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Tendoscopic Surgery for Peroneal Tendons Instability: A Literature Review

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Abstract

Introduction: There has been a surge in the use of tendoscopic surgery for treating peroneal tendons instability. The novelty of this approach demanded a literature review of its indications, limitations, and clinical outcomes. **Aim:** A literature review of the clinical studies reporting on tendoscopic peroneal tendon stabilisation surgery along with its outcomes and complications. **Methods:** We carried out a comprehensive review of the literature up until September 2022 with an extensive search of the MEDLINE, Embase and Cochrane library databases. **Results:** Initial search resulted in 66 articles. Four duplicate articles were removed. Further 30 articles were excluded after title and abstract screening. Eight studies satisfied the inclusion criteria and were included in this review. Articles were analysed for outcomes and complications. **Conclusion:** The tendoscopic technique for peroneal tendon instability is an effective and safe surgical technique with very low failure rate. Levels of Evidence: Level IV.

Keywords

Peroneal Tendons, Instability, Tendoscopy

1. Introduction

Acute Peroneal tendons instability has been reported to occur in 0.5% of acute trauma to the ankle. The mechanism of injury usually involves an element of dorsiflexion and inversion with forceful peroneal tendon contraction [1]. Chronic instability can be the sequel of either failed treatment or diagnosis of acute injury, recurrent ankle instability, or repetitive subacute trauma in athletes or patients with hindfoot varus malalignment as in Charcot-Marie-Tooth disease or idio-

pathic pes cavus [2].

Anatomically, both Peroneus Brevis (PB) and Peroneus Longus (PL) muscles become tendinous 3 - 4 cm proximal to the ankle joint running in a common tendon sheath lying posterior to the lateral malleolus in the retro-fibular groove with the PB tendon lying anterior and medial to the PL tendon [3].This groove is normally concave with a fibrocartilaginous ridge adding 2 - 4 mm of depth to the groove [4]. The Superior Peroneal Retinaculum (SPR) plays a critical role in stabilization of peroneal tendons in the groove. It originates from the periosteum of the lateral malleolus and inserts in the aponeurosis of the Achilles tendon (**Figure 1**) [5].

Numerous anatomic variations have been reported that would predispose peroneal tendons to instability. For instance, flat or convex retro-fibular grooves can predispose tendons to instability more than normally concave ones. Also, the absence or smaller than normal size of the fibrocartilaginous ridge can be a contributing factor for instability [6]. The presence of an accessory Peroneus Quartus (PQ) muscle or low lying muscle belly of the peroneal brevis into the retro-fibular groove could cause an increase in the volume pressure within the groove which in turn could attenuate the SPR leading to the risk of subluxation [7].

Peroneal tendons subluxation was classified in 1976 by Eckert and Davis and later modified by Oden in 1987 into four grades [6] [8]. In grade I injuries, the SPR is avulsed from the lateral malleolus, with the tendons dislocated between the bone and periosteum. In grade II injuries, the fibrocartilaginous ridge is avulsed along with the retinaculum, the tendons dislocate between the fibrocartilaginous ridge and the fibula. In grade III injuries, there is a bony avulsion injury of the fibular origin of the SPR. In grade IV, the SPR is torn from its posterior attachment and the tendon dislocates superficial to the peroneal retinaculum (**Figure 2**).

In some patients, abnormal movement of the peroneal tendons in relation to each other within the groove during active ankle motion can present as painful clicking or snapping sensation in a retro-malleolar area without clinically reproducible tendon dislocation or subluxation from the groove. In 2008, Raikin *et al.* coined this phenomenon as intra-sheath subluxation of the peroneal tendons

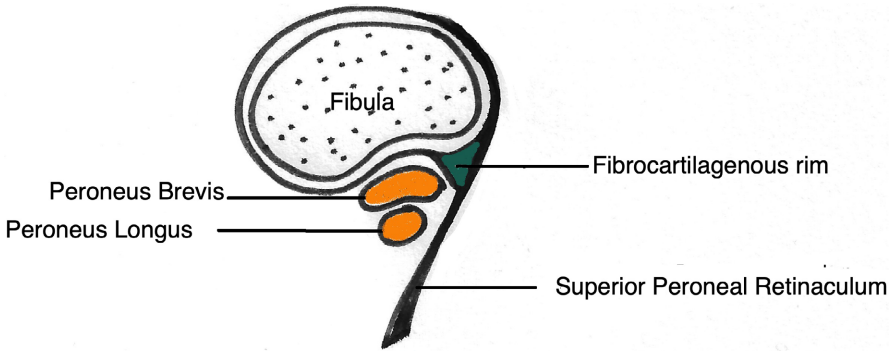

Figure 1. Author's drawing of retro-fibular groove and the stabilizing structures of peroneal tendons.

