Inside-Out Meniscal Repair: A Modified Vertical Suture Technique

Abstract

Introduction: Meniscal tears are one of the most common knee injuries, and effective repair techniques are crucial for maintaining long-term knee function and preventing degenerative changes. Among various repair methods, the vertical mattress sutures are frequently utilized. we present a technique that we believe provides the strongest fixation for longitudinal meniscal tears.

Materials & Methods: Over a period of 4 years, modified vertical mattress suture technique was performed on 34 cases of longitudinal and bucket handle meniscal tears. All the tears were aassociated with ACL tears and ACL reconstructions were performed in all of them. final results were evaluated by Lysholm score, clinical examination and need for menisectomy.

Results & Discussion: Meniscectomy following initial meniscal repair was performed for 3 patients (10.7%) due to persistent knee pain and locking. The other 23 patients had full range of knee motion with no complaint of pain, tenderness, swelling and locking in their final follow up visit. McMurray test was negative in these patients. The outcome of the Lysholm score was excellent and good in 21 (75%) patients and fair in 7 (25%).

Conclusion: The modified vertical suture technique is a reliable, rapid and cheap technique for longitudinal meniscal tears repair.

Keywords: Meniscus, Tibial Meniscus Injuries, Suture Technics.

Accepted: 47 days before printing

Fardin Mirzatolooei, MD[1], Amin Moradi, MD[2], Hamed Sheikhzadeh, MD[2]

1. Department of Orthopedic Surgery, University of Medical Sciences, Urmia, Iran.
2. Department of Orthopedic Surgery, University of Medical Sciences, Tabriz, Iran.

Corresponding Author:
Fardin Mirzatolooei, MD
Email address:
fardin_tolouei@yahoo.com

Introduction

Menisci play the role of load transfer and stability in the knee, and also play a role in joint lubrication. This ability of menisci to transmit and distribute force depends on their unique shape and texture[1,2]. Due to the role and function of the menisci, they are always exposed to mechanical damage[3,4]. There are two basic treatments for torn meniscus, menisectomy and meniscal repair. Meniscal repair has become a preferred treatment approach, as it preserves the tissue and restores normal knee function (Lynch et al., 2019). Although the short-term clinical results of Partial meniscectomy and meniscus repair are the same, in the long term, there are better clinical results for meniscus repair[5-8]. Unfortunately, meniscus repair overally has a 10-15% chance of success[9]. The geometry and location and time of the tear are the determining factors in the success rate of meniscus tear repair.

In order to achieve better clinical results, meniscus repair must follow specific technical principles. The most important principle in this regard is that the fixation must be solid[10]. In addition, the sutures used must be non-absorbable or with delayed absorption[11]. In the past, other materials and devices such as arrows and anchors made of UMH were used, which were abandoned due to their fragility and complications[12,13]. Currently, the all-inside technique along with ablation and debridement of the meniscus tear site is the gold standard for meniscus repair in posterior horn longitudinal tears of the meniscus. It is widely done with the Fast Fix device, but it has own complications. The most important complications are anchorage slippage on the capsule, when tightening or pulling the thread, as well as interference in inserting the anchor into the meniscus[14]. Also, the delayed loosening of the anchor has been reported by Ryan[15].

In addition, due to the non-uniformity of the length of the anchor discharge path Fast Fix has a technical weakness in creating a vertical mattress suture [16,17]. Fastfix is relatively expensive and sometimes several sutures are needed to repair a bucket handle tear.
Various suture techniques are employed in meniscal repair, including vertical mattress and horizontal sutures, each with unique biomechanical properties and clinical outcomes.
Vertical mattress is characterized by two passes through the tissue: one pass through the anterior aspect of the tear and another deeper pass through the posterior aspect.
We present here a technique for creating a vertical mattress suture that we believe provides the most reliable and solid fixation due to the creation of vertical fixations at both the superior and inferior levels of the meniscus.

