

Open Peroneal Tendon Stabilization With Fibular Groove Deepening



Inga M. Hwang, B.S., Shane Rayos del Sol, M.S., Sarah M. Jenkins, M.D., Stewart A. Bryant, M.D., Brandon B. Gardner, M.D., Ph.D., Patrick McGahan, M.D., and James Chen, M.D., M.P.H.

Abstract: Peroneal tendon subluxation often occurs because of sudden dorsiflexion of the ankle, leading to a traumatic rupture of the superior peroneal retinaculum. Currently, there are several surgical techniques to deepen the fibular groove, but there is no universally accepted gold standard. This technique article describes a fibular groove deepening with preservation of the fibrocartilage in conjunction with repair of the superior peroneal retinaculum. Addressing the main pathologies that may be leading to subluxation of the peroneal tendons, we offer an approach that avoids many of the common pitfalls from previously proposed techniques while preserving the natural fibrocartilage within the malleolar groove and repairing the retinaculum.

Introduction

Peroneal tendon dislocation is associated with ankle instability and pain.¹ In 1803, Monteggia was the first to identify a traumatic peroneal tendon dislocation and document its pathology.² Today, the incidence of peroneal tendon dislocations is considered underreported in the literature because the pathology is often misdiagnosed as a sprain of the lateral ankle.^{1,3-5} The most common cause of traumatic peroneal tendon dislocation is sudden dorsiflexion of the ankle.^{3,5} The peroneus longus and brevis tendons contract as the ankle flexes, generating anterolateral force against the superior peroneal retinaculum (SPR). This force causes the superior peroneal retinaculum to rupture,

allowing the peroneal tendons to dislocate from the fibular groove.^{1,4,6}

Peroneal tendon dislocations have been treated both conservatively and surgically, though the literature indicates surgery is required to preclude chronic ankle pain and instability.^{1,5,7-9} Three established surgical approaches are indicated for repair of peroneal dislocation: fibular groove deepening, transfer of the peroneal tendon beneath the calcaneofibular ligament, and reattachment or repair of the retinaculum.^{1,4} The literature has not identified one gold standard surgical approach to treat peroneal tendon dislocation.

Multiple approaches to deepen the fibular groove have been documented. The fibular groove may be deepened directly using a chisel or mallet.^{1,7} Alternatively, the fibular groove may be deepened indirectly to better preserve natural fibrocartilage. One technique, first reported by Kelly in 1919, involves fixating a resected piece of the fibula at the lip of the peroneal groove.¹⁰⁻¹² Another technique, originally described by Zoellner and Clancy in 1979, deepens the fibular groove via lateral translation of osteoperiosteal flaps from the distal fibula and lateral malleolus.¹³⁻¹⁷ A third approach deepens the fibular groove by impacting the fibula with a mallet or tamp after its cortex has been thinned via reaming.^{9,18-22} This technical note and accompanying video present an indirect fibular groove deepening technique via creation of a modified osteoperiosteal flap coupled with retinacular repair.

Advanced Orthopedics and Sports Medicine, San Francisco, California, U.S.A. (I.H., S.R.dS., S.M.J., B.B.G., P.M., J.C.); and Department of Orthopaedic Surgery, University of Hawaii Honolulu, Hawaii(S.A.B.).

The authors report the following potential conflicts of interest or sources of funding: J.C. reports personal fees from Arthrex, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received August 14, 2021; accepted October 31, 2021.

Address correspondence to Inga Hwang, B.S., Advanced Orthopedics and Sports Medicine, San Francisco, CA, 94108, U.S.A. E-mail: imhwang97@engineering.ucla.edu

© 2021 THE AUTHORS. Published by Elsevier on behalf of the Arthroscopy Association of North America. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

2212-6287/211177

<https://doi.org/10.1016/j.eats.2021.10.028>

Surgical Technique

Preoperative Assessment

Preoperative assessment for ankle pain consists of a detailed history, comprehensive physical exam, and corresponding imaging studies. Physical exam to evaluate for peroneal tendon instability is significant for subfibular ankle pain, tenderness to palpation posterior to the lateral malleolus, and popping/subluxation of the peroneal tendons with passive dorsiflexion or resisted eversion of the ankle. Although an MRI is not required for diagnosis, it can be useful to evaluate for concomitant intra-substance tendon tears, tendinopathy, and tenosynovitis.

Patient Setup

The patient is positioned in supine with the head and all bony prominences well padded. A hip bump is positioned on the ipsilateral side, and the lower extremity is prepped and draped in the usual sterile fashion.