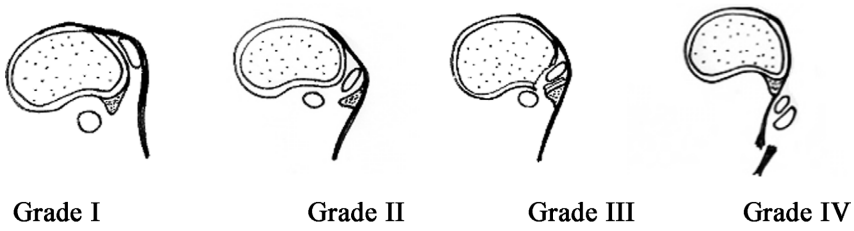

Figure 2. Author's drawings of anatomic grades of Superior Peroneal Retinaculum (SPR) Tears as classified by Eckert and Davis and modified by Oden.

[9]. They described two patterns of instability in which anatomic position of the peroneal tendon switches within the retro-fibular groove. In Type A, the peroneal longus tendon dislocates anterior to the peroneal brevis tendon within the groove. Apart from acute or chronic injury to SPR, this could also be caused by the presence of low lying BP or accessory muscle can lead to stretched out but still intact SPR. In Type B, the peroneal longus tendon subluxate through a longitudinal tear in the peroneal brevis tendon.

Patients with acute peroneal tendon instability usually present with a history of acute ankle injury where foot was forced in inversion and/or dorsiflexion. They may recall sense of painful pop and pain at lateral ankle. In chronic presentation, patient usually report sense of instability, painful popping or snapping around lateral ankle. Intra-sheath subluxation could present also similarly symptoms of painful clicking in the retro-fibular groove [7].

Examination of acute injury usually reveals lateral ankle tenderness, swelling and reduced ankle range of motion. Specific testing for the peroneal tendons includes active dorsiflexion and eversion whilst watching and feeling for any tendon subluxation and or dislocation. This can be felt around the lateral malleolus or as a click in the reto-fibular groove. It is easier to elicit these findings in chronic presentation than acute injury where examination is limited due to pain. Examination should also include ankle stability, alignment any general ligamentous laxity [10].

Plain radiographs in acute setting of ankle injury can show avulsion of SPR fibular attachment. Dynamic ultrasound is of value in assessing real-time tendon movement, subluxation, intra-sheath dislocation, SPR integrity and any associated tendon tears. MRI is valuable is detecting peroneal tears, accessory PQ, low lying PB muscle belly and associated ankle pathology such as osteochondral or ligaments injuries [11].

Treating acute peroneal tendon instability is initially non-operatively. Strategies such as non-steroidal anti-inflammatory drugs, ice therapy, bracing or short period immobilization and physiotherapy can lead to good results in the majority of patients. Chronic instability or failed management of acute injury usually requires some form of surgical stabilization [10]. Open surgical technique for peroneal tendon instability is well established utilizing many strategies targeting at either repair or reconstruction of natural stabilizer of the tendons or correcting any anatomical anomalies. These strategies can be grouped in 4 main catego-

ries which can be used in combination or isolation. 1) Repair or reconstruction of SPR. 2) Groove deepening via various fibular osteotomies or bone block procedures. 3) Tendons re-routing under calcaneao-fibular ligament. 4) Space occupying lesion debulking *i.e.*, debridement of the fleshy thickened part of low lying muscle belly of BP or accessory PQ [12].

Overall, studies on open surgical techniques for peroneal tendon stabilization are reporting excellent or good results in 90% of cases [13] [14]. Having said that, traditional open surgical treatment usually uses an extensive lateral exposure to facilitate adequate visualisation, diagnosis, and treatment. This approach is associated with scar formation, adhesions, and entrapment of the sural nerve. There have been also reports of other complications including infection, recurrent instability, bone block fractures, nerve injury and scar hypersensitivity [15].

Tendoscopic surgery of the tendons was first described in 1995 by Wertheimer *et al.* in the management of posterior tibial synovitis [16]. Following this report, tendoscopic surgery has become more popular in treating different pathologies of other tendons such as Achilles tendon and flexor hallucis longus. It was Van Dijk who first described endoscopic surgery of the peroneal tendon in 1998 through a cadaveric study and a cases series of nine patients [17]. Technically, tendoscopy allows for a minimally invasive approach with reduced risk of surgical wounds scarring, nerve damage and pain. Furthermore, the full length of the involved peroneal tendon can be examined from the musclo-tendinous junction to the level of the peroneal tubercle [12].

