

## The fate of unrepaired stable ramp lesions: a systematic review

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**This study was performed according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. PubMed and Medline databases were searched in October 2023 for studies reporting outcomes of arthroscopic anterior cruciate ligament (ACL) reconstruction and stable medial meniscal ramp lesion treatment. Studies focused on diagnostic approaches, biomechanical properties, unstable ramp lesions, isolated ramp lesions, and concomitant intraarticular/extraarticular pathologies other than ACL rupture are excluded. A total of 314 studies were obtained after the initial search. Six studies met the inclusion criteria. Data from 186 stable medial meniscal ramp lesions that were left unrepaired were retrieved. At the last follow-up, mean preoperative Lysholm and IKDC scores were significantly improved and similar with repair patients and no ramp lesion patients, postoperatively. Healing rate was reported between 58.6% and 87.8%. Knee stability was similar in repaired and nonrepaired patients and a ramp existed and no ramp lesion patients. Although the return to sports rate was similar between ramp existed and no ramp lesion patients, the time to return to sports was higher in ramp existed patients than no ramp patients. Improved functional outcome scores, similar healing rates, knee stability, and return to sports rates can be obtained in repaired and nonrepaired patients as well as ramp lesions existing and no ramp lesion patients when the stable ramp lesions are left unrepaired. The time to return to sport is significantly higher than no ramp lesion patients.**

Level of Evidence III

**Keywords:** ramp, stable, repair, healing, return to sport, stability, meniscus, function.

### INTRODUCTION

A medial meniscus ramp lesion has been defined as the detachment of the articular capsule from the posterior horn of the meniscus or the tear of the meniscotibial ligament<sup>1</sup>. It is one of the most common intraarticular lesions in ACL rupture, reported between 9% and 42% of patients<sup>2,3</sup>. It has been associated with knee stability and stress on the ACL graft<sup>4,5</sup>. Repair of the medial meniscal ramp lesions has been recommended to increase knee stability and decrease the risk of ACL graft failure<sup>6</sup>. Currently, repair of all meniscal ramp lesions is questioned due to well vascularity of the peripheral meniscocapsular region and related high potential of healing capacity<sup>7</sup>. A ramp lesion <1.5 cm has been defined as stable and recommended not to repair<sup>8</sup>.

There have been few studies examining the outcomes of repair of stable medial meniscal ramp lesions or leaving them to heal without repair<sup>4,8,9-11,14</sup>. Of these,

some studies compared stable ramp lesion patients with no ramp lesion patients<sup>9,10</sup>. Repairing stable ramp lesions or leaving them to heal without repair can affect healing rates, early postoperative rehabilitation process, knee stability, and return to sports and time to return to sports. Therefore, a systematic review of the studies in the literature regarding the outcomes of stable ramp lesions is needed.

The purpose of this systematic review was to evaluate the functional outcome, healing rates, knee stability, and return to sport in patients with stable ramp lesion that is not repaired.

We hypothesized that there would be no significant difference between repair and no repair, and ramp lesions existed and no ramp lesion patients regarding functional outcome scores, healing rates, knee stability outcome, and return to sport rates. We also hypothesized that the time to return to sports would be significantly increased in patients with stable ramp lesions that were left unrepaired.

**MATERIALS AND METHODS**

This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.

A systematic literature search was conducted on PubMed and Medline databases between January 1977 and October 2023 by 2 independent researchers individually. The search term was “ramp lesion”. The term was combined with “stable”, “anterior cruciate ligament”, “repair”, “unrepair” and “nonrepair” (Table I). Duplicated items were removed and evaluated titles and abstracts for eligibility. A full-text review was performed in the presence of disagreement between reviewers. In a consensus meeting, a full agreement was reached.

Inclusion criteria were: (1) medial meniscus stable ramp lesion confirmed during arthroscopic ACL reconstruction surgery, (2) studies including stable meniscal ramp lesion repair and no repair or stable ramp lesion or no ramp lesion, (3) at least 1-year follow-up, (4) studies reporting healing rate (5) studies reporting functional outcome measures, and (6) level of evidence 1 to 4. Articles reporting biomechanical and diagnostic interventions, combined procedures, letters, reviews, expert opinions, and editorials were excluded (Fig. 1).

Data extraction was performed by two authors independently. Baseline characteristics were recorded.