Approach to Peroneal Tendons and Distal Fibula Coring

The lateral malleolus and the course of the peroneal longus tendon are marked (Fig 1). An 8-cm curvilinear incision is made with a #15 blade over the posterior margin of the fibula and is extended 1 cm past the distal tip of the fibula. Dissection is performed until the superficial peroneal tendon and peroneal retinaculum are identified, and the sural nerve and short saphenous vein are protected with posterior retraction (Fig 2). The superior peroneal retinaculum is retracted to allow access into the fibular groove, and a 2.4-mm pin (Arthrex) is drilled into the distal fibular tip in the distal to proximal direction (Fig 3A). Multiple radiographs with a mini-C-arm are taken to confirm the correct



Fig 1. View of the left ankle. The patient is positioned supine with the ankle internally rotated. The locations of the lateral malleolus and peroneal tendon are marked.

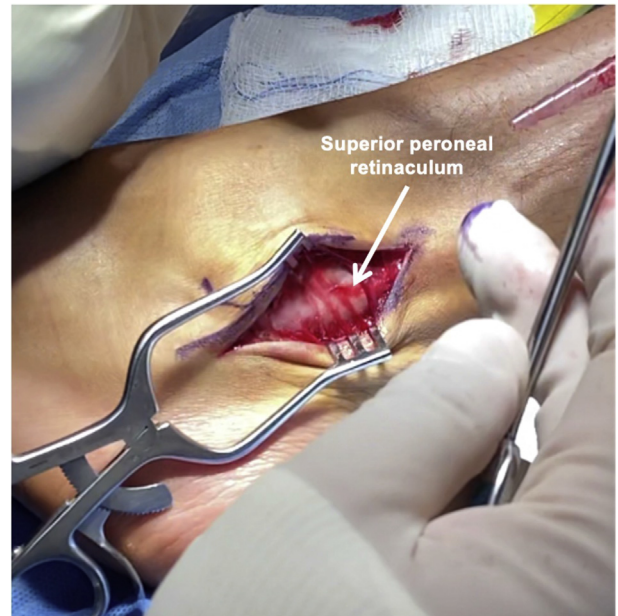


Fig 2. Viewing the lateral left ankle with the patient positioned supine and the ankle internally rotated. The skin is dissected to expose the superior peroneal retinaculum, which will be incised to expose the peroneal tendon and the distal fibula.

trajectory prior to reaming (Fig 3B). A 5-mm acorn reamer (Arthrex) is initially reamed over the length of the pin, thinning the inner cortex of the distal fibula. This is repeated with progressively larger diameter reamers, up to an 8-mm acorn reamer (Fig 4A). Repeat radiographs are taken to confirm that the inner posteromedial cortex of the distal fibula has been thinned appropriately without risk of breaching the outer cortex (Fig 4B).

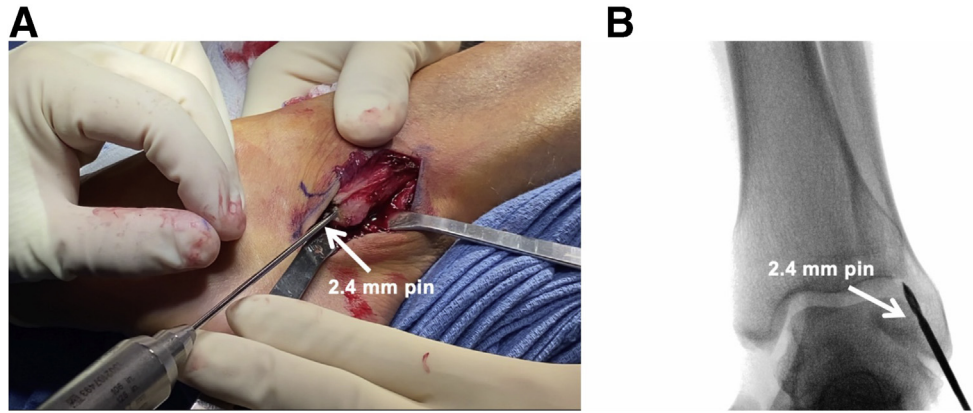
Osteoperiosteal Flap Creation

A 25.0-mm sagittal saw (9 cm × 18 mm, 1.19 mm thick; Stryker model 6118-119-090) is used to create medial and lateral cuts 2 mm deep from the posterior fibular cortex, extending 4 cm inferiorly to the distal tip (Fig 5). Care is taken to ensure the preservation of the fibrocartilage of the fibular groove. A tamp (Stryker) is used to gently mallet the fibular cortex between the medial and lateral sagittal cuts, deepening the peroneal groove and preserving the fibrocartilage (Fig 6).

