroneus brevis tendon tears. Publications on the use of allograft in the treatment of peroneal tendon tears are also sparse and limited to a few published case reports. The purpose of this study is to report outcomes of peroneus brevis tendon tear repairs using human amniotic membrane allograft. We hypothesize that human amniotic allograft is a safe and effective treatment option for peroneus brevis tendon tears with minimal complications and preservation of function. Since it is an area where 2 tendons will be stagnant during the acute healing phase, there is a higher potential for scarring between tendons and between the tendons and the sheath/retinaculum. It is felt that the addition of human amniotic allograft in the repair may minimize or assist in negating the acute immobilization of these tendons and thereby improving outcomes.

## METHODS

A total of 368 ankle arthroscopy cases that underwent the triad procedure were reviewed from January 2006 to May 2013. All patients with talar osteochondral defects, peroneus longus pathology, previous ankle surgery, diabetes, body mass index greater than 30.1, subtalar joint pathology, and inadequate follow-up were excluded. Each patient was treated operatively by a single surgeon (JJA). The final patient cohort consisted of 45 consecutive triad cases, all with human amniotic allograft used at the brevis repair site. All patients had a history of injury to the ankle, with continued pain, instability, and inability to perform regular activity including exercise and sports. All patients failed conservative care that included bracing, a minimum of 4 weeks of physical therapy, nonsteroidal anti-inflammatory drugs, rest, and immobilization.

Each patient received physical therapy preoperatively and postoperatively, averaging 6.6 and 5.3 weeks, respectively. The operative procedure included the triad surgical procedure, which consists of ankle joint arthroscopy, lateral ankle ligament reconstruction, and peroneal retinacular tightening. The peroneus brevis tendon repair used tubularization, and excision of low lying muscle belly (33). The human amniotic allograft was then wrapped around the peroneus brevis repair site prior to repair of the peroneal retinaculum. Primary outcomes were patient satisfaction using preoperative and postoperative visual analog scale (VAS) scores, and modified American College of Foot and Ankle Surgeons (ACFAS) hindfoot ankle score system. The VAS was taken preoperatively and at 24 months postoperatively. The ACFAS score was modified for radiographic findings, which were converted to neutral points preoperatively and postoperatively. The modified ACFAS score was measured preoperative as well as at 3 months, 1 year, and 2 years postoperatively. A paired *t*-test was used to determine statistically significant findings.

## SURGICAL TECHNIQUE

A standard anterior, lateral, and medial ankle scope portal approach was used. Any superficial chondritis, anterior lipping, or anterior pinch lesions were addressed. An 8 cm curvilinear incision was made over the lateral portion of the ankle beginning 5 cm posterior to the lateral malleolus and curving distally anterolateral to incorporate the lateral portal and then posteriorly below the tip of the fibula for the lateral ligament exposure (Figures 1-5). The incision was deepened through soft tissue down to the level of the peroneal tendons. The peroneal retinaculum was entered proximally to allow its reattachment to the periosteum on the fibula. No anchors were used. Any presence of a low-lying peroneus brevis muscle belly, accessory tendon, and/or synovitis and redundant retinaculum were excised. The longitudinal tears were repaired with direct tubularization of the brevis.

The human amniotic allograft (NuShield protective patch, NuTech Medical) was applied as a sleeve around the brevis, and the peroneal retinaculum was oversewn with the peroneal tendons returned to their retrofibular groove. Lastly, the anterior talofibular ligament and calcaneofibular ligament were oversewn with incorporation of the lateral slip of the extensor retinaculum. The skin was closed in standard fashion with vicryl and nylon suture.

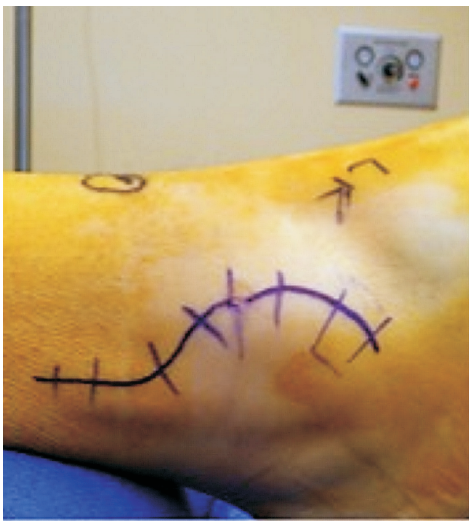

Figure 1. Curvilinear incision placement on lateral ankle.