The studies included various outcome measures and 2 types of comparative groups as (1) repair vs no repair, and (2) Ramp lesion existed vs no ramp lesion. Only 1 study included long term outcomes and complications of unrepaired ramp lesions in addition

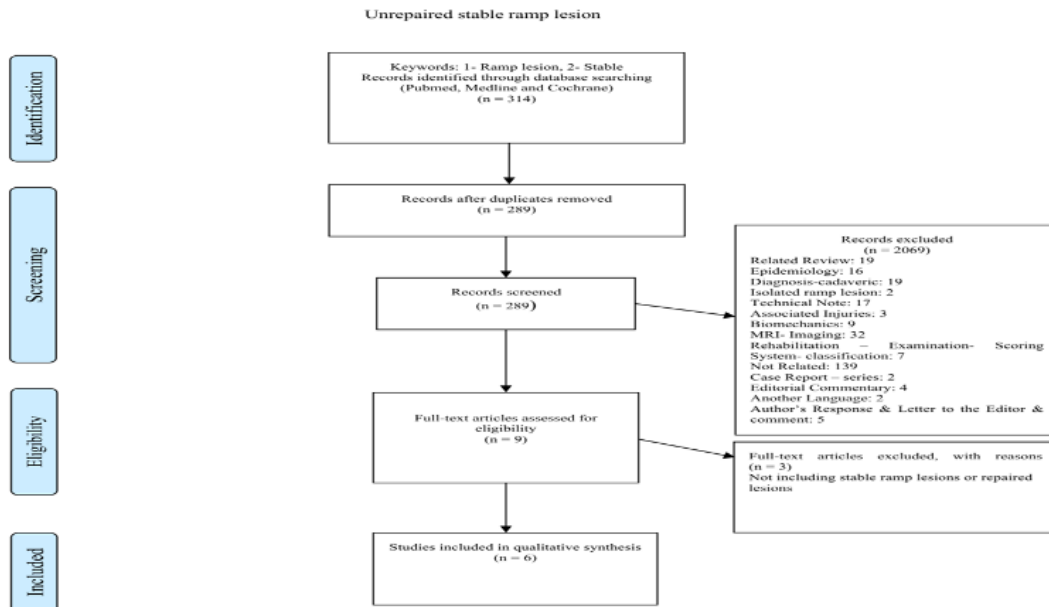


Fig. 1 — Prisma diagram.

Table I. — PICO (population, intervention, control and outcomes) table

PICO Elements	Keywords	Search term and strategy
Patients	Patients underwent ACL reconstruction with or without stable ramp lesion	Ramp lesion Ramp lesion AND (Stable OR Anterior cruciate ligament OR Repair OR Unrepair OR Nonrepair)
Intervention	ACL reconstruction and Stable ramp lesion repair	
Comparison	No ramp repair No ramp lesion	
Outcome	Meniscal healing rate Functional outcome Knee stability Quality of life Return to sport rate	

**Table II.** — Patient and study characteristics

	Level of Evidence/Study Design	Comparative groups	N of no repair patients	Age (Mean)	Time from injury to surgery (Mean)	Follow-up (months)	Functional and HRQoL outcome score preop/postop (Mean)	Healing rate	Reoperation	Knee stability assessment preop/postop (mm)	Return to sport
Yang	III, retrospective	repair vs no repair	31	34.8	42.5 days	24	Lysholm pre/Post: 64.2/90.3 IKDC Pre/post: 64.2/85.1	58% (MRI)	42% (Incomplete healing or nonhealing)	-	-
Hatayama	III, retrospective	repair vs no repair	25	29.5	680 days	24	Lysholm Post: 98.5 Tegner Post: 6.0	40% complete healing 20% partial healing 40% unhealing (MRI)	8% (Meniscectomy due to bucket handle tear)	Ant Tib Translation Pre/post: 8.1/2.4 Pivot shift Post: 84% negative 16% 1+	-
Liu	I, prospective	repair vs no repair	33	34.8	8.3 week	40.3	Lysholm Pre/post: 64.3/90.4 IKDC Pre/post: 53.6/82.2	87.8% complete healing 6.1% partial healing 6.1% unhealing (MRI)	-	Pivot shift Pre: 4.8% negative 63.4% 1+ 31.8% 2+ Pivot shift Post: 81.8% negative 12.1% 1+ 6.1% 2+ Lachman Pre: 17.0% 1+ 78.0% 2+ 5.0% 3+ Lachman Post: 84.8% negative 12.1% 1+ 3.1% 2+ KT-1000 Pre: 7.1 mm 24.4% (>5mm) 75.6% (<5mm) KT-1000 Post: 1.5 mm 87.8% (<3 mm) 12.2% (3-5 mm)	-
Albayrak	III, retrospective	stable ramp vs no ramp	33	28.3	15.8 week	45.2	Lyshol Pre/post: 54.1/86.0 IKDC Pre/post: 44.4/77.4 SF-12 MCS Pre/post: 53.6/58.5 SF-12 PCS Pre/post: 41.7/54.8	100% healing (Clinical examination)	9.0% 3 (One contralateral ACL rupture and 2 implant related pain)	Pivot Shift Pre: 66.7% 2+ 33.3% 3+ Pivot Shift Post: 100% negative Lachman Pre: 57.5% 2+ 42.5% 3+ Lachman Post: 93.9% negative 6.1% 1+	84.8% 10.7% lower level 89.3% same level Mean time to sports: 11.1 months
Balazs	III, retrospective	stable ramp vs no ramp	36	28.4	-	24 months median (range, 12 to 60 months)	IKDC Pre/post: 49.5/85.6 Marx Act. Scale Pre/post: 12.8/9.3 SF-12 MCS Pre/post: 51.3/51.7 SF-12 PCS Pre/post: 41.8/54.3	97% (Clinical examination)	8.3% (2 ACL re-rupture) (One unhealing, not specified)	-	-
Tuphe	IV, retrospective	Stable ramp, left unrepaired	28	26.9	22.6 mo	262.1 months (range, 12 to 60 months)	Lysholm Pre/post: 77.3/93.6 IKDC Pre/post: 67.3/87 Tegner Activity scale Pre/post: 6/5.7	93% at 5 years, 75% at 10 years, 71% at 15 and 20 years (Clinical and symptom based MRI investigation)	39% (Six meniscectomies due to bucket-handle tear) (Two re-rupture and 3 contralateral ACL rupture)	KT-2000 Pre: 7.1 mm (4-8 mm) 75.6% (>5mm) KT-1000 Post: 1.2 mm ([-3]-4 mm)	57%