Repairing Superior Retinaculum

Using a K-wire, we create a series of bone tunnels over the posterolateral fibula. No. 2 FiberWire sutures (Arthrex) are passed through the bone tunnels and through the superior peroneal retinaculum in a horizontal mattress configuration (Fig 7). These sutures are tied down and secured, reducing the superior peroneal retinaculum over the peroneal tendons. If needed, additional bone tunnels may be created to ensure

Fig. 3. (A) View of the lateral left ankle with the patient positioned supine and the ankle internally rotated. A pin is drilled into the distal fibula to guide the trajectory of ankle reaming. (B) Radiograph imaging of the left ankle shows the pin is drilled along the lateral malleolus.



proper reduction of the retinaculum. Final radiographs are taken to ensure that the distal fibula structure and integrity are well maintained, with no evidence of osseous abnormalities.

Final Examination and Postoperative Care

After confirming adequate deepening of the fibular groove and repair of the superior retinaculum, the incision is closed with closing suture, and appropriate dressings are applied. A posterior lower leg splint is applied over the extremity, and it is secured with ACE wrap. The operative extremity will remain non-weight bearing for 6 weeks postoperatively with crutches.

Since the procedure involves tamping the posterior cortex of the distal fibula, a short leg cast is placed on the lower extremity during the patient's first postoperative visit, after dressings and suture are removed. The short leg cast is removed 1 month postoperatively, and the patient remains non-weight bearing with a CAM walker boot. The patient progresses to passive and active range of motion exercises 7 weeks postoperatively, as tolerated.

Discussion

The malleolar groove containing the peroneus longus and peroneus brevis tendons is located posterior to the lateral malleolus and has a thick layer of fibrocartilage

at its distal end.²³ The peroneus longus rests on top of the peroneus brevis, and both tendons are secured inside the malleolar groove by the superior peroneal retinaculum.²³⁻²⁴ The SPR is often characterized as a fibrous band located between the posterior ridge of the fibula and the lateral wall of the calcaneus.²⁵

Several surgical techniques have been proposed to treat acute and chronic peroneal tendon subluxations. Retinacular reconstruction aims to restore the integrity of the SPR, whose rupture is a common pathology of peroneal tendon subluxation.²⁶ Retinacular reconstruction may be combined with a malleolar groove-deepening procedure. A systematic review by van Dijk et al. found improved clinical outcomes following combined retinacular reconstruction and groove-deepening relative to retinacular reconstruction alone.²⁷

Multiple techniques to deepen the malleolar groove have been documented. The fibular groove may be deepened directly using a chisel, mallet, motorized shaver, or burr.^{1,7,28-29} The Zoellner and Clancy technique entails formation of an osteoperiosteal flap along the posterolateral distal fibula and lateral malleolus, whose medial side remains attached to the fibula and acts as a hinge. The flap is swung posteriorly along this hinge and fixated, directly deepening the groove.¹³ Saragas et al. propose a

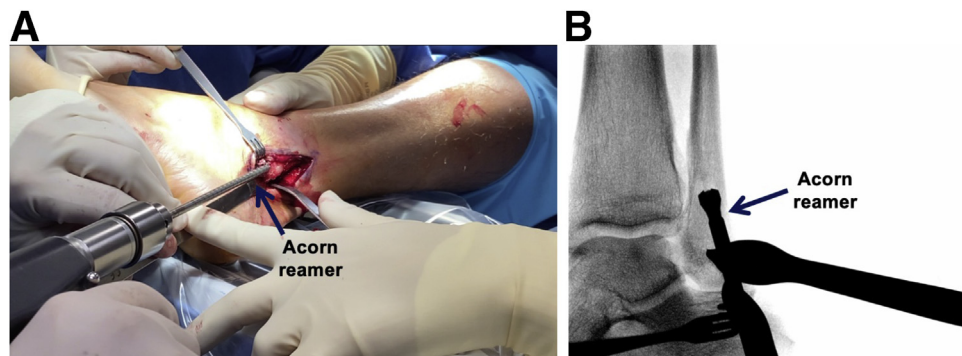


Fig 4. (A) View the lateral left ankle with the patient positioned supine and the ankle internally rotated. The distal fibula is reamed using 5 mm, 6 mm, 7 mm, and 8 mm reamers to weaken the inner cortex of the distal fibula prior to fibular groove deepening. (B) Radiograph imaging of the left ankle shows the positioning of the 8-mm reamer and thinning of the inner posterior cortex of the distal fibula.

