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CASE STUDY

Injury to the posterolateral corner of the knee: emergency department assessment and management

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1. Introduction

Registered advanced nurse practitioners (RANPs) are recognised as senior decision makers within the emergency department team (ED). The RANP employs a range of skills such as comprehensive health history, advanced physical examination, problem solving, clinical decision-making, and expert judgment to formulate diagnoses and management plans for their patient's health care needs (Gibbons, 2013).

Nurses working in Advanced Practice roles are an increasingly vital component of the multidisciplinary approach to care delivery within the Irish emergency care setting (HSE, 2013a). RANPs are recognised as a senior clinical decision maker within the emergency department team (HSE, 2013b).

RANPs are increasingly extending and expanding their scope of practice beyond their initial competencies (Lowe, 2010), and must therefore be aware of emerging trends in injury presentations. To ensure optimal patient care many of these patient care episodes are managed collaboratively with other health care professionals (NCNM, 2008).

2. Initial case presentation

A 40 year old man self presented to the ED following an injury to his left knee. He was triaged as a triage category 3 (Manchester Triage) to the RANP on duty who undertook the initial patient assessment. Systems review outruled head, neck, abdominal, spinal, chest, or pelvic injuries and other distracting injury. The patient reported tripping the previous evening and a fall down the last three steps of a staircase at home following alcohol ingestion, with immediate pain and a feeling of "something going" in his knee. He was immediately unable to weigh bear following injury. He did not however notice any swelling until the subsequent morning of his initial presentation.

Previous relevant medical history was limited to a right knee arthroscopy 5 years previously. He was not taking any regular medications, and had no known medication allergies. His self report of pain was 7/10 on presentation. Analgesia (paracetamol/acetaminophen 1 g and ibuprofen 400 mg) was prescribed and provided at triage in line with departmental protocol, which reduced the patient's self report of pain to 3/10 at time examination. The patient was noted to smell of alcohol, but was alert, orientated and did not appear intoxicated at the time of examination.

3. Overview of posterolateral corner knee injuries

Despite being the largest joint in the body the knee lacks inherent stability, making it dependant on ligamentous structures to maintain alignment of its articulating bones (Bickley, 2009). The structures of the posterolateral corner (Fig. 1) act in conjunction with the anterior cruciate and posterior cruciate ligaments to provide static and dynamic joint stability (Geiger et al., 2013). There is an increasing awareness of the clinical significance of posterolateral corner (PLC) injuries (Davenport, 2010) and of the importance of early recognition of these injuries to improve surgical and clinical outcomes (Sekiya, 2008) as untreated injuries may result in chronic functional instability (Raheem, 2007). The incidence of posterolateral knee injuries remains unclear, although it is recognized that many of these injuries go unrecognized. The incidence in patients with acute knee ligament injuries with a hemarthrosis was 9.1% (LaPrade et al., 2007), with advances in clinical examination and imaging techniques

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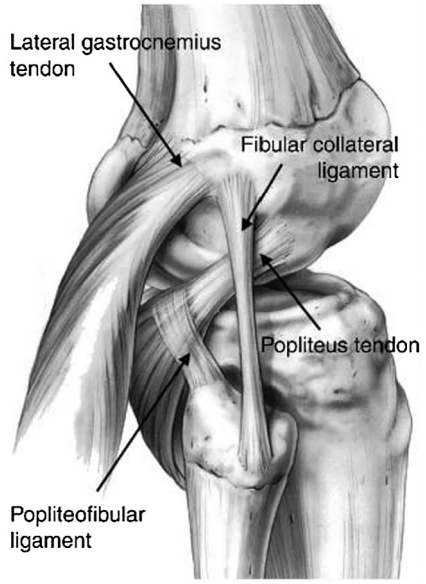

Fig. 1. Illustration of the anatomy of the posterolateral corner demonstrating the three major components: lateral (fibular) collateral ligament, popliteus tendon, and popliteofibular ligament. Reproduced with permission from *Journal of the American Academy of Orthopaedic Surgeons*.

resulting in increased numbers of patients diagnosed with these injuries.

4. Anatomy and biomechanics

The PLC of the knee is an anatomic structure which has a complex arrangement of structures (Geiger et al., 2013). This anatomy can be divided into three tissue layers; however there does not seem to be standardisation of the layers, as can be seen in the differences in the papers of Davies et al. (2004), Geiger et al. (2013) and Morelli et al. (2013). This may be in part attributable to the high anatomic variability in the PLC (Green and Swiontkowski, 2008) and competing nomenclature in the literature (DeLee et al., 2009). For the purposes of this paper the systematic approach of Geiger et al. is outlined below.

