13 Groove Deepening Procedures and Approaches to Treatment of Peroneal Tendon Dislocations

David A. Porter and Joseph E. Jacobson

Introduction

Peroneal tendon dislocation is often associated with athletic activity. It was first popularized as a diagnosis in the sport of downhill skiing [20]. It was surmised that the tip of the ski itself would get caught in the snow and the athlete dorsiflexes and evert the ankle while the momentum carries them down the hill. The tip of the ski would remain lodged in the snow and cause the peroneal tendon to seek a more direct path from the lateral foot to the retrofibular area and dislocate anteriorly and laterally around the fibular tip. This dislocation has now been noted in almost all sports and can be associated with similar activity that commonly causes an ankle sprain. From personal observation, lateral ankle instability and peroneal tendon dislocation together is uncommon, occurring in only 10% of cases. It is speculated that a smooth or convex posterior fibula contributes to instability of the peroneal tendons. Nonoperative treatment for peroneal tendon dislocation historically has been proven to be unsuccessful. However, surgical procedures for stabilization have historically shown excellent outcomes. With appropriate rehabilitation and avoidance of some common pitfalls, such as extensive immobilization which leads to scarring, a successful return to recreational or competitive athletics is typically attainable.

D. A. Porter (✉)
Methodist Sports Medicine, Indianapolis, IN, USA
e-mail: davidaporter@sbcglobal.net

J. E. Jacobson
Department of Orthopedics, Indiana University, Indianapolis, IN, USA
e-mail: jacobsje@iu.edu

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Historical Perspective

Peroneal tendon injury is a common problem in both the athletic and nonathletic populations. Most peroneal tendon injuries occur in the middle-aged patient. Peroneal tendon tear and tendinopathy is the most common injury to the peroneal tendon complex. The degenerative tearing of the peroneal tendon occurs in the older population, while the younger athletic population has a much lower incidence of peroneal tendon injury. However, in the younger population, and especially the athletic population, peroneal tendon dislocation is much more common [4, 10]. In fact, peroneal tendon dislocation may be the most common presentation for peroneal tendon complex injury in the teenage and young adult athlete [7]. A great deal of attention has been given to instability of the peroneal tendons, but true dislocation remains uncommon. Pseudosubluxation or intrasheath peroneal tendon instability is also another cause of peroneal tendon pain [26, 27, 37]. This involves the peroneal tendons subluxing within the sheath. Intrasheath subluxation involves the peroneus longus tendon displacing lateral to the brevis within a stretched-out sheath and “loose” superior peroneal retinaculum.

The Anatomy of the Tissue (Peroneals, Retinaculum, and Posterior Fibula) [6]

The peroneus brevis originates off the proximal intermuscular septum and middle third fibula, descends distally in the lateral compartment of the lower leg, and then positions itself in the peroneal sulcus on the posterior distal fibula. The peroneus longus tendon, in a similar manner, originates off the proximal tibia lateral condyle and proximal fibula, is also in the lateral compartment of the lower leg, and positions itself just posterior to the brevis tendon. The longus is slightly more lateral and is more prone to dislocation than the brevis. The posterior sulcus of the fibula has a variable contour; thus, a flat or convex contour is considered a predisposition to dislocation [1, 14]. The two tendons exist in a fibro-osseous tunnel bordered anteriorly by the posterior fibular fibrocartilaginous sulcus (distal 4 cm), posteriorly and laterally by the superior peroneal retinaculum (primary constraint to dislocation) and medially primarily by the calcaneal fibular ligament (CFL), though the posterior talofibular ligament and posterior–inferior tibiofibular ligament form part of the medial border also. There is a posterolateral fibrocartilaginous meniscal-like structure that adds depth and lateral constraint to the retromalleolar groove [1, 14]. This structure is often avulsed with acute tendon dislocations and degenerated in chronic dislocations. The posterior fibular anatomy has a varied surface contour: 82% are concave, 11% are “flat,” and 7% are convex [6, 15]. The flat and convex anatomy, in association with peroneal dislocation, requires a formal fibular osteotomy for groove deepening in addition to reconstruction of the superior peroneal retinaculum, regardless of the acuteness of the dislocation. It should be noted, however, Adachi and coworkers [1] did not find a difference between the inherent anatomy between subjects treated for peroneal dislocation and a similar population of subjects that have not had a peroneal tendon instability history. Schon’s lab has demonstrated that a peroneal groove deepening procedure can reduce the pressure within the peroneal sheath [38], and presumably decrease the risk of recurrent instability.

The Nature of the Problem

A shallow, flat, or convex posterior fibula is thought to lead to poor bony stability of the peroneal tendons. After a dislocation of the peroneal tendon, lack of inherent bony stability puts a significant strain on the repaired or reconstructed superior peroneal retinaculum. It has been concluded that groove deepening of the posterior fibula is not only helpful, but also necessary, in situations where there is no deep bony stability. Even a mild concavity to the posterior fibula is typically enough to prevent redislocation after appropriate superior peroneal repair in the acute settings. However, in the chronic recurring dislocation setting, more concavity is needed to the posterior groove requiring fibular osteotomy for deepening to support the retinacular reconstruction.

Routine ankle imaging does not assess the posterior fibular sulcus. Advanced imaging with MRI, often used in the chronic setting to assess for peroneal tendon tears, can also evaluate the posterior groove, and, in the acute setting, assess the integrity of the superior peroneal retinaculum [35] Thomas has utilized ultrasound (U/S) to evaluate the dislocating peroneal tendons and the integrity of the superior peroneal retinaculum [37]. We have not commonly used this imaging modality but think it will have a more common role as U/S becomes more prevalent in the office practice.