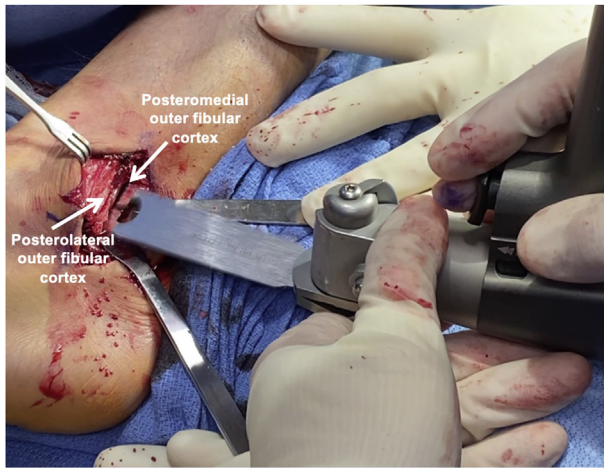


Fig 5. Viewing the lateral left ankle with the patient positioned supine and the ankle internally rotated. After the distal fibula is reamed, a 25-mm sagittal saw is used to create two sagittal cuts over the posteromedial and posterolateral outer fibular cortex.

modified version of this technique, which elevates the osteoperiosteal flap via an osteotome and removes the cancellous bone beneath. The flap is then returned to its original position and directly impacted to deepen the groove.³⁰ Suh et al. describe a similar technique, which secures the osteoperiosteal flap into its original position via snap-off screws following cancellous bone removal.³¹

Shawen and Anderson outline a technique combining indirect fibular groove deepening with SPR reconstruction. The posterior cortex of the fibula is first thinned by sequentially reaming the fibula distal to proximal, up to a diameter of 7-8 mm. The posterior cortex is then collapsed using a tamp and mallet, and



Fig 6. Viewing the lateral left ankle with the patient positioned supine and the ankle internally rotated. After the posterior inner cortex of the distal fibula is thinned and two sagittal cuts to the outer cortex are created, the posterior outer cortex of the fibula is impacted using a tamp. The fibular groove is deepened, as the weakened bone collapses, and the fibrocartilage is pushed deeper into the fibula itself.



Fig 7. View of the lateral left ankle with the patient positioned supine and the ankle internally rotated. A series of bone tunnels are created over the posterolateral distal fibula with a K-wire, and a no. 2 FiberWire suture is passed through the fibula and superior peroneal retinaculum. The suture reattaches the superior retinaculum to the fibula, preventing subsequent peroneal tendon dislocations.

the distal fibula is tamped to prevent future impingement of the peroneal tendons. Finally, the SPR is reconstructed.²¹ van Dijk et al. propose a modification of the Shawen and Anderson technique, in which two sagittal cuts are made to the posterior fibula after sequential reaming. The region of the posterior fibular cortex between these two cuts is then impacted using a tamp and mallet.⁹

This surgical technique and accompanying technical video follow the fibular groove deepening approach pioneered by van Dijk et al.⁹ One advantage of this technique is the minimal risk of damaging the natural fibrocartilage inside the malleolar groove. In addition to



Fig 8. Radiograph of the left ankle, viewed anterior to posterior, shows an intact distal fibula postsurgically.

Table 1. Advantages and Disadvantages

| |
|---|
| Advantages |
| - Minimizes risk of damage to the natural fibrocartilage of the malleolar groove |
| - Minimizes risk of unintended fibular fracture while impacting the posterior cortex of the fibula with a tamp and mallet |
| - Technique leaves other structures and tendons in the ankle untouched, as it does not require formation of an osteoperiosteal bone flap or tissue graft. |
| - Less technically demanding than other fibular groove deepening techniques |
| Disadvantages |
| - Risk of fibrocartilage injury while creating the sagittal cuts to the posterior fibula and tamping the posterior fibular cortex |
| - Risk of sharp fragment formation in the malleolar groove due to inadequate tamping, leading to postsurgical peroneal tendon irritation |
| - Superior peroneal retinaculum must be cut if not already compromised by traumatic injury. |
| - Risk of inadequate superior peroneal retinaculum reconstruction and recurrent peroneal tendon subluxation |

ensuring the peroneal tendons glide smoothly within the groove, this fibrocartilage shields the malleolar groove from shear and compressive forces generated by the tendons.²³ This approach is also less technically demanding than the Zoellner and Clancy technique, as it does not require the lateral translation of osteoperiosteal bone flaps. A key advantage of this approach is the reduced likelihood of unintended fibular injury relative to other groove-deepening techniques. The risk of additional fibular fractures is decreased relative to the Shawen and Anderson approach by the two sagittal cuts made to the posterior fibula, which decrease the force required to collapse the cortex using the tamp and mallet. The process of creating an osteoperiosteal bone

