Original Article

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Complex Knee Injuries

R.B. Uppin[1], S.K. Saidapur[2], Chintan N. Patel[3]

Author Affiliation: [1]Professor, Dept. of Orthopaedics, KLE Academy of Higher Education, J.N. Medical College & Dr. Prabhakar Kore Hospital and Medical Research Center, Belgaum–590010, Karnataka, India. [2]Assistant Professor [3]Postgraduate Student, Dept. of Orthopaedics, J.N. Medical College, Belagavi, Karnataka 590010, India.

Corresponding Author: R.B. Uppin, Professor, Dept. of Orthopaedics, KLE Academy of Higher Education, J.N. Medical College & Dr. Prabhakar Kore Hospital and Medical Research Center, Belgaum–590010, Karnataka, India. E-mail: uppinrajendra@rediffmail.com

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Abstract

As quoted by Rene Descartes [1] "The human body is a machine whose movements are directed by soul"; and knee being a complex joint with myriad ligaments and stability and may lead to varying degree of impairments. Management of four complex knee joint injuries following trauma are discussed in this article.

Keywords: Injuries; Myriad ligaments.

Introduction

The knee joint is the largest and most complicated synovial joint in the body. Knee joint is a modified-hinge diarthrodial synovial joint [2] with articulation between the femur and tibia which is weight bearing and the articulation between the patella and femur which allows the pull of quadriceps femoris muscle to be directed anteriorly over the knee to the tibia without tendon wear. The fibro-cartilagenous menisci [2] are on each side, between the femoral condyles and tibia accommodating changes in the slope of the articular surface during joint movements.

The detailed movements of the knee are complex interaction of flexion, extension, rotation, gliding, and rolling. Like all hinge joints, the knee joint is reinforced by collateral ligaments which remain on medial and lateral sides of the joint. In addition two very strong cruciate ligaments interconnect the adjacent ends of the femur and tibia and maintain their opposed positions during movements. As the knee joint is involved in weight bearing, it has an efficient 'locking' mechanism to reduce the amount and muscle energy required to keep the joint extended. Great stability mainly depends on the integrity of the ligamentous structures.

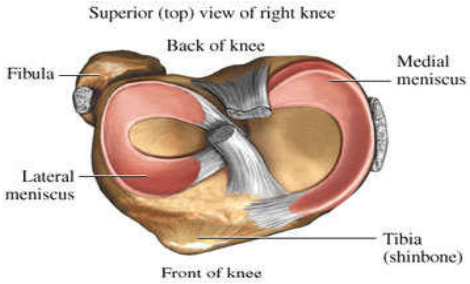

Fig. 1: Menisci of knee joint

Biomechanics

The knee joint is one of the most commonly injured joint in the human body. The complexity of the joint is due myriad of ligamentous attachments, along with numerous muscles crossing the joint. The anatomic complexity is essential to allow for elaborate interplay between the joint's stability. The knee joint works in conjugation with the hip joint and ankle to support the body's weight during static

erect posture. Dynamically, the complex is responsible for moving and supporting the body during variety of both routine and difficult activities. The fact that knee must fulfill major as well as mobility roles is reflected in its structure and function.

