Acta Med. Okayama, 2019
Vol. 73, No. 6, pp. 495-501

Acta Medica Okayama
http://escholarship.lib.okayama-u.ac.jp/amo/

Original Article

Transtibial Pullout Repair Reduces Posterior Extrusion of the Medial Meniscus

Shin Masuda, Takayuki Furumatsu*, Yoshiki Okazaki, Yusuke Kamatsuki, Yuki Okazaki, Yuya Kodama, Takaaki Hiranaka, Eiji Nakata, and Toshifumi Ozaki

Department of Orthopaedic Surgery, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama 700-8558, Japan

Medial meniscus posterior root tear causes rapid knee cartilage degradation by inducing posteromedial displacement of the medial meniscus. We evaluated medial meniscus posterior extrusion before and after pullout repair for medial meniscus posterior root tear using magnetic resonance images. Twenty-eight patients with symptomatic medial meniscus posterior root tear were included. The inclusion criteria were: acute (< 3 months) or chronic (≥ 3 months) medial meniscus posterior root tear after painful popping events. The exclusion criteria were: other meniscus and anterior cruciate ligament injuries. We measured medial meniscus posterior extrusion and medial meniscus anteroposterior interval at knee flexion angles of 10° and 90° preoperatively and at 3 months postoperatively. The posterior extrusion at 90° knee flexion decreased from 4.42 ± 1.38 mm preoperatively to 3.09 ± 1.06 mm ($p < 0.001$) postoperatively, while at 10° knee flexion it was −4.17 ± 1.63 mm preoperatively and −3.77 ± 1.72 mm postoperatively, showing no significant change. The anteroposterior interval at 10° knee flexion increased from 19.74 ± 4.27 mm preoperatively to 22.15 ± 5.10 mm postoperatively ($p < 0.001$); at 90° knee flexion, it increased from 16.81 ± 4.51 mm preoperatively to 19.20 ± 4.30 mm postoperatively ($p < 0.001$). Medial meniscus posterior extrusion and movement decreased after pullout repair. Pullout repair for medial meniscus posterior root tear improves medial meniscus posterior extrusion, especially at 90° knee flexion.

Key words: medial meniscus posterior root tear, pullout repair, extrusion, open magnetic resonance imaging

The meniscus has an important multifunctional role in load transmission, shock absorption, joint stability and lubrication, proprioception, and nutrient supply to maintain overall knee function [1]. The most important function for the prevention of arthritis is the maintenance of hoop tension, which allows correct intraarticular load transmission, for which the medial meniscus (MM) is approximately 90% responsible [2]. Even in a normal knee, the MM is known to move posteriorly as the knee flexes [3].

Posterior root tear (PRT) of the MM (MMPRT) is an injury to the posterior meniscal insertion on the tibia. With this injury, the MM hoop function is damaged, and the MM undergoes MM extrusion from the superior articular surface of the tibia. This severely damages the load-distribution function of the MM, greatly increasing the contact pressure on the tibiofemoral joint and resulting in the rapid acceleration of friction and osteoarthritis in the articular cartilage, and, occasionally, in spontaneaus osteonecrosis of the knee [4].

Currently, conservative treatment, meniscus resec-

Received March 6, 2019; accepted July 3, 2019.
*Corresponding author. Phone : +81-86-235-7273; Fax : +81-86-223-9727
E-mail : matino@md.okayama-u.ac.jp (T. Furumatsu)

Conflict of Interest Disclosures: No potential conflict of interest relevant to this article was reported.

tion, and meniscal repair surgery are used for treating MMPRT. Traditionally, MMPRT has been treated using meniscectomy. However, a previous biomechanical study showed that MMPRT caused a 25% increase in the peak contact pressure, whereas its repair restored the peak contact pressure to normal [5]. Additionally, studies have reported that when conservative treatment or partial resection of the meniscus is performed to treat MMPRT, it causes joint space narrowing, varus deformity progression, and rapid osteoarthritis progression [6,7]. Thus, the success rate of conservative medical treatment or partial meniscectomy for MMPRT is unfavorable; presently, meniscal repair using the pullout or suture anchor method is recommended [8]. However, the latter method is controversial and needs clarification. For example, meniscal repair is unable to completely repair medial extrusions [9].