Materials & Methods

In this technique, the patient's leg is positioned hanging from the side of the bed. A posteromedial incision is made along the medial aspect of the knee, and the sartorius fascia is released while preserving the saphenous nerve. Dissection is then performed with the finger between the medial head of the gastrocnemius muscle and the joint capsule. Subsequently, an anterolateral portal is created for the arthroscope, and an anteromedial portal is established for the insertion of instruments.
A two-zero fiber wire is loaded into a scorpion device, which is then introduced into the knee. At a distance of 3 to 4 mm from the tear, a suture is inserted into the meniscus from the inferior surface, and the scorpion is withdrawn (Figure 1).
Through the same anteromedial portal, a meniscus repair needle, along with its corresponding guide, is inserted into the knee (Figure 2). The needle is positioned on the capsule on the superior side of the tear, and is subsequently removed through the posteromedial incision (Figure 3). The guide is then removed, and the thread on the superior side of the tear is passed through the needle's end hole, allowing the repair to be completed by pulling the needle (Figure 4). Through the posteromedial incision, the fiber wire is retrieved. The needle, along with the guide, is reintroduced into the knee through the same anteromedial portal. This time, it is positioned on the inferior side of the tear on the capsule. The needle is again removed through the posteromedial incision, and after removing the guide, the thread is passed through the needle's hole. Once both threads are retrieved, the knot is tightened on the capsule (Figure 5). This procedure is repeated for several sutures, spaced approximately 5 to 6 mm apart, resulting in a complete and reliable meniscal repair.

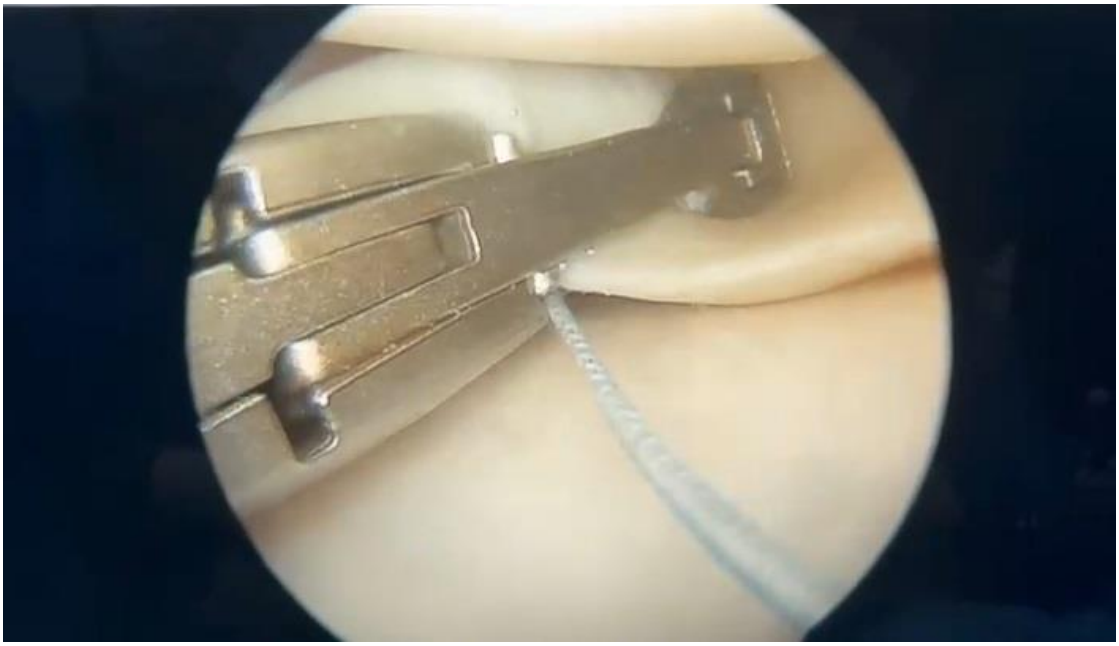

Figure 1: Fiberwire loaded scorpion is inserted in to the meniscus

Figure 2: Meniscus repair needle with its guide is inserted into the knee through the same portal where the scorpion entered.

Figure 3: Needle guide is placed on the upper surface of tear.

Figure 4: The upper end of suture thread is loaded to needle and needle is pulled out of the posteromedial incision.

