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Prevalence and Role of a Low-Lying Peroneus Brevis Muscle Belly in Patients With Peroneal Tendon Pathologic Features: A Potential Source of Tendon Subluxation

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ABSTRACT

A peroneus brevis low-lying muscle belly (LLMB) is a rare anomaly. A few published studies have supported the presence of this anomaly as an etiology for a peroneal tendon tear. However, the association between a peroneus brevis LLMB and tendon subluxation has not been well explored. In the present retrospective study, the magnetic resonance imaging (MRI) and intraoperative findings of 50 consecutive patients undergoing primary peroneal tendon surgery during a 5-year period were assessed. The sensitivity and specificity of MRI compared with the intraoperative findings for identifying peroneal tendon disease were investigated. The presence of associated peroneal tendon pathologic features in patients with and without a peroneus brevis LLMB was also compared. The sensitivity of MRI was high for identifying peroneal tenosynovitis (81.58%) and tear (85.71%). Although the sensitivity of MRI for detecting a peroneus brevis LLMB (3.23%) and tendon subluxation (10.00%) was low, MRI had high specificity at 94.74% and 100%, respectively. Intraoperatively, a peroneus brevis LLMB was seen in 62.00% of the patients with chronic lateral ankle pain and was associated with 64.52% of the patients with tenosynovitis, 29.03% of those with tendon subluxation, and 80.65% of those with a peroneus brevis tendon tear. Although the presence of a peroneus brevis LLMB did not show any statistically significant association with peroneus brevis tendon subluxation, of the 10 patients with intraoperatively observed tendon subluxation, 9 had a concomitant peroneus brevis LLMB. More studies with larger patient populations are needed to better investigate the role of a peroneus brevis LLMB as a mass-occupying lesion resulting in peroneal tendon subluxation.

Peroneal tendon injuries as a result of lower extremity trauma have been well recognized and studied. Advances in magnetic resonance imaging (MRI) have enhanced our ability to diagnose soft tissue pathologic entities such as tenosynovitis and tendon tears. A low-lying muscle belly (LLMB) (Fig.) is a rare anomaly, most commonly associated with the peroneus brevis tendon (1–3). A LLMB is defined as a muscle extending beyond its normal length. In the case of the peroneus brevis muscle, it is expected that the muscle would end an average of 1.6 to 2.0 cm above the distal tip of the fibula (4). Cases of a peroneus brevis LLMB have been documented in published studies (1,3,5–9). However, to our knowledge, the association between a peroneus brevis LLMB and tendon subluxation has not been well studied.

The 3 primary peroneal tendon disorders are tenosynovitis, tendon subluxation, and tendon tears (10,11). Peroneal tendon synovitis and tears are common findings, especially as a result of ankle sprains. Previous studies have addressed peroneal tendon tears, highlighting the need for appropriate diagnosis and surgical treatment (10–14). It is well recognized that MRI can be a useful tool to assess peroneal tendon tears. However, in the published data, concerns have been reported regarding the false reading of a tendon tear when relying on MRI studies as the only imaging source. Khoury et al (15) evaluated the accuracy of MRI findings for surgically proven peroneal tendon tears. They found 2 false-positive results (16.67%) and 1 false-negative result (8.33%) among 12 patients who had undergone surgery for a suspected peroneal tendon tear. In another retrospective study by Lamm et al (7), the MRI findings of peroneal

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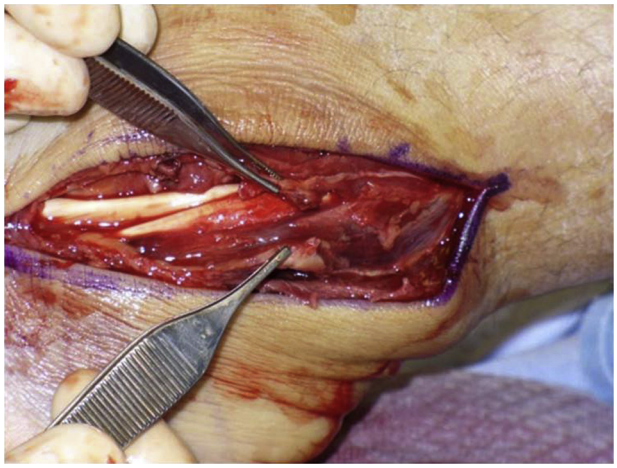

Fig. An intraoperative photograph of a peroneus brevis tendon with a low-lying muscle belly. In our study, a low-lying muscle belly was defined as an extension of the muscle belly within the fibular groove. As noted in this patient, the muscle belly extended beyond the tip of fibula.

tendon tears were compared with the intraoperative findings in 32 patients. The MRI diagnosis of a peroneus brevis tendon tear had a sensitivity and specificity of 83% and 75%, respectively. In their study, they reported 2 false-positive (6.25%) and 4 false-negative (12.50%) cases of a peroneus brevis tendon tear using MRI. Although the investigators included patients with LLMB, it is unclear how many cases of LLMB were identified from the imaging studies or intraoperatively (7). In addition, the investigators did not clearly discuss the relation of LLMB to any observed peroneal tendon pathologic entity.