Magnetic resonance imaging (MRI) is effective for evaluating MMPRT [10,11]. To date, the characteristic findings of MMPRT have been reported to include giraffe-neck, radial tear, ghost, and cleft signs [12]. In addition, MRI can show MM medial extrusion, in which the MM extrudes from the tibial articular surface as it tears with the posterior root. Furumatsu *et al.* found that absolute MM medial extrusion increased progressively within a short duration after the onset of symptomatic MMPRT [13,14]. However, it has been reported that MM medial extrusion does not improve even if meniscal repair is performed for MMPRT [10,15,16].

Several studies found that, in cases of MMPRT, MM causes posterior extrusion at 90° knee flexion. In the transtibial pullout repair method, once the suture is passed into the MM posterior segment, the suture is pulled out from the bone in the posterior root anatomical attachment area of the MM [17,18], and is fixed to the anterior surface of the tibia [19,20]. Thus, after the pullout repair, the MM posterior segment is drawn to the anterolateral side. We therefore hypothesized that the MM posterior extrusion at 90° knee flexion after meniscal pullout repair would decrease after MM root repair. This study aimed to evaluate MM posterior extrusion before and after pullout repair for MMPRT at knee flexion angles of 10° and 90° using open MRI.

Materials and Methods

All procedures were performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Written informed consent was obtained from all participants included in the study.

Patients. Twenty-eight patients (22 women and 6 men; mean age, 60.1 ± 9.3 years) who underwent transtibial pullout repairs for MMPRT between March 2016 and January 2018 were included (Table 1). All patients were diagnosed with MMPRT using MRI and surgical findings. The osteoarthritic knees of the patients were Kellgren-Lawrence grade 0, 1, or 2. Patients with other meniscus injuries and anterior cruciate ligament injuries according to MRI and arthroscopic findings and based on previous research were excluded, and patients with the acute (< 3 months) or chronic (≥ 3 months) type of MMPRT after painful popping events were included [14]. Fourteen and 10 patients had acute and chronic MMPRT, respectively. The MMPRT types were determined by careful arthroscopic examinations according to the meniscal root tear classification [11]. In this study, we performed transtibial pullout repair for a partial tear (type 1) of the MMPRT if the patient had severe knee pain.

Surgical procedures. A standard anterolateral portal was used for arthroscopic visualization using a 30° arthroscope (Smith & Nephew, Andover, MA, USA). A standard anteromedial portal was used for the instruments. Tibial tunnel creation was performed using the MMPRT guide (Smith & Nephew). After abrasion, the aiming guide was inserted from the anteromedial portal to create a tunnel aperture at the most anatomic location of the MM posterior root by referring to the posterior peak of the medial tibial eminence and the anterior border of the posterior cruciate

Table 1 Demographics and clinical characteristics

Number of patients	28
Gender, men/women	6/22
Root tear classification Type 1/2/3/4/5	3/22/0/3/0
Kellgren-Lawrence grade Grade 0/I/II/III/IV	4/17/7/0/0
Age (years)	60.1 ± 9.3
Height (m)	1.57 ± 0.07
Body weight (kg)	65.5 ± 13.8

Data of age, height, and body weight are displayed as mean ± standard deviation.

ligament. A 2.4-mm guide pin was inserted at a 55° angle, and the tibial tunnel was created with a 4.5-mm cannulated drill. Using a previously published technique, the torn end of the MM posterior root/horn was grasped and repaired using the FasT-Fix 360 meniscal repair system (Smith & Nephew) [20]. Tibial fixation was performed using a double spike plate and screw (Meira, Aichi, Japan) at 40° knee flexion with 20-N initial tension [18].

Assessments of MR images. MRI was performed using an Oasis 1.2 T system (Hitachi Medical, Chiba, Japan) with a coil at 10° and 90° knee-flexed positions in a non-weight-bearing condition. The standard sequences of the Oasis included a sagittal proton density-weighted sequence (repetition time [TR]/echo time [TE], 1718/12), using a driven equilibrium pulse with a 90° flip angle and a coronal T2-weighted multi-echo sequence (TR/TE, 4600/84) with a 90° flip angle. The slice thickness was 4 mm with a 0-mm gap. The field of view was 16 cm with an acquisition matrix size of 320 (phase) × 416 (frequency) [21]. MM measurements were performed using a simple MRI-based meniscal sizing technique on the sagittal and coronal views at 10° and 90° knee flexions.

