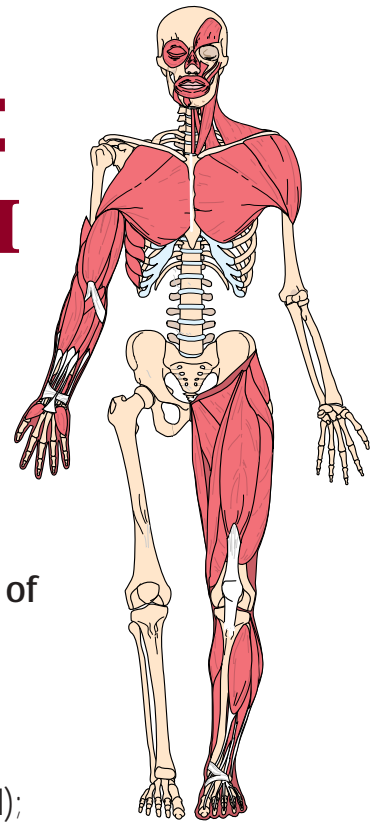

THE SPORTS MEDICINE SPECIALIST'S APPROACH TO THE KNEE AND THIGH



This is the third in a series of sports medicine articles. The intent of this series is to review easily diagnosed and managed musculoskeletal conditions that are commonly brought to the primary-care physician's attention.

By Aly S. Abdulla, BSc, MD, LMCC, CCFP(C), DipSportMed (CASM);
and Faiza Abdulla, CDA, executive director and owner, The
Kingsway Health Centre.

Throughout the lead author's tenure as a sports medicine specialist, he has found problems of the knee and thigh tend to be the most prevalent, but the least well understood. He believes the reason for this paradox is the plurality of conditions possible and the vagaries of their explanation. This article will use classical vignettes to deal with the conditions related to the knee and thigh that most commonly present to the primary-care physician. The secondary intent of this article is to develop a systematic approach to the history and physical examination of the knee and thigh as was done for the leg, ankle, feet and toes in previous articles.^{1,2} Upon completion of this series, a comprehensive mus-

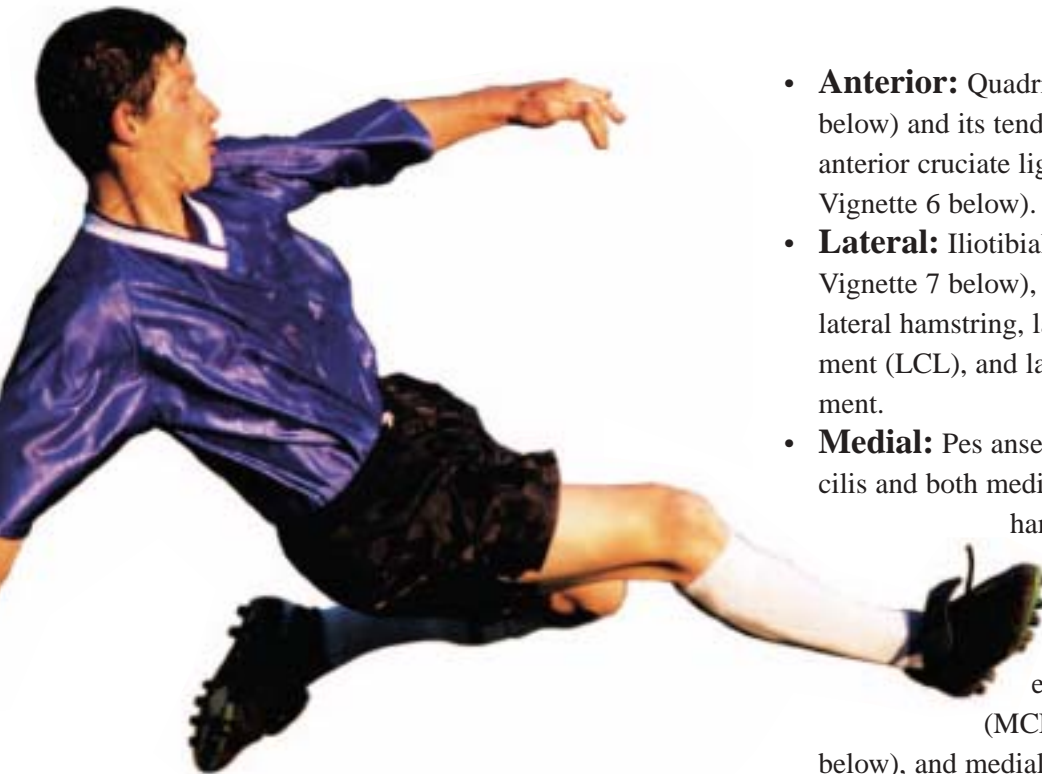
culoskeletal approach will be available for readers to modify for their own compendium.

