The Source of Fluid Deep to the Iliotibial Band: Documentation of a Potential Intra-Articular Source

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Objective: To determine whether there is a consistent extension of the lateral synovial recess under the iliotibial band (ITB) in an unembalmed cadaveric model.
Design: A prospective laboratory investigation.
Setting: A procedural skills laboratory of a tertiary medical center.
Subjects: Twelve unembalmed cadaveric knee specimens.
Methods: The suprapatellar recess, ITB, and region deep to the ITB were examined sonographically to document the absence of fluid in each knee. Thereafter, 60 mL of normal saline solution was injected into each knee to distend the joint recesses. Post-injection sonographic examination of the ITB at the level of the lateral femoral epicondyle was repeated at 0°, 25°, and 45° of knee flexion to detect and characterize any fluid visualized in the region of the ITB. The location of fluid in relation to the ITB was recorded as anterior, deep, posterior, or a combination of these positions.
Results: Fluid was observed anterior and deep to the ITB in 100% of 12 specimens. In 2 specimens, fluid also was noted posterior to the ITB. The presence and location of the fluid did not appear to change as a function of knee position. Using dynamic sonographic evaluation, we could track the fluid deep to the ITB back to the knee joint.
Conclusions: The lateral synovial recess appears to regularly extend beneath the anterior ITB. Fluid deep to the ITB should precipitate further evaluation of the knee joint when clinically indicated. Although distention of the lateral synovial recess is not always symptomatic, synovial irritation may be a pathoetiologic factor in the production of lateral knee pain syndromes, including ITB syndrome.

PM R 2014;6:134-138

INTRODUCTION

Iliotibial band syndrome (ITBS) is a common cause of lateral knee pain among athletes, especially runners [1,2]. Patients typically present with activity-related, deep, achy, lateral knee pain at the level of the lateral femoral epicondyle [3]. Multiple risk factors have been identified, but overuse during running and cycling activities is most commonly associated with ITBS [1,2,4]. Although the precise pathoetiology of ITBS has not been defined, researchers have hypothesized that cyclical iliotibial band (ITB) motion during running and cycling may produce symptoms via 2 mechanisms: (1) anteroposterior ITB motion over the lateral femoral epicondyle resulting in frictional, translatory stresses, or (2) medial-lateral ITB movement resulting in compression-related stresses [2-13]. These pathoetiologic mechanisms are not necessarily mutually exclusive, and common to both is the development of irritative stresses on the ITB and the underlying tissues.

The anatomic source of pain in patients with ITBS has not been precisely defined and may exhibit interindividual variability. Pain generators may include the ITB, the neurovascular-rich, periepicondylar fatty tissue located deep to the ITB, and the ITB bursa. ITB thickening, signal change in the periepicondylar fatty tissue, and fluid deep to the ITB have all been reported in patients with ITBS. However, some patients have no imaging findings despite a classic history and physical examination [14]. Fluid deep to the ITB is often interpreted to represent inflammation of an adventitial bursa—that is, ITB bursitis. However, the existence of a true ITB bursa remains controversial [6,8,14]. Some authors have proposed that the pain generator in ITBS is the lateral synovial recess of the knee [11,15].

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Disclosure: nothing to disclose

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Peer reviewers and all others who control content have no relevant financial relationships to disclose.

Submitted for publication May 10, 2013; accepted August 17, 2013.

Vol. 6, 134-138, February 2014
http://dx.doi.org/10.1016/j.pmrj.2013.08.594

Using magnetic resonance imaging (MRI), anatomic dissection, and intraoperative visualization, Nemeth and Sanders [15] reported the consistent presence of the lateral synovial recess deep to the ITB at the lateral femoral epicondyle. Isolated surgical removal of inflamed tissue within this recess resulted in clinical improvement in a small group of patients with refractory ITBS [16]. Thus fluid beneath the ITB may in fact represent intra-articular fluid located within the lateral synovial recess and not necessarily an inflamed ITB bursa.

Our previous sonographic study in asymptomatic recreational runners revealed fluid deep to the ITB in 100% of 20 subjects [12]. This fluid most often was located deep and anterior to the ITB. Although the prevalence and location of this fluid was assessed, no attempt was made to identify the source of the fluid. We hypothesized that the location and behavior of this fluid was more consistent with intra-articular fluid as opposed to an adventitial bursa. Further clarification of the source of fluid deep to the ITB is necessary to facilitate our interpretation of imaging findings, as well as our understanding of the potential pathoetiology of ITBS.