Table 2. Pearls and Pitfalls

| |
|--|
| Pearls |
| - Place an ipsilateral hip bump prior to applying surgical drapes to allow for adequate internal rotation and visualization of the lateral aspect of the ankle. |
| - Obtain multiple radiographic images with the mini-C-arm to ensure correct trajectory to properly ream the inner posterior cortex of the distal fibula. |
| - While reaming the inner cortex of the fibula, gradually increase the side of the reamer until cortical chatter is appreciated. |
| - Gently tamp the outer cortex of the distal fibula to preserve fibrocartilage. |
| - Place an adequate amount of FiberWire suture through the drill holes of the distal fibula and superior retinaculum, repairing the superior retinaculum and providing additional stability to the peroneal tendons. |
| Pitfalls |
| - Avoid posterior dissection past the fibular groove and peroneal tendons to prevent injury to the sural nerve. |
| - Incorrect trajectory of the reamer may cause inner cortical thinning of an inappropriate segment of the distal fibula. |
| - Excessive tamping, inadequate reaming, and incomplete sagittal cuts over the posterior distal fibula may cause inadvertent damage of the fibrocartilage, eliminating the advantages with this technique. |

flap in the Zoellner and Clancy technique also carries increased risk of unintended fibular damage. As shown by the radiograph in Fig 8, the fibula was uninjured after this surgical procedure.

While less demanding than the Zoellner and Clancy method, this surgical technique is still considered complex and is associated with its own set of potential pitfalls. The sagittal cuts made to the posterior fibula require a high level of precision, and the surgeon must ensure the two cuts do not converge to prevent fibrocartilage injury. Additionally, the posterior fibular cortex must be impacted uniformly and adequately to prevent formation of sharp fragments in the malleolar groove that could irritate the peroneal tendons postsurgically. Directly impacting the fibrocartilage with the tamp and mallet also carries risk of unintended fibrocartilage or fibular injury if not performed carefully. Finally, this technique involves cutting through the SPR, introducing the additional step of retinacular reconstruction to nontraumatic cases in which the SPR is not already compromised. The peroneal tendons may continue to subluxate after fibular groove deepening if the SPR is not adequately reconstructed. A complete list of this surgical technique's advantages and disadvantages are included in Table 1, as well as the pearls and pitfalls of this technique in Table 2.

This technical note describes an indirect fibular groove deepening technique via creation of a modified osteoperiosteal flap and coupled with SPR reconstruction, modeled after the approach described by van Dijk et al.⁹ Video 1 shows this technique in its entirety with intraoperative radiographic imaging. This technique minimizes risk of unintended fibular fracture or damage to the natural fibrocartilage of the malleolar groove, and we recommend this procedure for treatment of chronic peroneal tendon subluxations.

References

1. Hu M, Xu X. Treatment of chronic subluxation of the peroneal tendons using a modified posteromedial peroneal tendon groove deepening technique. *J Foot Ankle Surg* 2018;57:884-889.
2. Monteggia GB. *Parte secondu*. Milan: Italy: Institutuzini Chirurgiche, 1803;336-341.
3. McLennan J. Treatment of acute and chronic luxations of the peroneal tendons. *Am J Sports Med* 1996;24:432-436.
4. Mason R, Henderson I. Traumatic peroneal tendon instability. *Am J Sports Med* 1996;24:652-658.
5. Arrowsmith S, Fleming L, Allman F. Traumatic dislocations of the peroneal tendons. *Am J Sports Med* 1983;11:142-146.
6. Eckert W, Davis E. Acute rupture of the peroneal retinaculum. *J Bone Joint Surg* 1976;58-A:670-673.
7. Karlsson J, Eriksson BI, Swård L. Recurrent dislocation of the peroneal tendons. *Scand J Med Sci Sports* 1996;6:242-246.