This will not be a comprehensive approach to all possible conditions inflicted on the knee and thigh. There may be some entities that should be incorporated.

ANATOMY REVIEW

The knee is the largest joint in the body. It is a synovial joint with the superior femur articulating with the inferior tibia. The patella also articulates anteriorly within the trochlear groove of the femur (see Vignette 1 below); the fibula articulates with the lateral tibia. The patella is a sesamoid bone lying in the quadriceps tendon with cush-

KNEE & THIGH



ioning bursa (see Vignette 2 below). Its lower pole is joined by the patellar tendon (see Vignette 3 below) to the tibial tubercle (see Vignette 4 below).³⁻⁷

The muscles, tendons, and ligaments of the knee and thigh are best divided into four distinct stabilizing complexes, from superior and superficial to inferior and deep, as follows:

- **Anterior:** Quadriceps (see Vignette 5 below) and its tendon, patellar tendon, anterior cruciate ligament (ACL)(see Vignette 6 below).
- **Lateral:** Iliotibial band (ITB) (see Vignette 7 below), biceps tendon of the lateral hamstring, lateral collateral ligament (LCL), and lateral capsular ligament.
- **Medial:** Pes anserine (sartorius, gracilis and both medial components of the hamstrings, semimembranous and semitendinous) and its bursa, medial collateral ligament (MCL)(see Vignette 8 below), and medial capsular ligament.
- **Posterior:** Hamstrings (see Vignette 9 below), gastrocnemius medial and lateral heads, popliteus, posterior capsule, and posterior cruciate ligament (PCL).³⁻⁷

There are two menisci (see Vignette 10 below) in the knee joint: the medial meniscus and the lateral meniscus. The medial meniscus is more commonly damaged because of its limited mobility.³⁻⁷



Dr. Abdulla is the medical director and sports medicine specialist for The Kingsway Health Centre, Toronto, The Family Sports Medicine Consultants and The Healthy Performer in Toronto, Kanata, and Ottawa.



Faiza Abdulla is executive director and owner, The Kingsway Health Centre, Toronto, Ontario.

HISTORY

Obtaining a detailed history is tantamount to obtaining an accurate diagnosis.

- Ask about the main complaint (acute or chronic condition), time of onset, method of injury, location, description, and severity of symptoms.
- Ask about trauma, especially the position of the lower extremity during the injury.
- Ask about the ability to weight bear immediately post-injury and in the hours afterwards, and the effect on functional activities and gait.
- Ask if there is locking, clicking with pain, or “giving out.”
- Ask about aggravating and alleviating factors.
- Ask about tingling, numbness, swelling, weakness, stiffness, skin or temperature changes.
- It is important to ask what treatments the patient has tried and their effectiveness.
- Ask about previous injuries or similar conditions and their treatments.

As well, it is important to know about pre-existing musculoskeletal abnormalities, especially those involving proximal joints including the hip, pelvis, and lumbar spine; and those involving distal joints such as the leg, ankle, and foot. Finally, questions about other medical conditions (infectious, inflammatory, or congenital), medications, and family history are part of the complete evaluation.²⁻⁷ In the section Conditions and Their Management (see below), the salient history points will be described as classical vignettes.

PHYSICAL EXAMINATION

Inspection

The author's approach to examination of the knee and thigh is similar to his examination of all of lower extremities. It starts with inspection while the patient is standing while wearing shoes.^{1,2} Some patients with knee and thigh injuries come in with crutches. First evaluate the patient's capacity for weight-bearing, lower extremity alignment, and gait.^{1,2} The patient is then instructed to remove his/her socks and shoes and change into shorts. The patient initially stands facing the physician and then faces away. This allows evaluation of alignment and arches, and observation of any swelling, masses, joint effusions, bruising, and changes in the skin. Deformities of bone or soft tissue also are noted. Remember to inspect all of the limb from hips to feet and compare both sides.^{1,2}

Gait

The patient is asked to walk and the gait is evaluated for normal push off, swing phase, heel strike, foot flat and mid-stance.⁴

Range of Motion

The active range of the motion is assessed by getting the patient to toe raise, heel raise, hop, jump and squat. The passive range of motion is evaluated with manual palpation.