- Superficial layer: includes the lateral fascia, iliotibial tract and biceps tendon
- Middle layer: includes the patellar retinaculum and the patellofemoral and patellomeniscal ligaments
- Deep layer: includes the lateral collateral ligament, the lateral meniscotibial ligament, the popliteus muscle and tendon, the popliteiofibular ligament, the arcuate ligament, the fabellofibular ligament and the lateral joint capsule with its attachment to the lateral meniscus edge

The PLC structures in addition to resisting varus and external rotation forces, have also been shown to assist in resisting posterior translation of the tibia (Geiger et al., 2013).

The passive stabilisers in the PLC are the capsular and non-capsular ligaments, while the dynamic stabilizers are the musculotendinous units and their aponeuroses (Geiger et al., 2013). The passive stabilisers include the lateral collateral ligament (LCL), the popliteofemoral ligament, the posterolateral joint capsule, the arcuate ligament complex and the fabellofibular ligament (Green and Swiontkowski, 2008). In support of the anatomic variability of the posterolateral corner, Seebacher et al. (1982) demonstrated that the arcuate or fabellofibular ligaments were absent in 20% and 13% of the population respectively. The dynamic stabilizers of the posterolateral corner include the popliteus, iliotibial band, lateral head of gastrocnemius and biceps femoris tendon.

Many structures which may be considered anatomically one unit, often provide both passive and dynamic stability. An example is the popliteus muscle–tendon complex (DeLee et al., 2009), where the popliteofemoral ligament acts to passively stabilize the PLC while the popliteus acts as a dynamic stabiliser. Of the posterolateral corner stabilizers Canale and Beaty (2012) suggest that the LCL and the popiteal tendon provide the major restraints to posterolateral instability.

5. Mechanism of injury

The majority of PLC injuries occur due to athletic activity participation, with the remainder primarily due to falls or road traffic collisions (DeLee et al., 2009). While it has been proposed that all PLC injuries involve some rotational force (Griffin and Miller, 2013), a number of specific mechanisms have been found in the relevant literature (see Table 1).

6. Clinical assessment of the knee

Joint assessment is framed by the look, feel and move orthopaedic framework to assess joint function by comparing the affected joint to the contralateral side (Firestein et al., 2012; Purcell, 2010). This is combined with a comprehensive history taking which includes but is not limited to presenting chief complaint, events surrounding the present illness, past history, family history, personal and social history and systems review (Bickley, 2009). Thorough assessment is required to adequately manage posterolateral knee injuries with a clear understanding of the regional anatomy, biomechanics and common mechanisms of injury as undiagnosed PLC injuries can result in chronic posterolateral instability (Geiger et al., 2013). As the knee is the most commonly injured joint in the body (LaPrade et al., 2012), RANPs should be adept in physical examination techniques which improve their sensitivity to detect clinical important injuries, including those involving the PLC.

Physical examination of the knee should ideally begin with observation of gait followed by a focused inspection, palpation, and movement (Bickley, 2009). Both knees should be compared as well as the hip and ankle joints for related injuries (Talley and O'Connor, 2014). Inspection involves observing for alignment, joint contours and effusions, scars, wounds, colour, deformity, muscle wasting, and symmetry (Bickley, 2009). Palpation involves checking for temperature, areas of tenderness including joint lines, specific bony tenderness (patella and fibula head), collateral ligaments, medial and lateral compartments, posterior soft tissues, quadriceps and patellar tendons, effusions, and neurovascular examination. Movement is performed within the confines of the patient's pain. Active, passive and resisted movements which comprise of flexion, extension and straight leg raise should be tested (Bickley, 2009; Kastelein et al., 2008).

Table 1
Specific mechanism of injury for PLC.

- Direct blow to the medial aspect of the proximal tibia in a fully extended knee, with the force directed in a posterolateral direction or external rotation (Green and Swiontkowski, 2008)
- Hyperextension injury (Beall et al., 2007) (often non-contact)
- Anterior rotatory dislocations (varus stress and hyperextension)
- Posterior rotatory dislocation (varus stress, posteriorly directed blow to a proximal tibia in flexion, i.e dashboard injury)
- Forceful deceleration while the distal leg is planted (Green and Swiontkowski, 2008)
- Abrupt external rotation of the extended knee (Beall et al., 2007)