A common question facing the surgeon is Do I need to deepen the groove? And if I do, how deep does it need to be? Also, if I am going to do bony work, does that lead to potential scarring of the tendon? If I choose a groove deepening procedure, should I perform an indirect method? Or is a direct groove deepening procedure more reliable and effective? Further, how does undergoing a groove deepening procedure impact my rehabilitation and return to sports and activity? To further answer these questions, let us examine historically the different groove deepening approaches. Each approach requires some form of an osteotomy of the fibula. See also Ferran's [8], Heckman's [10], and Marti's [17] review on this topic for other approaches and opinions. The earliest approach was described by Kelly [12] and involved a true rotational fibular osteotomy. We have organized our discussion by classifying the approaches as direct and indirect osteotomies/groove deepening's. We should note here that another approach taken by several authors (covered in another chapter in this book) involves rerouting the peroneal tendons under the CFL by osteotomizing the CFL attachment to the distal fibula [16, 25, 31, 32].

Direct Groove Deepening Approaches

RE Kelly, in 1920 reporting from Liverpool England in the British Journal of Surgery [12], first proposed groove deepening for a recurrent peroneal tendon dislocation. He reported making a posterolateral approach to the fibula, remaining anterior to the peroneal groove, and staying out of the peroneal sheath. He

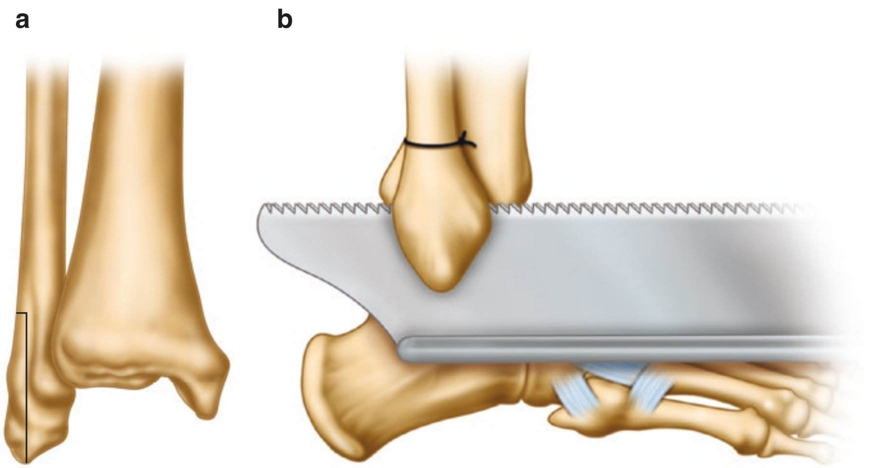


Fig. 13.1 (**a**, **b**) Kelly [12] Veneer graft in lateral malleolus, lateral aspect of fibula is rotated posterior to deepen posterior malleolar sulcus. (Cited with permission)

performed a sagittal "veneer"-type osteotomy of the distal 2 inches above the distal fibular tip and then rotated the lateral bony "veneer" posteriorly to create a deepened groove (Fig. 13.1). The procedure was performed on a sergeant in the Salatonika army and reported a 1-year follow-up with no recurrence to the dislocation.

Zoellner and Clancy [43] proposed and reported on approaching groove deepening via a direct groove approach also. However, rather than a true rotational osteotomy of the fibula, they approached the groove deepening via a hinged posterior flap of the retromalleolar groove which results in a more direct posterior deepening. Their technique involved "*the groove for the (peroneal) tendons is deepened by removal of some inner fibular substance, while the smooth tenosynovial channel is maintained as an intact periosteal flap on the fibula"* [43] (Fig. 13.2). The authors desired *"a simple procedure that corrects the basic deformity of a shallow peroneal groove, without the use of metallic fixation or transfer of a tendon or ligament.*"

Slatis and coworkers [30] modified the Zoellner and Clancy [43] report of direct deepening by removing the cartilaginous gliding layer of bone from the retromalleolar fibular groove, removing further cancellous bone using a curved chisel, and replacing the cartilaginous gliding bone by impacting it into the deepened groove [30] (Fig. 13.2a–c). The tendons are then replaced. No fixation is utilized to secure the replaced posterior bone. Plaster cast immobilization was required to allow healing of the replanted bone. Four case reports were reported and return to sports was 4–5 months postoperative without any redislocations (Fig. 13.3).

Porter, McCarroll, and coworkers [24] also modified the Zoellner and Clancy approach by removing the posterior corticocancellous retromalleolar groove with the intact serosa surface, deepened the distal posterior groove by removing cancellous bone with a motorized 4.0 egg burr, and then replaced the gliding surface by reattaching it with sutures in the depth of the deepened groove [24] (Fig. 13.4a–d).