Palpation

The lead author's approach to manual palpation starts with the patient facing and sitting with legs bent at 90° over the edge of a table. The normal knee and thigh are examined first and compared to the injured side.

- The proximal **anterior** thigh is palpated

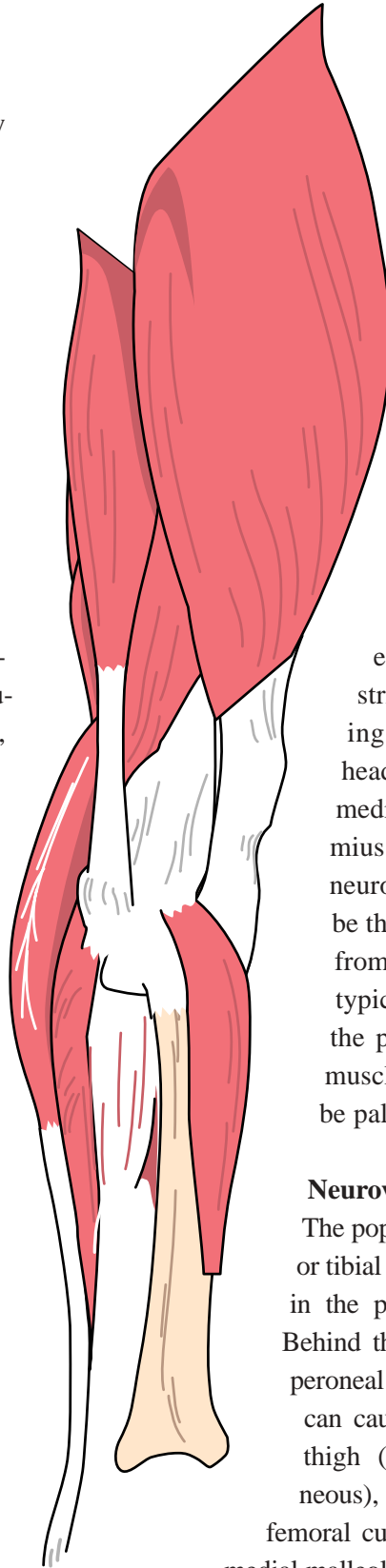


to review the continuity of the quadriceps. It is followed distally to the patella and its associated bursa, the trochlear groove between the two femoral condyles, the patellar tendon and its insertion to the tibial tubercle.

- The **lateral** aspect palpation starts at the lateral femoral condyle, which is the origin of the LCL, the lateral tibial condyle and the fibular head. These, in turn, are the insertions of the ITB, LCL and biceps tendon of the hamstring, and finally the lateral joint line for the lateral meniscus and capsule.

The **medial** aspect palpation starts with:

- The medial femoral condyle and its contiguous adductor tubercle, which is the origin of the MCL and the insertion of the adductor magnus respectively;
- The medial tibial condyle, which is the insertion of the MCL;



- The inferior flare of the medial tibial plateau, which is the insertion of the pes anserine and its bursa; and
 - The medial hamstring heads and finally the medial joint line for the medial meniscus and capsule.³⁻⁷

The palpation of the **posterior** aspect of the thigh and knee requires the patient to lie prone. The entire length of the hamstrings can be palpated, including both lateral and medial heads, as can both the lateral and medial heads of the gastrocnemius. The popliteal fossa contains neurovascular structures and can be the site of a Baker's cyst (fluid from an intra-articular condition, typically the menisci). Deep in the popliteal fossa, the popliteus muscle and posterior capsule can be palpated.³⁻⁷

Neurovascular

The popliteal artery, vein and posterior tibial nerve posterior are all located in the posterior aspect of the knee. Behind the fibular head, the common peroneal is palpable. If it is injured, it can cause a foot drop. The anterior thigh (L1-3/anterior femoral cutaneous), the lateral thigh (L2-3/lateral femoral cutaneous), medial knee to the medial malleolus (L4/saphenous), the lateral

knee to the first toe medial edge (L5/superficial peroneal), and the posterior thigh (S2/posterior femoral cutaneous) is tested for pinprick. The knee extensors and flexors are tested for muscle strength. The knee reflex (L4), the Achilles' reflex (S1), and Babinski (upper motor nerve) are tested.³⁻⁷