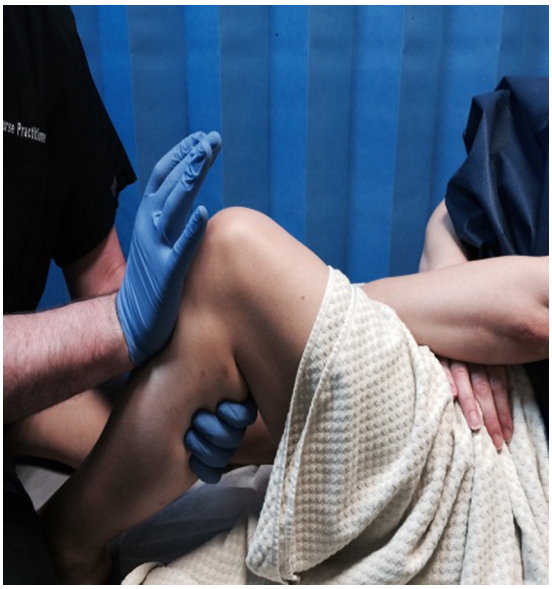

Fig. 2. Posterior drawer test.

A number of specific knee examination tests are critical to the initial evaluation of the acute knee injury. These include valgus and varus stress test in 0° and 30° flexion, to assess collateral ligament integrity; anterior and posterior drawer tests (Fig. 2) to assess the cruciate ligaments; Lachmann and pivot shift test for ACL integrity, and McMurray's and Appley's tests to evaluate meniscal involvement. Additionally integrity of the patellar restraints, and assessment of patellar dislocation/subluxation is assessed by conducting a patellar apprehension test (Hattam and Smeatham, 2010; LaPrade et al., 2012).

The dial test (sometimes referred to as the tibial external rotation test) (Buckup, 2008) (Fig 3) is one of the most important tests to evaluate the PLC. Its purpose is to elicit rotary instability in the knee. The test is performed with the patient prone and the knee flexed at 30° and again at 90°. The foot is externally rotated at the chosen angle and the degree of external rotation (using the medial border of the foot in its neutral position is used as a reference point) is measured relative to the axis of the femur. Comparison is made with the contra-lateral leg to determine asymmetry.

Fig. 3. Prone dial test at 90°.

The dial test is considered positive (i.e. pathological) if a 10° difference in the amount of external rotation is elicited between the injured and uninjured sides (Buckup, 2008). If the test is positive at 30° of knee flexion, but negative at 90° of knee flexion an isolated PLC injury is suspected. If the dial test is positive at both 30° and 90° of knee flexion the test raises suspicion of a combined posterior cruciate ligament and the PLC injury. The dial test needs to be interpreted in association with the other clinical findings due to the dearth of information regarding the sensitivity and specificity of this test (Hattam and Smeatham, 2010; Strauss et al., 2007).

7. Back to the case: clinical assessment findings

The patient was observed using crutches (not weight bearing) during his transition from the triage area to the ambulatory care area (ACA) within the ED. During the assessment the patient was observed to independently partially weigh bear with an antalgic gait into the examination area and onto the examination couch. He was observed to have a suprapatellar effusion. No wounds or critical areas of skin were observed.

During the feel (palpation) portion of assessment the patient was found to have tenderness to the lateral joint line, and at the fibular head which was exacerbated by anteroposterior translation of the fibula head. Tenderness was also elicited over the posterior soft tissues laterally. Capillary refill was <2 seconds, with no neurovascular deficit detected (specifically to the common peroneal nerve). His popiteal and distal pedal pulses were intact and regular, with +2 strength (Bickley, 2009).

The patient could straight leg raise, but had a painful arc of flexion to <90°, and slight loss of extension. Lachman's test and the anterior drawer test for anterior cruciate ligament involvement were negative. The posterior drawer test applied at 45° of hip flexion and 90° of knee flexion elicited pain, but no discernable laxity to the posterior cruciate ligament (PCL). He did not have a posterior sag, the presence of which would have suggested involvement of the PCL. The valgus stress test for medial collateral ligament was negative at 20° flexion, but the varus stress test, which stresses the LCL, elicited a soft endpoint (when compared with the contralateral limb) and pain at 30° flexion. None of these ligamentous stability tests could be applied in full extension due to pain and restricted range of movement (ROM).

