Retromalleolar Groove Deepening in Recurrent Peroneal Tendon Dislocation

Technique Tip

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Peroneal tendon dislocations are most prevalent in the active and athletic population, so accurate diagnosis and management are essential for optimal return of function. Although many nonoperative and surgical management options have been described, the optimal treatment method continues to be debated. In this technique article, a modified retromalleolar groove–deepening technique is described for addressing all anatomic variations of the posterior distal fibula and retromalleolar groove without unduly disturbing the important anatomic facets meant for retention in this region. This technique is indicated for chronic dislocated peroneal tendons, recurrent dislocating peroneal tendons, and dislocation of the tendons after acute injury with a shallow fibular peroneal groove. Although it remains unclear what effect a cortically abraded fibular gliding surface or forceful cortical impaction on the fibrocartilage gliding surface might have on peroneal tendon integrity and function long term, it would seem preferable to avoid such techniques if reliable alternatives are available.

Keywords: peroneal; tendon; dislocation; groove deepening; retinaculum repair

Peroneal tendon dislocations can be subtle and sometimes difficult to diagnose. Accurate diagnosis and management are therefore essential for maximized return of function.[1,8] Although many nonoperative and surgical management options have been described, the optimal treatment method continues to be debated.[11]

Nonoperative treatment with a period of cast immobilization can be successful in patients with acute dislocation, although this form of management has been associated with both poor clinical outcomes and failure rates approximating 50% to 76%.[3,4] Therefore, surgical management can reasonably be considered as an appropriate initial treatment alternative, especially in high-demand individuals.[9] Over the past century, more than 20 surgical reconstruction techniques have been described for relocating the peroneal tendons and restoring the integrity of the superior peroneal tunnel. A recent systematic review found a greater rate of return to sports in patients treated with both repair of the superior peroneal retinaculum (SPR) and deepening of the retromalleolar groove as compared with SPR repair alone.[17] By stabilizing the peroneal tendons behind the fibular tip and reducing pressure within the retromalleolar groove,[16] the risk of redislocation has been drastically reduced.[6]

Groove deepening may be performed utilizing a number of different techniques, many of which vary in whether they explicitly preserve the fibrocartilage-gliding surface along the posterior lateral malleolar surface. Some authors

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describe direct deepening of the groove by burring through the fibrocartilage-gliding surface into the subchondral bone beneath the tip of the fibula.[2,7,10,13,18] Others preserve this natural fibrocartilage by various indirect means, including elevating a flap of periosteal bone followed by cancellous bone removal and bone flap reduction into the newly deepened groove.[5,12,15,19] These techniques, however, are also not without technical shortcomings.

The senior author (C.W.D.) has modified the indirect groove-deepening approach with an emphasis on (1) preserving the integrity of the fibrocartilage gliding surface, (2) avoiding any requirement for creating a bone flap, and (3) allowing for a simple, reproducible means of groove deepening without significant anatomic disturbance. This technique entails image-guided intramedullary bone removal in the distal fibula using sequentially larger caliber cannulated drills, followed by double "reverse trap door" sagittal plane fibular osteotomies, and finally, gentle compression of the newly created flap to a desired depth as a means of creating the necessary space for stable peroneal relocation. This simplified approach preserves the fibrocartilaginous gliding layer while minimizing any chance of iatrogenic damage to this surface and its surrounding anatomy by avoiding bone flap elevation as well as decreasing the amount of force needed to impact the posterior fibula to physically deepen the groove.

Over the past 5 years, the 2 senior authors (C.W.D. and A.Y.) have collectively performed more than 60 surgeries using the currently described technique. This technique is believed to be useful for addressing all anatomic variations of the posterior distal fibula and retromalleolar groove without unduly disturbing the important anatomic facets meant for retention in this region. This technique is indicated for chronic dislocated peroneal tendons, recurrent dislocating peroneal tendons, and dislocation of the tendons after acute injury with a shallow fibular peroneal groove.