Special Tests

If indicated, the special tests include:

- **Patellar femoral grinding.** The patella is compressed and ground against the femoral groove while the patient is lying in a supine fashion. Pain or apprehension is positive for infrapatellar pathology like patellar pain syndromes.³⁻⁷
- **Apprehension.** While the patient is lying supine and relaxed, his/her patella is distracted either medially or laterally. If the patella begins to dislocate, the patient will exhibit an expression of apprehension.³⁻⁷
- **Lachman's.** This is the first test to examine for ACL integrity. This is a better test than the anterior drawer test. It is performed with the patient lying supine and his/her knee flexed at about 5° to 10°. With the thigh supported, the tibia is pulled forward on the femur. Excessive forward movement suggests a torn ACL.⁸
- **Pivot shift.** This is the second test for ACL integrity. It should be used in combination with the Lachman's test for maximum sensitivity. It is performed with the patient lying supine, his/her knee flexed at about 45° and the foot externally rotated. While applying a valgus stress and internally rotating the foot, the knee is straightened. If, at about 20° of flexion, there is a pivot shift, this is a positive test for ACL compromise.¹⁰
- **The drawer test.** The patient lies supine with his/her knee bent to 45°. The tibia is pushed forward and backward. If there is excessive movement forward, there is ACL compromise and if there is excessive backward movement, there is PCL compromise.³⁻⁷
- **Valgus and varus challenge.** As the name suggests, this challenges the stability of the medial and lateral collateral ligaments respectively. The patient sits with the knee in slight flexion (5° to 10°). The joint is stressed valgusly to determine the integrity of the MCL. Pain or increased laxity is a positive test. The LCL is challenged in the reverse process.³⁻⁷
- **McMurray's.** This test examines the integrity of the menisci. The patient lies supine with his/her legs flat in the neutral position. With one hand, take hold of the heel and flex the knee fully. Then place your free hand on the knee joint with your fingers touching the medial joint line and your thumb and thenar eminence on the lateral joint line. Rotate the patient's leg internally and externally to relax the knee. Apply valgus stress, by pushing on the lateral side, then externally rotate the leg while simultaneously extending it. Your fingers will be on the medial joint line, palpating for a click. It also may be audible. If this click can be heard or felt, the McMurray's test is positive for a probable tear of the medial meniscus.⁹

A varus stress and internal rotation of the knee is applied, while the leg is extended and the lateral joint line is palpated for a lateral meniscus tear.⁹

- **Bounce home.** The patient lies supine with his/her knee held in flexion of about 20°. The knee is passively extended and should fully bounce home into full extension. If it does not, then there is some intra-articular impingement, such as a torn meniscus.³⁻⁷
- **Homan's test.** When the foot is dorsiflexed or the calf is compressed, there normally should be no pain. If there is pain, then consider deep vein thrombosis.²⁻⁷

CONDITIONS AND THEIR MANAGEMENT

Vignette 1: Patellofemoral syndrome, patellar pain syndromes and malalignment

A 16-year-old international model presented with recurrent bilateral patellar pain. Over the last few years, her knees had been an intermittent source of discomfort. When standing up after flying to Europe, or after a bike ride, her knees would ache for an hour and then slowly improve. Sometimes there was associated mild puffiness. There was no history of trauma, her patella once felt locked and took a few minutes to straighten. Besides taking ibuprofen, she had done nothing. She had recently grown very tall and was 180 cm (71") at presentation. She said she felt like an old woman.

On examination, she demonstrated femoral anteversion (the femoral condyles rotated internally), external tibial torsion

(the tibial condyles rotated externally), patella facing inward toward each other (squinting patella), bilateral pes planus (flattened medial arch and increased pronation), high riding patella (the superior line of the patella is above the downslope of the thigh giving the appearance of a ski jump when viewed from the side) and underdevelopment of the medial quadriceps (also known as the vastus medialis obliquus [VMO]) when her legs were extended 45°. This is the classic "miserable malalignment syndrome."¹¹ She demonstrated a positive patellar femoral grind and apprehension test for increased patellar laxity. She responded well to ice, anti-inflammatories, temporary taping, orthotics, and most importantly, improvement in the strength of her VMO using muscle stimulation and old-fashioned exercises.^{3-7,11,12}

Vignette 2: Patellar bursitis

A 49-year-old high-tech executive came into the office with a grossly swollen patella. He had been resurfacing his deck. He had spent his two-week holiday sanding, priming and painting while on his hands and knees. On the last day of the project, his left knee started to swell and it was difficult for him to fully bend his knee. He was instructed by his primary-care physician to ice and rest the knee. There was some relief, but the condition did not resolve. On examination, the prepatellar bursa was swollen. The rest of the exam was normal, except for full flexion due to the tension of the bursa.