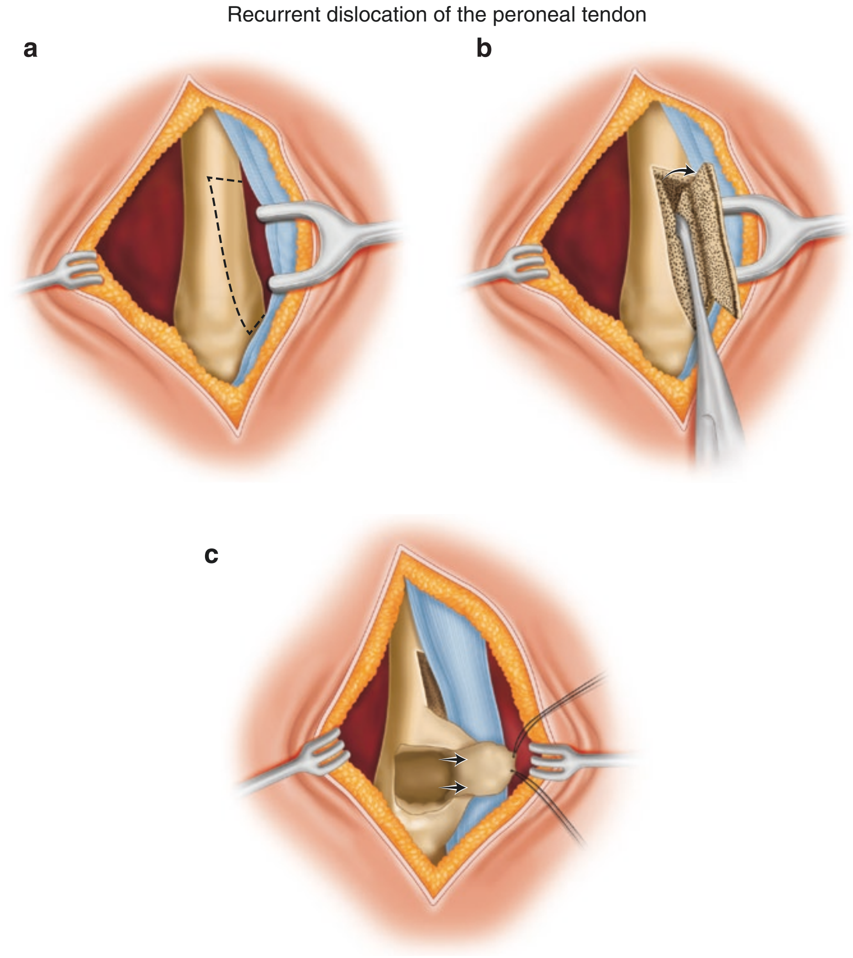


Fig. 13.2 Direct Groove deepening procedure as reported by Zoellner and Clancy [43]. (**a**) Demarcation of osteotomy off posterior fibular with peroneal tendons posteriorly retracted. (**b**) Hinged posterior flap raised initially to allow removal of cancellous bone and then swinging back of the posterior hinged bony flap into area of removed bone to allow "deepen the groove". (**c**) Periosteal flap off lateral fibula with posterolateral hinge to re-inforce and reconstruct the superior peroneal retinaculum after peroneal tendons replaced in deepened groove (cited with permission [43])

The authors note the degree of deepening within the posterior fibula must be enough such that the posterior border of the peroneal tendons lies flush with, or anterior to, the posterior border of the deepened groove. This degree of depth and concavity to the posterior fibula gives a strong bony resistance to recurrent dislocation. This detailed groove deepening and a standard superior peroneal retinacular reconstruction allowed the authors to be more accelerated in their rehabilitation. The authors reported on 13 athletes (14 ankles) allowed early weight bearing (1–2 weeks PO), only used intermittent immobilization with a walking boot (4 weeks total and then

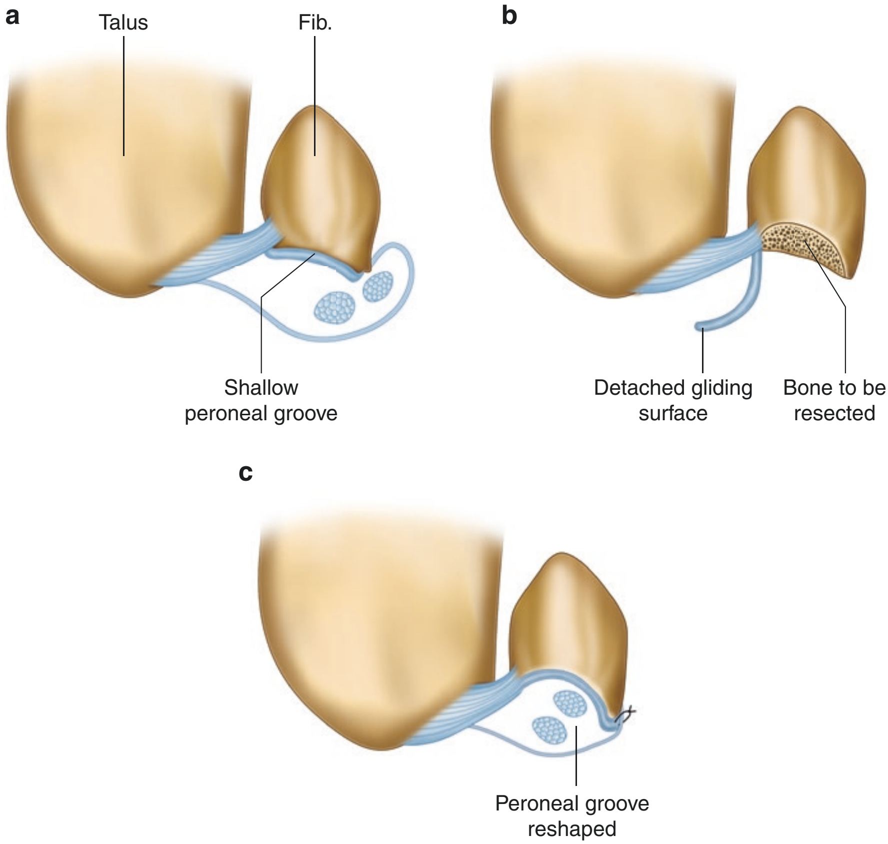


Fig. 13.3 (**a**–**c**) Slatis and coworker's method of surgical repair of chronic dislocation of the peroneal tendons. The retromalleolar groove is reshaped and the cartilaginous gliding layer is at the same time maintained. First, the retromalleolar groove is exposed (**a**), then the bone is resected under the displaced serosal surface (**b**), then the groove deepened, the serosal surface replaced, and the tendons replaced in the deepened groove. The SPR then is reattached (**c**). (Cited with permission [30])