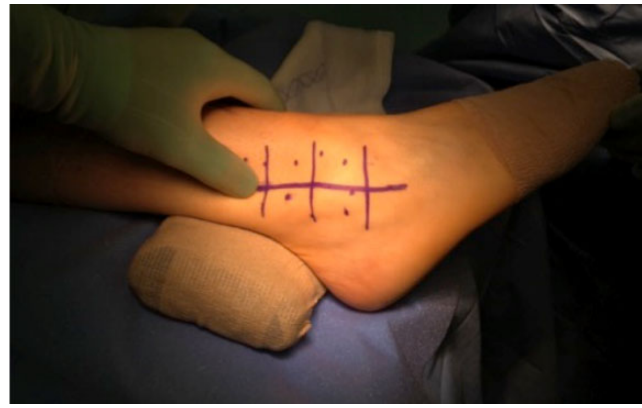

Figure 1. A 4- to 6-cm insertion is made directly posterior to the fibula and curves distally around the fibular tip.

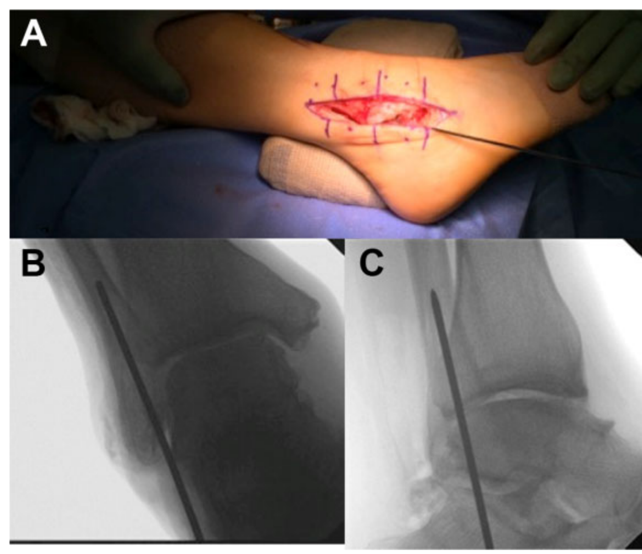

Figure 2. (A) The tip of the fibula is exposed and a guidewire is introduced in the center of the fibular shaft (Arthrex Biotenodesis; Arthrex). (B) Anteroposterior fluoroscopy of the ankle. (C) Lateral fluoroscopy of the ankle.

OPERATIVE TECHNIQUE

This technique can be performed under local, regional, epidural, or general anesthesia. The patient is placed in a lazy lateral position with a support placed under the ipsilateral leg to promote free ankle motion during surgery and easy access to the peroneal tendons and the posterior fibula. A tourniquet is placed around the upper thigh to optimize visualization with the mini C-arm during radiographic assessment if desired. A 4- to 6-cm incision is made along the lateral margin of the fibula and curved distally around the fibular tip in line with the peroneal excursion (Figure 1). The dissection carefully isolates the SPR over the peroneal tendons and reflects the sural nerve posteriorly. The SPR is then incised 1 to 2 mm posterior to its fibular attachment to allow easy repair after the procedure. It can also be removed directly off the bone if one elects to utilize a bone tunnel repair technique. Often a "Bankart-type" lesion of the SPR is found on the lateral edge of the distal fibula, having been created or perpetuated by the dislocated peroneal tendons. The remainder of the anatomical SPR is carefully preserved while the donor site of the reflected flap is then roughened to a bleeding cortical surface to maximize healing and provide a healthy bed on which to later resuture the reflected retinaculum to the fibula at the conclusion of the groove-deepening procedure.

The peroneal tendons are dislocated out of the retromalleolar groove to inspect the tendons, repair any tears, and evaluate the fibular anatomy and fibrocartilage along the posterior aspect of the fibula. The tip of the fibula is thereafter exposed, and a guide wire from the Arthrex biotenodesis set (Arthrex) or other anterior cruciate ligament tunnel reamer set is introduced up the center of the fibular shaft. This position can be verified under fluoroscopy in orthogonal planes (Figure 2). Sequentially, the shaft is then reamed 3 cm proximally until "chatter" can be heard. It is recommended to start with a 4-mm acorn reamer and increase by 1-mm increments, but rarely is anything greater than 8 mm necessary, and a 6-mm final reaming