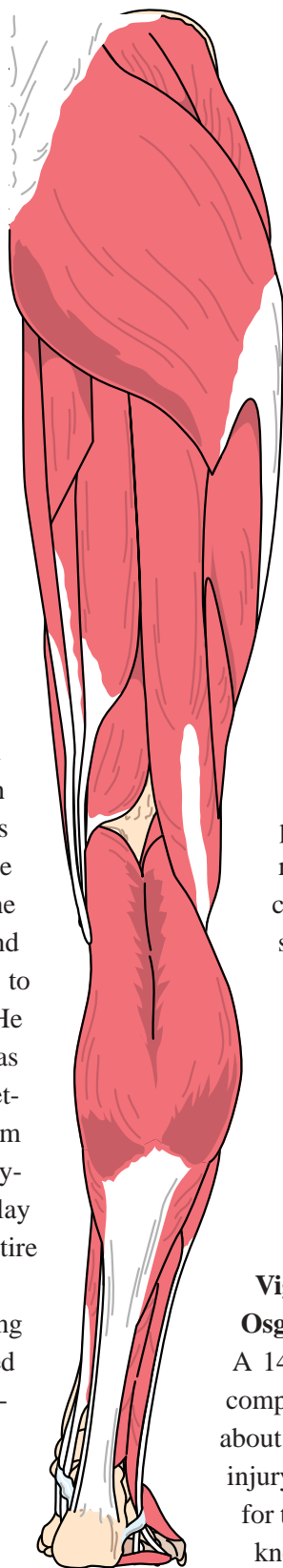
The decision was made to drain the knee. Eighteen millilitres of serous fluid was aspirated aseptically with the use of

local anesthetic and cortisone was injected with a compression bandage to fuse the swollen bursal walls. This solved his problem.³⁻⁷

Vignette 3: Patellar tendonitis

A 25-year-old international level beach volleyball player presented with patellar pain. The pain used to occur only after playing. Recently, to help cope with a longer season, he started doing squatting exercises with heavy weights to develop his leg muscles. It seemed that, despite gains in strength and stamina, the pain symptoms were more frequent and were present both during and after the matches. He had tried ice and anti-inflammatories, but wanted to solve his problem definitely. He does remember that when he was playing junior high school basketball, he had a similar problem which required him to quit playing. He states that if he could play another year or two he could retire comfortably.

On examination, he was starting to develop pes planus (flattened medial arch and increased pronation) which was further aggravated by playing barefoot on the sand playing surface. His patellar tendon was very tender and so was the tibial tubercle. X-ray



evaluation revealed Osgood-Schlatter disease and spurring of the distal pole, denoting a chronic condition.

Because he was in the middle of his season, the approach was modified to minimize symptoms until there was time to treat it. The squatting exercises were eliminated. Ice massage, anti-inflammatories, the use of shoes on the playing surface, iontophoresis (dexamethasone and xylocaine driven by ultrasound) and the use of a neoprene knee support with a patellar stabilization ring seemed to keep things in check. In the end, he required some surgical assistance.

Sometimes, patients are given cortisone injections for this condition. The author is not in favour of doing so, as cortisone injections are associated with a higher probability of rupture.^{3-7,13}

Vignette 4:

Osgood-Schlatter disease (OSD)

A 14-year-old junior high track star complained of bilateral knee pain for about a year. He only remembers one injury when he tripped while training for the hurdles. He fell onto his right knee, but he had pain prior to this and it would not explain both of

his knees giving him trouble. He tried to ease off training between track events, but the discomfort returned quickly. Eventually, he just kept taking acetaminophen and kept going. He had grown four inches this year and was almost six feet tall.

