International Journal of
Science Inventions Today
www.ijsit.com
ISSN 2319-5436
Review Article

SHORTLY OVER-VIEW ON MENISCUS, ITS TEAR, REPAIR AND TREATMENT: A REVIEW

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ABSTRACT

It's quite difficult to diagnose the meniscus tear by clinical examination even by the experience orthopaedic surgeon, so this review has shortly focused on clinical examination and its treatment. How to overcome missed diagnosis of meniscus tear in clinical set up? Recent review article has highlighted the importance of early diagnosis and treatment; fortunately, these processes have been vastly improved by advances in Magnetic resonance imaging (MRI) and Arthroscopy. These articles present a review of the clinically relevant anatomic, function, repair and healing mechanism, description of the meniscus attachment as well as current strategies for accurate diagnosis and treatment of common injuries to these meniscus attachments.

Keywords: Meniscus, healing and repair, medial meniscus, lateral meniscus, diagnostic and clinical test.

INTRODUCTION

Meniscal function is essential to the normal function of the knee joint. For the menisci to function properly, the biomechanical integrity of each meniscus root on the tibial plateau must be maintained [1, 2]. Various functions have been attributed to the menisci, some of which are known or proved and others that are theorized. The menisci act as joint filler, compensating for gross incongruity between femoral and tibial articulating surface. So located, the menisci prevent capsular and synovial impingement during flexion-extension movements. The menisci are believed to have a joint lubrication function, helping to distribute synovial fluid throughout the joint and aiding the nutrition of the articular cartilage [3-6]. They undoubtedly contribute to stability in all planes but are especially important rotary stabilizers and are probably essential for the smooth transition from a pure hinge to a gliding or rotary motion as the knee moves from flexion to extension. The menisci are crescents, roughly triangular in cross-section, that cover one half to two thirds of the articular surface of the corresponding tibial plateau [7-9]. They are composed of dense, tightly woven collagen fibres arranged in a pattern providing great elasticity and ability to withstand compression. The major orientation of collagen fibres in the meniscus is circumferential; radial fibres and perforating fibres determines to some extent the characteristic pattern of meniscal tears. When meniscal samples are tested by application of a force perpendicular to the fibre direction, the strength is decreased to less than 10% because collagen fibres function primarily to resist tensile force along the direction of the fibres. The circumferential fibres act in much the same way as metal hoops placed around a pressurized wooden barrel [3, 4, 6] as shown in Figure 1 and 2.

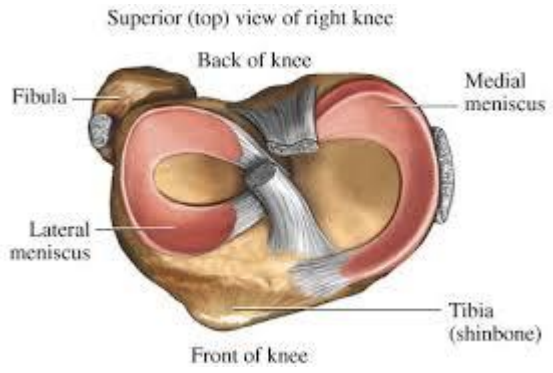

Figure 1: Normal meniscus of knee. **Figure 2:** Showing difference between normal and torn meniscus

The peripheral edges of menisci are convex[3, 10], fixed and attached to the inner surface of the knee joint capsule, except where the popliteus is interposed laterally; these peripheral edges also are attached loosely to the borders of the tibial plateaus by the coronary ligaments. The inner edges are concave, thin and unattached. The menisci are largely a vascular except near their peripheral attachment to the coronary ligament. The inferior surface of each meniscus is flat, contour of the underlying tibial plateau and