The MM posterior extrusion measurements are shown in Fig. 1. First, knee flexion was set with the femoral and tibial axial angles at 10° and 90°; next, scout views were taken. In axial imaging, cross-sections of both the medial and lateral menisci can be visualized in the same slice. Axial imaging of the distal femur was used to set the posterior condylar axis, and a reference line was drawn perpendicular to it. The reference line set the sagittal cross-section that passed through the center of the transverse diameter of the MM as the measured cross-section for MM posterior extrusion. MM posterior extrusion was measured using a line passing orthogonally through the medial tibial plateau, which is the distance from the posterior edge of the tibia (excluding osteophytes) to the posterior edge of the MM. Using the posterior edge of the tibia as the standard, extrusions toward the posterior from the tibial edge were given positive values, whereas a negative value was defined as the absence of such extrusions (Fig. 2). We also measured MM posterior movement. Additionally, we set the distance between the anterior and posterior MM-free edges (inner edges) when the knee was flexed at 10° and 90° as the anteroposterior interval (API) of the MM and measured the value for each knee flexion angle. For all patients, we measured the MM posterior extrusion and the API of the MM at 10° and 90° knee flexion angles preoperatively and 3 months postoperatively using open MRI.

Statistical analysis. Data are presented as means ± standard deviations. Differences between groups were compared using the Mann-Whitney *U*-test. Power and statistical analyses were performed using EZR-WIN software (Saitama Medical Center, Saitama, Japan). The significance level was set at $p < 0.05$. The sample size was estimated for a minimal statistical power of 80% ($\alpha = 0.05$). All sample size and power calculations were completed using EZR-WIN software. The Hospital

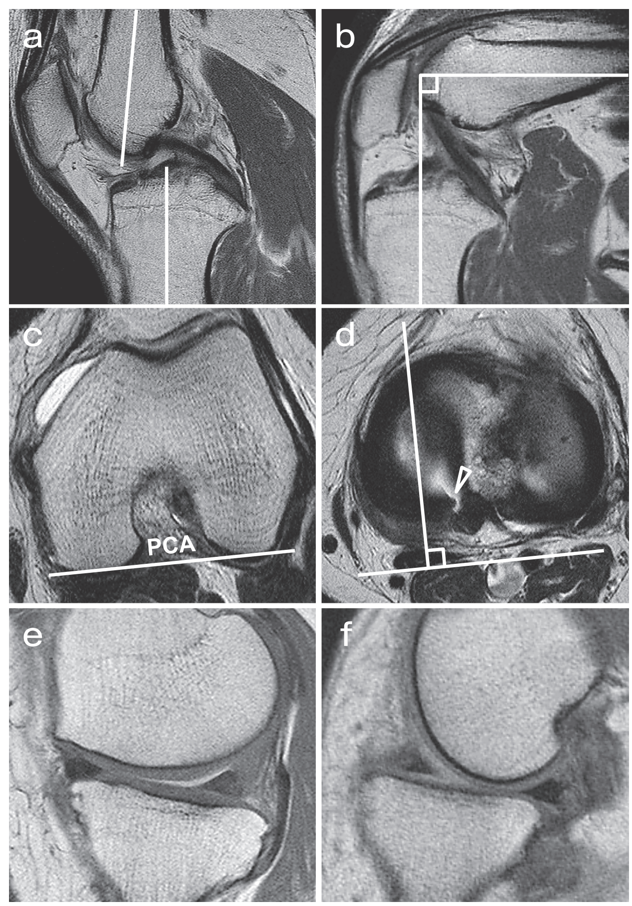

Fig. 1 Magnetic resonance imaging-based measurements: knee flexion is set with the femoral and tibial axial angles at 10° (a) and 90° (b). The posterior condylar axis (PCA) is set (c), and a reference line, defining the sagittal cross-section that passes through the center of the medial meniscus (MM) transverse diameter, is drawn perpendicular to it (d). The arrowhead shows a radial tear sign (e) and the measurement section for MM posterior extrusion at 10° and 90° knee flexion (f).