Fig. 2: Cruciates and collateral ligaments

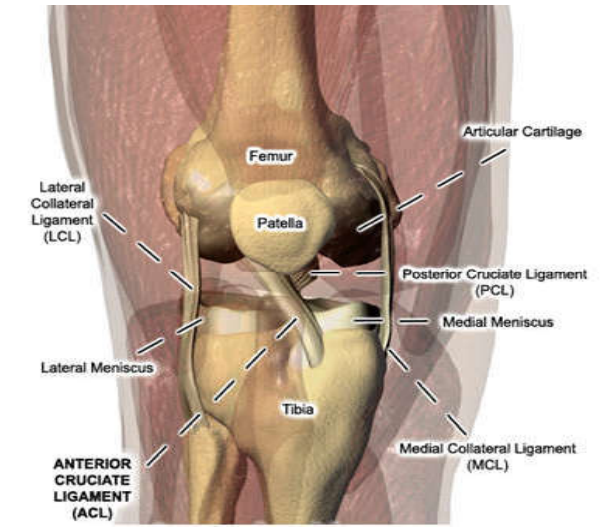

Fig. 3: Anatomy of anterior of knee joint

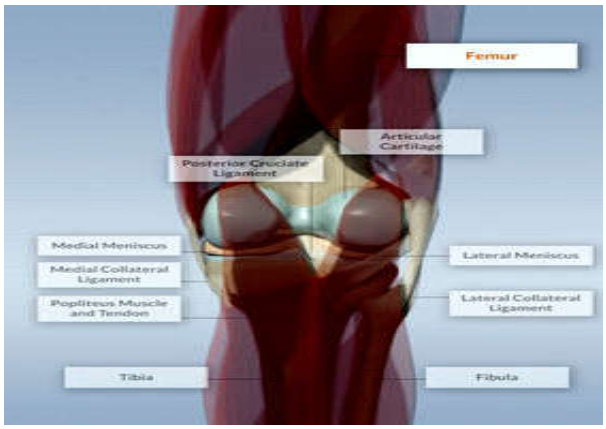

Fig. 4: Anatomy of posterior of knee joint

Knee Joint Kinematics

The primary angular (or rotator) motion of the tibio-femoral joint is flexion-extension, although both medial-lateral (internal-external) rotation and varus-valgus (abduction-adduction) motions can also occur to a lesser extent. These motions occur about changing but definable axis. In addition to the angular motions, on both medial and lateral tibial plateaus to a lesser extent, medial and lateral translations can occur in response to varus and valgus forces. The small amount of antero-posterior and medial-lateral displacements that occur in the normal knee are the result of joint incongruence and variations in ligamentous elasticity.

Although these translations may be seen as undesirable, they are necessary for normal motion to occur. Excessive translational motions however, should be considered abnormal and generally indicate some degree of ligamentous incompetence. We will focus here on the normal knee joint motions including both osteokinematics and arthrokinematics.

Case Reports

1. A 38 year old male had history of Road Traffic Accident – patient being two wheeler rider collided with another two wheeler. Patient presented at Emergency Department (ED) with complaints of pain, swelling and instability in the right knee. On examination, swelling and tenderness were present over right knee with signs of instability.Anterior drawer's test, Lachman test, Posterior drawer's test, Varus stress test were found to be positive.Patellor tap test, Sulcus sign were also noted to be positive. X-rays were done which showed fibular head avulsion fracture and no other bony inuries. Further evaluation of right knee with MRI scanning was done which was suggestive of – Grade 2 to 3 anterior cruciate ligament tear at its tibial attachment, grade-3 midsubstance tear of posterior cruciate ligament with lateral collateral ligament complex avulsion from fibular attachment with 1.5cm avulsed fracture fragment of fibular head. Arthroscopic evaluation of right knee was done to confirm MRI findings, which was suggestive of partial tear of anterior cruciate ligament, complete tear of posterior cruciate ligament with lateral collateral ligament complete avulsion from fibular head with avulsion fracture of fibular head. Decision to operate for posterior cruciate ligament and lateral collateral ligament and not to operate for anterior

cruciate ligament was made after discussion with patient and attenders. Posterior cruciate ligament reconstruction was performed with BPTB (Bone patellor tendon bone) graft harvested from same lower extremity. In view of long tourniquet time, lateral collateral ligament avulsion repair with S.S. wire (Stainless steel wire) was performed in 2nd stage surgery. Patient was started with physical therapy for knee bending 0° to 90° within the first 2 weeks after surgery. Further range of motion was achieved between weeks 4 and 8. After 8 week, the patients was started with partial weight bearing followed by full weight bearing and at 6 month follow up patient could walk comfortably keeping the balance on both limbs with no signs of instability and 110° of knee bending. Patient is satisfied with his function and stability, and feels adequate to perform job related activities and activities of daily living.

