PASIG MONTHLY CITATION BLAST: No.16 **November 2006**

Dear PASIG members:

This month's Citation BLAST continues our special topic series: *popliteus dysfunction*, contributed by PASIG Nominating Committee member, Sheyi Ojofeitimi MSPT. The format is an annotated bibliography of articles on the selected topic from 1996 – 2006. Special topics are targeted periodically throughout the year. If you'd like to suggest a topic or create one, please let me know.

As a reminder, each month's citations will be added to specific EndNote libraries: 1) Ice Skating, 2) Gymnastics, 3) Music, and 4) Dance. This topic will be kept in a separate library, as it applies to several of our performing arts populations. The updated libraries are posted on the PASIG webpage for our members to access and download. (Information about EndNote referencing software can be found at http://www.endnote.com, including a 30-day free trial).

Don't forget, the PASIG sponsors an annual student research scholarship. There's still time for students to apply. **Our deadline has been extended to November 22nd**. This award is to recognize students, who have had an abstract accepted to CSM, for their contribution to performing arts research. For more information on the research award please check our webpage (www.orthopt.org/sig_pa.php) or contact PASIG Treasurer, Leigh Roberts DPT, OCS (Lar@LarPT.com).

If you or your students are interested in conducting performing arts research and want to start planning now for next year, please let us know how we can assist you.

As always, your comments and entry contributions to these Citation BLASTs are always welcome. Please drop me an e-mail anytime.

Shaw Bronner PT, PhD, OCS
Chair, PASIG Research Committee
sbronner@liu.edu

SPECIAL TOPIC: POPLITEUS DYSFUNCTION

The popliteus muscle is seldom regarded as an important component of the knee musculature. However, popliteus dysfunction can have a significant impact of the stability of the posterolateral corner (PLC) of the knee. The excessive rotational requirements (turnout) of classical dance, genu recurvatum postures, and squatting / stomping movements in modern and other dance forms, place many dancers at risk for popliteus injuries. As performing arts clinicians, it is imperative that we educate ourselves about popliteus dysfunctions to ensure proper diagnosis and treatment.

Sheyi Ojofeitimi MSPT

Burstein DB, Fischer DA (1990). Isolated rupture of the popliteus tendon in a professional athlete. Arthroscopy **6**(3): 238-41.

A 24-year-old professional football player sustained an isolated rupture of the popliteus tendon. The injury was confirmed by arthroscopic examination. No clinical instability was present initially or during the recovery period. The injury was managed nonoperatively with the patient able to return to full sports participation. No residual ligament laxity or weakness on isokinetic testing resulted.

Conroy, J, King D, et al. (2004). Isolated rupture of the popliteus tendon in a professional soccer player. Knee **11**(1): 67-9.

We report an unusual case of an isolated intra-substance rupture of the popliteus tendon in a professional soccer player. The injury, sustained in a soccer tackle, was diagnosed on magnetic resonance imaging and subsequently confirmed on arthroscopic examination of the knee. The impinging proximal stump was debrided and the patient returned to playing competitive soccer within 6 weeks of surgery.

Cooper DE (1999). Snapping popliteus tendon syndrome. A cause of mechanical knee popping in athletes. Am J Sports Med **27**(5): 671-4.

Six patients with snapping in the knee were evaluated with clinical history, examination, radiographs, and other imaging. All patients were younger than 40 years and none had an arthritic process. Onset was traumatic in three patients, spontaneous in two, and post-surgical in one. The popping was on the direct lateral aspect of the knee. A consistent examination finding was that the popping was more prominent when the knee was loaded with varus stress during passive flexion and extension cycling, and that it was easily palpated midway between the lateral epicondyle and lateral joint line. Four patients were treated nonoperatively and two had operations. Of those treated without surgery, two had spontaneous resolution of the popping, in one the popping persisted, although not symptomatic enough to require surgery, and one had surgery later. In the surgical group, one patient was treated with popliteus tendon release and one with

tenodesis of the popliteus tendon to the fibular collateral ligament. Both procedures were curative and neither led to complicating problems. Follow-up information was not available for the patient with late surgery. Snapping of the popliteus tendon should be recognized as a cause of lateral popping in the knee. It is easily confused with more common sources of mechanical symptoms. Awareness will allow accurate diagnosis and treatment, avoiding unnecessary diagnostic arthroscopy.

Covey DC (2001). Injuries of the posterolateral corner of the knee. J Bone Joint Surg Am **83-A**(1): 106-18.