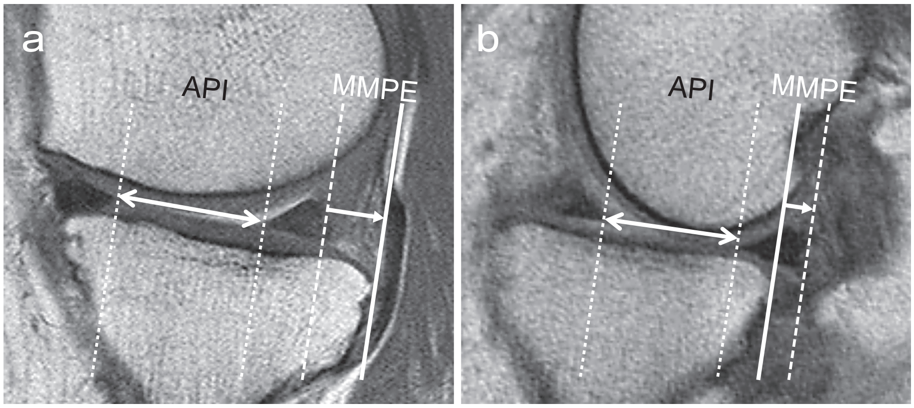

Fig. 2 Magnetic resonance imaging-based measurements: sagittal images at 10° (a) and 90° (b) knee flexion. Anteroposterior interval, API (double-headed arrows, dotted lines); medial meniscus posterior extrusion, MMPE (arrows); posterior margins of the medial tibial plateau (solid lines) and medial meniscus (dashed lines).

Ethics Committee and Internal Review Board of Okayama University, Okayama, Japan (#1857), approved this study, and informed consent was obtained from all patients.

Results

A comparison of the MM posterior extrusion between before and after pullout repair for MMPRT revealed that the intervention significantly decreased the extrusion at 90° knee flexion (4.42 ± 1.38 vs. 3.09 ± 1.06 mm, $p < 0.001$; Table 2 and Fig. 3g, h) but did not significantly affect it at 10° knee flexion (−4.17 ± 1.63 mm vs. −3.77 ± 1.72 mm, $p = 0.833$; Table 2 and Fig. 3c, d). The posterior edge of the MM moved posteriorly by a mean of 8.59 ± 2.21 mm with the shift from 10° to 90° knee flexion. After the pullout repair, the posterior movement of the MM decreased to a mean of 6.86 ± 1.77 mm.

With respect to the API, the preoperative and postoperative API values at 90° knee flexion were 16.82 ± 4.51 mm and 19.20 ± 4.30 mm, respectively ($p < 0.001$; Table 2 and Fig. 3e, f), and those at 10° knee flexion were 19.74 ± 4.27 and 22.15 ± 5.10 mm ($p < 0.001$; Table 2 and Fig. 3e, f). API increased significantly at both the 10° and 90° flexion positions.

Table 2 Measurement of magnetic resonance imaging

	Preoperative	Postoperative	*P* value
MMPE (10°, mm)	−4.17 ± 1.63	−3.77 ± 1.72	0.833
MMPE (90°, mm)	4.42 ± 1.38	3.09 ± 1.06	<0.001
API (10°, mm)	19.74 ± 4.27	22.15 ± 5.10	<0.001
API (90°, mm)	16.82 ± 4.51	19.20 ± 4.30	<0.001

MMPE, medial meniscus posterior extrusion; API, anteroposterior interval; Data are displayed as mean ± standard deviation.

Discussion

The most important outcome of this study is that MM posterior extrusion at 90° knee flexion in patients with MMPRT decreased significantly after the pullout repair.

Along with this decrease in MM posterior extrusion at 90° knee flexion, MM posterior movement also decreased significantly after the pullout repair. With a normal meniscus, MM posterior movement is reported to increase up to 3.8 ± 1.63 mm [3]. In cadavers, during flexion, the MM posterior movement has been reported as 5.1 mm [22]. Compared with previous research, the MM posterior movement in the present study was much greater in cases of MMPRT. Because MM posterior movement increases as the knee flexes from 10° to 90°, MM posterior extrusion is thought to increase as well. In this study, with regard to the amount of MM posterior movement, the MM did not return to its pre-injury state after the pullout repair, but it did approach the pre-injury state. Collectively, these results suggest that transtibial pullout repair in patients with MMPRT returns the MM posterior horn to the pre-injury position at 90° knee flexion.