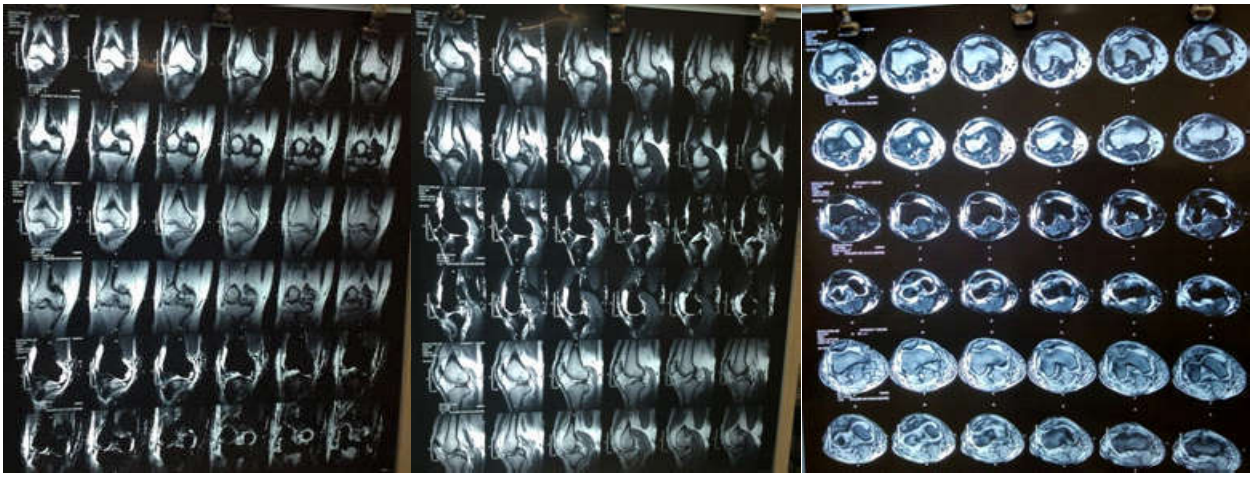

Fig. 5: Pre-Op MRI of Right Knee

2. A 39 year old male had history of fall from bike, patient being a rider, 1 month back. Patient consulted at out-patient clinic with complaints of pain, swelling and instability in the left knee. On examination, swelling and tenderness were present over right knee with instability signs present. Anterior drawer's test, Lachman test, Valgus stress test, Mc-murray's test were positive. Patellor tap test was also positive. X-rays were done which showed no obvious bony injuries.Further evaluation of right knee with MRI scanning was done which wassuggestive of– Grade 3 anterior cruciate ligament tear, bucket handle tear of medial meniscus with medial collateral ligament complete tear (also known as unhappy triad of knee joint). Arthroscopic evaluation of right knee was done to confirm MRI findings followed by Anterior cruciate ligament reconstruction with Quadruple Hamstrings graft (semitendinosus and gracilis) harvested from same lower extremity with partial meniscectomy of medial meniscus with medial collateral

