Isolated meniscal ramp lesion without obvious ACL rupture

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Research article

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Abstract

Background To study isolated meniscal ramp lesion without obvious ACL rupture, analysis its clinical characteristics and evaluate clinical effect of all-inside horizontal mattress suture.

Methods From 2015-2017, there are 20 isolated meniscal ramp lesion patients without obvious ACL rupture in our hospital. These isolated ramp lesions were arthroscopically repaired through all-inside horizontal mattress suturing method with 12 0 Mitek Omnispan meniscal repairing system. MRI was performed preoperatively and postoperatively 3 months later during follow-up. The Tegner-lysholm score and VAS score were recorded preoperatively and postoperatively at 2 years follow-up. T-test was performed to detect statistical significance.

Results MRI postoperatively 3 months later shows healing of the isolated ramp lesion. Postoperatively at 2 years follow-up, VAS score was significantly decreased and Tegner-lysholm score was significantly raised comparing preoperatively. All patients recover their knee function without pain, including walking, stairs climbing and descending, squatting et al.

Conclusion Isolated meniscal ramp lesion without obvious ACL rupture may exist because of ACL longitudinal splits. Through all-inside horizontal mattress suturing method with 12 0 Mitek Omnispan meniscal repairing system, isolated ramp lesion can be repaired through routine anterolateral and anteromedial portal.

Background

Ramp lesion (or “hidden” lesions), tear of the peripheral meniscocapsular attachments of posterior horn of medial meniscus (PHMM), is usually concurrent with acute anterior cruciate ligament (ACL) rupture or following chronic ACL laxity after ACL rupture. The term “ramp lesion” was first described by Strobel in the 1980s[1], and useful for differentiating from other types of longitudinal posterior horn tears. These lesions have been reported in 15–17% of patients undergoing an ACL reconstruction [2, 3, 4].

Can Ramp lesion happened solely without obvious ACL rupture? There are no previous article reporting isolated ramp lesion without obvious ACL rupture. In our hospital, isolated ramp lesions without obvious ACL rupture were encountered. We retrospectively review clinical characteristics of these patients and arthroscopic repairing method.

Methods

From 2015-2017, there are 20 isolated meniscal ramp lesion patients without obvious ACL rupture in our hospital. Clinical data of these patients were reviewed.

Inclusion criteria: (1) Ramp lesion detected through Magnetic resonance image (MRI) (2) ACL integrity is good in MRI without obvious anterolateral laxity (3) The patient with posteromedial knee pain and flexion

limitation has medial joint line tenderness in the posterior part with positive McMurray test during extreme flexion and external rotation. Exclusion criteria: (1) severe knee osteoarthritis with obvious varus and/or flexion contracture deformity (2) knee rheumatoid arthritis (3) knee septic arthritis (4) The patient with posteromedial knee pain and flexion limitation has obvious anterolateral laxity with MRI-detected ACL complete or partial rupture.

Patients demographic data: 3 male patients, 17 female patients, mean age: 56.9 years old (27-75 years old).

Ramp lesion was arthroscopically repaired through all-inside horizontal mattress suturing method with 12⁰ Omnispan meniscal repairing system (Depuy Mitek Inc, Rayhanm MA, USA). Patients were evaluated postoperatively at 6 weeks, and at 3, 6, 12, and 24 months in outpatient clinic. The mean follow-up period is about 26 months. MRI was performed preoperatively and postoperatively 3 months later during follow-up (Figure 1). The Tegner-Lysholm score and Visual analogue scale (VAS) score were recorded preoperatively and in the last follow-up. T-test was performed to detect statistical significance between preoperative and the last follow-up.

