MANAGEMENT OF MULTI-LIGAMENTOUS KNEE INJURIES AT THE NAIROBI HOSPITAL

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ABSTRACT

Objective: To demonstrate the primary author's experience in a series of three patients with multi-ligamentous knee injuries managed with 2-stage reconstruction at The Nairobi Hospital.
Methods: This study presents three patients, two with acute and one with chronic Multi Ligamentous Knee Injuries (MLKIs) who underwent staged operative treatments. These patients were managed with harvested ipsilateral bone-patella tendon-bone autografts for anterior cruciate ligament reconstruction and ipsilateral hamstring autograft for posterior cruciate ligament reconstruction where it was injured and, hamstring from the contralateral knee for posterolateral corner reconstruction, due to a lack of allografts in our setting.
Results: The surgeries are demanding and time-consuming but confidence is gained with performing them. The outcomes have been great with pain-free ambulation and resumption of common peroneal nerve function in one of the patients.
Conclusion: The lack of allografts necessitates harvesting autografts from the contralateral knee. Short-term outcomes are good. The surgeries are demanding and time-consuming but confidence is gained by performing them.

Key words: Multi-Ligamentous Knee Injury (MLKI), Anterior Cruciate Ligament (ACL), Posterior Cruciate Ligament (PCL), Medial Collateral Ligament (MCL), Bone-Patella Tendon-Bone (BPTB)

INTRODUCTION

Multi-Ligamentous Knee Injury (MLKI) is defined as the disruption of two of the four major knee ligamentous structures, namely: the Anterior Cruciate Ligament (ACL), the Posterior Cruciate Ligament (PCL), the Medial Collateral Ligament (MCL), and the Lateral Collateral Ligament (LCL) (1). Knee dislocations are synonymous with multi-ligamentous knee injuries since about 50% of knee dislocations do reduce spontaneously and are associated with multiple ligament injuries (2–4).

MLKIs may also be defined by loss of tibiofemoral articulation with associated disruption of multiple knee ligaments. Of all orthopaedic injuries, knee dislocations account for approximately 0.02%, and 0.5% of all joint dislocations (5,6). Interestingly, knee dislocations usually cause multi-ligamentous injuries but not all MLKIs are knee dislocations. MLKIs are diverse, and therefore an in-depth diagnostic work plan and management strategy is vital when giving care to patients with such injuries.

Knee dislocation more commonly occurs in males with a male to female ratio of 4:1(7). Knee dislocations may result from both high energy mechanism (e.g., motor-vehicular crashes, fall from height, sorts injuries and pedestrian-vehicular collisions) as well as low energy mechanisms (e.g., falls from trampoline, tripping while walking) (8).

In such injuries, the rate of neurovascular injury increases when both cruciate ligaments are torn (2). Twenty three to thirty two percent of knee dislocations are associated with injuries to the popliteal artery (9), while 14-40% of knee dislocations are associated with injury to the common peroneal nerve (10,11). From registry studies, MLKIs had concomitant meniscal injuries in 23-31%, and cartilage injuries in 16% (12,13). These injuries can be devastating and both limb- and life- threatening. Amputation of the lower limb after these injuries have an incidence of 12% as a result of common popliteal injury (10). Controversies exist concerning timing of surgery, repair versus reconstruction, single- versus two-stage reconstruction, use of autografts versus allografts, as well as post operative rehabilitation.

There are two classification systems used; Kennedy positional classification developed in 1963 that described the direction of displacement of the tibia in relation to the femur, and the Schenck anatomical classification (14) developed in 1994, that was based on ligamentous structures damaged rather than direction of displacement.

The purpose of this study is to demonstrate the primary author's experience in a series of three patients with MLKIs managed with 2 stage-reconstruction and reported clinical outcomes over a period of 6 months to just over 1 year.

MATERIALS AND METHODS

Case 1

A 20-year-old male student who tripped and fell awkwardly while jogging on the wet field sustaining excruciating left knee pain, numbness of the left leg and left knee deformity arrived within 2 hours of injury in October 2020.

On examination, the left knee was deformed, in obvious recurvatum, light touch sensation was reduced over the dorsal surface of the foot, and was unable to dorsiflex the foot. Dorsalis pedis pulse was low volume.

