Meniscus Root Injury: A review

Rajkumar S Amaravathi[1]

Abstract

The meniscus provides shock absorption and stability by generating circumferential stresses as load bearing occurs. This is because of the root attachments of the meniscus to the tibia, preventing meniscus extrusion and a subsequent alteration of the transmitted hoop .Meniscus root tears lead to an increase of peak tibiofemoral contact pressure and tibiofemoral contact area which has been shown to lead to altered biomechanics and an acceleration of degenerative changes of the knee. The treatment method for meniscus injuries now primarily is preservation and anatomic restoration, because non-operative and meniscectomy treatments are associated with poor clinical outcomes and progression to degenerative changes in the joint.

Keywords: Meniscus Root Injury

Introduction

Meniscus root tears leads to increase in peak Tibiofemoral contact pressure and Tibiofemoral contact area which in turn alters the knee biomechanics leading to acceleration of degenerative changes in the knee.

The incidence of PMRT is around 10.1% to 21.4% while the PLRT is around 8%-9.8% with or without association of ACL tear. (1,2).

This review has tried to bring out the anatomy, biomechanics, classification of injury, diagnosis and management of posterior and anterior the root tear of both medial and lateral menisci with special mention on authors preferred treatment.

Anatomy (3)

The anterior horn of medial meniscus is inserted onto the anterior intercondylar crest (watch out during IL nailing of tibia), anterior horn of lateral meniscus is attached anterior to the lateral tibial spine lateral to ACL (watch out during ACLR), PRMM is attached posterior and lateral to medial tibial spine with the white shiny fibres of PHMM called as the light house of PCLand finally PHLM is posterior to PL bundle of ACL posterior and medial to lateral tibial spine. Structurally the anterior root fail at higher loads when compared to posterior root The lateral because of their greater thickness and presence of uncalcified cartilage fail more in trauma.

[1]Department of Arthroscopy and Sports Injury,St John's Medical College, Bangalore 560034, Karnataka

Address of Correspondence
Dr. Rajkumar S Amaravathi,
Professor Orthopedics,
Head Division of Arthroscopy and Sports Injury,St John's Medical College, Bangalore 560034, Karnataka
E-mail: rajamarvathi@gmail.com

Medial meniscus posterior root attachment(MPRA)

The MPRA is 9.6 mm posterior and 0.7 mm lateral to the medial tibial eminence (MTE), which is the most reproducible osseous landmark. Additionally, the centre point of the MPRA can be found 3.5 mm lateral to the medial cartilage inflection point and 8.2 mm directly anterior to the most proximal aspect of the PCL tibial attachment point, which represent two other consistent landmarks [Figure 1]

Lateral meniscus posterior root attachment (LPRA)

The LPRA is 1.5 mm posterior and 4.2 mm medial to the lateral tibial eminence (LTE). Additionally, the centre point of the LPRA is 4.3 mm medial to the lateral cartilage inflection point and 12.7 mm directly anterior to the most proximal aspect of the PCL tibial attachment.

Medial meniscus anterior root attachment(MARA)

The MARA inserts along the anterior intercondylar crest of the anterior slope of the tibia. The centre of the MARA was reported to be 18.2 mm anteromedial from the centre of the anterior cruciate ligament (ACL) tibial footprint and 27.5 mm anterolateral from the medial tibial eminence apex. The MARA is at risk during intramedullary nailing of tibial fractures.

Lateral meniscus anterior root attachment(LARA)

LaPrade et al reported that the area of the LARA averaged 140.7 mm2, given the considerable overlap with the ACL footprint. Furthermore, the LARA site was 5.0 mm anterolateral from the centre of the ACL footprint, 14.4 mm from the lateral tibial eminence apex and 7.1 mm from the nearest edge of the lateral articular cartilage. Therefore, the LARA is at high risk for iatrogenic injury during

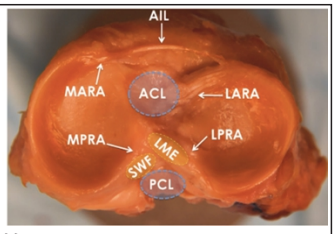

Figure 1: ???

ACL tibial tunnel reaming.

Biomechanics:(4,5,6,7)

Injury are seen more in posterior root than anterior root because of the greater mobility and high failure strength respectively. As a result of which in PRLM injury we see greater anterior translation of tibia at low flexion angle of knee also increased internal rotation of knee at higher flexion angel of knee leading to greater stress on ACL. Similarly, injury to PRMM increases the load and stress across the medial compartment leading to OA. Please note SPONK is sometimes an association with PRMM tear. Meniscus function to convert axial tibiofemoral loads to hoop stresses. Injury to meniscus root alters the mechanics thereby reducing the contact area and increasing the peak contact pressure by 25%.