2 weeks wean into a stirrup brace), and reported earlier return to sports (3 months). No dislocations were observed and near-normal ROM was achieved.

Zhenbo and colleagues [42] report in 2014 an approach reminiscent of the Kelly procedure. Their approach also involved a sagittal osteotomy in the fibula with a posterior slide of the osteotomy fixed with absorbable screws [42] (Fig. 13.5). After the posterolateral approach to the fibula and incision of the peroneal tendon sheath, the peroneals are inspected and repaired as indicated, with excision of any low-lying muscle belly. *"The periosteum (is) then detached anteriorly, keeping the anterior talofibular ligament and calcaneofibular ligament attached to the distal fibula. An oblique 20-degree (toward the sagittal plane) osteotomy was made anteromedially with a small oscillating saw extending from about 3 cm above the lateral malleolus*

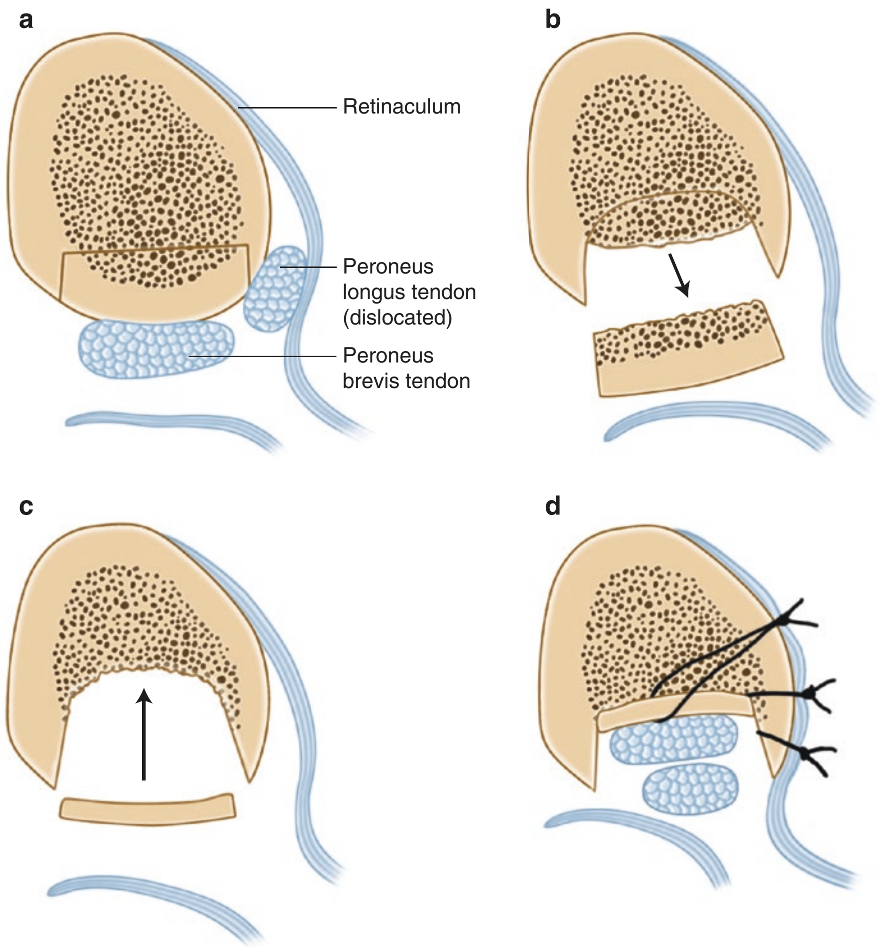


Fig. 13.4 (**a**–**d**) Porter and associates approach to direct fibular osteotomy for groove deepening. A modified approach to the Zoellner and Clancy [43] approach involves removing the posterior cortical cancellous sulcus (**a**, **b**: rather than hinging), deepening the cancellous groove, and replacing the posterior sulcus in the deepened cancellous bed with reattachment of the superior peroneal retinaculum (**c**, **d**). [Cited with permission FAI [24]]

*to the fibular apex. When the saw nearly reached the posterior edge, the osteotomy exit(s) posterolaterally without damaging the cartilaginous ridge. The graft (3 × 2 × 0.5 cm) (is) slid 20 to 30 degrees (3–5 mm) posteriorly to ensure an adequate block to dislocation (*Fig. 13.5*). After application of bone wax to the raw surface, the tendons were manipulated into their correct position while the graft was secured to the distal fibula with 2 or 3 absorbable self-reinforced polylactide (SR-PLLA) screws (Conmed Biofix SmartScrew, ConmedLinvatec, Espoo, Finland), taking care to avoid intraarticular screw insertion. To protect the tendons from being frayed by the coarse interface, the SPR and tendon sheath were fastened to*