Immediate investigations done included plain radiographs which showed anterolateral knee dislocations. He had emergent reduction under general anaesthesia and the limb was splinted in an above knee backslab. The bilateral dorsalis pedis pulse were equally palpable but the neurological status remained the same- left foot drop and dorsal foot loss of sensation.

Figure 1
Pre-reduction attitude of the limb, and pre-reduction radiographs, anteroposterior and lateral demonstrating an antero-lateral knee dislocation

(a) (b) (c)

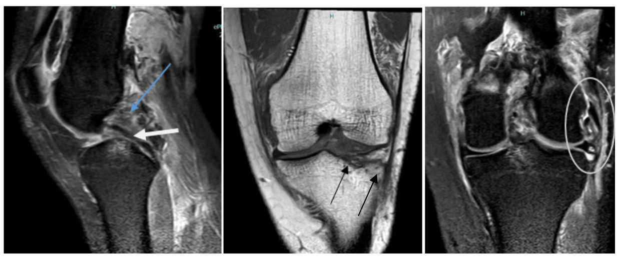
Figure 2
Post reduction radiographs demonstrating reduction of tibio-femoral dislocation

(a) (b)

MRI of the left knee demonstrated: torn anterior cruciate ligament, posterolateral corner (PLC) injury, posterior horn root tear lateral meniscus, and anterolateral tibial plateau depressed fracture. This injury was therefore classified as a multi-ligamentous knee injury with tibial plateau fracture and associated common peroneal nerve injury i.e. multi-ligamentous knee injury with tibial plateau fracture and associated common peroneal nerve injury i.e. KDVn.

Figure 3
a) Shows torn ACL (blue arrow), intact PCL (white arrow), b) depressed anterolateral tibial plateau fracture (black arrow), and c) posterolateral corner (PLC) injury (centered within oval gray circle) all on MRI

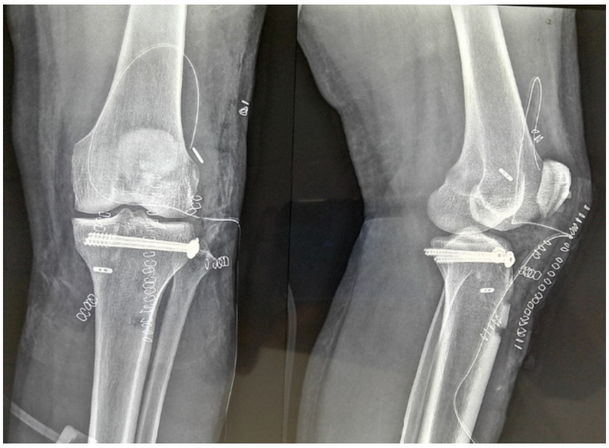
(a) (b) (c)



After 5 days he underwent left knee arthroscopy, all-inside ACL reconstruction with Bone-Patella Tendon-Bone (BPTB) autograft, meniscal root repair, and fixation of tibial plateau with cannulated screws. He had an ankle foot orthosis secured too.

Figure 4

Anteroposterior and lateral left knee radiographs demonstrating lateral tibial plateau fracture fixation with screws, and cortical buttons for ACL suspensory



Six weeks later, the PLC was reconstructed using the La Prade *et al* 2004 anatomical technique with ipsilateral hamstring tendon autografts, and after removal of the cannulated screws. The cannulated screws were removed to enable the formation of the tunnel for popliteal reconstruction.

Figure 5

a) shows the healed scars on the extended knee and b) demonstrating good knee flexion 1 year postoperatively

(a) (b)

On follow-up, his foot drop resolved in about 1 year duration from initial injury, evidenced by resumption of sensation over the dorsum of the foot and ability to evert the foot (SPN) and resumption of dorsiflexion of the toes and foot (DPN).

Case 2

A 22-year-old lady presented with a 2-day history of left knee pain, swelling and inability to use the left lower limb after tripping and falling down the stairs while carrying a load and landing directly onto the knee in August 2021.