The two tunnel transtibial pull out repair has the ability to restore tibiofemoral contact pressure and contact area at time zero and has added benefit of providing growth factors and progenitor cells for healing from the bone marrow. Poor result of repair is due to the failure of the meniscus and suture interface rather than the "Bungee effect" of the long length of suture.

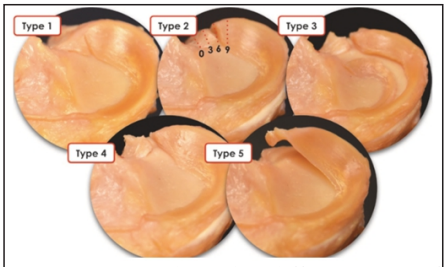

Figure 2: Laprade et al -5 different types of posterior horn medial meniscus root tears

Diagnosis:(8)

There is no definitive clinical test or sign to diagnose these injuries. However, the sudden onset of pop in knee after a trivial trauma, recurrent swelling of knee, with pain and limited ROM are all pointers towards a root tear. The influence of BMI, OA, alignment of limb, SONK, female sex and increasing age cannot be undermined in these injuries.

High index of suspicion with no mechanical syptoms, pain on deep knee flexion, joint line tenderness, positive Murray test in 50%-60% of cases help to diagnose these injuries.

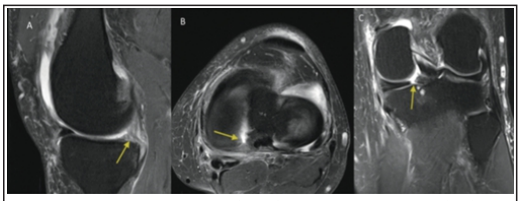

Figure 3: MRI T2 weighted images, a-sagittal-ghost sign, b-axial, c- coronal(truncation sign)

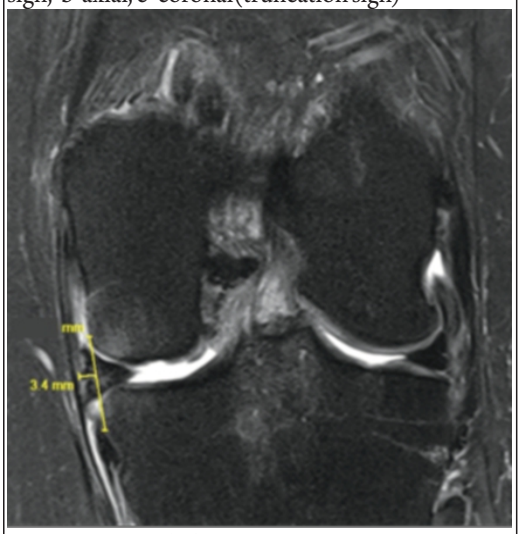

Figure 3: Extruded meniscus

Figure 4: Transtibial double tunnel with pull out suture

Classification:

Historically the PRMM was first described by NA Antao (9), however the term Root tear was not clearly used to describe these injuries:

1a. Complete avulsion of PHMMwith fresh bleeders

1b. Avulsed bulky horn of PHMM with synovitis

1c. Avulsed but lack of inflammation with less bulbous ends

1d. Avulsed end show more of fibrillation and fragmentation

2a. Partial avulsed PHMM with swollen ends

2b. Partial avulsed with less inflammation of ends

2c. Partial avulsed with cleavage tear

Another Classification that is followed is by LaPrade CM et al (10) for posterior horn medial meniscus root tears:(Figure2)

1. Partial root tear0-9mm from root (7%).

2. Complete radial tear (68%)- a.0-3mm, b.3-6mm and c.6-9mm from root

3. Bucket handle with root tear (6%)

4. Complex oblique or longitudinal tear extending into root (10%)

5. Bony avulsion of root

Forkel et al (11) classified the posterior root tears of the lateral meniscus as follows:

1.avulsion of the root with intact meniscofemoral ligament

2. radial tear with intact meniscofemoral ligament

3. complete tear of the root with tear of the meniscofemoral ligament

Laprade et al classified LM root tears as-

1.intact PH root

2. foot print tear

3.root avulsion

4. PH radial tear of root within 3mmm or 6mm.

Imaging: (12,13)