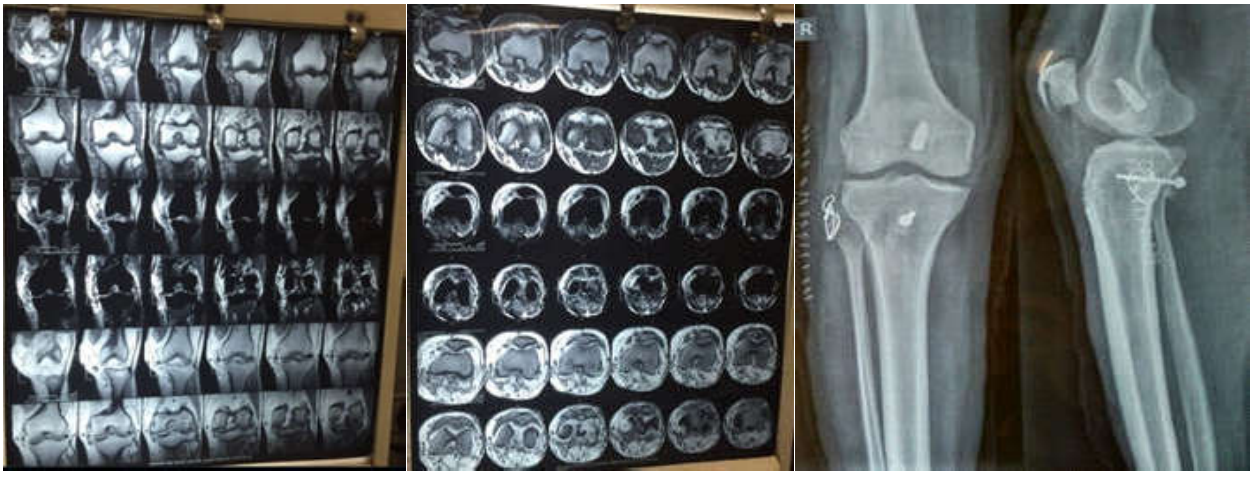

Fig. 6: Post-operative X-ray

Fig. 7: Pre-Operative MRI of Left Knee

ligament repair. Post-operatively, patient was started with physical therapy for knee bending 0° to 90° within the first 2 weeks and further range of motion was achieved between weeks 2 and 6. After week 6, the patients was started with partial weight bearing followed by full weight bearing and at 6 month follow up patient could walk comfortably keeping the balance on both limbs with no signs of instability and 120° of knee bending. Patient could perform activities of daily living and occupational activities satisfactorily.

Fig. 8: Post-operative x-ray

3. A 38 year old male had history of fall from bullock-cart presented at emergency department with complaints of pain, swelling and instability in the left knee. On examination, swelling and tenderness were present over right knee and proximal leg with crepitus present and restricted range of movements at right knee joint. Single 2*3 cm puncture wound was present over anterior aspect of proximal of leg. Distal pulses (dorsalispedis and posterior tibial) were not palpable and SpO2 was not recordable in right lowerlimb. Moreover, patient was unable to move the toes with altered sensation over the dorsum of foot.X-rays were done which showed left knee posteriorsubluxation with comminuted fracture of proximal tibia, avulsion fracture of head of fibula with proximal 1/3rd fibula fracture, tibial tuberosity fracture.Blood investigations were within normal limits. Further evaluation for suspected vascular injury was done by micro-vascular surgery team. Diagnosis was confirmed to be 'type -3c' compound injury of left lower limb with injury to left popliteal artery with multiple fractures of proximal tibia and fibula. Patient was taken for surgery on emergency basis and embolectomy was performed for left popliteal artery and posterior tibial artery along with fasciotomy by micro-vascular surgery team. Open reduction and internal fixation with 3.5mm non-locking 4-hole buttress plate and 4 inter-fragmental screws of 4.5mm for proximal tibia fracture, with posterior capsule repair and fixation of head of fibula with sutures was performed.Post-operatively after stabilization of the patient for 1 week, 2nd stage definitive fixation of proximal tibia fracture was performed by open reduction and internal fixation with 5-hole hockey plate and screws. Closure of fasciotomy wounds with STSG (split thickness skin grafting) was undertaken in same sitting. Given the complexity of his injury, the patient remained non-weight bearing for 12 week but continued with his knee range of motion exercises and knee brace wear. The patient progressed to full weight bearing without assisted device by 4thmonth post injury with almost 90° of knee bending with active physiotherapy sessions.