In MMPRT, the API decreased during knee flexion from 10° to 90°. In a previous study, the distance between the anterior and posterior horns of the MM

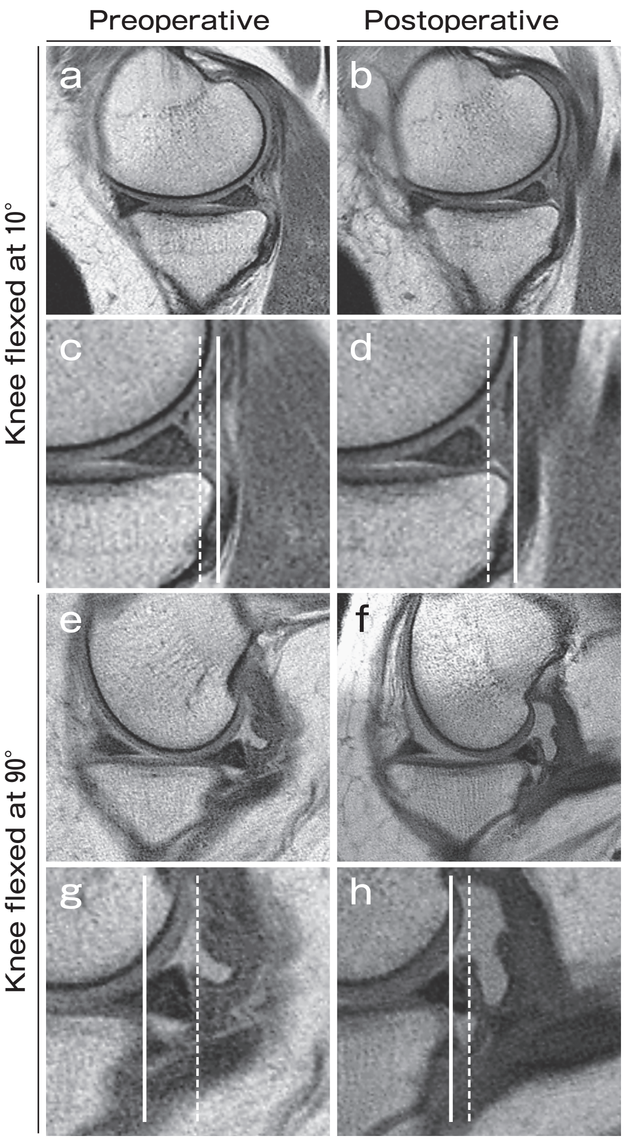

Fig. 3 Magnetic resonance images of the medial meniscus: a 47-year-old woman with medial meniscus posterior root tear. Preoperative sagittal images of the medial meniscus at 10° (a, c) and 90° (e, g) knee flexion. Postoperative sagittal images of the medial meniscus at 10° (b, d) and 90° (f, h) knee flexion. Posterior margins of the medial tibial plateau (solid lines) and medial meniscus (dashed lines).

was 25.88 ± 3.33 mm in cadaveric knees [23]. Normal volunteers at our institute (n = 19) showed −4.58 ± 0.95 mm of MMPE at 10° knee flexion and 0.86 ± 1.65 mm of MMPE at 90° knee flexion (Table 3). The APIs in these normal volunteers were 24.5 ± 3.02 mm and 21.7 ± 4.10 mm at 10° and 90° of knee flexion, respectively. We speculate that the MM anterior horn may be pulled posteriorly by an excessive posterior movement of the MM posterior horn. In addition, the shape of the medial femoral condyle may induce a larger API at 10° knee flexion than at 90° knee flexion. The distal articular surface of the medial femoral condyle is flatter than the posterior articular surface. Therefore, the API of the MM may be larger at 10° knee flexion. In MMPRT, contact pressure applied to the tibiofemoral contact area may increase at 90° knee flexion, possibly causing secondary articular cartilage damage. However, the postoperative API increased at both 10° and 90° knee flexions compared with the preoperative API. Pullout repair improved the MM posterior extrusion and physiological external rotation of the tibia during knee flexion [26], and the MM posterior horn would approach the pre-traumatic position; thus, the API may improve after the pullout repair. It is suggested that the MM anterior horn movement in MMPRT is also important.

Table 3 Measurement of magnetic resonance imaging

	Normal knees (n = 19)
MMPE (10°, mm)	−4.58 ± 0.95
MMPE (90°, mm)	0.86 ± 1.65
API (10°, mm)	24.5 ± 3.02
API (90°, mm)	21.7 ± 4.10

MMPE, medial meniscus posterior extrusion; API, anteroposterior interval; Data are displayed as mean ± standard deviation.