8. Stover C, Bryan D. Traumatic dislocation of the peroneal tendons. *Am J Surg* 1962;103:180-186.
9. van Dijk P, Vopat B, Guss D, Younger A, DiGiovanni C. Retromalleolar groove deepening in recurrent peroneal tendon dislocation. *Orthopaed J Sports Med* 2017;5:1-5.
10. Kelly RE. An operation for the chronic dislocation of the peroneal tendons. *Brit J Surg* 1919;7:502-504.
11. Wirth C, Schloz M. The Viernstein/Kelly procedure for recurrent dislocation of the peroneal tendons. *Orthopaed Traumatol* 1992;1:208-213.
12. Zhenbo Z, Jin W, Haifeng G, Huanting L, Feng C, Ming L. Sliding fibular graft repair for the treatment of recurrent peroneal subluxation. *Foot Ankle Int* 2014;35:496-503.
13. Zoellner G, Clancy W. Recurrent dislocation of the peroneal tendon. *J Bone Joint Surg* 1979;61-A:292-294.
14. Kollias G, Ferkel R. Fibular grooving for recurrent peroneal tendon subluxation. *Am J Sports Med* 1997;25:329-335.
15. Porter D, McCarroll J, Knapp E, Torma J. Peroneal tendon subluxation in athletes: Fibular groove deepening and retinacular reconstruction. *Foot Ankle Int* 2005;26:436-441.
16. Slätis P, Santavirta S, Sandelin J. Surgical treatment of chronic dislocation of the peroneal tendons. *Brit J Sports Med* 1988;22:16-18.
17. Raikin S, Elias I, Nazarian L. Intrasheath subluxation of the peroneal tendons. *J Bone Jt Surg* 2008;90:992-999.
18. Cho J, Kim JY, Song DG, Lee WC. Comparison of outcome after retinaculum repair with and without fibular groove deepening for recurrent dislocation of the peroneal tendons. *Foot Ankle Int* 2014;35:683-689.
19. Mendicino R, Orsini R, Whitman S, Cantanzariti A. Fibular groove deepening for recurrent peroneal subluxation. *J Foot Ankle Surg* 2001;40:252-263.
20. Ogawa B, Thordarson D, Zalavras C. Peroneal tendon subluxation repair with an indirect fibular groove deepening technique. *Foot Ankle Int* 2007;28:1194-1197.
21. Shawen S, Anderson R. Indirect groove deepening in the management of chronic peroneal tendon dislocation. *Techniques Foot Ankle Surg* 2004;3:118-125.
22. Walther M, Morrson R, Mayer B. Retromalleolar groove impaction for the treatment of unstable peroneal tendons. *Am J Sports Med* 2009;37:191-194.
23. Kumai T, Benjamin M. The histological structure of the malleolar groove of the fibula in man: Its direct bearing on the displacement of peroneal tendons and their surgical repair. *J Anat* 2003;203:257-262.
24. Ferran N, Oliva F, Maffulli N. Recurrent subluxation of the peroneal tendons. *Sports Med* 2006;36:839-846.
25. Hodges Davis W, Sobel M, Deland J, Bohne W, Patel M. The superior peroneal retinaculum: An anatomic study. *Foot Ankle Int* 1994;15:271-275.
26. Maffulli N, Ferran N, Oliva F, Testa V. Recurrent subluxation of the peroneal tendons. *Am J Sports Med* 2006;34:986-992.
27. van Dijk PAD, Gianakos AL, Kerkhoffs GMMJ, Kennedy JG. Return to sports and clinical outcomes in patients treated for peroneal tendon dislocation: a systematic review. *Knee Surg Sports Traumatol Arthrosc* 2016;24:1155-1164.
28. Maqdes A, Steltzlen C, Pujol N. Endoscopic fibular groove deepening for stabilization of recurrent peroneal tendons instability in a patient with open physes. *Knee Surg Sports Traumatol Arthrosc* 2017;25:1925-1928.
29. Guelfi M, Vega J, Malagelada F, Baduell A, Dalmau-Pastor M. Endoscopic treatment of peroneal intrasheath subluxation: A new subgroup with superior peroneal retinaculum injury. *Foot Ankle Int* 2018;39:542-550.
30. Saragas NP, Ferrao PNF, Mayet Z, Eshraghi H. Peroneal tendon dislocation/subluxation. Case series and review of the literature. *Foot Ankle Surg* 2016;22:125-130.
31. Suh JW, Lee JW, Park JY, Choi WJ, Han SH. Posterior fibular groove deepening procedure with low-profile screw fixation of fibrocartilaginous flap for chronic peroneal tendon dislocation. *Foot Ankle Surg* 2018;57:478-483.