Surgical method: The knee joint was examined through anterolateral portal with 30⁰ arthroscope by an experienced arthroscopic surgeon. The ACL integrity and tension was routinely checked through arthroscopic examination and probe tensioning. Usually some longitudinal spilt may be found without obvious ACL complete or partial rupture. In order to enlarge the posteromedial vision, the medial collateral ligament was pie-crust released with 5ml syringe needle in joint line percutaneously. Otherwise view of PHMM may be partly blocked by medial femoral condyle. With valgus and hyperextension of the knee, examination of the PHMM with meticulous probing were performed to find the ramp lesion. If the probe hook tip (4mm length) can be inserted into meniscocapsular junction (meniscofemoral ligament) from upper surface of medial meniscus, it shows the ramp lesion of PHMM (Figure 2). Because of tension of medial collateral ligament and convex contour of medial condyle, it is not easy to explore ramp lesion from routine anterolateral portal arthroscopically. Usually, we will explore and confirm ramp lesion through intercondylar notch view (between medial condyle and posterior cruciate ligament/PCL). To visualize the posteromedial compartment for inspection of meniscocapsular junction area, a 30⁰ arthroscope was advanced through the intercondylar notch space[5]. A 70⁰ arthroscope may be more helpful with wider vision. The posteromedial portal was created with 5ml syringe needle insertion into posteromedial compartment. The meniscocapsular junction of PHMM was examined with a probe to detect a ramp lesion through posteromedial portal. The meniscocapsular junction of PHMM may be easily visualized and confirmed through posteromedial view (Figure 3). We utilize 12⁰ Omnispan meniscal repairing system to perform all-inside horizontal mattress repair through anteromedial portal with anterolateral view. To facilitate the repairing procedure, the knee was placed in valgus and hyperextension position to avoid blocking of medial femoral condyle to the needle in the Omnispan applier. And medial collateral ligament pie-crusting is also helpful to perform all-inside repairing

procedure. Although it may be difficult, we perform all these ramp lesions repairing though the method successfully.

Rehabilitation procedure: Usually, we use knee brace for patients about 3 months during walking with crutches to prevent pivot shifting activity. In 6 weeks postoperatively, the knee is limited in 0° extension. After 6 weeks, the knee is limited in less than 60° flexion. On the first day postoperatively, patient begin straight leg raising exercise for improving quadriceps muscle strength and knee flexion/extension on bed. The knee flexion range is increased gradually on bed. After 2 weeks, knee flexion can be more than 90° . After 3-4 weeks, knee flexion can be more than 120° . Postoperatively 3 months later, with MRI proved healing of RAMP lesion, without knee pain and with full range of motion, squatting and jogging was permitted. With normal Single leg hop for distance (the distance hopped on the involved leg is more than 85% of the uninvolved leg) and negative Thessaly test, pivot activity at 6 months and full activity at 9 months were permitted.

Results

After 3 months, these patients manifest as no posteromedial pain in the knee. They can walk without knee brace or crutches supporting in daily life. After knee rehabilitation exercise, full range of motion can be acquired. But until 6 months postoperatively, pivot activity should be avoided to prevent retear of ramp area. With normal Single leg hop for distance and negative Thessaly test, pivot activity at 6 months and full activity at 9 months were permitted.

VAS score was decreased from preoperative $6.5 (\pm 1.5)$ points to postoperative $2.1 (\pm 1.4)$ points. The Tegner-Lysholm knee function score was raised from preoperative $35.6 (\pm 5.3)$ points to postoperative $85.7 (\pm 3.5)$ points. Both have statistical significance through Student's T test, shown in Table 1.

Table 1 VAS and Tegner-Lysholm score (n=20, $\bar{X} \pm S$)

	VAS score	Tegner-lysholm score
preoperative	6.5 ± 1.5	35.6 ± 5.3
postoperative	2.1 ± 1.4	85.7 ± 3.5
T-value	9.96	73.58
P-value	0.0000	0.0000

Preoperative MRI examination of ramp lesion of PHMM with intact ACL integrity manifest as high signal fluid between posterior horn of medial meniscus and posterior capsule. Postoperative MRI examination 3 or more months after arthroscopic repairing of isolated ramp lesion shows healing of ramp lesion, manifesting as low signal meniscocapsular attachment tissue of PHMM. (Figure 1)

Discussion

Meniscal ramp lesion, defined as peripheral detachment lesion of posterior horn of medial meniscus, usually occurs at the time of acute ACL rupture and in knees with following chronic ACL laxity after ACL

rupture, which significantly increases with time until 24 months after initial ACL injury. Patients younger than 30 years of age and male patients were more susceptible[3].

