Clinical outcomes of pullout repair combined with osteochondral autograft transplantation for medial meniscus posterior root tear with focal cartilage lesion: A comparative study with pullout repair alone and unicompartmental knee arthroplasty

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Disclosures: The authors have no conflicts of interest.

Introduction: It is desirable to treat Medial meniscus (MM) posterior root tear (PRT) early, as MMPRT compromises the meniscus's ability to convert hoop stress, resulting in increased contact pressure within the knee joint and accelerated progression of knee osteoarthritis (OA) [1-3]. Favorable clinical outcomes following pullout repair of MMPRTs have been reported by many researchers [4]. However, selecting the appropriate surgical method can be challenging in cases with mild varus deformity accompanied by localized severe cartilage damage. Several surgical approaches have been developed to address focal cartilage defects, and treatment strategies are generally characterized as palliation, repair, or restoration [5]. Osteochondral autograft transplantation (OAT) is one established treatments for symptomatic chondral or osteochondral lesions, with favorable mid- and long-term outcomes reported. Other studies have also demonstrated good results for OAT when combined with adjunctive treatments such as platelet-rich plasma or meniscus transplantation [6,7]. To date, however, no report have described clinical outcomes following OAT combined with pullout repair for MMPRTs. The purpose of this study was to compare the radiological and clinical outcomes of patients with MMPRTs who underwent pullout repair combined with OAT, pullout repair alone, or unicompartmental knee arthroplasty (UKA). We hypothesized that all three groups would demonstrate clinical improvement.

Methods: The study was approved by our Institutional Review Board, and informed consent was obtained from all patients. This retrospective study compared radiological and clinical outcomes among patients with MMPRTs who underwent pullout repair combined with OAT (Group O), pullout repair alone (Group P), or UKA (Group U). The final sample sizes were 6, 120, 24 in groups O, P, and U, respectively. Clinical outcomes were assessed with the Knee Injury and Osteoarthritis Outcome Score (KOOS), Lysholm score, Tegner activity score, International Knee Documentation Committee (IKDC) score, and visual analog scale (VAS) for pain. Radiological evaluation was also performed. Improvements were expressed as Δ values (postoperative – preoperative), except for VAS pain, which was calculated as preoperative – postoperative.
Statistical analyses were conducted using EZR (Saitama Medical Center, Jichi Medical University, Tochigi, Japan). Sex was evaluated with Fisher's exact test, whereas the Kruskal-Wallis test was applied to compare other characteristics and outcomes among the three groups. A p-value of less than 0.05 was considered statistically significant.

Results: Patients' demographics and preoperative radiological characteristics are summarized in Table 1. The mean final follow-up period is 5.8 years in Group O, 4.7 years in Group P, and 4.2 years in the Group U. The femorotibial angle (FTA) was significantly smaller in Group O and significantly larger in Group U (P = 0.02). Group U also demonstrated a significantly higher KL grade (P<0.001). Preoperatively and at 1-year postoperatively, Group O showed significantly lower KOOS pain, symptoms, and ADL subscales (Figure 1). However, at the final follow-up, only the IKDC score remained significantly lower in Group O (Figure 1). In terms of changes in clinical outcomes from the preoperative stage to the final follow-up, Group O demonstrated significantly greater improvements (Δ values), particularly in KOOS symptoms and VAS Pain, compared with Group P and U (Figure 3, P<0.003).

Discussion and conclusion: The most important finding of this study is that clinical outcomes improved in all three groups, confirming our hypothesis. Regarding KOOS symptoms, Group O showed significantly greater improvement than Group P, and for VAS pain, Group O demonstrated significantly greater improvement than both Group P and U. The minimal clinically important difference (MCID) threshold values for subjective scores at 2 years after arthroscopic meniscal repair have been reported as 10.9, 12.3, 11.8, 11.4, 16.7, and 16.9 for the IKDC score and KOOS symptoms, pain, ADL, sport, and QOL subscales, respectively [8]. In the present study, all clinical scores at the final follow-up exceeded these MCID thresholds (Figure 3). In MMPRTs, the meniscus loses its ability to convert load into hoop stress [2-4], leading to increased contact pressure in the knee joint. Pullout repair can restore this increased contact pressure to nearly normal in the medial compartment, creating a favorable environment for osteochondral autograft plug to integrate and heal. Thus, mid-term clinical outcomes can be achieved after pullout repair combined with OAT in carefully selected patients with focal cartilage lesions. This treatment strategy may be particularly suitable for younger patients or those wishing to preserve their native knee joint. However, further studies with long-term follow-up are warranted. The limitations of this study include its retrospective design, the small size of Group O, and the relatively short follow-up period.
Clinical relevance: Pullout repair combined with OAT appears to be an effective treatment option for patients with MMPRTs and severe focal cartilage damage, provided that lower limb alignment is not severely varus.

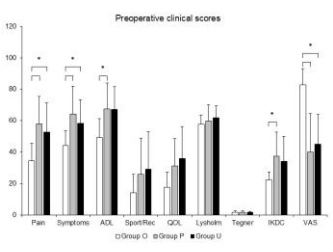
References: **1.** PMID: 29183645; **2.** PMID: 27761625; **3.** PMID: 32150112; **4.** PMID: PMC12056713**; 5.** PMID: 37892577; **6.** PMID: 27206692; **7.** PMID: 36195078; **8.** PMID: 33964390.

Acknowledgement: We thank our collaborative researchers for their cooperation.

Table 1. Patients' characteristics.

Characteristic	Group O	Group P	Group U	P-value
Number	6	120	24	
Age (years)	61.7	63.3±8.9	68.1±6.8	0.93
Sex, male/female	1/5	27/93	5/19	0.04*
Body mass index (kg/m²)	26.8±5.5	25.9±4.2	25.2±3.3	0.64
Femorotibial angle (°)	176.8±1.1	177.4±1.7	178.5±2.0	0.02*
Medial posterior tibial slope (°)	9.7±3.2	9.7±3.0	10.0±3.6	0.77
Medial proximal tibial angle (°)	84.8±0.9	85.0±1.6	85.1±1.6	0.07
Kellgren-Lawrence grade, 0/1/2/3/4	3/3/0/0/0	44/65/11/0/0	3/7/12/2/0	<0.001*
Follow-up period (years)	5.8±1.2	4.7±1.5	4.2±1.4	0.051

Figure 1.



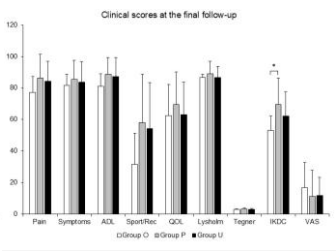


Figure 2.

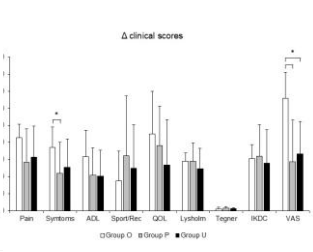


Figure legends: **Figure 1.** Clinical Outcomes (Preoperative scores and scores at the final follow-up). **Figure 2.** Δ clinical scores. *P< 0.05.