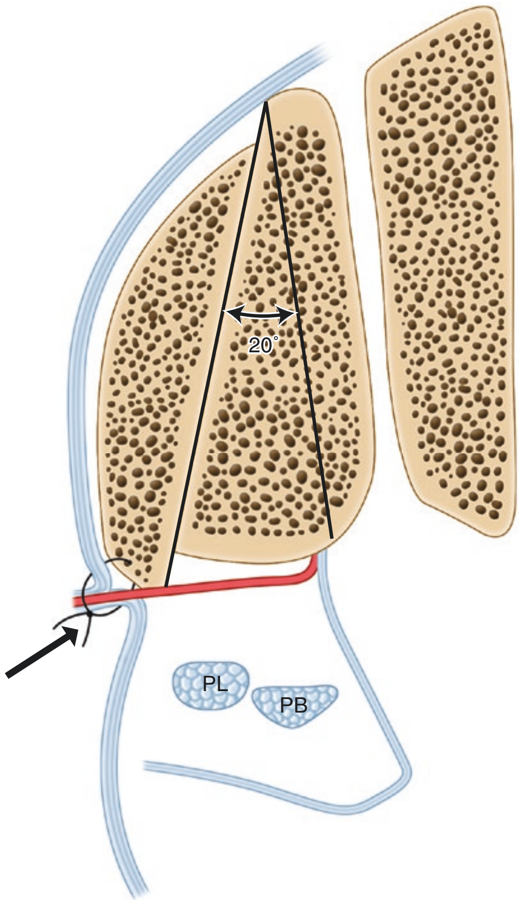


Fig. 13.5 Sagittal Oblique osteotomy of the fibula/lateral malleolus is undertaken, positioned posteriorly, and fixed with absorbable screws. The tendon sheath and superior peroneal retinaculum is attached to the periosteal sleeve on the posterior surface of the distal fibula while the needle was rerouted back to affix the SPR and sheath through 5 drill holes in the graft, using the modified Das De technique [39]

the periosteal sleeve on the posterior surface of the distal fibula with nonabsorbable suture (2–0 Ethibond, Ethicon Endosurgery, Somerville, NJ), while the needle was rerouted back to affix the SPR and sheath through 5 drill holes in the graft, using the modified Das De technique [39]. *Finally, the periosteum (is) affixed to the SPR/sheath insertion with the graft enveloped in a soft tissue capsule."*

Routine closure is utilized with 4 weeks in a below knee cast in neutral followed by NWB in a boot for an additional 2 weeks. The greater caution in rehabilitation is secondary to the true fibular osteotomy.

Indirect Groove Deepening Approachesv

Shawen and Anderson first described the indirect approach [29]. These authors prefer a "sloppy lateral position" with a 10-pound sand bag under the ipsilateral hip. A standard posterolateral approach is undertaken to access the groove and peroneal

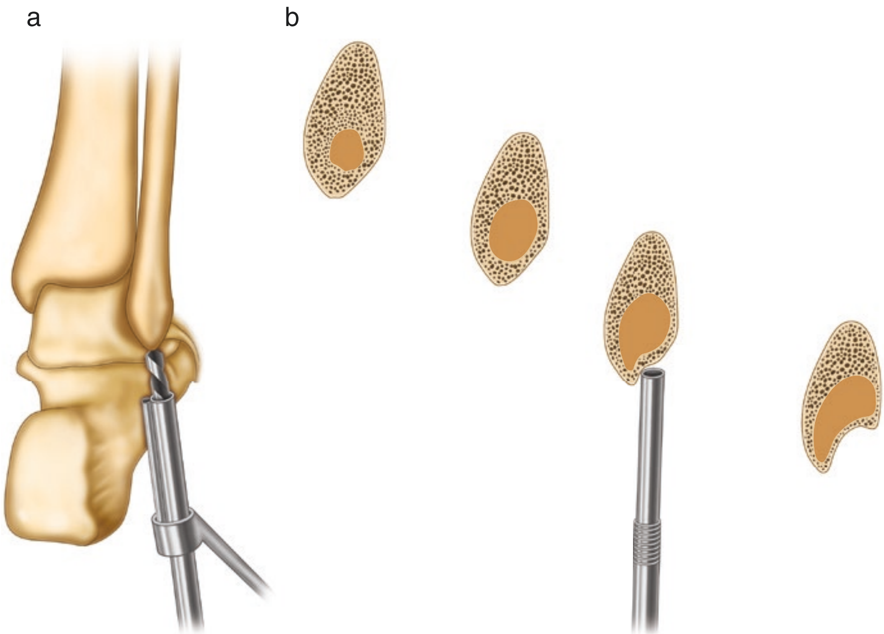


Fig. 13.6 (**a**) Indirect method of retrofibular groove deepening for treatment of dislocating peroneal tendons with inadequate bony stability [29]. An "appropriately sized reamer" is utilized to thin the retromalleolar, subcortical bone through the exposed fibular tip. (**b**) The thinned retromalleolar bone then allows a blunt 3–4-mm impactor to deepen the groove to provide enhanced bony stability

tendons. The peroneal tendons are repaired if indicated. The tip of the fibula is exposed, and the "reamer from the Arthrex bio-tenodesis screw set" and a "suitably sized" reamer are used to "thin" the posterior cortex of the groove. A moderate, wide bone impactor is used to deepen the posterior surface in an indirect manner, recreating the concavity needed to insure stability. The superior retinaculum was sewn back and imbricated to give soft tissue restraint to redislocation (Fig. 13.6).