ACL rupture will increase tibial anterior translation and internal rotation, which make medial meniscus to “engage” the posteromedial femoral condyle and act as a wedge against the postero- medial tibia[6,7,8]. On the other hand, Hughston[9] suggested that semimembranosus muscle contraction with wedge effect of PHMM would produce great stress at the meniscocapsular junction and possibly result in a peripheral meniscocapsular longitudinal tear (Ramp lesion).

But in our clinic, isolated meniscal ramp lesion without obvious ACL rupture were observed in some patients. ACL longitudinal splits or minor laxity were observed arthroscopically in these patients. An important suspicious finding during probe examination is probe insertion into meniscocapsular junction despite the lack of a visible lesion in the posterior horn of medial meniscus.

During intraoperative ACL integrity assessment, there are maybe following conditions: a. normal (synovium intact) b. synovium damaged c. longitudinal splits d. partial rupture e. complete rupture. ACL longitudinal splits or minor laxity were observed intraoperatively with probe tensioning in these patients. ACL longitudinal splits will cause minor anterior and internal rotation instability. To resist the minor instability, semimembranosus muscle will contract. Minor instability and semimembranosus muscle contraction may cause wedge effect of PHMM and stress increase in meniscocapsular junction of PHMM and gradually result in isolated ramp lesion without obvious ACL rupture. The mechanism of isolated meniscal ramp lesion without obvious ACL rupture is similar to ramp lesion with following chronic laxity after acute ACL rupture.

In young patients, ACL longitudinal splits may be caused by daily knee pivot activity or hyperextension. In older patients, ACL longitudinal splits may be caused by degenerative osteoarthritis, such as impingement and attrition of ACL by intercondylar fossa osteophyte.

PHMM is known to have secondary effect of limiting anterior translation of tibia[10]. Ramp lesion repairing significantly increases postoperative knee function following ACL reconstruction[11]. Peltier[12] concluded Ramp lesions appear to play a significant role in knee stability and also increase the forces in the ACL. Numerous other investigators have demonstrated that isolated ACL reconstruction fails to restore normal joint kinematics and results in residual laxity in the presence of a ramp lesion. [5,12,13] Furthermore, it has been demonstrated that repair of Ramp lesions abolishes [13,14,15] the pathologic increase in laxity and therefore provides a biomechanical rationale for identifying and repairing these lesions.

Isolated ramp lesion without obvious ACL rupture also need to be repaired to increase postoperative knee function. Pre-operative identification of isolated ramp lesions may aid surgeon in surgical planning and patient education to improve postoperative knee function, which may have otherwise been missed. The patient with posteromedial knee pain and limitation of flexion or squatting will give surgeon suspicion of ramp lesion. If physical examination shows negative lachman test or anterior drawer test, isolated ramp

lesion without obvious ACL rupture should be considered. Pre-operative MRI is necessary to detect ACL integrity and isolated ramp lesion. Combined with patient symptom, physical examination and MRI examination, isolated ramp lesion without obvious ACL rupture may not be missed preoperatively.

Arner et al reported that Sensitivity of detecting a ramp lesion on MRI ranged from 53.9 to 84.6%, while specificity was 92.3-98.7%. Negative predictive value was 91.1-97.4%, while positive predictive value was 50.0-90.0%. MRI studies investigating Ramp lesions suggested the presence of posteromedial tibial edema, and detachment between medial meniscus and joint capsule as the most significant indicator of a Ramp lesion[16].

According to Sonnery-Cottet classification[17], isolated ramp lesion without obvious ACL rupture is meniscocapsular rupture without meniscotibial ligament disruption (Type1). These lesions are very peripherally located in the synovial sheath of posteromedial capsule. Their mobility at probing is very low. These characteristics make it possible to perform all-inside isolated ramp lesion repair with Omnispan meniscal repairing system through routine anterolateral and anteromedial portal. Because of longitudinal rupture of isolated ramp lesion, horizontal mattress suture can be performed to restore good stability. After 3 months, these patients can acquire healing of isolated ramp lesion (Figure 1) because of good blood supply in Ramp region and good repairing stability.

Arthroscopy is considered gold standard for diagnosis of ramp lesions[18]. However, it is not without pitfalls[19]. Forty percent of ramp lesions are not identified through standard anterior portal visualization and inspection of the posterior compartment via a trans-notch view, and posteromedial probing is required to identify them[17,18].