Fig. 5: Pre-Operative X-ray of Left Knee

Fig. 6: Post-operative X-ray after Initial emergency fixation

Fig. 7: X-ray after final fixation

4. A 30 year old female with history of Road traffic accident presented at Emergency Departmentwith complaints of inability to bear weight on right lower limb with painful and restricted movements of the right knee joint. On examination, swelling and tenderness were present over right knee and proximal leg with crepitus present and restricted range of movements of right knee. Varus stress test was positive. Neurovascular examination was unremarkable and Ankle-Brachial index was 1.0 on the injured leg. On further radiological evaluation, X-rays revealed proximal tibial fracture, with fibula head avulsion fracture.When subjected to MRI and CT scanning, it was found that with lateral collateral and lateral meniscus of right knee were injured. ORIF (open reduction and internal fixation) of proximal tibial fracture was performed through posterior approach with proximal tibialtitanium T-plate and screws. Primary repair of LCL with anchor sutures and ethibond sutures, with partial meniscectomy of lateral meniscus was done. Post operatively gradual passive knee bending was started within 5 days withnon weight bearing mobilization with knee brace locked in extension for a period of 6 weeks.

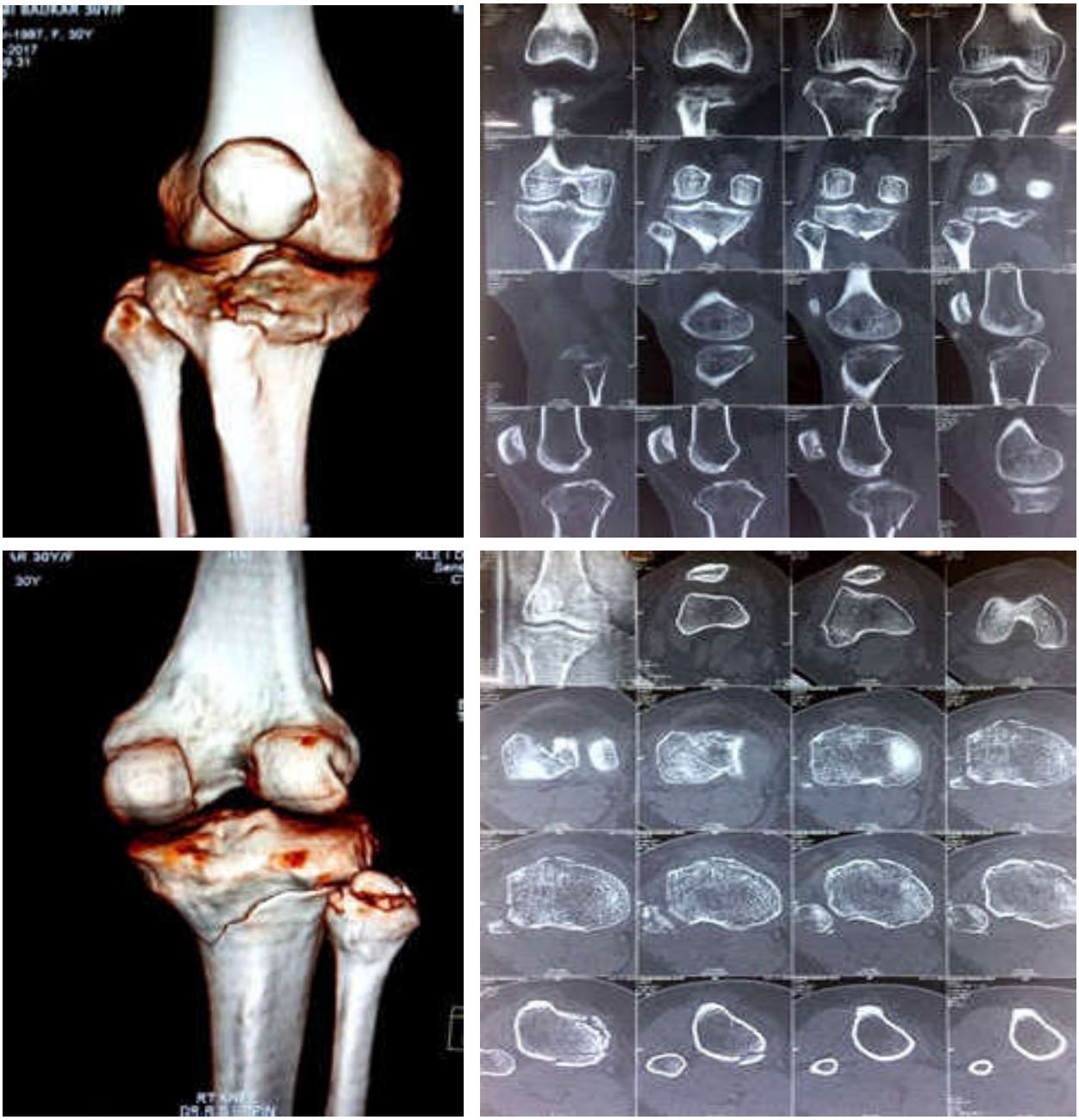

Fig. 8: Pre-Operative CT Scan of Left Knee

Fig. 9: Post operative X-ray

Discussion

The knee joint contains many strong ligaments that compensate for the lack of stability provided by the bony framework. Because of the joint's dependence on these ligaments, they are commonly injured in athletes as a result of over-exertion or sudden trauma. The general physical examination has 5 major components: observation of patient's stance and gait, range of motion, palpation, examination for a knee effusion and specific stability tests. After completing these general examinations and considering the patient's history, the clinician can make out a differential diagnosis and do focused work-up accordingly.Recent literature has shown early operative treatment with ligament reconstruction of MKIs (multi-ligament knee injury) leads to the most effective results in terms of return to prior activity [4].