The complex anatomy of the posterolateral corner of the knee is due largely to the evolutionary changes in the anatomic relationships of the fibular head, the popliteus tendon, and the biceps femoris muscle. Recent research has improved our understanding of the popliteus complex, particularly the role of the popliteofibular ligament. Biomechanical studies provide a scientific basis for clinical examination of the knee with suspected injury of the posterolateral corner. All grade-I and most moderate grade-II injuries of the posterolateral structures can be treated nonoperatively, but residual laxity may remain, especially in knees with grade-II injury. Acute grade-III isolated or combined injury of the posterolateral corner is best treated early, by direct repair, if possible, or else by augmentation or reconstruction of all injured ligaments. Chronic injury of the posterolateral corner, whether isolated or combined, is probably best treated by reconstruction of the posterolateral corner along with reconstruction of any coexisting cruciate ligament injury. Failure to diagnose and treat an injury of the posterolateral corner in a patient who has a known tear of the anterior or posterior cruciate ligament can result in failure of the reconstructed cruciate ligament.

Crites BM, Lohnes J, et al. (1998). Snapping popliteal tendon as a source of lateral knee pain. Scand J Med Sci Sports **8**(4): 243-4.

A 25-year-old female patient underwent surgery for a history of pain and popping on the lateral aspect of her right knee. It was initially thought that the patient had iliotibial (IT) band syndrome, which was refractory to conservative treatment. However, upon release of the IT band, the snapping which was audible and palpable pre-operatively was still present. Further exploration of the posterior-lateral aspect of the knee revealed that the popliteal tendon was snapping over the incisura poplitea extensoria on the lateral femoral condyle. Excision of the prominent portion of the articular ridge below the sulcus popliteus eliminated the snapping sensation. The patient has remained asymptomatic since surgery for the past 22 months.

Feipel V, Simonnet ML, et al. (2003). The proximal attachments of the popliteus muscle: a quantitative study and clinical significance. Surg Radiol Anat **25**(1): 58-63.

Controversies about the existence of accessory proximal popliteus muscle attachments can be found in the literature. The aim of this study was to verify the occurrence and width of popliteus attachments on the articular and periarticular structures of the knee joint. The relation of these attachments to tibiofemoral cartilage and meniscus degeneration was also investigated. Forty-two anatomical specimens were dissected. The incidence of accessory proximal attachments was determined and their width measured using a caliper. The fibular attachment of the popliteus was observed in 98% of cases; its mean width was 11 (SD 3) mm. At least one attachment on the lateral meniscus was found in 95% of the specimens, with a mean width of 6 (SD 2) mm. Three types of meniscal attachments of the popliteus could be identified. The severity of meniscus and tibiofemoral cartilage alterations was significantly related to the number of meniscopopliteal fascicles: more severe alterations were seen in knees with fewer

meniscopopliteal fascicles. Popliteus attachments on the posterior knee joint capsule (57%), arcuate (90%) and oblique popliteal (79%) ligaments were also observed in most specimens. Popliteus muscle relationships with the posterior cruciate (5%) and meniscofemoral (33%) ligament were less common. In conclusion, accessory popliteus attachments on the fibula, lateral meniscus and arcuate popliteal ligament can be considered constant characteristics. The results of this study suggest a role of the popliteus in the protection of knee menisci and tibiofemoral cartilage.

Geissler WB, Corso SR, et al. (1992). Isolated rupture of the popliteus with posterior tibial nerve palsy. J Bone Joint Surg Br **74**(6): 811-3.

We report the case of a 59-year-old man with severe knee pain and inability to flex his toes or invert his plantar flexed foot after an external rotation injury to his knee. MRI showed rupture of the popliteus with a haematoma compressing the neurovascular bundle in the proximal calf, and electromyography demonstrated signs of an axonotmesis of the posterior tibial nerve. There was progressive nerve recovery over 24 weeks. Isolated rupture of the popliteus should be considered in any patient with an acute haemarthrosis, lateral tenderness and a stable knee, especially after an external rotation injury.

Guha AR, Gorgees KA, et al. (2003). Popliteus tendon rupture: a case report and review of the literature. Br J Sports Med **37**(4): 358-60.

Isolated rupture of the popliteus musculotendinous unit is an uncommon injury. A case is here reported of a semiprofessional athlete with a ruptured popliteus tendon without significant instability of the knee. The diagnosis was made by magnetic resonance imaging and confirmed by arthroscopy.

Kirkham B, Churchill M, et al. (1991). Anterolateral rupture of popliteal cysts in rheumatoid arthritis. Ann Rheum Dis **50**(3): 187-8.

Popliteal cysts occur commonly in both normal and arthritic knees. Most cysts are formed by distension of the medially situated semimembranosus bursa. Popliteus bursa distension occurs uncommonly as a lateral popliteal cyst. Two cases of rupture of lateral cysts which produced symptoms related to the anterolateral lower leg are reported. The difficulty of diagnosing the condition because of this unusual site of inflammation and subsequent management problems are discussed.