Improved visualization through intercondylar view is key to (1) improved diagnosis of Ramp lesion[20], (2) better diagnosis through probing and debridement from posteromedial portal before repairing, and (3) better control of the complete closure of the Ramp lesion[21], all of which lead to a better healing rate for these lesions. After diagnosis confirmation through intercondylar visualization, debridement from posteromedial portal before repairing is important. Then horizontal mattress all-inside suture of meniscocapsular rupture can be performed through anteromedial portal with routine anterolateral view[22]. For longitudinal ACL spilt, we utilize radiofrequency to shrink ACL and increase ACL tension. Together with all-inside meniscal ramp lesion repair, the instability was well decreased.

Postoperatively 3 months later, MRI was used to confirm meniscocapsular rupture healing with improved knee function score and no posteromedial knee pain or flexion/squatting limitation. MRI signal of healing meniscocapsular rupture manifests as low signal meniscocapsular attachment. Because of unwillingness for surgery of Chinese patients, we can not acquire second-look arthroscopic examination to confirm meniscocapsular rupture healing.

Conclusion

Our study shows isolated meniscal ramp lesion without obvious ACL rupture may exist because of ACL minor laxity caused by longitudinal splits. Through all-inside horizontal mattress suturing repair with Omnispan meniscal repairing system, isolated ramp lesions can be repaired through routine anterolateral and anteromedial portal and can heal with improved knee function and without posteromedial knee pain.

Abbreviations

ACRC: Arthritis Clinic and Research Center; ACL: anterior cruciate ligament; PHMM: posterior horn of medial meniscus; MRI: Magnetic Resonance Image; FS: fat suppression; VAS: visual analogue scale; PCL: posterior cruciate ligament; MFC: medial femoral condyle; MTP: medial tibial plateau; PM-Cap: posteromedial capsule; SN: spinal needle; JJ: Jun Jiang; LN: Lei Ni; JC: Jian Chen.

Declarations

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Availability of data and materials

Please contact author for data requests.

Author's contribution

JJ performed all these operations and follow-up, collected clinical data, performed the statistical analysis, and drafted the manuscript. LN and JC instructed the study. All authors read and approved the final manuscript.

Author's information

JJ is an arthroscopy specialist in ACRC. LN and JC are arthroscopy specialist and professor in ACRC.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Peking University People Hospital. Informed written consent was taken from all patients.

Consent for publication

All authors reviewed the final version of the manuscript and approved it for submission.

Competing interests

The authors declare that they have no competing interests.

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Figures

Figure 1

A 36 years old woman patient suffer from posteromedial left knee pain without obvious ACL rupture. (a)Preoperative fat suppression (FS) T2 MRI sagittal image shows isolated ramp lesion of PHMM (black arrow) with intact but degenerative ACL integrity (white triangle), manifesting as high signal fluid between posterior horn of medial meniscus and posterior capsule. (b) After 6 months, postoperative FS T2 MRI sagittal images shows healing of ramp lesion (white arrow), manifesting as low signal meniscocapsular attachment tissue of PHMM.

Figure 2

(a) Ramp lesion of posterior horn of medial meniscus in left knee of a 71 years old woman patient was viewed through anterolateral portal. The hook tip can be inserted into meniscocapsular junction, which shows meniscocapsular tear—Ramp lesion. (b) probe examination from inferior surface shows meniscotibial ligament intact (c) The view from anterolateral portal shows all-inside horizontal mattress repair with 120 Omnispan meniscal repairing system from the upper surface of ramp lesion (white triangle). (d) The view from anterolateral portal shows ACL longitudinal splits (black arrow) and intercondylar fossa osteophyte (white arrow) .

Figure 3

Arthroscopic view of a ramp lesion in a left knee. A, view through anterolateral portal; the posterior horn of the medial meniscus seems normal. B, view through intercondylar notch; the dashed area shows the ramp lesion. C, view through the posteromedial portal. MFC, medial femoral condyle; MTP, medial tibial plateau; PM-Cap, posteromedial capsule; SN, spinal needle; PHMM, posterior horn of the medial meniscus.