superimposed femoral condoyle. *The medial meniscus* is a C-shaped structure larger in radius than the lateral meniscus, with the posterior horn being wider than the anterior. The anterior horn is attached firmly to the tibia anterior to the intercondylar eminence and to the anterior cruciate ligament. Berlet and Flowler also described the anterior horn as associating with the ACL in 59% of knees. Other researchers have reported the anterior horn as connecting to the anterior intermeniscal ligament, also known as transverse ligament, in approximately 70% of knees[8, 11-13].Most of the weight is borne on the posterior portion of the meniscus. The posterior horn is anchored immediately in front of the attachments of the eminence. Its entire peripheral border is firmly attached to the medial capsule and through the coronary ligament to the upper border as the tibia. *The Lateral meniscus* is smaller in diameter, thicker in periphery, wider in body, and more than the medial meniscus. It is attached to both cruciate ligaments and posteriorly to the medial femoral condoyle by either the ligament of Humphry or the ligament of Wrisberg, depending on which is present; it is also attached posteriorly to the popliteus muscles. It is separated from the lateral collateral ligament by the popliteal tendon. In contrast, the medial meniscus is much larger in diameter, is thinner in its periphery and narrower in body, and does not attached to either cruciate ligament. It is loosely attached to the medial capsular ligaments. Zantop reported that anteromedial bundle of the ACL was an average of 5.2 mm medial and 2.7mm posterior to the lateral anterior root, while the poster lateral bundle was an average 11.2mm posterior and 4.1mm medial to the anterior root[14]. Ziergler reported that centre of ACL was on average 7.5mm medial to the anterior root of the lateral meniscus centre, 8.5mm anteromedial to the poster medial aspect of the anterior horn of the lateral meniscus and 10.2 poster medial to the anteromedial aspect of the anterior horn[15].The vascular supply to the medial and lateral menisci originates predominantly from the lateral and medial geniculate vessels(both inferior and superior). Branches from these vessels give rise to a perimeniscal capillary plexus within the synovial and capsular tissue.

Meniscal healing and Repair:

The vascular supply to the meniscus determines its potential for repair. The peripheral meniscal blood supply is capable of producing a reparative response similar to that observed in other connective tissues because of a perimeniscal capillary plexus that supplies the peripheral 10% to 25% of the menisci. Meniscal tears have been classified on the basis of their location in three zones of vascularity [Figure 3]:

1. Red (fully within the vascular area).
2. Red-white (at the border of the vascular area)
3. White (within a vascular area)

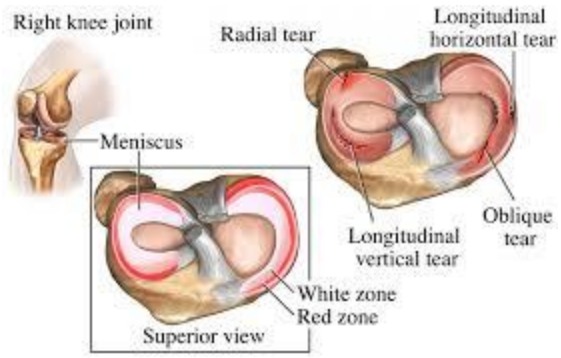

Figure 3: Showing Red, Red-White, White zone of vascularity.

This classification indicates the potential for healing after repair and section on surgical repair of torn menisci. After injury within the peripheral vascular zone, a fibrin clot that is rich in inflammatory cells forms. The healing process depend on debriment or abrasion of wall of the tear, especially in chronic lesion[16]. Vessels from the peri-meniscal capillary plexus proliferate throughout this fibrin scaffold and are accompanied by the proliferations of differentiated mesenchymal cells. The lesion is eventually filled with cellular fibro vascular scar tissue that glues the wound edges together and appears continuous with the adjacent normal meniscal fibro cartilage. Vessels from the peri-meniscal capillary plexus as well as the proliferative vascular pannus from the synovial fringe penetrate the fibrous scar to provide a marked inflammatory response. Although several months are required for maturation to fibro cartilage that appears normal.

Tears of Menisci:

A meniscus usually is torn by a rotational force incurred while the joint is partially flexed. During vigorous internal rotation of the femur on the tibia with the knee flexion, the femur tends to force the medial meniscus posteriorly and toward the centre of the joint. A strong peripheral attachment posteriorly may prevent the meniscus from being injured [Figure 5], but if this attachment stretches or tear, the posterior part of the meniscus is forced toward the centre of the joint, is caught between the femur and the tibia, and is torn longitudinally when the joint is suddenly extended. If this longitudinal tear extends anteriorly beyond the medial collateral ligament, the inner segment of the meniscus is caught in the intercondylar notch and cannot to its former position: thus, a classic bucket-handle tear with locking of the joint is produced [Figure 4].

Figure 4: Bucket handle tear.

Figure 5: Posterior meniscus tear.