8. Patient diagnostic results

Initial x-rays revealed a small joint effusion, but no fracture or significant abnormality. The patient was initially discharged with POLICE (protection, optimal loading, ice, compression, elevation) advice, crutches (non weigh bearing), analgesia, and exercises to increase ROM and maintain muscle bulk. The POLICE approach was adopted rather than the more traditional acronym RICE (rest, ice, compression, elevation) as inappropriate rest has been shown to be harmful and result in alterations in tissue biomechanics and morphology (Bleakley et al., 2012). He was referred to our consultant-led review clinic 5 days later. This clinic provides senior clinician review for patients whom the ED doctors and RANPs feel require such review, but who do not meet the requirement for referral to a tertiary clinic (e.g. fracture clinic). At review by the ED Medicine Consultant and RANP the patient had persistent lateral joint line tenderness and painful arc of flexion to 90° only. He was tearful at review. He felt his knee was "unstable" and he was concerned regarding his ability to work as a scaffolder. From a psychosocial perspective the potential diagnoses were discussed with the patient, as well as the likely rehabilitation time and general information regarding access to social welfare benefits during his rehabilitation.

A magnetic resonance scan (MRI) was requested. MRI revealed a grade 2–3 sprain at the popliteus tendon insertion on the lateral femur and underlying marrow oedema in the femur compatible with contusion. In addition there was a grade 2 sprain of the lateral collateral ligament. Although there are no exact MRI criteria to diagnose clinically relevant PLC instability visualization of tears involving 2 or more structures of the PLC on MRI are suggestive of PLC instability, especially in the presence of concomitant tears of the cruciate ligament (Morelli et al., 2013).

9. Patient referrals

The patient was referred to our orthopaedic trauma clinic the following day with a continuation of the management plan outlined above. He was initially managed in a Donjoy Deluxe Hinged Knee Brace ™ for 6/52 in addition to physiotherapy, and regained a normal gait. Unfortunately he continued to report a persistent subjective instability following his physiotherapy regime and subsequently underwent a diagnostic arthroscopy. He was advised that chronicity may lead to secondary injuries, and the requirement for more extensive surgery has been discussed with him.

10. Psychological support

In addition to managing the physical injury and instability sustained, it is paramount that psychosocial factors are addressed for patients with orthopaedic injuries in order to ensure holistic injury recovery (Bauman, 2005). There is a common misconception that minor and moderate orthopaedic injuries, which account for the vast majority of such injuries, are of little consequence (Clay et al., 2010). This case highlights that in the absence of significant bony injuries, significant morbidity occurs after sustaining soft tissue injuries to the knee. Due to the underestimation of these injuries oligoanalgesia is frequently experienced among ED patients (Duignan and Dunn, 2008) with soft tissue injuries. RANPs are well positioned to address this issue and enable patients to adequately manage their pain concerns. In this case, the RANP managed the patient with a combination of ibuprofen and paracetamol, as part of an analgesic plan which included appropriate rest and optimal loading. Upon review this regime was adequately assisting him to control his pain.

11. Conclusion

Injuries to the posteolateral corner of the knee require early detection and treatment in the Emergency Department to achieve a good functional outcome. Failure to recognise these injures, can result in poor clinical outcomes in terms of rehabilitation and return to work. Of similar importance are the adverse psychosocial consequences of having sustained a PLC injury. These may result in patients experiencing significant morbidity after having sustained a 'minor injury'. RANPs possess skills in advanced health assessment, medicinal and imaging prescribing, and management strategies. As RANPs continue to increase both the depth and breadth of their knowledge, interprofessional collaboration has the potential to improve both patient outcomes and care quality.

References

Bauman, J., 2005. Returning to play: the mind does matter. Clinical Journal of Sport Medicine. 15 (6), 432–435.

Beall, D.P., Googer, J.D., Moss, J.T., et al., 2007. Magnetic resonance imaging of the collateral ligaments and the anatomic quadrants of the knee. Radiologic Clinics of North America. 45 (6), 983–1002.

Bickley, L.S., 2009. Bates Guide to Physical Examination and History Taking, tenth ed. Lippincott Williams & Wilkins, Philadelphia.

Bleakley, C.M., Glasgow, P., MacAuley, D.C., 2012. Price needs updating, should we call the POLICE. British Journal of Sports Medicine. 46 (4), 220–221.

Buckup, K., 2008. Clinical Tests for the Musculoskeletal System, Thieme, New York.

Canale, S.T., Beaty, J.H., 2012. Campbell's Operative Orthopaedics, twelfth ed. Elsevier Mosby, Philadelphia.

Clay, F.J., Newstead, S.V., Watson, W.L., et al., 2010. Bio-psychological determinants of persistent pain 6 months after non-threatening acute orthopaedic trauma. The Journal of Pain. 11 (5), 420–430.