The left knee was grossly swollen, limited range of motion, marked tenderness over the lateral aspect of the knee including the joint line, equal bilateral dorsalis pedis pulse and normal neurological examination of the left lower limb.

Figure 6

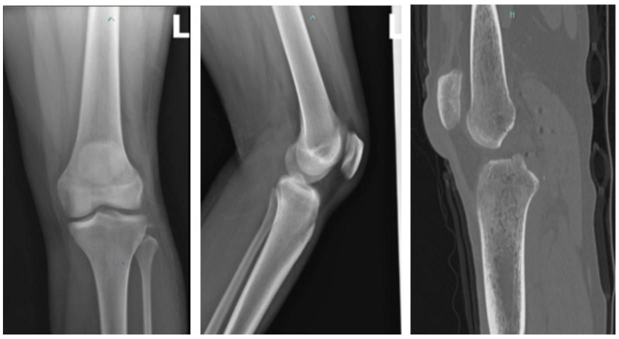
Grossly swollen left knee, no abnormality in the attitude of the limb

Radiographs of the left knee showed an avulsion fracture of the fibular head and widened lateral joint space. The tibiofemoral joint was reduced. CT scan of the left knee demonstrated, in addition to the radiographic signs, a posterolateral tibial plateau minimally displaced fracture.

Figure 7

Anteroposterior and lateral radiographs demostrating avulsion fracture of the fibular head and widened lateral joint space. c) is a CT scan of the same knee demostrating minimally displaced posterolateral tibial plateau fracture

(a) (b) (c)

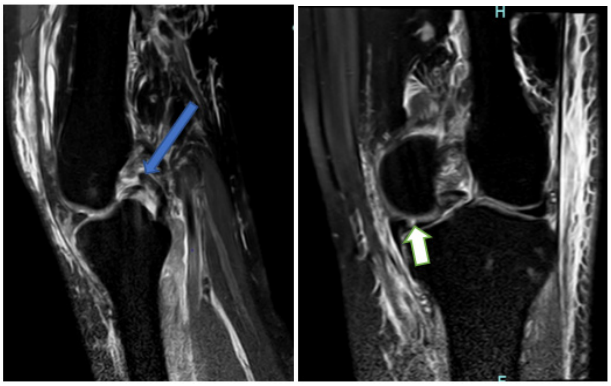


An MRI of the knee showed an avulsion fracture of the fibular head, posterior horn medial meniscus tear. She had suffered a KDV injury.

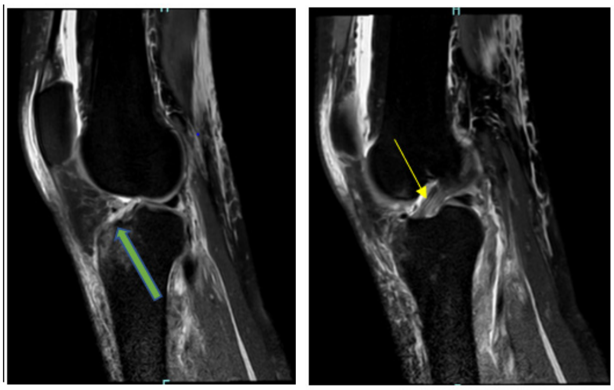
Figure 8

Select sagittal MRI scans demonstrating complete PCL tear (blue arrow) in a) and a medial meniscal horizontal tear in b). In c) anterolateral tibial plateau minimally displaced fracture (green arrow) with surrounding bone edema is shown. d) shows an intact ACL (yellow arrow)

(a) (b)



(c) (d)



Intraoperatively, dial test done on the left knee was positive. She underwent staged left knee arthroscopic medial meniscal tear, PCL reconstruction with ipsilateral hamstring autograft, and fixation of the lateral tibial plateau fracture with cannulated screws. Radiographs done postoperatively demonstrated good fracture fixation, slight varus deformity of the left knee and well secured endobuttons for the PCL reconstruction.

She underwent physiotherapy and within 6 weeks, the second stage of the surgery was done entailing removal of the cannulated screw and PLC reconstruction, with good distal neurovascular status, good range of motion of the knee and stable knee with valgus and varus stress test. She went on with postoperative ambulatory physiotherapy. Her gait was stable too.