MRI is the choice of investigation to diagnose these injuries which is 77%

sensitive and 73% specific. T2 weighted sequence in coronal, saggital and axial help to diagnose these injuries (Figure 3). Look for tear within 1cm of the tibial attachment, a radial tear (axial plane), truncation sign (coronal plane) and ghost sign (sagittal plane). Also look for extrusion of medial meniscus more than 3mm to the medial margin of proximal tibia along with subchondral bone edema. Comparison of MMPRT versus LMPRT (14)

Treatment (3)

Historically it was debridement, partial menisectomy, but currently transtibial pull through sutures over a button, all inside sutures or meniscus anchors are more commonly used. Anchor fixation is preferred if MCL grade 3 injury is there. Fiber tape gives better outcome than fiber wire(2-0).Type of stich that is preferred is modified Mason Allen stich or 2 luggage stich than a simple stich. The stich should be placed in the body of the meniscus rather than the root ligament or the transition zone of the root.Also a double transtibial tunnel technique gives better outcome than single transtibial tunnel technique. If the root tear is chronic and adhesions are there, it is preferable to release the soft tissue both on the superior and inferior surface to bring the root to near anatomical positon. However we should be mindful of the poor blood supply of the medial meniscus compared to the lateral meniscus.

Non-operative treatment

It is considered in elderly patient with grade 3-4 Outerbridge or a poor candidate for surgery. Unloader brace with analgesics and physiotherapy is advised.

	MMPRT	LMPRT
Age	More	Less
Etiology	degenerative	Trauma
Extrusion	Often	Less
Menisco synovial recess	Less	More
Menisco-capsular attachment	Tight	Loose
ACL injury	Less	More
Chondral defects	More	Less

Menisectomy

It is an option for cases with advanced OA or failed conservative treatment with mechanical symptoms. Partial or or subtotal menisectomy is the treatment of choice.

Indications for root repair

1. Chronic symptomatic root tear
2. Medial meniscus extrusion >3mm
3. Bone marrow edema
4. Varus malalignment of knee upto 3 degrees
5. Outerbridge 2 or Kellegreen-Lawrence < 3

Contrindication for surgery is if varus is more than 3 degrees ,and poor prognosis is there if varus is more than 5 degrees.

Posterior horn root tear

Two methods are used popularly, the suture anchor method and the trans tibial pull out method.

Suture anchor method is technically challenging and the fixation point is not yet standardized. Trans tibial tunnel technique can be a single or a double tunnel one with pullout suture tied over a button or fixed with a bio-screw or over a bony bridge. However, the double tunnel method is more viable biomechanically (Figure 4).

The sutures that are used are either simple sutures or Mason Allen suture to secure the meniscus. But the best results are seen in Mason Allen suture fixation.

Complication: (15)

1.Retear
2. Neuro-vascular injury
3. Attrition rupture of sutures
4. Chondral damage
5. Progression of OA

Rehabilitation:(3)

0-6 weeks- NWB with ROM 0-900
6 weeks – 4 months –increase ROM, Full weight bearing, avoid deep squats
5-6 months- RTS based on the associated injury status

Anterior horn meniscus root tear (16)

It is mostly iatrogenic in nature. The lateral meniscus during ACLR and the medial one during IM nailing of tibia. Early degenerative changes occur within the synovial fluid, menisci, and tibial sub chondral bone after meniscus root tear while the articular cartilage remains unaffected @8 weeks in a cadaver study. Integrity of the meniscus decreases including the glycosaminoglycan's and the material properties. Hence it will be worth while to consider treating these injuries. A separate fixation tunnel for the lateral meniscus and a fixation point for medial has to be planned. However, when the intercondylar area is distorted due to bone loss or avulsion same tunnel for ACL and anterior horn of lateral meniscus can be used (17).

Special situations

There is a grey area in the area of treatment if malalignment of knee and root tear coexist. Some authors feel that HTO and root repair can improve outcome and healing of the root tear. In addition the rate of progression of OA is reduced and also the medial meniscus extrusion.The healing of meniscus can be classified on second look arthroscopy as ,Complete healing, partial healing and failed healing.(18).A tension free repair yields better results along with a medialisation of the tunnel upto 3mm. However some authors feel that there is no clear clinical benefit of doing HTO and root repair together.(19)

Conclusion

It is now being clearly understood based on the scientific literature and evidence that meniscal root tears are common and that their repair in an anatomic position is required to restore joint loading and function. However, meniscus root repair in properly indicated patients is

recommended to prevent or defer the progression of OA.

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