The primary purpose of this investigation was to determine whether there is a consistent extension of the lateral synovial recess under the ITB in an unembalmed cadaveric model. We hypothesized that creation of an iatrogenic knee effusion would produce fluid deep to the ITB as observed by ultrasound in 12 of 12 cadaveric knee specimens. If confirmed, these observations would suggest that fluid deep to the ITB may represent intra-articular fluid within the lateral synovial recess and lend credence to the theory that irritation of the lateral synovial recess may be pathoetiologic in some patients who present with ITBS.

METHODS

All components of this investigation were completed in the Mayo Clinic Procedural Skills Laboratory. The Mayo Clinic's Bio-Specimens Subcommittee of the Institutional Review Board approved the project. Twelve unembalmed cadaveric knee specimens were included in the study. Before being injected with saline solution, each knee was scanned with a Philips iU22 ultrasound machine and a 12-5 MHz linear array transducer (Philips Healthcare, Bothell, WA). With the knee fully extended in a supine position, the suprapatellar recess and peri-ITB region were scanned to identify any pre-existing fluid (yes/no). The knee was then injected with 60 mL of saline solution through a medial mid-peripatellar approach while ultrasound was used to monitor the suprapatellar recess for distention to ensure intra-articular placement (Figure 1). The amount of saline solution injected was based on a preliminary investigation during which the amount of fluid necessary to distend all sonographically visualized knee recesses was determined, as well as data from a previous study by Muhle et al [14].

With the knee in full extension (0° of flexion), the ITB was identified in a short-axis view at the level of the lateral femoral epicondyle. The presence (yes/no) of fluid was recorded in the region of the ITB. If fluid was present, its location was recorded as anterior, deep, or posterior to the ITB, or any combination of locations. A goniometer was then used to place the knee in 25° of knee flexion. The presence or absence of fluid and its relationship to the ITB was again recorded. Finally, the knee was placed in 45° of knee flexion with use of a goniometer and the presence and location of fluid was again recorded. Knee flexion values of 25° and 45° were chosen based on the fact that the ITB translates posteriorly over the lateral femoral epicondyle within this range of knee flexion [13]. This was important given that the location of fluid relative to the ITB was determined at the level of the lateral femoral epicondyle. Descriptive statistics were used to summarize the demographic characteristics of the cadaveric specimens, as well as the location of fluid in relation to the ITB.

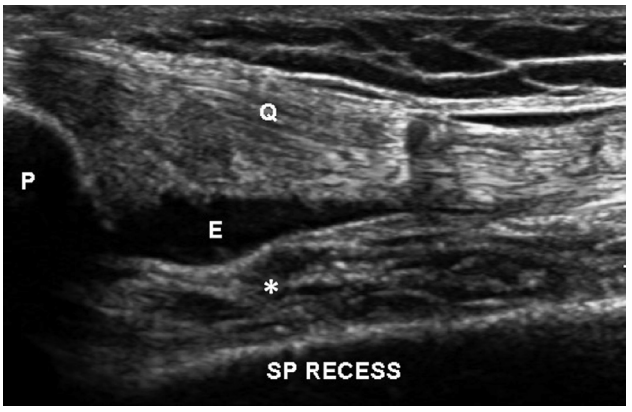

Figure 1. Long-axis view of the suprapatellar recess (SP RECESS) during intra-articular knee injection to produce an iatrogenic effusion. Note the fluid/iatrogenic effusion (E) deep to the quadriceps tendon (Q) and superficial to the prefemoral fat pad (asterisk). P = patella; top = superficial; bottom = deep; left = caudad; right = cephalad.

Table 1. *Fluid location relative to the iliotibial band after iatrogenic knee effusion at 0°, 25°, and 45° of knee flexion*

Specimen	0° Knee Flexion	25° Knee Flexion	45° Knee Flexion
1	A, D	A, D	A, D
2	A, D	A, D	A, D
3	A, D	A, D	A, D
4	A, D	A, D	A, D
5	A, D	A, D	A, D
6	A, D	A, D	A, D
7	A, D, P	A, D, P	A, D, P
8	A, D	A, D	A, D
9	A, D, P	A, D, P	A, D
10	A, D	A, D	A, D
11	A, D	A, D	A, D
12	A, D	A, D	A, D

A = anterior; D = deep; P = posterior.