The same mechanism can produce a posterior peripheral or a longitudinal tear of the lateral meniscus; the lateral femoral condoyle forces the anterior half of the meniscus anteriorly and toward the centre of the joint, and this strain in turn may tear the posterior half of the meniscus from its peripheral attachment. When the joint is extended, a longitudinal tear result. Because it not as susceptible to bucket-handle tears; however, because it is more sharply curved and is neither attached to nor controlled by the lateral collateral ligament, the lateral meniscus sustains incomplete transverse tears more often than does the medial meniscus.

Classification:

Numerous classifications of tears of the menisci have been proposed on the basis of location or type of tear, etiology and other factors; most of the commonly used classification are based on the type ot tear found at surgery:

1. Longitudinal tears.
2. Transverse and oblique tears.
3. Combination of longitudinal and transverse tears.
4. Tears associated with cystic menisci.
5. Tears associated with discoid menisci.

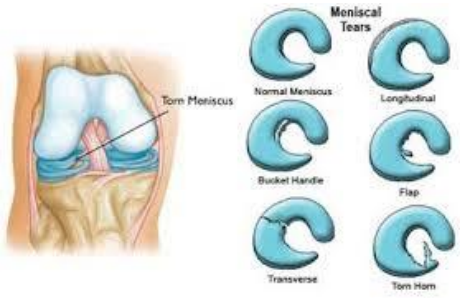

Figure 6: Various types of meniscus tears.

The most common type of tear is *longitudinal tear*, usually involving the posterior segment of either the medial or the lateral meniscus, before the extensive use of arthroscopy for diagnosis and treatment of

meniscal injuries, tears of the medial meniscus in most series were approximately five to seven times more common than those of the lateral meniscus. However, as use of the arthroscopy has increased, allowing more thorough inspection of both menisci, more lateral meniscal tears have been diagnosed. Small tears limited to the posterior horn are not capable of producing locking but will cause pain, recurrent swelling and a feeling of instability in the joint. Extensive longitudinal tear can cause mechanical locking if the central portion of the meniscus is displaced into the intercondylar notch. A pedunculated fragment may result if either the posterior or anterior attachment of the bucket-handle fragment becomes detached. *Transverse, radial or oblique tears* can occur in either meniscus but more commonly involve the lateral meniscus. Because the lateral meniscus is more of a circle and has a shorter radius, the inner free edge is more easily torn transversely than its medial counterpart. Transverse tears also can result from degenerative change within the meniscus itself or from injury or conditions such as cystic changes at the periphery that render the meniscus less mobile. *Cysts of menisci* are frequently associated with tears and are nine times more common on the lateral than on the medial side. The most common cause is trauma that produces degeneration and secondary mucinous and cystic changes follow, the meniscus may become less mobile during flexion, extension and rotary motions and thus more susceptible to additional longitudinal or transverse tearing. *Discoid menisci* are abnormal and because of hyper mobility and the bulk of the tissue between the articular surfaces, they are vulnerable to compression and rotary stresses, Degeneration within the discoid meniscus, as well as tear, may develop. The diagnosis often is not producing significant symptoms unit some derangement of the meniscus occurs.

Diagnosis:

The diagnosis of a meniscal tear can be difficult even for an experienced orthopaedic surgeon. Use of a careful history and physical examination and supplementation of standard radiographs in specific instances with special imaging techniques and arthroscopy can keep errors in diagnosis of tears of the menisci to less than 5%. When a meniscus has been injured, capsular and ligamentous structures as well as the articular surfaces also often have been injured. The syndrome caused by tears of the menisci can be divided into two group; those in which there is locking is absent and the diagnosis is more difficult. If a patient does not have locking, the diagnosis of a torn meniscus is more difficult even for the most astute surgeon. A patient typically gives a history of several episodes of trouble referable to the knee, often resulting in effusion and a brief period of disability but no definite locking. A sensation of *"giving way"* or snaps, clicks, catches or jerks in the knee may be described or the history may be even more indefinite, with recurrent episodes of pain and mild effusion in the knee and tender see in the anterior joint space after excessive activity. When they are well understood, the following clues can be important in the differential diagnosis in this second group: a sensation of giving way, effusion, atrophy of the quadriceps, tenderness over the joint line (or the meniscus during the physical examination).