Maynard MJ, Deng X, et al. (1996). The popliteofibular ligament. Rediscovery of a key element in posterolateral stability. Am J Sports Med **24**(3): 311-6.

We have recently become aware of a strong direct attachment of the popliteal tendon to the fibula. To investigate the importance of this attachment, we examined 20 cadaveric knees. The popliteofibular ligament was identified in all 20 knees. The cross-sectional area of the popliteofibular ligament was 6.9 +/- 2.1 mm2, compared with 7.2 +/- 2.7 mm2 for the lateral collateral ligament. Biomechanical testing of these structures, simulating a purely varus stress on the knee, revealed that the lateral collateral ligament always failed first, followed by the popliteofibular ligament, and then the muscle belly of the popliteus. The mean maximal force to failure of the popliteofibular ligament approached 425 N (range, 204 to 778), compared with 750 N (range, 317 to 1203) for the lateral collateral ligament. Our results indicate that the popliteofibular ligament contributes to posterolateral stability.

McAllister DR, Parker RD (1999). Bilateral subluxating popliteus tendons. A case report. Am J Sports Med **27**(3): 376-9.

Murray JR, Grundy JR, et al. (2004). Spontaneous rupture of the popliteus tendon in a 74-year-old woman and review of the literature. Arthroscopy **20**(8): 860-4.

Spontaneous rupture of the popliteus tendon has not previously been reported. We report the case of a 74-year-old patient, discuss its diagnosis and management, and review the current literature on isolated popliteus lesions. A multi-database electronic literature review suggests that the injury is invariably traumatic and has essentially been reported only in young, active individuals. It should be suspected in a patient with acute lateral knee pain who, on examination, has a hemarthrosis and a stable, possibly locked knee. The diagnosis is readily made using arthroscopy. While both conservative treatment with physiotherapy and open repair have been advocated, we describe a successful outcome of arthroscopic resection in an elderly patient and propose that popliteus injury is not confined to a younger age group. The balance of opinion in the current literature is that acute traumatic rupture in the young patient is managed by primary surgical repair, but successful outcome is also reported with nonoperative treatment.

Naver L, Aalberg JR (1985). Avulsion of the popliteus tendon. A rare cause of chondral fracture and hemarthrosis. Am J Sports Med **13**(6): 423-4.

A case of isolated avulsion of the popliteus tendon in a 20-year-old male athlete is reported. The avulsion was caused by forward gliding of the femur on the fixed tibia which produced a chondral fracture and hemarthrosis.

Nyland J, Lachman N, et al. (2005). Anatomy, function, and rehabilitation of the popliteus musculotendinous complex. J Orthop Sports Phys Ther **35**(3): 165-79.

We present a clinical commentary of existing evidence regarding popliteus musculotendinous complex anatomy, biomechanics, muscle activation, and kinesthesia as they relate to functional knee joint rehabilitation. The popliteus appears to act as a dynamic guidance system for monitoring and controlling subtle transverse- and frontal-plane knee joint movements, controlling anterior-posterior lateral meniscus movement, unlocking and internally rotating the knee joint (tibia) during flexion initiation, assisting with 3-dimensional dynamic lower extremity postural stability during single-leg stance, preventing forward femoral dislocation on the tibia during flexed-knee stance, and providing for postural equilibrium adjustments during standing. These functions may be most important during mid-range knee flexion when capsuloligamentous struCtures are unable to function optimally. Because the popliteus musculotendinous complex has attachments that approximate the borders of both collateral ligaments, it has the potential for providing instantaneous 3-dimensional kinesthetic feedback of both medial and lateral tibiofemoral joint compartment function. Enhanced popliteus function as a kinesthetic knee joint monitor acting in synergy with dynamic hip muscular control of femoral internal rotation and adduction, and ankle subtalar muscular control of tibial abduction-external rotation or adduction-internal rotation, may help to prevent athletic knee joint injuries and facilitate recovery during rehabilitation by assisting the primary sagittal plane dynamic knee joint stabilization provided by the quadriceps femoris, hamstrings, and gastrocnemius.

Olson WR, Rechkemmer L (1993). Popliteus tendinitis. J Am Podiatr Med Assoc **83**(9): 537-40.

Popliteus tendinitis is a relatively infrequent and often misdiagnosed injury of the posterior aspect of the knee. The clinical significance of this injury is particularly relevant to the serious runner and triathlete, as the symptoms resulting from this injury can be disabling.

Peterson L, Pitman MI, et al. (1984). The active pivot shift: the role of the popliteus muscle. Am J Sports Med **12**(4): 313-7.