Recently, there have been few reports on tendoscopic surgery for peroneal tendon instability. Most of the reports are case series, case reports and technical notes with no collective review of their outcomes and complications. In this review, we are trying to collect and present all the available evidence on this relatively new technique.

2. Methods

We conducted a comprehensive search of electronic databases of Medline on PubMed, Embase and Cochrane Library. Google Scholar was also searched to avoid missing out on any literature. The date search limit was set from January 2000 to September 2022. We used combined keywords and Mesh database to generate a search strategy for the electronic databases using the following search keywords (Peroneal tendons, subluxation, dislocation, instability, endoscopy, endoscopic, stabilization, intra-sheath and intrasheath).

2.1. Eligibility Criteria for Study Inclusions

The review included randomized controlled trials (RCTs), cohort studies, and case series as eligible studies for consideration. Participants in these studies were required to be 18 years or older. Only articles published in English-language peer-reviewed journals were considered between the years 1990 and 2022. To accommodate the novelty of techniques, studies with more than five reported

cases were accepted for review. However, cadaveric studies and technical notes were excluded due to their lack of clinical outcomes.

2.2. Data Collection and Article Selection

Data base search results were exported to spreadsheet files. Duplicate articles were removed. Abstracts were screened for elimination of illegible articles. Residual articles manuscripts were assessed for final inclusion. Each stage was screened independently by two authors (IM and AA) and any disagreements were resolved through discussion.

2.3. Data Analysis

Data were extracted from all the eligible included studies using a data extraction sheet created in Microsoft® Excel. The following data was extracted and aggregated in the data extraction sheet: Study design, sample size, patient demographics, mechanism of injury, tendoscopic findings, surgical technique used, and duration of follow up. Outcomes were collected in same data sheet to include recurrence rate and surgery related complications. The total number of included ankles was calculated for all included studies. The failure rate and complication incidence were determined using the formula: Total recurrence = number of total recurrence/number of ankles in all studies. Incidence of each complication was calculated as the average for all included studies using descriptive statistics.

3. Results

The initial search resulted in 66 articles. 4 duplicate articles were removed. Further 30 articles were excluded after title and abstract screening. The full manuscripts of the remaining 32 articles were assessed for eligibility. Finally, eight studies satisfied the inclusion criteria and were included in this review and listed in number order in one table (**Table 1**) [14] [18]-[24].

A total number of 90 patients were reported in the included studies with mean age of 25.8. In 6 studies, 61 cases were managed for peroneal dislocation and in two studies 29 patients were treated for intra-sheath subluxation (studies number 7 and 8). The mean follow up period was 32 months.

3.1. Tendoscopic Technique

In all eight studies, setup for tendonscopy followed the Van Dijk technique with patient in lateral position and thigh torniquet in place [17]. In 6 out of 8 studies, gravity fluid irrigation was preferred to fluid pump to avoid excessive distension of soft tissue which may make conversion to open procedure more difficult. Six studies followed the traditional distal portal first order but in the other two, proximal portal was recommended first. According to Guillo S & Calder JD, the proximal portal first technique will help the procedure because locating the peroneal tendon sheath is much easier at proximal level where it is thicker and

Table 1. List of the final studies included in the review.

Author/Year	Type of study	Number of cases	Fibular Groove Deepening	SPR repair	Muscle debulking	Complications
1. Guillo & Calder. (2013) [14]	Retrospective cohort	7	0	7	0	1
2. Vega *et al.* (2013) [18]	Retrospective cohort	7	7	0	7	None
3. Nishimura *et al.* (2020) [19]	Retrospective cohort	14	0	14	0	1
4. Vega *et al.* (2011) [20]	Case series	6	2	0	5	None
5. Shimozono & Kennedy (2019) [21]	Retrospective cohort	20	20	0	0	None
6. Waseda (2017) [22]	Case series	7	1	7	0	None
7. Guelfi *et al.* (2018) [23]	Case series	18	11	0	7	1
8. Dimnjaković *et al.* (2022) [24]	Case series	11	1	0	10	None

the sural nerve at that level is more toward the midline and less likely to be injured [14].

3.2. Operative Findings

In the 61 cases of peroneal tendon instability, the SPR was found to torn in 42 of the patients (68%). Flat or convex groove was found in 18 patients (30%). Mass occupying lesion (low lying PB muscle belly and/or accessory PQ) was found in only 5 patients (8%). In cases of intra-sheath subluxation, SPR was found to be torn in only 6 patients (20%). Abnormal fibular groove was found in 16 patients (55%). Mass occupying lesion was the most common findings with 17 patients (58%) affected.