Figure 9

a) to c) are postoperative radiographs demonstrated good fracture fixation, slight varus deformity of the left knee and well secured endobuttons for the PCL reconstruction. d) is the intraoperative demonstration of the common peroneal nerve during neurolysis

(a) (b)

(c) (d)

Case 3

A 50-year-old gentleman presented in January 2022 with a 5-month history of left knee instability and pain after accidentally stepping into a ditch and twisting his knee. The left knee had an effusion, tender lateral joint line, no obvious abnormal coronal attitude but was sagging, positive anterior and posterior drawer tests, varus stress test was positive, and good range of motion. He was neurovascularly intact distally. Erect radiographs of the left knee demonstrated slight varus deformity but no osseous anomalies. MRI of left knee reported multi-ligamentous injury involving anterior and posterior cruciate ligaments and the posterolateral corner injury. His injury was classified as KDIIIL.

Figure 10

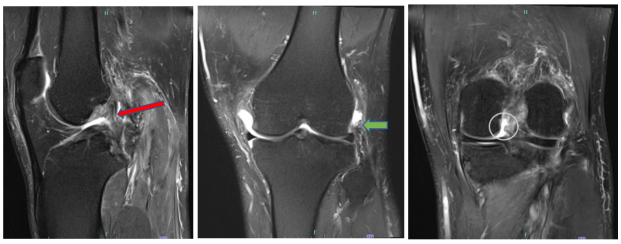
Erect left knee radiographs a) demonstrating slightly widened lateral joint compartment on antero-posterior view and on the lateral view b), normal sagittal attitude of the knee

(a) (b)

Figure 11

MRI T2 weighted films of the left knee demonstrating torn PCL (red arrow) on the saggital images of a), torn LCL with a large lateral effusion (green arrow) on the coronal image b), and empty posterolateral corner sign demonstrating torn ACL (grey circle) on the soronal image c)

(a) (b) (c)



He underwent arthroscopic ACL and PCL reconstruction with BPTB and hamstring ipsilateral grafts respectively. In 6 weeks having had reconstruction of the cruciate ligaments, and range of motion of the knee at about 100°, and with obvious varus knee instability, the posterolateral corner was reconstructed. He was then followed up while undergoing close monitored ambulatory physiotherapy.

Figures 12

Two weeks postoperatively. a) shows left knee PLC reconstruction and previous hamstring and BPTB autograft harvest sites and, b) Good healing on the right knee hamstring donor site

Table 1

Anatomic classification system describing the ligaments torn. The higher the number, the more severe the injury

Classification	Description
KD1	Dislocation including disruption of one cruciate ligament (ACL or PCL)
KDII	Dislocation including disruption of both cruciate ligaments only (ACL and PCL)
KDIII	Dislocation including disruption of both cruciate ligaments (ACL and PCL) and either collateral ligament (MCL or LCL)
KGIIIM	Dislocation including disruption of both cruciate ligaments (ACL and PCL) and the MCL
KDIIIL	Dislocation including disruption of both cruciate ligaments (ACL and PCL) and the LCL
KDIV	Dislocation including disruption to both cruciate ligaments (ACL and PCL) and both collateral ligaments (MCL and LCL)
KDV	Fracture-dislocation

Dislocations with associated nerve injury are indicated with "N," and dislocations associated with arterial injury are indicated with "C".

The injuries in these patients are classified according to Scenk classification shown below.

Knee Dislocation Classification System (Schenck *et al.*)(15)

DISCUSSION

Knee dislocations by definition are clinical and radiological loss of tibiofemoral congruency. Fifty percent of these reduce spontaneously and are associated with multiple knee ligament tears (4). Knee dislocations account for <0.02% of orthopaedic injuries (5) and close to 0.5% of all joint dislocations (6). Clinically, knee dislocations are characterized by tears of both cruciate ligaments and grade 3 medial or lateral side injury (2,16). However, knee dislocations with one of the cruciate ligaments intact have been reported (17,18).