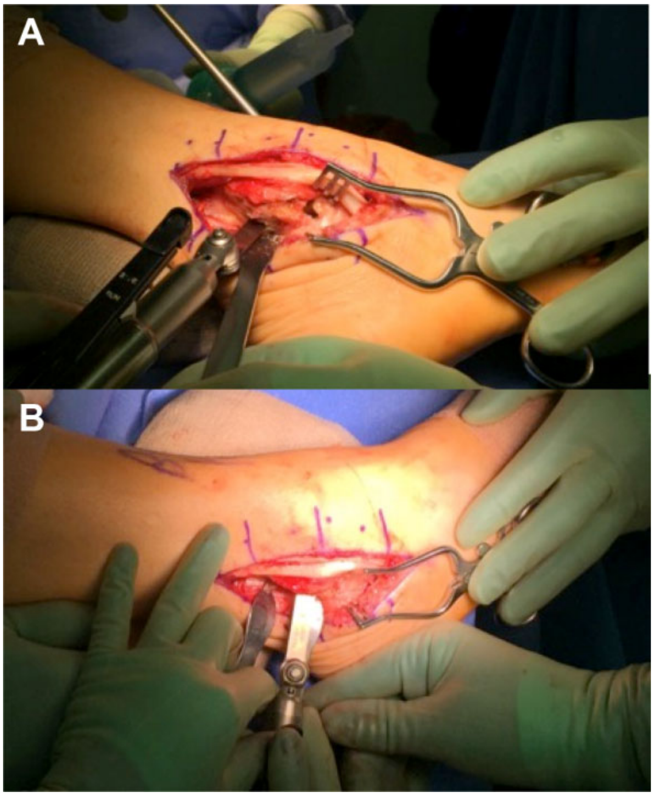

Figure 3. Two vertical osteotomies are created in the fibula using a sagittal saw. (A) The first cut is made on the lateral aspect of the fibula and (B) the second cut is made on the medial aspect of the fibula.

has been typical. Fluoroscopy can also be helpful in determining whether an adequately sized reamer has been used.

Next, an approximately 3 × 1–cm sagittal saw blade (9 × 25 mm, 0.51-mm thick; Stryker model 2296-033-111) is used to make 2 fibular corticotomies approximately 2 mm deep in the sagittal plane, starting from the posterior cortex of the fibula. The first cut is made just inside the lateral-most edge (cortical margin) of the posterior distal fibula and the second is made just inside the medial-most edge in a similar fashion (Figure 3). Both are allowed to exit distally from the fibular tip. Gentle tamping can thereafter be used to carefully recess the posterior fibular fibrocartilaginous cortical flap located between these 2 cuts from posterior to anterior. With minimal effort, the flap easily impacts into the drilled subcortical bone and rotates on its proximal, intact cortical hinge to create a stable, deepened groove without the requirement of fixation (Figure 4). The newly deepened groove is inspected to ensure that there is no bone spike on the medial aspect of the fibula that could cause tendon impingement or irritation. Bone wax can be applied to the more prominent lateral ledge of the peroneal tunnel to further facilitate a smooth edge over which the peroneal tendons must travel. The peroneal tendons can then be relocated and manually tested to ensure stable reduction. In the rare event that further deepening is required, additional tamping can be performed. Once the peroneal tendons are deemed stably relocated, attention can be turned back to the avulsed SPR. This margin is repaired back to its previous bed, which is now a roughened cortical edge, using either 2 G2 suture anchors (Dupuy Synthes Mitek Sports Medicine) or an osseous tunnel technique. The latter can be achieved using a 0.054 K-wire for the repair holes through which No. 1.0 Vicryl suture (Ethicon) can be passed. Interrupted sutures are passed through the fibula and SPR and then tied over the SPR in a horizontal fashion to reattach it back to the fibula without the possibility of further peroneal dissection. The redundant retinaculum can be advanced during repair to ensure that the retinaculum is tight. After SPR reattachment, the remaining retinacular exposure more proximally can be repaired using interrupted 0 Vicryl suture. Typically, the senior author (C.W.D.) recommends that the lowest 2 or 3 sutures are passed transosseously through the posterior lateral aspect of the fibula and then through the posterior portion of the retinaculum in a horizontal mattress fashion to reapproximate the retinaculum over the peroneal tendons and minimize any chance for recurrent peroneal subluxation (Figure 5). The remainder of the retinaculum can then be closed more proximally with running 0 Vicryl suture via direct soft tissue repair, making sure that the SPR is not overly tightened during closure. After care is taken to ensure that neither the tendons nor the sural nerve is included in the retinacular reapproximation, the subcutaneous tissues and skin are closed.