Davenport, M., 2010. Knee and leg injuries. Emergency Medicine Clinics of North America. 28 (4), 861–884.

Davies, H., Unwin, A., Aichroth, P., 2004. The posterolateral corner of the knee. Anatomy, biomechanics and management of injuries. Injury. 35 (1), 68–75.

DeLee, J.C., Drez, D., Jr., Miller, M.D., 2009. DeLee & Drez's Orthopaedic Sports Medicine, third ed. Saunders Elsevier, China.

Duignan, M., Dunn, V., 2008. Congruence of pain assessment between nurses and emergency department patients: a replication. International Emergency Nursing. 16 (1), 23–28.

Firestein, G.S., Budd, R.C., Gabriel, S.C., et al., 2012. Kelley's Textbook of Rheumatology, ninth ed. Elsevier Saunders, Philadelphia.

Geiger, D., Chang, E., Pathria, M., et al., 2013. Posterolateral and posteromedial corner injuries of the knee. Radiologic Clinics of North America. 51 (3), 413–432.

Gibbons, L., 2013. Diagnosing Achilles tendon injuries in the emergency department. Emergency Nurse. 16 (7), 26–30.

Green, N.E., Swiontkowski, M.F., 2008. Skeletal Trauma in Children, vol. 3, fourth ed. Saunders Elsevier, Philadelphia.

Griffin, J.W., Miller, M.D., 2013. MRI of the knee with arthroscopic correlation. Clinics in Sports Medicine. 32 (3), 507–523.

Hattam, P., Smeatham, A., 2010. Special Tests in Musculoskeletal Examination, Churchill Livingstone Elsevier, Edinburgh.

HSE, 2013a. Emergency Medicine Programme: a guide to enhance advanced nurse practitioner services across emergency care networks in Ireland.

HSE, 2013b. National Emergency Medicine Programme: guidance on staffing for local injury units (LIU's).

Kastelein, M., Wagemakers, H.P.A., Luijsterburg, P.I.J., et al., 2008. Assessing medial collateral ligament knee lesions in general practice. The American Journal of Medicine. 121 (11), 982–988.

LaPrade, R.F., Wentorf, F.A., Fritts, H., et al., 2007. A prospective magnetic resonance imaging study of the incidence of posterolateral and multiple ligament injuries in acute knee injuries presenting with a hemarthrosis. Arthroscopy: The Journal of Arthroscopic and Related Surgery. 23 (12), 1341–1347.

LaPrade, R.F., Pierce, C.M., Bahr, R., et al., 2012. Acute knee injuries, in: Bahr, R. (Ed.), The IOC Manual of Sports Injuries: an Illustrated Guide to the Management of Injuries in Physical Activity, Wiley-Blackwell, West Sussex.

Lowe, G., 2010. Scope of emergency nurse practitioner practice: where to beyond clinical practice guidelines? Australian Journal of Advanced Nursing. 28 (1), 74–82.

Morelli, V., Bright, C., Fields, A., 2013. Ligamentous injuries of the knee: anterior cruciate, medial collateral, posterior cruciate, and posterolateral corner injuries. Primary Care. 40 (2), 335–356.

NCNM, 2008. Accreditation of Advanced Nurse Practitioners and Advanced Midwife Practitioners, 2nd ed. NCNM, Dublin.

Purcell, D., 2010. Minor Injuries: a Clinical Guide, second ed. Elsevier Churchill Livingstone, Edinburgh.

Raheem, O., 2007. Anatomical variations in the anatomy of the posterolateral corner of the knee. Knee Surgery, Sports Traumatology, Arthroscopy. 15 (7), 895–900.

Seebacher, J.R., Inglis, A.E., Marshall, J.L., et al., 1982. Green, N.E., Swiontkowski, M.F. (Eds.), Skeletal Trauma in Children, vol. 3, fourth ed. Saunders Elsevier, Philadelphia.

Sekiya, J.K., 2008. A clinically relevant assessment of posterior cruciate ligament and posterolateral corner injuries. Evaluation of isolated and combined deficiency. The Journal of Bone and Joint Surgery. 90 (8), 1621–1627.

Strauss, E.J., Ishak, C., Inzerillo, C., et al., 2007. Effect of tibial positioning on the diagnosis of posterolateral rotatory instability in the posterior cruciate ligament-deficient knee. British Journal of Sports Medicine. 41, 481–485.

Talley, N.J., O'Connor, S., 2014. Clinical Examination: a Systematic Guide to Physical Diagnosis, seventh ed. Churchill Livingstone Elsevier, Chatswood, NSW.