MLKIs are classified using either of the two classification systems: the Kennedy classification (19) developed in 1963 or the Schenck classification system (3,15,20) developed in 1994. Kennedy's standardized positional classification system describes the direction of displacement of the tibia in relation to the femur. It is limited in severity and extent but its major limitation is inability to be used in knee dislocations with spontaneous reductions. The Schenck classification (Table 1), as it is used in this study, is based on the number of ligaments injured (types 1-4) and MLKIs with associated periarticular fracture (type 5). The classification is an important tool for communication, anatomical preoperative planning and prognostication. Its major limitation is the lack of validation.

Knee dislocations are associated with short term complications like neurovascular injuries, compartment syndrome, limb amputation, and, long-term complications such as knee instability and posttraumatic osteoarthritis. There is paucity of high-level evidence-based studies to direct definitive management course and recommendations in regards to the optimal timing of surgery in multi-ligamentous injuries of the knee.

The first case was a male patient with obvious knee dislocation due to a low velocity sports injury and a foot drop, picked early in the clinical assessment. This was important in the overall plan of care. Once the neurolysis confirms possible nerve contusion but no lacerations, the chances of recovery improve. Treatment of CPN palsy with knee dislocation is usually quite challenging -especially rehabilitation of the knee with a foot drop. The earlier the management is started the better the chances of recovery. Two stage management was performed with a careful choice of graft, we thus used a BTB graft to reconstruct the ACL and spared the hamstrings for the La Prade reconstruction of the PLC. This is occasioned by the lack of allografts in our environment.

The second case, was also an acute injury in a young female, the radiographs were misleadingly benign but the clinical examination demonstrated a more devastating knee injury. It was not clear as to whether she had suffered a knee dislocation, but it is likely that the knee dislocated and reduced spontaneously. A thorough clinical examination was done and MRI scans performed. The mechanism of causation was of a low velocity nature. The challenge here was the seemingly benign injury that on a thorough assessment revealed that she had suffered a MLKIs. Be wary of a fibular head fracture which may suggest a posterolateral corner injury as was the case here.

Our third case was a chronic knee injury in a middle-aged gentleman. The patient had had knee instability for a while. His mechanism of injury demonstrated MLKI and the surgeries done had good short-term outcomes.

Management strategies for MLKIs are controversial. Levy *et al.* (1) in their evidence based systemic review study demonstrated that operative treatment, compared with the nonoperative option, had excellent/good International Knee Documentation Committee (IKDC) scores (58% vs 20%), higher rates for return to work (72% vs 52%) and full sports (29% vs 10%) (1). Of the operative methods, reconstruction is favored over repair, and treating them early before 6 weeks (1,21,22). The reconstructive treatment may be done as single or staged, arthroscopic and open.

Proponents of early reconstruction hold on to the first 3 weeks post injury as the critical period to establish anatomical relationships and best timing to restore knee biomechanics (23). Others advocate for delayed surgery (> 3 weeks, with a mean of 51 weeks) believing that this offers the advantage of achieving better preoperative range of motion of the knee, while giving extraarticular structures the opportunity to heal on their own (24). However, the functional outcome scores and outcome measures were interestingly similar in both groups (25).

While early reconstruction has shown better results, the current debate is whether all ligaments are to be repaired at once or in staged fashion. Patients who undergoes repair and reconstruction of three or more ligaments are at a higher risk of stiffness of the knee after surgery. A systematic review by Jiang *et al.* (26) showed better results resulting from staged reconstruction compared with single stage ligament repairs in acute and chronic injuries. Similarly, KD3M and KD3L knees showed no difference in outcomes.

Staged surgery encompasses collateral ligament repair or reconstruction in the acute stage (<3 weeks), which is then followed by supervised rehabilitation for 3-6 weeks, to achieve knee range of motion beyond 100°, the second stage ACL and PCL reconstruction is done. This staged option reduced surgery time, reduces risk of arthrofibrosis and reduced the risk of infection.