POSTOPERATIVE CARE

For the first 2 weeks postoperatively, the patient is placed in a posterior splint and made nonweightbearing until the incision has healed. The patient is then placed into a short-leg cast and allowed touch-down weightbearing until 6 weeks after surgery not only to permit interval retinacular and bony healing but also to allow for some early mobilization of the tendons to prevent adhesions. Finally, the patient is transitioned to a controlled ankle movement (CAM) boot with more formal active physical therapy, progressive weightbearing, and weaning out of the boot by roughly 10 weeks. Full normal activity can be resumed by 12 weeks, but return to competitive, impact, or pivot sports is not permitted until at least 4 months postoperatively.

DISCUSSION

The optimal treatment method for peroneal tendon dislocation remains a topic of discussion in the literature. The majority of techniques primarily attempt to restore the superior peroneal tunnel by deepening the retromalleolar groove and repairing the SPR. While most of these have been documented to have good results, a number entail additional and potentially unnecessary steps or violate the natural fibrocartilaginous surface to create a roughened surface that has unknown consequences for peroneal gliding.[5,12,13,19] Although it remains unclear what effect a cortically abraded fibular gliding surface or forceful cortical impaction on the fibrocartilage gliding surface might have on peroneal tendon integrity and function long term, it

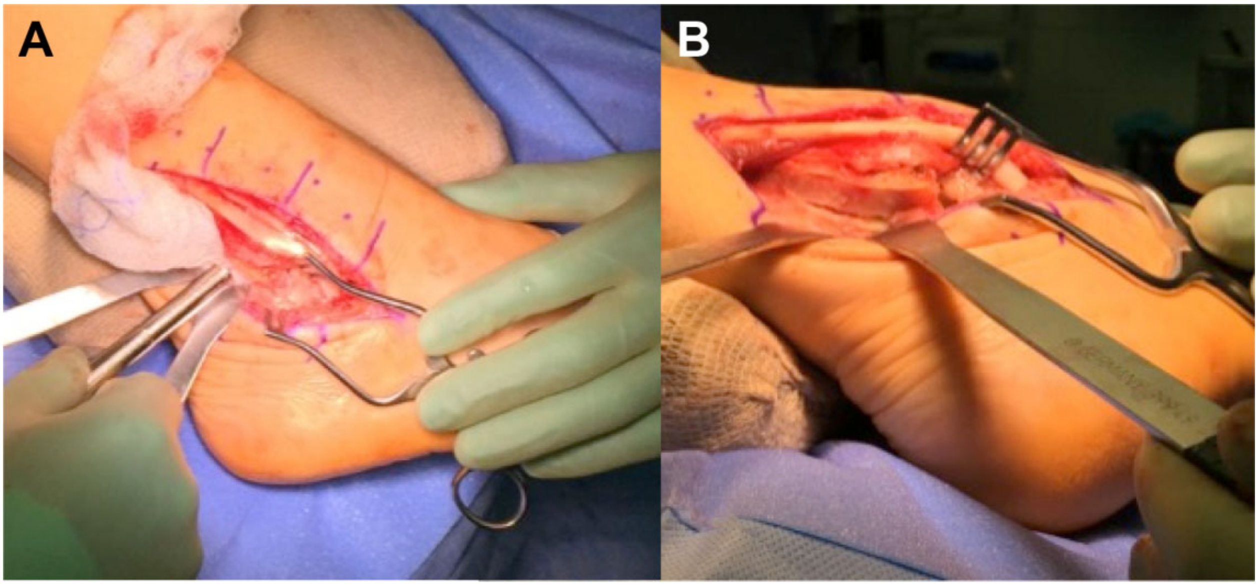

Figure 4. (A) A tamp is used to carefully recess the fibrocartilage layer. (B) The groove is deepened approximately 1 cm.