Figure 5: Both ends of suture thread tie together on the capsule while a hook is stabilizing the meniscus

Results

Over a period of 4 years, we performed this technique on 34 cases of longitudinal and bucket handle meniscal tears. All the tears were associated with ACL tears and ACL reconstructions were performed in all of them. Six patients missed the final follow up. Meniscectomy following initial meniscal repair was performed for 3 patients (10.7%) due to persistent knee pain and locking. The other 23 patients had full range of knee motion with no complains of pain, tenderness, swelling and locking in their final follow up visit. McMurray test was negative in these patients. The outcome of the Lysholm score was excellent and good in 21 (75%) patients and fair in 7 (25%). No neurovascular injury, synovitis and other knot-related complications were documented. The procedure displayed 89.3% clinical success rate.

Discussion

Different techniques are mentioned for suturing the torn meniscus in the inside-out method. The choice between them largely depends on the tear type, the vascularity of the tear site, and the surgeon's experience. The vertical mattress suture provides excellent compression and is particularly effective for longitudinal tears, offering good fixation and promoting tissue healing. Vertical sutures are usually applied in such a way that one end of the thread passes through the meniscus and the other end passes through the capsule to stabilize the tear. As the strength and durability of the meniscus and the capsule are different, applying force to the knot may causes the meniscus to rotate up or down (Figure 6). In the technique presented by us, both ends of the thread pass through the meniscus and then through the capsule. concomitant tension on both ends while fixation causes the meniscus to be compressed uniformly at the site of the tear (Figure 7).

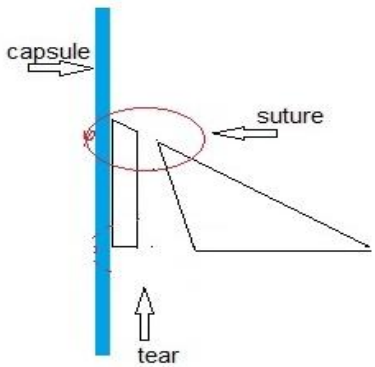

Figure 6: Suture at upper surface rotates tear configuration

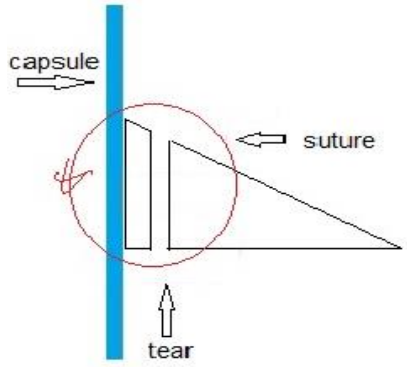

Figure 7: One tie suture give a global tension to tear pattern

In fact, the force is equally distributed in the upper and lower surfaces. More over in the usual techniques, the sutures of the upper surface are not exactly parallel to the lower sutures, and as a result, these sutures apply force at different points. In our technique, the upper and lower sutures apply force at the same point, and the force is applied more effectively.

We should be mention it here that as this is a vertical mattress sutures, and due to its compressive nature, it may lead to a higher risk of meniscal over compression and extrusion in some cases and over tension should be avoided[18].

Conclusion

Ultimately, the choice of suture technique should be tailored to the individual patient, taking into account the tear pattern, location, and the surgeon's expertise. Further studies comparing long-term outcomes of these techniques, particularly in terms of functional recovery and osteoarthritis prevention, are needed to refine the indications for this technique.