Walters and coworkers, from Germany, reported in The American Journal of Sports Medicine (AJSM) on their technique for groove deepening via an indirect approach [41]. The authors describe the patient in a lateral position with the operative side up. A standard approach is made to the fibular groove. The peroneal tendon sheath is taken directly off the posterior border of the fibula to enter the peroneal sheath and expose the posterior fibular groove. After determining that groove deepening is required, the authors describe their indirect approach (Figs. 13.7) [41].

The fibular tip is identified and exposed. A 3.5-mm drill is used to make multiple passes under the posterior cortex as shown in Fig. 13.7a. Then, a "small" osteotome is utilized to perforate the medial and lateral border of the retromalleolar groove. The posterior cortical serosal surface can then be impacted/"compacted" to "deepen" the groove to a depth of at least 5 mm utilizing a wide blunt bone tamp/impactor.

The posterior cartilage rim is retained, if it is present. The superior peroneal retinaculum is then sewn into the medial border of the cancellous surface (Fig. 13.7b) to further inhibit redislocation of the peroneal tendons [41].

Intrasheath Peroneal Dislocation Without SPR Avulsion

Intrasheath dislocations typically present as a "snapping tendon" [26, 27, 37]. There may or may not be a definable history of a lateral ankle injury. It is proposed that the SPR has been either torn or stretched but not avulsed, and thus there is added redundancy to the superior peroneal retinaculum. Thus, the peroneus longus subluxes laterally around the brevis but still within the retinaculum and sheath, creating this "snapping" sensation that can, at times, be audible.

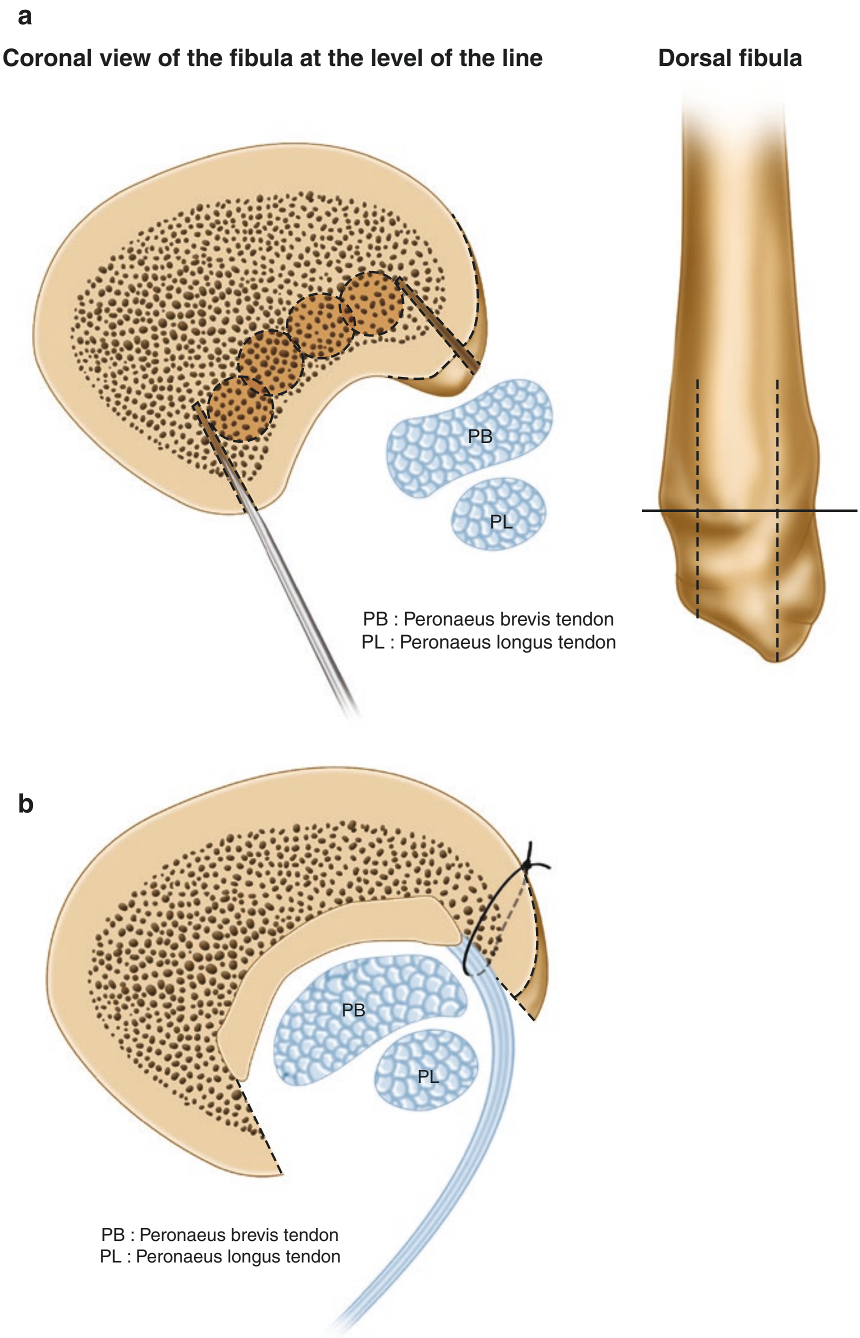
Our approach is the same as the chronic dislocation. We surmise that, to adequately return the tendons permanently to their rightful position (longus posterior to the brevis), a deep groove is required to provide both bony and soft tissue constraints to subluxation. We have not attempted to treat these athletes/patients with a soft tissue correction only. Vega, Guelfi, and coworkers [9, 40] from Barcelona have reported experience with tendonoscopy for treatment with 6 of the 8 patients not requiring a fibular osteotomy but resection of a peroneus quartus and/or resection of low-lying peroneus brevis muscle with good results. Our rehabilitation of these surgically treated intrasheath subluxations is the same as the chronic dislocation and is discussed below.