Many studies have reported on MM medial extrusion in MMPRT [10, 13]. Previous studies have linked MM medial extrusion to the progression of osteoarthritis in the knee [24]. The congruity of the MM and the medial femoral condyle is related to secondary cartilage damage and osteoarthritis, and many studies have reported that the MM medial extrusion does not decrease even if pullout repair is performed for the MMPRT [15, 16]. However, this study shows that the MM posterior extrusion decreases following pullout repair. In particular, since MM posterior extrusion decreases at 90° knee flexion, the amount of extrusion from the tibial posterior edge decreases, and it is possible to endure the tibiofemoral joint contact pressure caused by 90° knee flexion. Thus, the MM may recover its function and reduce knee cartilage damage. We therefore believe that the pullout repair for MMPRT partially restores MM function and that measuring the MM posterior extrusion at 90° knee flexion using open

MRI is useful for diagnosing MMPRT, determining its severity, and evaluating the treatment outcome.

Limitations. First, the number of cases studied was small. Second, MM posterior extrusion of age-matched normal knees was not evaluated using open MRI. The knee joints of middle-aged and older patients commonly exhibit some injury to the MM, and normal MM cases are few [1,25]. Third, the facilities in which open MRI examination is possible are limited. Fourth, MRI examinations of the knees at 10° and 90° flexion were used to evaluate the dynamic MM movement using perfectly matched sagittal sections. Normally, the tibia undergoes internal rotation as the knee flexes. In MMPRT cases, the function of the MM as a secondary stabilizer is also reduced, leading to an increased possibility that the tibia will rotate externally during knee flexion. Fifth, using open MRI, we could evaluate non-weight-bearing menisci but not weight-bearing menisci.

In conclusions, in our patients with MMPRT, MM posterior extrusion decreased at 90° knee flexion postoperatively, and MM posterior movement decreased after the pullout repair. Our results suggest that because the pullout repair for MMPRT specifically reduced MM posterior extrusion at 90° knee flexion, the pullout repair may restore the contact pattern between the tibiofemoral joint and the MM. In the diagnosis of MMPRT, open MRI-based measurement of the MM posterior extrusion at 90° knee flexion is useful both for determining the injury severity and evaluating the treatment outcome.

Acknowledgments. We thank Drs. Shinichi Miyazawa, Takaaki Tanaka, Masataka Fujii, and Tomohito Hino for their contributions to this study. This research was not supported by any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Ozkoc G, Circi E, Gonc U, Irgit K, Pourbagher A and Tandogan RN: Radial tears in the root of the posterior horn of the medial meniscus. Knee Surg Sports Traumatol Arthrosc (2008) 16: 849–854.
2. Lee DW, Ha KJ and Kim JG: Medial meniscus posterior root tear: a comprehensive review. Knee Surg Relat Res (2014) 26: 125–134.
3. Seil R, Duck K and Pape D: A clinical sign to detect root avulsions of the posterior horn of the medial meniscus. Knee Surg Sports Traumatol Arthrosc (2011) 19: 2072–2075.
4. Stärke C, Kopf S, Lippisch R, Lohmann CH and Becker R: Tensile forces on repaired medial meniscal root tears. Arthroscopy (2013) 29: 205–212.
5. Allaire R, Muriuki M, Gilbertson L and Harner CD: Biomechanical consequences of a tear of the posterior root of the medial meniscus. Similar to total meniscectomy. J Bone Joint Surg Am (2008) 90: 1922–1931.
6. Moon HK, Koh YG, Kim YC, Park YS, Jo SB and Kwon SK: Prognostic factors of arthroscopic pull-out repair for a posterior root tear of the medial meniscus. Am J Sports Med (2012) 40: 1138–1143.
7. Krych AJ, Reardon PJ, Johnson NR, Mohan R, Peter L, Levy BA and Stuart MJ: Non-operative management of medial meniscus posterior horn root tears is associated with worsening arthritis and poor clinical outcome at 5-year follow-up. Knee Surg Sports Traumatol Arthrosc (2017) 25: 383–389.
8. Sung JH, Ha JK, Lee DW, Seo WY and Kim JG: Meniscal extrusion and spontaneous osteonecrosis with root tear of medial meniscus: comparison with horizontal tear. Arthroscopy (2013) 29: 726–732.
9. Feucht MJ, Kühle J, Bode G, Mehl J, Schmal H, Südkamp NP and Niemeyer: Arthroscopic transtibial pullout repair for posterior medial meniscus root tears: a systematic review of clinical, radiographic, and second-look arthroscopic results. Arthroscopy (2015) 31: 1808–1816.
10. Koenig JH, Ranawat AS, Umans HR and Difelice GS: Meniscal root tears: diagnosis and treatment. Arthroscopy (2009) 25: 1025–1032.
11. Lee YG, Shim JC, Choi YS, Kim JG, Lee GJ and Kim HK: Magnetic resonance imaging findings of surgically proven medial meniscus root tear: tear configuration and associated knee abnormalities. J Comput Assist Tomogr (2008) 32: 452–457.
12. Furumatsu T, Fujii M, Kodama Y and Ozaki T: A giraffe neck sign of the medial meniscus: A characteristic finding of the medial meniscus posterior root tear on magnetic resonance imaging. J Orthop Sci (2017) 22: 731–736.
13. Furumatsu T, Kamatsuki Y, Fujii M, Kodama Y, Okazaki Y, Masuda S and Ozaki T: Medial meniscus extrusion correlates with disease duration of the sudden symptomatic medial meniscus posterior root tear. Orthop Traumatol Surg Res (2017) 103: 1179–1182.
14. Furumatsu T, Kodama Y, Kamatsuki Y, Hino T, Okazaki Y and Ozaki T: Meniscal extrusion progresses shortly after the medial meniscus posterior root tear. Knee Surg Relat Res (2017) 29: 295–301.
15. Chung KS, Ha JK, Ra HJ, Nam GW and Kim JG: Pullout fixation of posterior medial meniscus root tears: correlation between meniscus extrusion and midterm clinical results. Am J Sports Med (2017) 45: 42–49.
16. Chung KS, Ha JK, Ra HJ and Kim JG: A meta-analysis of clinical and radiographic outcomes of posterior horn medial meniscus root repairs. Knee Surg Sports Traumatol Arthrosc (2016) 24: 1455–1468.
17. Fujii M, Furumatsu T, Xue H, Miyazawa S, Kodama Y, Hino T, Kamatsuki Y and Ozaki T: Tensile strength of the pullout repair technique for the medial meniscus posterior root tear: a porcine study. Int Orthop (2017) 41: 2113–2118.
18. Furumatsu T, Kodama Y, Fujii M, Tanaka T, Hino T, Kamatsuki Y, Yamada K, Miyazawa S and Ozaki T: A new aiming guide can create the tibial tunnel at favorable position in transtibial pullout repair for the medial meniscus posterior root tear. Orthop Traumatol Surg Res (2017) 103: 367–371.
19. Fujii M, Furumatsu T, Kodama Y, Miyazawa S, Hino T, Kamatsuki Y, Yamada K and Ozaki T: A novel suture technique