The association between tears of the peroneus brevis tendon and the distal extent of its muscle belly was reported by Freccero and Berkowitz (5). The average distance between the musculotendinous junction to the distal fibula measured 33.1 mm on MRI in 29 patients with a surgically confirmed peroneus brevis tendon tear. However, this distance was reported to be 41.2 mm for 30 patients with a surgically confirmed intact peroneus brevis tendon (5). Although the investigators discussed the association between peroneus brevis tears and the extent of the muscle belly, they did not report any tendon subluxation relative to the presence of a peroneus brevis LLMB. Geller et al (1) also discussed the crucial effect of a peroneus brevis LLMB on peroneal tendon tears. Using 30 cadaver legs, they reported the influence of the presence of a lower musculotendinous junction on an increased prevalence of peroneal tendon tears. The musculotendinous junction was significantly more distal in the torn specimens than in those without a tear (1). That study, however, included a small number of specimens with tendon tears (n = 4). The association between a peroneus brevis LLMB and tendon subluxation was not studied in their cadaveric study (1). In another study, Pollack et al (2) reported 1 case of a peroneal tendon tear that was missed on MRI. On exploration of the tendon, a peroneus brevis LLMB was noted and thought to be the possible source of the tendon tear. (2).

The published studies on the relationship between peroneal tendon subluxation and a peroneus brevis LLMB are very limited. To our knowledge, only a single case study has reported on the presence of a peroneus brevis LLMB in the setting of peroneal tendon subluxation (6). In another study, peroneal tendon subluxation was seen as a result of a bifid peroneus brevis tendon, rather than a LLMB (16).

Although the presence of a peroneus brevis LLMB in cases of peroneal tendon tears has been documented in several studies (1–3), the prevalence of a peroneus brevis LLMB and its association with peroneal tendon subluxation has not been adequately studied. In the present study, our primary goal was to determine whether any association existed between a peroneus brevis LLMB and tendon subluxation. We hypothesized that a peroneus brevis LLMB could be a contributing factor to peroneal tendon subluxation secondary to its mass effect. Our secondary aim was to determine the prevalence of peroneal tendon pathologic entities, more specifically a LLMB, in our patient population. The sensitivity and specificity of MRI in identifying surgically proven tendon pathologic entities were also studied.

We undertook a retrospective study of patients who had undergone lateral ankle surgery to assess the reliability of MRI, determine the prevalence of peroneal tendon pathologic features, and compare the presence of tenosynovitis, tendon tear, and subluxation in patients with and without a peroneus brevis LLMB.

Patients and Methods

A sample size power analysis was completed, and it was determined that 50 patients were adequate to provide 80% power ($\alpha = 0.05$). The human research review committee at the University of New Mexico, which served as the institutional review board of record for the New Mexico Veterans Affairs Health Care System, approved the present study. We performed a review of the medical records of 50 consecutive patients who had undergone peroneal tendon repair.

A database of those patients who had undergone peroneal tendon repair during a 5-year period from November 2008 to November 2013, in the practice of the senior author (R.M.), was generated using the Common Procedural Terminology (CPT®) codes from the surgical package of the New Mexico Veterans Affairs Health Care System. The CPT® codes used to identify patients with peroneal tendon surgery were 27659 and 27658. Using the keywords "peroneal" and "peroneus," the list of operations for these patients was then further narrowed to specifically identify those patients who had undergone peroneal tendon repair surgery. Only those patients who had undergone primary peroneal tendon repair with preoperative MRI studies of the affected ankle completed were included. Patients who had undergone revision peroneal tendon surgery, had the peroneal tendon or tendons used for lateral ankle ligament reconstruction, had a history of ankle fracture requiring open reduction internal fixation, or had incomplete medical records (including preoperative MRI studies) were excluded from the present study.

Each patient's medical records, including progress notes, MRI findings, and operative reports, were reviewed by all authors to record the documented clinical, imaging, and intraoperative findings of peroneal tendon tenosynovitis, subluxation, and tear and the presence of a peroneus brevis LLMB. A clinical finding was defined as patient having ≥1 symptoms of peroneal tenderness, subluxation, snapping, or pain at the posterolateral ankle on physical examination. All MRI scans were reviewed by 2 musculoskeletal fellowship-trained radiologists. The operations were performed by 2 surgeons at the senior author's (R.M.) practice.

Peroneal tenosynovitis was defined as the presence of a fluid collection within the peroneal tendon sheath or hypertrophy of the tendon on the MRI scans or evidenced intraoperatively (11). Subluxation of the peroneal tendon was defined as displacement of the tendon, within the tendon sheath, lateral to the retromalleolar groove. Peroneal tendon tear was defined as the documented presence of a longitudinal tear within the tendon seen on MRI or intraoperatively (11). A LLMB was defined as extension of the muscle belly within the fibular groove. The intraoperative findings were considered the reference standard for identifying the noted tendon pathologic entities, and the results were compared with the imaging findings.

The present study was designed to primarily investigate whether the presence of a peroneus brevis LLMB was associated with peroneal tendon tenosynovitis, subluxation, and tear. We also aimed to determine the prevalence of common peroneal tendon diseases in our patient population. Using the intraoperative findings, the sensitivity and specificity of MRI in identifying surgically proven tendon pathologic entities were also studied.

The sensitivity and specificity of MRI in detecting peroneal tendon disease was calculated using the Clopper-Pearson (exact) test, with the 95% confidence level. Because of the small size of the samples, Fisher's exact test was used to compare the significance for tenosynovitis, tendon tear, and subluxation in patients with or without a peroneus brevis LLMB. A 2-sided p value of $\leq .05$ was considered statistically significant.

Results

The medical records of 50 consecutive patients who had undergone primary peroneal tendon surgery in a 5-year period, from November 2008 to November 2013, and met the study criteria were reviewed. Of the 50 patients, 8 were female and 42 were male, with mean age of 50.05 (range 24 to 68) years.