On examination, both tibial tubercles were very tender with swelling. The patella was normal without tenderness especially at the distal pole. There was tightness of the quadriceps, hamstrings, gastrocnemius, and the ITB resisted knee extension reproduced pain. Both X-ray and ultrasound confirmed OSD. The initial treatment involved rest, ice, and anti-inflammatories. Later stretching and muscle-strengthening exercises were instituted as he gradually returned to his various activities. This conservative regimen settles most patients.^{3-7,14-15}

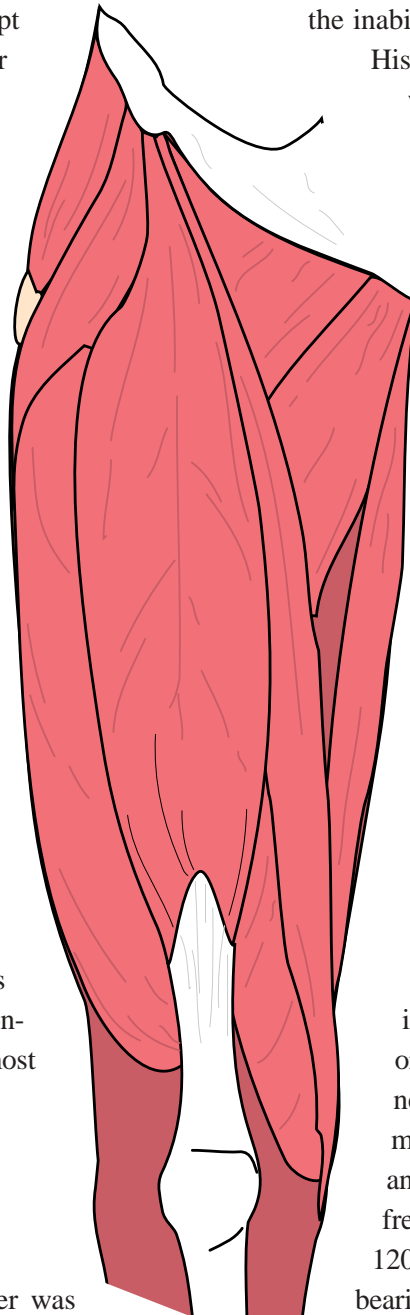
**Vignette 5:
Quadriceps contusion
and myositis ossificans**

A 15-year-old rugby player was referred after a blunt trauma to his right quadriceps. He admitted to two injuries. The first occurred six weeks prior and left him with extensive ecchymosis, but no

functional restrictions. The second occurred three weeks ago and left him with a bigger bruise that tracked down to his calf and ankle. More importantly, he was left with the inability to flex his leg past 60°.

His parents had taken him to a walk-in clinic, where an X-ray was ordered. The parents were told their son may have a sarcoma. He did not have night or rest pain.

On examination, the patient had an evident painless firm mass in his quadriceps and the leg was restricted to 70° in passive flexion. Given the concern for sarcoma, a bone scan and magnetic resonance imaging (MRI) scan were ordered. They both confirmed the diagnosis of myositis ossificans, a frequent complication of quadriceps contusion.¹⁶ Ice and immobilization were initially used to reduce hemorrhaging and swelling. The next phase involved heat, massage, anti-inflammatories and restoration of full pain-free range of motion. Once 120° of knee flexion and weight bearing were tolerated, functional rehabilitation of full range of motion, flexibility, isotonic and isokinetic strengthening exercises were instituted as he returned to active sports. The recovery peri-



od is usually four to six weeks.^{3-7,16}

Vignette 6:

ACL injuries (most common cause of acute hemarthrosis)

A 17-year-old soccer player presented with a right knee that gave way and was unsteady. One year ago, she was reaching up in hyperextension to play a ball and she felt and heard a “pop” in her right knee. Within minutes, the knee swelled to twice its size and she was carried off the field and sent to the emergency department. In emergency, they told her she had an acute hemarthrosis and possibly had injured the inside of her knee. The X-rays were negative. She was on crutches for about a week and then successfully went through physiotherapy. Over time, as she returned to playing soccer, she felt her knee give way at times with associated swelling. Within a day, she felt okay again. There was something wrong and she wanted a second opinion.

On examination, she had obviously positive Lachman’s, pivot shift and anterior drawer tests for complete ACL tear. There was an equivocal MacMurray test. Her other musculotendinous supports were intact. She required surgical correction because she wanted to be competitively athletic in her future. These injuries are much more common in women than men.^{3-7,17-18}

Vignette 7:

Iliotibial band (ITB) friction syndrome

A 36-year-old triathlete presented after a miserable outing at the Iron Man competition in Hawaii. He had significant left lateral knee pain without swelling. He had finally qualified for his first Iron Man triathlon after years of hard training. He had slowly

improved his cycling and running times by gradually training up to three times for each segment per week. He was a natural swimmer, so that wasn’t an issue. The typical predisposing factors of downhill running, rapid increase in speed, excessive mileage, or running on a banked track were not evident.