References

1 Allen CR, Wong EK, Livesay GA, Sakane M, Fu FH, Woo SLY. Importance of the medial meniscus in the anterior cruciate ligament-deficient knee. J Orthop Res. 2000; 18:109–115. https://doi.org/10.1002/jor.1100180116
2 Allen P, Denham R, Swan A. Late degenerative changes after meniscectomy. Factors affecting the knee after operation. J Bone Joint Surg Brit.1984; 66:666–671 https://doi.org/10.1302/0301-620X.66B5.6548755
3 Ochi M, Uchio Y, Okuda K, Shu N, Yamaguchi H, Sakai Y.Expression of cytokines after meniscal rasping to promote meniscal healing. Arthroscopy, 2001; 17: 724-731. https://doi.org/10.1053/jars.2001.23583
4 Pujol N, Seil R. Meniscus repair: updated techniques.C. Hulet, H. Pereira, G. Peretti, M. Dentied (Eds.), Surgery of the Meniscus, Springer Verlag, Berlin Heidelberg (2016):211-223. https://doi.org/10.1007/978-3-662-49188-1_22
5 Harper KW, Helms CA, Lambert HS, III, Higgins LD. Radial meniscal tears: significance, incidence, and MR appearance. Am J Roentgenol. 2005;185(6):1429–1434. https://doi.org/10.2214/AJR.04.1024
6 Kidron A, Thein R. Radial tears associated with cleavage tears of the medial meniscus in athletes. Arthroscopy. 2002;18(3):254–256. https://doi.org/10.1053/jars.2002.30650
7 Hurmuz M, Ionac M, Hogea B, Catalin, Miu C, Tatu F. Osteoarthritis Development Following Meniscectomy vs. Meniscal Repair for Posterior Medial Meniscus Injuries: A Systematic Review. Medicina (Kaunas). 2024; 60(4):569.https://doi.org/10.3390/medicina60040569
8 Kim Y-M, Rhee K-J, Lee J-K, Hwang D-S, Yang J-Y, Kim S-J. Arthroscopic pullout repair of a complete radial tear of the tibial attachment site of the medial meniscus posterior horn. Arthroscopy. 2006; 22(7): 795.e1-795.e4. https://doi.org/10.1016/j.arthro.2005.12.040
9 Matsubara H, Okazaki K, Izawa T, Tashiro Y, Matsuda S, Nishimura T, et al. New suture method for radial tears of the meniscus: biomechanical analysis of cross-suture and double horizontal suture techniques using cyclic load testing. Am J Sports Med. 2012; 40(2):414–418. https://doi.org/10.1177/0363546511424395
10 Keyhani S, Abbasian M, Siatiri N, ;Sarvi A, Mardani Kivi M, Esmailiejah A.A. Arthroscopic Meniscal Repair: "Modified Outside-In Technique" .Arch Bone Jt Surg. 2015;3(2):104–108. PMID: 26110176
11 Beaufils B, Pujol N. Meniscal repair: Technique. Orthop Traumatol Surg Res. 2018;104(1):137-145. https://doi.org/10.1016/j.otsr.2017.04.016
12 Choi N.H, Son K.M, Victoroff B. Arthroscopic all-inside repair for a tear of posterior root of the medial meniscus: a technical note. Knee Surg Sports Traumatol Arthrosc. 2008;16(9):891-983. https://doi.org/10.1007/s00167-008-0581-3
13 Rankin CC, Lintner DM, Noble PC, Paravic V, Greer E. A biomechanical analysis of meniscal repair techniques. Am J Sports Med. 2002;30(4):492-497. https://doi.org/10.1177/03635465020300040801
14 Tingart M, Höher J, Bouillon B, Tiling T. Meniscus refixation: suture or anchor?. Unfallchirurg. 2001;104(6):507-512. https://doi.org/10.1007/s001130170113
15 Walgrave S, Claes S, Bellemans J. High incidence of intraoperative anchorage failure in FasT-fix all inside meniscal suturing device. Acta Orthop Belg. 2013;79(6):689-693. PMID: 24563975
16 Rauck RC, Jain S, Flanigan DC. Complications Associated with FAST-FIX All-Inside Meniscal Repair: A Report of Two Cases. JBJS Case Connect. 2015;5(3):e62. DOI: 10.2106/JBJS.CC.O.00040
17 Miller M.D, Kline A.J, Gonzales J, Beach W.R. Pitfalls associated with FasT-Fix meniscal repair. Arthroscopy. 2002;18(8):939-943. https://doi.org/10.1053/jars.2002.36146
18 Petersen, W., & Tillmann, B. Meniscal tears and their repair: Techniques and outcomes. Journal of Knee Surgery. 2007; 20(1):20-28.