Figure 5. Repair of the superior peroneal retinaculum with at least 3 horizontal 0 Vicryl sutures. The sutures are passed in a transosseous fashion through the posterior lateral aspect of the fibula and then through the posterior portion of the retinaculum to close it over the peroneal tendons.

would seem preferable to avoid such techniques if reliable alternatives are available.

Several authors have described techniques that attempt to preserve the fibrocartilage gliding layer by cortical elevation of bone, followed by removal of the cancellous bone beneath the fibrocartilaginous flap.[5,12,15,19] This technique, however, is less predictable and perhaps more technically demanding than the one described. The force needed to create such a bone flap has the capacity to uncontrollably damage the posterior fibula, and the technique has unclear effects on fibrocartilage viability—especially if repeated elevations are necessary to deepen the groove further. More recently, other authors have advocated an indirect groove-deepening technique by burring the cancellous bone from under the cortex, starting at the tip of the fibula, followed by direct impaction of the cortex.[2,7,10,13,14,18] Shawen and Anderson[14] described cannulating the fibula using a biotenodesis system followed by tamping the posterior cortex down without making an osteotomy in the posterior fibula. Without osteotomizing of the fibula, however, additional force is needed to tamp down the posterior cortex. This may also cause increased iatrogenic damage to the fibrocartilage or even fracturing of the bone. When bone quality is good, such as one would expect with a young athlete, this method of impaction can be particularly destructive.

Walther et al[18] described a technique creating multiple drill holes up the fibula followed by 2 vertical osteotomies in the fibula using an osteotome. Over the years it seems that portions of this approach are adopted independently, although it feels that the singular cannulated reaming system is more easily reproduced and perhaps quicker given that only 1 tract needs to be made down the center of the fibula under fluoroscopic visualization.

While both the aforementioned techniques have significant merit, our technique is considered a combination of the strengths of these individual approaches. In recent years, the senior authors (C.W.D. and A.Y). have chosen to deepen the groove using sequential, cannulated reaming of the intramedullary canal as opposed to relying on multiple small drill holes followed by 2 small subcortical osteotomies. A thin and narrowly curved saw is used instead of an osteotome, since this requires less energy delivery to the distal fibular bone during use. This sequence allows the posterior cortex to be tamped down with almost no force, preserving the integrity of the natural fibrocartilage gliding layer along the peroneal margin, and is easily expandable should additional depth be necessary without fear of compromising the initial construct.

It is acknowledged that the aforementioned groove-deepening techniques offer effective means of providing additional space for the peroneal tendons, but it is believed that our described constellation of modifications offers distinct advantages to these various approaches and does not require any formal fixation. To capitalize on the advantages of this procedure, though, several potential complications must be considered. The sural nerve is always in direct proximity of this exposure and should be identified and then protected, particularly during reaming of the fibula. Care must also be taken to remain cognizant of the nerve's location during retinacular closure to avoid iatrogenic entrapment. A final potential pitfall to be avoided with this and all related techniques is overtightening of the retinaculum, which can result in either retinacular tearing (loss of integrity) or overconstraint, which can lead to symptomatic stenosis.

In summary, the modified retromalleolar groove–deepening technique described has been designed to (1) preserve the gliding layer of fibrocartilage within the retromalleolar groove, (2) theoretically prevent iatrogenic damage by reducing the force needed for creating the bony flap and then impacting the posterior fibula, and (3) enable what the senior authors have found to be a reproducible single-step centralized reaming technique to avoid the possibility of eccentric or unpredictable cortical flap creation. Over the past 5 years, the senior authors (C.W.D. and A.Y.) have seen no complications using this proposed technique and, therefore, it is recommended as an optimized way of respectfully resculpturing the anatomy around the retromalleolar groove when dealing with peroneal dislocation, in situ subluxation, or tenostenosis.

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