Ligament insufficiency due to athletic injury is widely recognized and reported as an etiological factor in knee joint instability. It was recognized that a patient presenting with knee joint instability due to past hockey injury to the anterior cruciate ligament, subsequently verified surgically, was able to voluntarily and actively perform the pivot shift maneuver with his knee as a result of his anterolateral rotatory instability. During a subsequent 6 month period, three other patients with similar anterior cruciate deficiencies presented with this same active pivot shift maneuver phenomenon. A study was designed to determine the active muscle or muscles involved in this abnormal active motion in the knee joint with anterolateral rotatory instability. Electromyographic studies with needle electrodes were conducted on a variety of muscles in four subjects presenting with the instability. Results indicated that the popliteus muscle plays a major role in the active performance of the pivot shift maneuver.

Radhakrishna M, Macdonald P, et al. (2004). Isolated popliteus injury in a professional football player. Clin J Sport Med **14**(6): 365-7.

Tibrewal, S. B. (2002). Acute calcific tendinitis of the popliteus tendon--an unusual site and clinical syndrome. Ann R Coll Surg Engl **84**(5): 338-41.

Three cases of acute calcific tendinitis of the popliteus tendon presenting in the accident and emergency department as 'locked knee' are described. All patients presented with acute pain, flexion deformity and marked limitation of movements of the knee. All patients were unable to weight-bear on the affected side. The radiographs revealed well circumscribed calcification in two patients and faint stippled calcification in the third. All patients were referred to the next fracture clinic with a diagnosis of a mechanical problem within the knee joint due either to a 'loose body' or a meniscal tear. All patients responded to an injection of corticosteroids and local anaesthetic with immediate pain relief and lasting resolution of symptoms.

Tsien, CL, Trepman E (2001). Internal rotation knee injury during ballroom dance: a case report. Journal of Dance Medicine and Science **5**(3): 82-6.

Dance injuries associated with internal totation of the leg are unusual and the injuries observed in ballet, modern, and aerobic dance are often associated with the externally rotated (turned out) or neutral (parallel) positions. This report presents a case of an international-style ballroom dancer who sustained a strain to the popliteus tendon without lateral meniscus tear during execution of the syncopated spin, a dance figure involving internal rotation of the leg. Transient locking of the knee occurred. Pain was located at the posterolateral knee. Examination showed posterolateral joint line tenderness and pain with active external rotation of the flexed knee. Magnetic resonance imaging (MRI) showed effusion around the popliteus tendon. The patient recovered with activity limitation over several weeks. The case demonstrates that ballroom dance activity may result in an internal rotation injury to the knee, an injury that is uncommon in other dance forms.

Weresh MJ, Gabel RH, et al. (1994). Popliteus function in ACL-deficient patients. Iowa Orthop J **14**: 85-93.

Anterior cruciate ligament (ACL) injuries commonly result in anterolateral instability, resulting in a "pivot shift" phenomenon. Given that popliteus muscle stimulation results in a pivot shift, others have postulated that the popliteus muscle has a role in the pivot shift

phenomenon. We hypothesized that patients with instability from ACL injuries may have excessive popliteus muscle activity. Therefore, we studied the EMG activity (using fine wire electrodes) of the popliteus muscle in sixteen normal subjects and ten ACL-deficient subjects. We recorded the EMG in six activities (level walking and jogging, ascending walking and jogging, and descending walking and jogging). Person's Product Moment Correlations were above 0.7, except in the case of ascending the treadmill (r = 0.427) and ascending jogging (r = 0.645), suggesting that the timing of the signals was similar for injured and uninjured limbs. Variance ratios for the injured and uninjured limbs were statistically similar, suggesting similar variability of patterns. Thus, we observed only minor popliteus EMG signal differences in this group of patients. We conclude that the popliteus muscle does not contribute to instability in the studied activities.

Westrich GH, Hannafin JA, et al. (1995). Isolated rupture and repair of the popliteus tendon. Arthroscopy **11**(5): 628-32.

The authors report the case of a 21-year-old woman who sustained a femoral avulsion of the popliteus tendon in a motor vehicle accident. The posterolateral injury was suspected on physical examination and confirmed by magnetic resonance imaging and arthroscopic examination. The popliteus tendon was repaired using two suture anchors. Mild clinical instability was present initially and resolved postoperatively. No residual pain, weakness, or posterolateral instability was noted.

Winge S, Phadke P (1996). Isolated popliteus muscle rupture in polo players. Knee Surg Sports Traumatol Arthrosc **4**(2): 89-91.

Isolated rupture of the popliteus muscle seems to be extremely rare, with only two cases described in the English literature. We present two cases of magnetic resonance imaging-verified isolated rupture of the popliteus muscle in polo players with the same injury mechanism-external rotation trauma on a flexed knee. Functional testing of the popliteus muscle in the figure of four position was positive in both cases. Full recovery was observed after 6 weeks of physiotherapy.