The primary author utilizes the staged-reconstruction with arthroscopic cruciate reconstruction, single or both, together with MCL repair with internal bracing if MCL is torn, then dealing with the PLC later at 6 weeks. The ACL and PCL are reconstructed first with the ipsilateral BPTB and hamstring autografts respectively, then the PLC follows as the latter stage with contralateral hamstring autografts. During the first stage, meniscal and cartilage injuries are repaired appropriately. In the first two cases we opted for early reconstruction, the third case presented long after the injuries. We also dealt with the cruciate ligaments early as opposed to the conventional more practiced method where the cruciates are reconstructed after the collateral ligaments.

Close follow up was maintained during the postoperative period after each stage to ensure the range of motion is improved while the reconstructed ligaments are protected in a multi-orthosis splint.

Of the MLKIs associated with common peroneal nerve injuries, 21% have complete and functional motor recovery (27). Several factors affect neurological recovery and include whether the injury was complete or incomplete at initial presentation, and young age (28). To improve on the outcome, strategies employed by the primary author include surgical exploration and decompression of haematoma, neurolysis to release perineural scar formation.

Posterolateral corner (PLC) injuries are managed as La Prade *et al* demonstrated in 2004 i.e., anatomic reconstruction of the three main structures: Popliteus Tendon (PLT), Fibular Collateral Ligament (FCL) and, Popliteofibular Ligament (PFL). The technique uses the two hamstring autografts and therefore quite available resource in many resource-constrained areas. The common important consideration is that KDIII injuries with PLC associated injury may warrant harvest of hamstrings from both lower limbs if autografts are to be employed as was the case here.

The outcomes have been encouraging and we believe we need to treat such patients in our country with the available specialized skills and resources and write up more papers from our region to contribute to the wealth of knowledge on the subject. There is also a need to set up tissue banks so we can have access to allografts.

CONCLUSION AND LIMITATIONS

Multi-ligamentous knee injuries are complex injuries and so is their management. The three managed MLKI consisted of two acute and one chronic. They are mostly associated with high energy mechanisms but in 40%, low energy mechanisms are involved. A high index of suspicion is important when looking out for neurovascular injuries. We have used the Schenck classification despite its lack of validation to emphasize the type of injuries with the respective trauma. Pre-operative planning and timing are important. The surgeries are demanding and time consuming but as we perform them, we are gaining confidence. The lack of allografts necessitates harvesting autografts from the contralateral knee. Two short term outcomes are good. It's a small series which is a limitation.

Conflict of interest: None to declare.

REFERENCES

1. Levy, B.A, Khaled, A. and Dajani, D.B.W. Decision making in the multiligament-injured knee: an evidence-based systematic review. *Arthroscopy*. 2009; **25**(4):430–438.
2. Wascher, D.C. and Dvirnak, P.C. Knee dislocation: initial assessment and implications for treatment. *J Orthop Trauma*. 1997; **11**(7):525–529.
3. Goebel, C.P. and Domes, C. Classifications in brief: The Schenck classification of knee dislocations. *Clin Orthop Relat Res*. 2020; **478**(6):1368–72.
4. Seroyer, S.T. and Musahl, V.H.C. Management of the acute knee dislocation. *Injury*. 2008; **39**(7):710–718.
5. Rihn J.A., Yram, J. and Groff, C.D.H. The acutely dislocated knee: evaluation and management. *J Am Acad Orthop Surg*. 2004; **12**(5):334–346.
6. Richter, M. and Lobenhoffer, H.T. Knee dislocation. Long-term results after operative treatment. *Der Chirurg*. 1999; **70**(11):1294–301.