using the FasT-Fix combined with Ultrabraid for pullout repair of the medial meniscus posterior root tear. Eur J Orthop Surg Traumatol (2017) 27: 559–562.
20. Kodama Y, Furumatsu T, Fujii M, Tanaka T, Miyazawa S and Ozaki T: Pullout repair of a medial meniscus posterior root tear using a FasT-Fix(®) all-inside suture technique. Orthop Traumatol Surg Res (2016) 102: 951–954.
21. Inoue H, Furumatsu T, Miyazawa S, Fujii M, Kodama Y and Ozaki T: Improvement in the medial meniscus posterior shift following anterior cruciate ligament reconstruction. Knee Surg Sports Traumatol Arthrosc (2018) 26: 434–441.
22. Vedi V, Williams A, Tennant SJ, Spouse E, Hunt DM and Gedroyc WM: Meniscal movement. An in-vivo study using dynamic MRI. J Bone Joint Surg Br (1999) 81: 37–41.
23. Braz PRP and Silva WG. Meniscus morphometric study in humans. J Morphol Sci 2010; 27: 62–66.
24. Kijima H, Yamada S, Nozaka K, Saito H and Shimada Y: Relationship between pain and medial meniscal extrusion in knee osteoarthritis. Adv Orthop (2015) 2015: 210972.
25. Lee JH, Lim YJ, Kim KB, Kim KH and Song JH: Arthroscopic pullout suture repair of posterior root tear of the medial meniscus: radiographic and clinical results with a 2-year follow up. Arthroscopy (2009) 25: 951–958.
26. Okazaki Y, Furumatsu T, Kodama Y, Hino T, Kamatsuki Y, Okazaki Y, Masuda S, Miyazawa S, Endo H, Tetsunaga T, Yamada K and Ozaki T: Transtibial pullout repair of medial meniscus posterior root tear restores physiological rotation of the tibia in the knee-flexed position. Orthop Traumatol Surg Res (2019) 105: 113–117.