On examination, there was tenderness of the left lateral femoral condyle. The pain was worse at approximately 30° of flexion and relieved in full extension. There was no effusion, no varus knee alignment, no hind-foot pronation, no ITB inflexibility, or meniscal or ligament injury. There was a leg length discrepancy, his left leg being 0.95 cm (3/8”) shorter.

This confirmed the diagnosis and etiology that causes repetitive rubbing of the ITB over the lateral femoral condyle during flexion and extension of the knee. This patient required relative rest, ice, anti-inflammatories, ITB stretching, ultrasound, a lift in his left shoe, and a reduction in his bicycle’s seat height to maintain 35° of flexion of his knees at dead bottom pedal crank.^{3-7,19-20}

Vignette 8:

MCL injuries

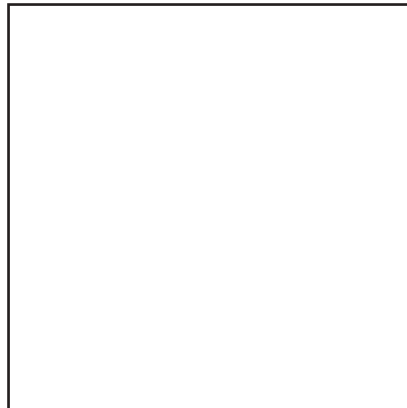
A 22-year-old varsity football player was tackled on the lateral side of his right knee. He immediately felt a tearing sensation of the medial aspect of this knee with intense pain. He was carried off the field.

On field examination, there was obvious tenderness of the MCL and joint line. Valgus stress revealed an abnormal increase in laxity, but with a firm end point. It was unclear if there was an associated meniscal injury, which is common with MCL injuries. Ice was applied immediately and the limb was elevated. He was prescribed

anti-inflammatories and told to ice the leg every waking hour for twenty minutes. The next day, he started physiotherapy for ultrasound and weight bearing with a unilateral hinged knee brace as tolerated. Range of motion exercises were instituted early in a cold water bath. Muscle stimulation also was included. In about two weeks, he was ready for strengthening exercises. First he started with a standard isotonic weight bench and progressed quickly to fewer repetitions and heavier free weights. Other aerobic activities were added. He returned to the team within 32 days of his injury, using his hinged knee to provide protection and support.^{3-7,21}

Vignette 9:
Hamstring strains and ruptures

A 20-year-old varsity short-distance runner was at a national event when she noticed a sharp disabling lateral posterior thigh pain that required her to stop her race. She felt a “pop” and a sudden weakness of her right leg. On field examination, there was tenderness of her right biceps tendon of the lateral hamstring. There was no swelling, or bruising, just muscle spasm. There was no defect in the muscle attachment. There was loss of knee extension by about 15°. Through rapid icing, anti-inflammatories, gradual stretching and strengthening, and muscle balancing of one hamstring to the other and the ipsilateral hamstring to quadriceps, she was able to be at the next event in two weeks. She said poor flexibility, easy fatigability and lack of an adequate warm-



up led to her hamstring strain.^{3-7,22} Hamstring strains are the most common in the entire body.²³


Vignette 10:
Meniscal lesions

A 55-year-old scrub nurse complained of intermittent right knee pain, swelling, locking and clicking. This had been going on for about three years. She had tried physiotherapy, anti-inflammatories, icing and a knee brace. She had even tried to lose weight and now weighs 91.2 kg (201 pounds) down from 180 kg (238 pounds). She denied having any particular injury, but on careful questioning admitted to various twisting episodes with her knee which have aggravated her symptoms.

On examination, she had mild genu valgum, mild effusion and obvious medial joint line tenderness. She was apprehensive about hopping on her right leg, because she felt it would give way. She was unable to squat or twist on her right knee due to pain. She was unable to fully flex because of pain and fully extend due to a Baker’s cyst. McMurray’s and bounce home were positive for a medial meniscal tear. Standing X-ray showed degeneration of her medial joint space with osteoarthritic changes. She responded well to cortisone injection.³⁻⁷

SUMMARY

Knee and thigh injuries are very prevalent in primary care. The above classical

vignettes were used to illustrate the common conditions that present to the primary physician's office. In an effort to simplify and not confuse the reader, the terminology and nomenclature was maintained throughout article. Not all possible conditions were included. The second intention of this article and series is to develop a systematic approach to history and physical examination of musculoskeletal conditions which will assist in focusing the reader's differential diagnosis. In the end, it is hoped that the knee and thigh are as simple as pie and ice cream. 