A Sensation of giving way is in itself of little help in diagnosis because it can occur in other

disturbances of the knee, especially loose bodies, chondromalacia of the patella and instability of the joint resulting from injury to the ligaments or from weakness of the supporting musculature, especially the quadriceps. When this symptom results from a tear in the posterior part of a meniscus, the patient usually notices this on rotary movements of the knee and often associates it with a feeling of subluxation or *"the joint jumping out of place".* When giving way is a result of other cause, such as quadriceps weakness, it usually is noticeable during simple flexion of the knee against resistance, such as in walking down stairs.

Diagnostic clinical Tests:

The McMurray test: With the patient supine and the knee acutely and forcibly flexed, the examiner can check the medial meniscus by palpating the poster medial margin of the joint with one hand while grasping the foot with the other hand. Keeping the knee completely flexed, the leg is externally rotated as far as possible and then the knee is slowly extended. As the femur passes over a tear in the meniscus, a *click* may be heard *or felt*. The lateral meniscus is checked by palpating the poster lateral margin of the joint, internally rotating the leg as far as possible and slowly extending the knee while listening and feeling for a *click. A click* produced by the McMurray test usually is caused by a posterior peripheral tear of the meniscus and occurs between complete flexion of the knee and 90 degrees. Popping, which occurs with greater degrees of extension when it is definitely localized to the joint line, suggests a tear of the middle and anterior portions of the meniscus. The position of the knee when the *clicks* occur thus may help locate the lesion. A McMurray *click* localized to the joint line is additional evidence that the meniscus is torn; a negative result of the McMurray test does not rule out a tear [figure 7]. McMurray testing was positive in only 57.1% of patient and effusion was noted in only 14.3% [17].

Figure 7: The McMurray test

The Grinding test: With the patient prone, the knee is flexed to 90 degrees and the anterior thigh is fixed against the examining table. The foot and leg are pulled upward to distract the joint and rotated to place rotational strain on the ligaments; When ligaments have been torn, this part of the test usually is painful. Next, with the knee in the same position, the foot and legs are pressed downward and rotated as the joint is slowly flexed and extended, when a meniscus has been torn, popping and pain localized to the joint line may

be noted. Although the McMurray, Apleys and other tests cannot be considered diagnostic, they are useful enough to be included in the routine examination of the knee [Figure 8].

Figure 8: The Grinding test

The Squat test: Several repetitions of a full squat with the feet and legs alternately fully internally and externally rotated as the squat is performed. Pain usually is produced on either the medial or lateral side of the knee, corresponding to the side of the torn meniscus. Pain in the internally rotated position suggest injury to the lateral meniscus, whereas pain in the external rotation suggests injury to the medial joint line or the lateral joint line, however, is a much more dependable localizing sign than the position of rotation.

Figure 9: The Squat test.

The Thessaly test: The examiner supports the patient by holding his or her outstretched hands while the patient stands flatfooted on the floor. The patient then rotates his or her knee and body, internally and externally, three times with the knee in slight flexion (5 degrees). The same procedure is carried out with the knee flexed 20 degrees. Patients with suspected meniscal tears experience medial or lateral joint-line discomfort and may have a sense of looking or catching. The test is always done on the normal knee first to teach the patient how to keep the knee in 5 and 20 degrees of flexion and how to recognize a possible positive result in the symptomatic knee. The Thessaly test at 20 degrees of knee flexion was suggested to be effective as a first-line clinical screening test for meniscal tears.

Figure 10: The Thessaly test

Imaging:

With the improvements in CT [18] and MRI scanning [19], have been shown to improve diagnostic accuracy in many knee disorder. MRI scanning is first choice for diagnosis of meniscus tear rarely use of arthrograph

Figure 11: M.R.I of meniscus tear.

A root tear could be demonstrated on pre-operative M.R.I in only 72.9% of the patient, while the rest demonstrated degeneration and/or fluid accumulation at the posterior horn without a visible meniscal tear[20]. Other, have reported significally improved detection ability- up to 93.3% sensitivity, 100% specificity and 100% positive predictive value using a variety of magnetic resonance sequences and interpretation signs suggestive of root tears[21-23].

Management of meniscus tear:

Non-Operative management: Consists of a groin-to-ankle cylinder cast or knee immobilizer worn for 4 to 6 weeks. Crutch walking with touch-down weight bearing is permitted when the patient gains active control of the extremity in the cast. The patient is instructed in a progressive isometric exercise program during the time the legs is in the cast to strengthen the quadriceps, the hamstrings and the gastrocnemius and soleus muscles around the knee as well as the flexors, abductors, adductors and extensors around the hip. At 4 to 6 weeks, the immobilization is discontinued and the rehabilitative exercise program for the muscles around the

hip and knee is intensified. The patient must be informed that any tear in the meniscus may not have healed despite this period of immobilization. If symptoms recur after a period of non-operative treatment, surgical repair or removal of the damaged meniscus may be necessary and more specific diagnostic procedures, such as MRI and arthroscopy, are used as indicated.