Surgical intervention is determined on a case by case basis, taking into account a patient's pre-injury activity level and patient's expectations.The operative methods include repair, repair plus augmentation, or reconstruction of injured structures combined with bracing and rehabilitation in the short term. Nonoperative treatment is usually indicated for partial (grade II) ligament tears and occasionally for initial treatment in special circumstances. The ultimate goal of treatment is to return the patient to pre-injury employment or activity with the hope of delaying post-traumatic arthritis. In cases of PCL or collateral ligament injury, weight-bearing is often delayed to allow more time for healing. In cases of ACL reconstruction, early motion generally results in a better outcome [5,6].

To minimize the risk of postoperative stiffness and graft failure, it is recommended that all injured structures be reconstructed concurrently and anatomically so that an early postoperative knee range of motion can be initiated.

Conclusion

The surgical management of complex knee injuries is challenging and associated ligamentous and vascular injuries should be timely diagnosed and treated appropriately. Simultaneous reconstruction/ repair of multiple injured ligaments can significantly improve sagittal, coronal and rotatory stability of the knee at short-term follow-up. Goal should be to facilitate early knee motion by reducing post-traumatic osteoarthritis and thus achieving optimal stable knee function.

References

1. Human Body Dynamics: Classical Mechanics and Human Movement -Springer Science & Business Media, 29-Dec-1999.
2. Rheumatology, Marc C. Hochberg, Alan J. Silman, Josef S. Smolen, Michael E. Weinblatt, Michael H. Weisman - Elsevier Health Sciences, 24-Jun-2014.
3. Frederick M Azar, S. Terry Canale,and James H. Beaty. Campbell's Operative Orthopaedics, 13th Edition.
4. Mook WR, Miller, Diduch DR, Hertel J, Boachie-Adjei Y, Hart JM. Multiple-ligament knee injuries: a systematic review of the timing of operative

intervention and postoperative rehabilitation. J Bone Joint Surg Am. 2009;91:2946–2957.

5. Noyes FR, Barber-Westin SD. Reconstruction of the anterior and posterior cruciate ligaments after knee dislocation. Use of early protected postoperative motion to decrease arthrofibrosis. Am J Sports Med. 1997;25:769–778.

6. Charles L. Cox, Kurt P. Spindler, N. Multiligamentous Knee Injuries–Surgical Treatment Algorithm, Am J Sports Phys Ther. 2008 Nov;3(4):198–203.