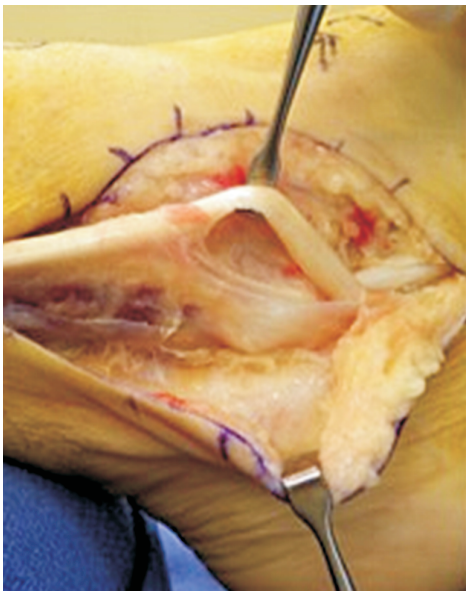

Figure 2. Peroneus brevis tendon tear prior to repair.

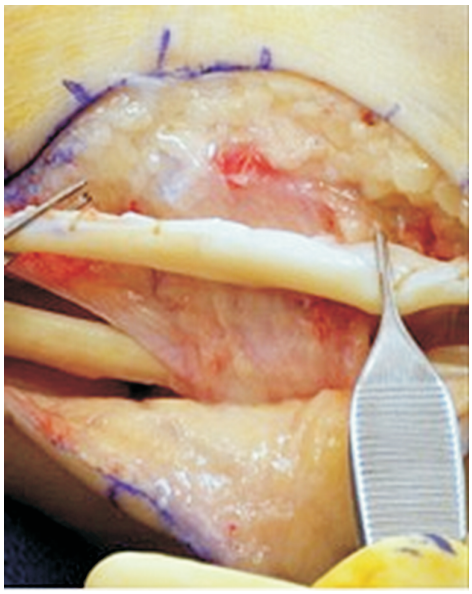

Figure 3. Peroneus brevis tendon after repair with direct tubularization.

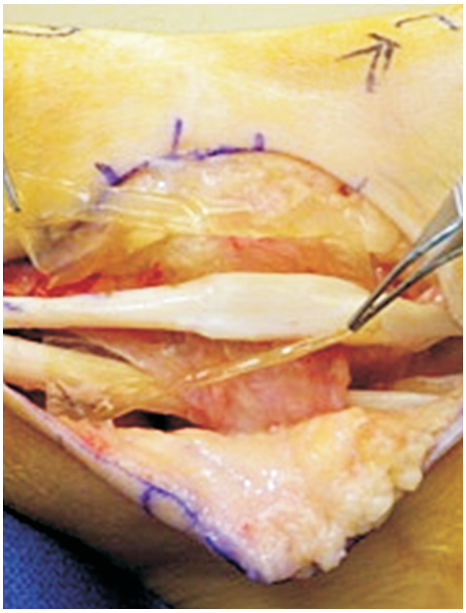

Figure 4. Peroneus brevis tendon with human amniotic allograft.

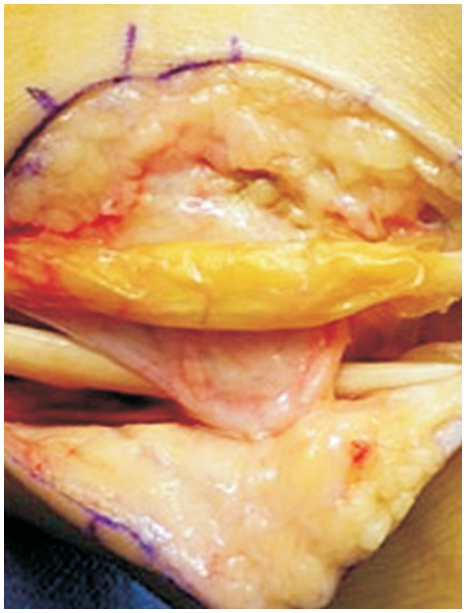

Figure 5. Human amniotic allograft wrapped around the repaired peroneus brevis tendon.

## RESULTS

The average age of the patients was 39 years (range 18-70 years). There were 19 females and 26 males. A total of 39 of 45 patients (86%) had intra-operative findings of a low-lying muscle belly defined as at or below the distal tip of fibula, and 82% of the patients had a magnetic resonance image confirmed split-tear of the peroneus brevis preoperatively. The average size of the peroneus brevis tendon longitudinal tear was 2.6 cm, (range1.5-4 cm). The average VAS score preoperatively was 6.1, and postoperatively was 1.2. This was a statistically significant improvement in pain ($P < 0.05$) (Table 1). The average modified ACFAS score was 72 preoperatively, 89 at 3 months postoperative, 90.9 at 1 year postoperative, and 90.2 at 2 years postoperative. These were also statistically significant (all $P < 0.05$ when compared to the preoperative score) (Table 2).