Rehabilitation Principles and Approaches

There is a significant difference in the rehabilitation protocols used. Some have utilized non-weightbearing for 2–6 weeks [3, 21], but Porter et al. [24] advocated early weight bearing and early ROM. We utilize an ankle block anesthetic with a Monitored Anesthesia Care (MAC) approach. We believe this gives excellent immediate postoperative pain control. To augment efficacy and duration of the ankle block, we utilize cold-compression therapy (AircastCryocuff DJO, Carlsbad, CA) in conjunction with removable boot intermittent immobilization [24]. The cold compression therapy, in conjunction with the block, gives 12–16 hours of effective anesthesia. We use NSAIDs and acetaminophen on a scheduled basis to give a baseline of continuous pain control. We believe this cold therapy with these scheduled over-the-counter medications reduces the need for oral opioids and certainly negates the need for overnight stay.

Fig. 13.7 Indirect method of groove deepening as described by Walter and coworkers [43]. A 3.5-mm drill is used to make multiple passes under the posterior cortex with the peroneal tendons displaced laterally, and a "small" osteotome is then utilized to perforate the medial and lateral border of the retromalleolar groove. This alteration is made at the level shown by the middle diagram of the posterior fibula (**a**). The posterior sulcus can then be impacted to deepen the groove and the peroneal tendons placed fully within the bony groove and the SPR sewn into the medial lip of the lateral border of the deepened groove as shown (**b**). PB Peronaeus brevis tendon, PL Peronaeus longus tendon

The intermittent immobilization allows us to initiate ROM (DF, PF, and inversion, but we hold DF with eversion until after 6 weeks) after the sutures are removed at 2 weeks. We also begin a stationary bike program with the boot immobilization starting at 1–2 weeks depending on how the ankle looks. Balance in the boot can be



initiated at 2 weeks. We instruct the athlete on how to wean off crutches over the first 10–14 days. We start desensitization massage immediately to reduce causalgia/neuralgia risk. We believe early weight bearing serves as initial proprioception retraining, but also aids as a form of desensitization.

We use boot immobilization for 6 weeks, then wean the athlete out of the boot into a stirrup brace between weeks 6 and 8. We do allow stationary biking with a stirrup brace and double standing toe-raise at 4 weeks. At the 6-week appointment, we instruct the athlete how to wean out of the boot into the stirrup brace for daily activities, start proprioception retraining in the brace, and go from double standing toe-raises to single standing toe-raises as well. We then allow dorsiflexion and eversion strengthening with elastic bands as well as strengthening in the other directions as mentioned above. We progress to weighted strengthening in all directions at 2–3 months postoperative. We allow full lower body weight training including squats, cleans, and lunges after full weightbearing treadmill running is achieved.

At 6–8 weeks, we progress from biking with a brace to stair stepper, elliptical, and partial weight bearing treadmill exercises (Alter-G). We progress to full body weight running on a treadmill when the athlete can do the other exercises for 30–40 minutes, 4–5 days a week without pain. A functional progression program is begun when the athlete can run full weightbearing without pain. Return to sports is allowed after the sports-specific function progression program has been completed without pain or apprehension.

Complications and Potential Pitfalls

Generally, complications are uncommon after groove deepening and superior peroneal retinacular reconstruction regardless of the technique used. No deep venous thrombotic events have been reported in the literature [2, 13, 24].

Recurrent Dislocation

Recurrent dislocation is the most dreaded complication, since this is the reason for the surgery to begin with. Fortunately, postoperative instability is uncommon, especially with groove deepening procedures [2, 11–13, 15, 17, 19, 21, 39, 41–43]. We have only had one redislocation and it was in a female with Ehlers-Danlos (that was not in our study report-24) that we tried using her native tissues. She did well with revision and use of allograft tissue.

Infection and Wound Healing

Infection is also rare after these procedures [2, 3, 14, 39, 41, 42] and should be less than 0.5%. Kollias did report 2 of 11 patients had a suture abscess that resolved with local treatment.

Complications surrounding wound healing is also rare in the athlete, but can be common if the patient is a smoker or diabetic. Even with early ROM, we did not see a high propensity for wound healing issues [24]. Walther and coworkers did report that one-third of their patients noted "suture knot irritability, but it resolved uneventfully over time." Other studies either did not mention wound healing or did not mention wound-healing problems [3, 39, 41].

Peroneal Tendon Tear

A peroneal tendon tear can be common at the time of surgery in chronic cases, and in our experience direct repair and/or tubularization has a high success rate in our experience. None of the prior reports have indicated a peroneal tendon tear postoperative as a common problem after groove deepening procedures [2, 3, 11–13, 15, 19, 21, 29, 39, 41–43]. Only Marti noted, "continued peroneal pain" in 2/12 patients [17]; however, the authors did not mention further workup or surgery. Raikin, in his report on intrasheath subluxation, reported there were 4 patients that had a peroneus brevis tear at the time of surgery, [26] which would be considered a complication of the injury, but not of the surgery.