7. Eranki V, Begg C WB. Outcomes of operatively treated acute knee dislocations. *Open Orthop J.* 2010; **4**:22–40.
8. Durbhakula, S.M., Shankar, P. and Das R.L.U. Traumatic anterior knee dislocation. *Orthopedics.* 2002; **25**(10):1083–85.
9. Wascher, D.C. High-velocity knee dislocation with vascular injury. treatment principles. *Clin Sport Med.* 2000; **19**(3):457–477.
10. Medina, O., Arom, G.A., Yeranosian, M.G., Petrigliano, F.A. and McAllister, D.R. Vascular and nerve injury after knee dislocation: A systematic review. *Clin Orthop Relat Res.* 2014; **472**(9):2621–29.
11. Molund, M., Engebretsen, L., Hvaal, K., Hellesnes, J. and Husebye, E. Posterior tibial tendon transfer improves function for foot drop after knee dislocation. *Clin Orthop Relat Res.* 2014; **472**(9):2637–43.
12. Lind, M., Menhert, F. and Pedersen, A.B. The first results from the Danish ACL reconstruction registry: Epidemiologic and 2 year follow-up results from 5,818 knee ligament reconstructions. *Knee Surg Sport Traumatol Arthrosc.* 2009; **17**(2):117–124.
13. Lind, M., Nelsen, T.G. and Behrndtz, K. Both isolated and multi-ligament posterior cruciate ligament reconstruction results in improved subjective outcome: results from the Danish Knee Ligament Reconstruction Registry. *Knee Surg Sport Traumatol Arthrosc.* 2018; **26**(4):1190–96.
14. Schenck, R.C. J. The dislocated knee. *Instr Course Lect.* 1994; **43**:127–136.
15. Schenck, R.C., Hunter, R.E., Ostrum, R.F. and Perry, C.R. Knee dislocations. *Instr Course Lect* [Internet]. 1999 Jan 1 [cited 2022 May 9]; **48**:515–522. Available from: https://europepmc.org/article/med/10098080.
16. Schenck, R., Jr. Classification of knee dislocations. *Oper Tech Sports Med.* 2003; **11**(3):193–198.
17. Bratt, H.D. and Newman, A.P. Complete dislocation of the knee without disruption of both cruciate ligaments. *J Trauma - Inj Infect Crit Care.* 1993; **34**(3):383–389.
18. Shelbourne, K.D. andPritchard, A.C.R. Knee dislocations with intact PCL. *Ortho Rev.* 1992; **21**(5):607–608.
19. Kennedy, J.C. Complete dislocation of the knee joint. *J Bone Jt Surg Am.* 1963; **45**:889–904.
20. Ockuly, A.C., Imada, A.O., Richter, D.L., Treme, G.P., Wascher, D.C. and Schenck, R.C. Initial evaluation and classification of knee dislocations. *Sports Med Arthrosc* [Internet]. 2020 Sep 1 [cited 2022 May 8]; **28**(3):87–93. Available from: https://pubmed.ncbi.nlm.nih.gov/32740459/
21. Chhabra, A. and Cha, P.S. Surgical management of knee dislocations. *J Bone Jt Surg Am.* 2004; **87**-a(Suppl 1):13–18.
22. Brett, D., Owens, Mark Neault, E.B. Primary repair of knee dislocations: results in 25 patients (28 knees) at a mean follow-up of four years. *J Orthop Trauma.* 2007; **21**(2):92–98.
23. Gwathmey, F.W., Shafique, D.A. and Miller, M.D. Our approach to the management of the multiple-ligament knee injury. *Oper Tech Sports Med.* 2010; **18**(4):235–244.
24. Karataglis, D., Bisbinas, I., Green, M.A. and Learmonth, D.J.A. Functional outcome following reconstruction in chronic multiple ligament deficient knees. *Knee Surg Sport Traumatol Arthrosc.* 2006; **14**(9):843–847.
25. Levy, B.A., Dajani, K.A., Whelan, D.B., Stannard, J.P., Fanelli, G.C., Stuart, M.J., *et al.* Decision making in the multiligament-injured knee: An evidence-based systematic review. *Arthrosc - J Arthrosc Relat Surg.* 2009; **25**(4):430–438.
26. Jiang, W., Yao, J., He, Y., Sun, W., Huang, Y. and Kong, D. The timing of surgical treatment of knee dislocations: a systematic review. *Knee Surg Sport Traumatol Arthrosc.* 2015; **23**(10):3108–13.
27. Niall, D.M., Nutton, R.W. and Keating, J.F. Palsy of the common peroneal nerve after traumatic dislocation of the knee. *J Bone Jt Surg - Ser B.* 2005; **87**(5):664–667.
28. Peskun, C.J., Chahal, J., Steinfeld, Z.Y. and Whelan, D.B. Risk factors for peroneal nerve injury and recovery in knee dislocation. *Clin Orthop Relat Res.* 2012; **470**(3):774–778.