Figure 12: Conservative treatment on meniscus tear using brace.

Operative management by Arthroscopy (menisectomy): This is a technique where a thin endoscope, about 4-5 mm in diameter- the arthroscopy, is introduced into the joint through a small stab wound, and inside of joint examined, repaired.

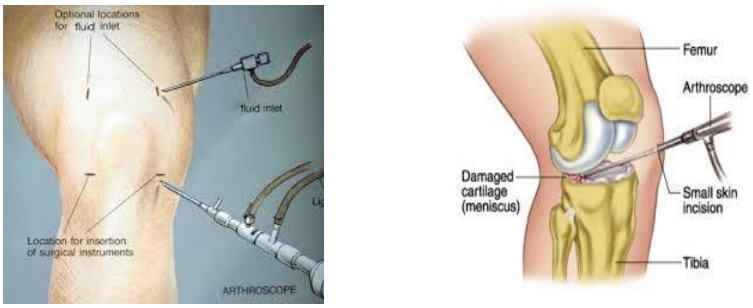

Figure 13: Technique for arthroscopy.

Treatment of acute meniscal tear: - If the knee is locked, it is manipulated under general anaesthesia. No special manoeuvre is needed. As the knee relaxes, the torn meniscus falls into place and knee is unlocked. The knee is immobilised in a Robert-Jones compression bandage for 2-3 weeks, followed by physiotherapy. In a case where locking is not present, Immobilisation with the Robert-Jones bandage is sufficient. With this, a small number of peripheral tear will heal. Rest of the tears may produce recurrent symptoms.

Treatment of a chronic meniscal tear: Once the diagnosis is established clinically, the treatment is it excise the displaced fragment of the meniscus by opening-up the joint (arthrotomy). Now a day, it is possible to excise a torn meniscus arthroscopically (arthroscopic surgery). By this technique, once the fault is detected e.g. a loose meniscal flap, the same is excised using fine cutting instruments introduced from another puncture wounds. This technique is a significant advance as it can be done as a day care procedure,

sometimes even under local anaesthesia. Since it is a minimally invasive technique, early return to work is possible. Recent research has shown that menisci are not "useless" structure as was through earlier. Hence, wherever possible the trend is to preserve the meniscus by suturing (Meniscorraphy).

Admittedly, success rates are high [24] and complication rates low (0.27% to 2.8%) But Salzler[25] reported a complication rate of 2.8% and did not consider knee arthroscopy to be benign procedure. In contrast, since 2002 and more particularly 2013, several controlled randomized studied compared arthroscopic menisectomy versus non-operative management (mainly by physiotherapy) [26-30] or "sham" surgery [31, 32]. The older studies, by Moseley and Kirkley concerned osteoarthritis knee and others knee free of macroscopic oestparthritis. The meta-analysis by Thorlund and Kise's recent study confirmed these finding [33, 34]. However, it should be noted that cross-over for failure of non-operative treatment in the randomized studies, however well-conducted, involved biases and limitation to which the reader must be alert [35, 36].

DISSUSION AND CONCLUSION

This review mainly aims on basic concept of meniscus tear and how to approach clinically and reach to proper diagnosis of meniscal tear**,** even experience orthopaedic surgeon missed during clinical examination which further lead to chronic tears of meniscus**.** This review had shortly reviewed all concept and management and treatment on meniscus tear. However, minimal invasive surgical procedure (Arthroscopy) is an advance treatment for chronic meniscus tear. It is quit very difficult to diagnosed meniscus tear clinically without having any investigation, if the diagnosis is done by having minimum investigation and earlier than conservative treatment will have better result. Which is quit economic to the patient, they don't have to admit to hospital no further mental tension about their health.

Conflict of Interest: NONE

Acknowledgement: *Prof. Lui ke bin(18972161001), liukb@sina.com,(H.O.D)Department of Orthopedics, the First Affiliated Peoples Hospital of Yangtze University Jingzhou, Hubei, PR. China.*

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