Nonunion

Nonunion should be uncommon, and none were reported in the nonrotational osteotomies [24, 39, 41]. The osteotomy is performed in well-vascularized cancellous bone. If secured, we have found no nonunions even with early weight bearing and early ROM. Higher risks for nonunion exist, in theory, with the earlier rotational osteotomies, but there were none reported [12, 17, 39].

Stiffness

We see this as a real potential for disability of the ankle due to stiffness if the ankle is immobilized for a prolonged period of time. To counteract this potential complication/risk, we choose to secure the bone flap in the deepened groove, fully place the posterior bone flap in the groove, maintain the serosa surface on the posterior flap, and encourage and allow early ROM. Boot immobilization, rather than casting, has now shown to be both reliable and near complication free [24]. Three additional authors [2, 3, 17] noted "good or full range-of-motion," and the other noted a 10% rate of "stiffness" [13]. Most authors did not report on range-of-motion (ROM).

Fibula Fracture

Large fragment fractures requiring ORIF are rare. Small fracturing of the posterior lateral lip of the lateral deepened groove can [39] and has occurred in our series [24], but responds well to boot immobilization for 3–4 weeks and then back into a stirrup brace with rare long-term difficulty and no requirements for further surgery.

Significant fracture after these fibular osteotomies for groove deepening is not reported [3, 21]. Zhenbo did report 3/21 patients suffered a "stress fracture" after their rotational osteotomy.

Sural Nerve Injury/Neuritis

Sural nerve irritability is rarely reported [2, 13, 24, 41]. The sural nerve is potentially in the operative field for all peroneal tendon surgery approaches. If the surgeon stays close to the posterior border of the fibula, this takes the surgical field anterior to the sural nerve. Drifting the incision or dissection more posterior certainly puts the nerve at risk. Desensitization massage (DSSM) is routinely instituted postoperatively in our practice. Mafulli did note 3/14 patients with "nerve irritability" that resolved after 6 months [15]. Interestingly, Ogawa [21] noted 4/5 worker compensation patients reported "nerve irritability," but none of the 10 nonworker compensation patients reported nerve irritability. We believe that with careful incision placement and early DSSM, nerve irritability should be avoided and resolve quickly in the postoperative period.

Principles of Groove Deepening

In summary, once it has been determined that a groove deepening is necessary, we think the following principles are crucial to an optimal outcome:

1. A fibular osteotomy is necessary to give adequate groove deepening if not inherently present.
2. The fibular osteotomy must be deepened to point that the posterior border of the peroneal tendons, when replaced within the deepened groove, must be flush with, or anterior to, the posterior border of the resultant groove.
3. Tightening and imbrication of the superior peroneal retinaculum must be undertaken also to give appropriate soft tissue constraint to dislocation. Reattachment of the SPR must be undertaken in instances of true dislocation (intrasheath dislocations do not require reattachment of SPR, just imbrication and tightening since SPR not detached).
4. Rehabilitation must include early ROM to prevent scarring and subsequent pain from tendon restriction. We believe that early weight bearing is also advantageous for accelerated recovery.

The Author's Preferred Approach

We first determine if there is an acute dislocation. That is, are we seeing the athlete/patient within the first 1–2 weeks of injury, or is this a chronic dislocation that has been reoccurring greater than 4 weeks from the time of initial injury?

For the acute dislocation, we still believe that operative treatment is the treatment of choice. In some situations, the posterior lateral cartilaginous rim is still intact and the posterior fibular anatomy has a reasonable concave contour. In this situation with a good underlying groove, we will initially try acute repair of the superior peroneal retinaculum. We have had good success when there is a naturally good deep groove in the acute setting. We do not take this acute repair approach without groove deepening in the chronic setting however.

For the chronic recurring dislocation, there are numerous techniques described [2, 3, 5, 9, 11–13, 15, 16, 18, 19, 21–26, 28–31, 33, 34, 36, 39, 41–43]. We always perform a groove deepening procedure. In this chronic setting, the posterior lateral cartilaginous rim is almost always absent and we have not found the posterior fibula to have enough concavity to support the peroneal tendons and their position. Thus, we do the fibular osteotomy described above by Porter et al. [24] and imbricate and reattach the superior peroneal retinaculum to the posterolateral fibula. We utilize the same rehabilitation protocol described above for all our procedures. Regarding intrasheath subluxations, our approach is the same as that of the chronic dislocation, but they do not require reattachment of the SPR; however, we tighten the SPR by overlapping the cut SPR fibers to those attached to the posterolateral fibula. For those patients/athletes with inherent ligament laxity (Ehlers-Danlos and its variants), we utilize gracilis allograft to reconstruct and augment the SPR and do a thorough groove deepening procedure. We attach the gracilis graft to the posterior tibia with a suture anchor and bone groove, then wrap it around the peroneal tendons and attach it to the typical SPR site on the posterolateral fibula.

Conclusion

In conclusion, groove deepening is a very satisfactory procedure with a high success rate in conjunction with superior peroneal retinacular reconstruction for the patient/athlete with acute or chronic peroneal dislocation. The surgeon has multiple approaches that have been documented to be successful. As noted, a fibular osteotomy is required to further deepen a shallow, flat, or convex fibula. We have described both direct and indirect approaches, as well as rotational approaches. Direct and indirect seem more popular today than the rotational osteotomies. Peroneal tendon dislocation/subluxation is not common; therefore, we recommend familiarizing with one or two of these groove deepening approaches and rely on that approach. Familiarity will serve the surgeon well in this approach and the success rate should be high with little risk of complications.

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