3.3. Surgical Techniques Used for Tendons Stabilisation

The stabilization techniques used in all studies can be grouped under 3 main techniques used in isolation or combination:

1) SPR reattachment;
2) Deepening of the groove;
3) Debulking of low lying muscle or removal of accessory muscle.

In the 61 patients treated for tendons dislocation, SPR re-attachment using anchors was used fibular groove deepening were used equally in 28 patients each. Five patients needed combination of SPR repair, fibular groove deepening and debulking of mass occupying lesion. In the 29 patients with intra-sheath subluxation, no SPR repair was required. Seven patients underwent groove deepening, 8 required debulking of mass occupying lesions and 14 required both procedures in combination.

3.4. Patients Rehabilitation

In all studies, patients who underwent SPR repair or debulking procedure were allowed immediate weight bearing and ankle exercises. For all the patients who had fibular groove deepening, a period of 2 - 3 weeks of protected weight bear-

ing in cast or boot was followed in all studies.

3.5. Patients Outcome

At the end of follow up in all studies, there was no case of recurrent instability. No reported nerve or vascular injury. In one study (Guillo S, Calder JD), one patient had skin irritation caused by the anchor suture under the skin requiring removal of suture after 3 months [14]. In another study (Nishimura *et al.*), one patient with history of atopic dermatitis had skin stitch infection that resolved after stitch removal [19]. In Guelfi *et al.* study, one patient had pain for 12 months after peroneal groove deepening. MRI scan showed signal changes in peroneal tendons without tears. The pain resolved with the use of orthotics [23].

4. Discussion

Open surgical techniques for treating peroneal tendon instability are well established with generally satisfactory outcome but are not risk free. Reports of nerve injury, wound complication, fracture of fibular osteotomy and bony blocks are not infrequent. Bony osteotomies in particular have shown to have more inherent complications, such as tendon irritation and tendon adherence [7] [15]. Since Van Dijk's first reported on technique for tendoscopy of peroneal tendons, many surgeons have been exploring the technique application in managing variant tendon pathologies such as tears, synovitis and instability [17]. The surgical strategy for tendoscopic stabilization lines up broadly similar to the open techniques such as groove deepening, SPR repair and decompression of mass occupying lesions. These techniques can be used in isolation or in combination. Despite several reports on these relatively new techniques, there are no collective reviews of their effectiveness, safety and/or complications. In this narrative review we inspected a total of eight studies satisfying criteria of inclusion as outlined above. All eight studied included were case series with a total number of 90 patients reported. The patients in these studies can be broadly grouped into two main groups according to pattern of tendon instability. First group is the where the tendons actually dislocate partly or completely from the fibular groove. In reviewed studies, SPR tear was most common finding in this group with incidence of 68%. The finding of abnormal fibular groove or mass occupying lesion was less frequent at 30% and 8% respectively. Equal numbers of patients were treated with either SPR repair or fibular groove deepening alone (28 patients each), and all of them had excellent results without recurrence. This supports that SPR repair is not absolutely mandatory for stability as long as surgeon can achieve good groove deepening specially in cases of flat or convex groove. In the second group of instability, the tendons move abnormally within the sheath in relation to each other, alternatively termed intra-sheath subluxation. In the presented studies, SPR was only torn in 20% of these patients. Most frequent findings were abnormal groove or mass occupying lesion in 55% and 58% of patients respectively. This was expected as this pattern of instability was partially theo-

rized by Raikin *et al.* to be caused by stretched SPR as a result from mass occupying lesion [9]. All the patients in this category had either PB debulking, PQ excision or groove deepening with none of the patients requiring SPR repair. In all eight studies, patient had very good outcome without recurrence or serious surgery related compilations. Apart from short period of protected weight bearing in fibular groove deepening patients, all other patients were fully mobilized immediately after surgery.

5. Conclusion

The results of our review show that tendoscopic technique for peroneal tendon instability is effective and safe surgery. Fibular groove deepening alone has shown similar success to SPR repair in cases of true tendon dislocation or subluxation. In case of intrasheath subluxation, fibular groove deepening for abnormal fibula groove and/or debulking of mass occupying lesion is effective strategy with no need for SPR repair. Despite the encouraging results concluded from this review, it is difficult to draw a bigger picture on the outcome of tendoscopic surgery for peroneal tendon instability across all clinical practice because of the small number of studies and low volume cases included in the review driven by the novelty of the technique. Future large scale critical analysis such as metanalysis and systematic review of high-volume studies will be required to yield more robust evidence.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations

PB: Peroneus brevis, PL: Peroneus longus, SPR: Superior peroneal retinaculum, PQ: Peroneus quartus.