**Table 1. Visual analog scale (VAS) scores**

| | Preoperative | Postoperative | *P* |
|---|---|---|---|
| **VAS** | 6.1 | 1.2 | <0.05 |

**Table 2. Modified American College of Foot and Ankle Surgeons (ACFAS) scores**

| | Preoperative | 3 months Postoperative | 1 year Postoperative | 2 years Postoperative |
|---|---|---|---|---|
| **Modified ACFAS** | 72 | 89 | 90.0 | 90.2 |
| ***P*** | | <0.05 | <0.05 | <0.05 |

Patient comorbidities were documented. There were 8 patients with hypertension. Of these 8, 2 also had moderate obesity, and 2 had thyroid disease. Complications included 1 patient who developed complex regional pain syndrome and another patient who experienced nerve entrapment postoperatively .

## DISCUSSION

The results of the present retrospective study have demonstrated promising outcomes for the use of human amniotic allograft as an adjunct to the triad procedure to repair peroneus brevis tendon tears. With minimal complications and zero postoperative infections, our results are consistent with prior publications showing that the use of human amniotic allograft in foot and ankle procedures is safe. Since its first use in skin transplantation in the early 1900s, there have been several studies showing its utility and safety in foot and ankle surgeries (20, 22-28). Demill et al published a retrospective study reporting the short-term outcomes of cryopreserved amniotic membrane and umbilical cord tissue in foot and ankle surgery (19). The authors reported 20 different surgical procedures that involved the use of amniotic allograft, with the most common procedure performed being Achilles and peroneal tendon repair. Of the 124 patients, the overall wound complication rate was 5.64% with only 2.4% having continued pain at surgical site. The authors found that the complication rate was much lower than what was historically noted to be (19).

Anderson et al found that using human amniotic allograft in addition to microfracture for treatment of talar dome lesions also helped decrease postoperative pain (22). In their retrospective study, 37 patients with osteochondral lesions measuring 2 cm or smaller were treated with microfracture and human amniotic allograft. Pain VAS scores and modified AFCAS ankle scores were recorded preoperatively and postoperatively and the authors' reported a statistically significant improvement in these scores with no identified complications. Another study by Anderson et al (25) reported the safety of human amniotic allograft in calcaneal osteotomies, which included 63 patients undergoing an Evans calcaneal osteotomy with implantation of tri-cortical iliac crest bone graft. The authors retrospectively reviewed all 63 patients with a 2 year follow-up and found that the use of human amniotic allograft did not alter the time to union or return to normal shoe gear for this procedure. There were no documented wound dehiscence, nonunion, infection, or immune reactions reported.

Warner et al examined the safety and efficacy of cryopreserved amniotic membrane and umbilical cord in 14 patients undergoing complex reconstructive and/or revision foot and ankle procedures (30). While the study sample was small, the outcomes showed no complications directly related to the use of the allograft, as well as a statistically significant improvement in pain and function via the ACFAS score (30).

The results of this retrospective study have also shown that the use of human amniotic allograft significantly improved pain and function as demonstrated by the VAS scores and modified ACFAS scores. Postoperative adhesions in tendon surgery are of concern to any foot and ankle surgeon due to its limiting range of motion, which may alter the rehabilitation period and lead to continued pain and immobility. It is thought that wrapping the tendon in human amniotic allograft can help decrease those complications. Almost all of the patients in their postoperative visits continued to improve and had increased VAS scores indicating the consistency of the allograft. While we cannot ascertain the role human amniotic allograft played in the reduction of pain, the results are nonetheless favorable in its adjunct use for peroneal tendon repair. While this was one of the limitations of the study, the authors are currently working on a comparative study, which will compare the results of the present study to a control group without the use of human amniotic allograft. This will help to more clearly identify the role human amniotic allograft plays in outcomes in pain reduction. Other limitations of this study include a relatively small sample size of our cohort (n = 39).

The clinical use of human amniotic allograft is steadily increasing in foot and ankle surgeries and additional larger, prospective studies will be useful in confirming its niche in this field. In conclusion, the present study has added to the growing body of research demonstrating the utility and safety of human amniotic allograft in foot and ankle surgery, specifically peroneal tendon repair. With its anti-microbial, anti-inflammatory, anti-fibrotic properties, human amniotic allograft offers numerous benefits to peroneal tendon repairs. Our results have shown that using human amniotic allograft has minimal short-term complications with significant improvement in VAS scores and ACFAS scores, making this an effective adjunct to surgical repair of peroneus brevis tendon tears.

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