- adolescent athletes: Retrospective study of incidence and duration. *Am J Sports Med* 1985; 13:236-42.
15. Krause BL, Williams JPR, Catrall A: Natural history of Osgood-Schlatter's disease. *J Pediatr Orthop* 1990; 10:65-9.
16. Jackson DW, Feagin JA: Quadriceps contusion in young athletes. *J Bone Surg Am* 1973; 55A:95-105.
17. Marshall JL, Rubin RM, Wang JB, et al: The anterior cruciate ligament: The diagnosis and treatment of its injuries and their serious prognostic implications. *Orthop Rev* 1978; 7:35-46.
18. Zelisko JA, Noble HB, Porter M: A comparison of men's and women's professional basketball injuries. *Am J Sports Med* 1982; 10:297-9.
19. Renne JW: The iliotibial band friction syndrome. *J Bone Joint Surg* 1975; 57A:1110-1.
20. Holmes JC, Pruitt AL, Whalen NJ: Iliotibial band syndrome in cyclists. *Am J Sports Med* 1993; 21:419-24.
21. Reider B, Sathy MR, Talkington J, et al: Treatment of isolated medial collateral ligament injuries in athletes with early functional rehabilitation. *Am J Sports Med* 1993; 22:470-6.
22. Sutton G: Hamstring by hamstring strains: A review of the literature. *J Orthop Sports Phys Ther* 1984; 5:184-95.
23. Petersen L, Renstrom P. *Sports Injuries: Their Prevention and Treatment*. Yearbook Medical Publishers, Chicago, IL, 1986, pp. 92-156.

References

1. Abdulla AS, Abdulla F: The sports medicine specialist's approach to leg and ankle. *The Canadian Journal of Diagnosis* 2001; 18(11):75-84.
2. Abdulla AS, Abdulla F: The sports medicine specialist's approach to feet and toes. *The Canadian Journal of Diagnosis* 2001; 18(10):123-32.
3. Mellion MB (ed.): *Office Sports Medicine*. Second edition. Hanley & Belfus, Philadelphia, PA, 1996, pp. 249-317.
4. Hoppenfeld S: *Physical Examination of the Spine and Extremities*. Appleton & Lange, East Norwalk, CT, 1976, pp. 171-96.
5. Roy S, Irvin R: *Sports Medicine. Prevention, Evaluation, Management, and Rehabilitation*. Prentice-Hall, Englewood Cliffs, NJ, 1983, pp. 293-368.
6. Snell RS: *Clinical Anatomy for Medical Students*. Third edition. Little Brown & Company, Boston, MA, 1986, pp. 553-692.
7. Garrett WE, Speer KP, Kirkendall DT (eds.): *Principles and Practice of Orthopaedic Sports Medicine*. Lippincott Williams & Wilkins, Philadelphia, PA, 2000, pp. 613-825.
8. Torg JS, Conrad W, Kalen V: Clinical diagnosis of anterior cruciate ligament instability of the athlete. *Am J Sports Med* 1976; 4:84-93.
9. McMurray's TP: The operative treatment of ruptured internal lateral ligament of the knee. *Br J Surg* 1918; 6:377-81.
10. Losee RR, Johnson TR, Southwick WO: Anterior subluxation of the lateral tibial plateau. A diagnostic test and operative repair. *J Bone Joint Surg Am*. 1978; 60A:1015-30.
11. James SL: Chondromalacia of the patella in the adolescent. In: Kennedy JC (ed.): *The Injured Adolescent Knee*. Williams & Wilkins, Baltimore, MD, 1979, pp. 117-27.
12. McConnell J: The management of chondromalacia patellae: A long term solution. *Aust J Physiother* 1986; 2:215-23.
13. Blazina ME, Kerlan RK, Jobe FW, et al: Jumper's knee. *Orthop Clin North Am* 1973; 4:665-78.
14. Kujala UM, Kvist M, Heinonen O: Osgood-Schlatter's disease in