to ACL reconstruction. In all studies, baseline, and last follow-up Lysholm and/or IKDC subjective knee evaluation scores were used in the evaluation of functional outcomes. In addition, healing status was evaluated by MRI investigation in 5 studies<sup>4,8,11,12,14</sup>. The Lachman and Pivot shift examinations were used in the assessment of knee stability in 4 studies. KT-1000 quantitative anteroposterior laxity was used in 1 study<sup>8</sup> and KT-2000 was used in 1 study<sup>14</sup>. Healing rate was used as a separate outcome measure for complete healing, incomplete healing, and nonhealing in 2 studies<sup>4,8</sup>. SF-12 scale score was used in 2 studies for Health-related quality of life (HRQoL) evaluation<sup>9,10</sup>.

The modified Coleman Methodology Score (MCSM) was used in the assessment of the Quality of methodology for individual studies<sup>13</sup>.

The mean and standard deviation were used for continuous data. Percent values were used for categorical data. A p-value < .05 was considered as statistically significant. SPSS v28 was used in the analysis.

## RESULTS

Of the 6 studies, three of them compared repaired and nonrepaired stable ramp lesion groups, 2 studies reported ramp lesions existed and no ramp lesion patients, and 1 study reported long term outcomes and complications of unrepaired stable ramp lesions. One of the studies had level I evidence while 4 studies had level 3 evidence, and 1 study had level 4 evidence. There was a total of 186 patients. The mean age of the patients was between 26.9 and 34.8 years. The male-to-female ratio was 145:41. The time from injury to surgery was between 6 and 97 weeks. The mean follow-up duration was between 24 and 262.1 months (Table II).

Lysholm and IKDC scores were reported in 5 studies (Table II). While there was a significant improvement in functional outcome scores compared to preoperative status in 5 studies, there was no significant difference in postoperative functional outcome scores between repaired and non-repaired patients in 3 study and between patients with and without ramp lesions in 2 studies (Table II). Short Form-12 (SF-12) score was reported in 2 studies<sup>2,9</sup> that were comparing stable ramp lesions existed and no ramp lesion patients. In both studies, physical and mental health composite scores were significantly increased in stable ramp patients and similar with no ramp patients.

Healing and reoperation rates were reported in 6 studies. In four studies, an MRI investigation at the last

follow-up was performed<sup>4,8,11,14</sup>. The healing rate was reported between 58% and 87.8%. Meniscocapsular trephination/abrasion (13 patients) was the most reported reoperation in partially healed or unhealed tears. In 15 patients, meniscectomy was reported due to secondary meniscal tears.

Pivot shift and Lachman test outcomes were reported in 3 studies as the knee stability measurement tool<sup>4,8,9</sup>. In all studies, both preoperative pivot shift and Lachman test grades were significantly improved mostly from grades 1 and 2 to grades 0 to 1. In 1 study, the KT-1000 quantitative measurement tool was used<sup>8</sup>. In this study, the preoperative mean anteroposterior laxity was significantly improved from 7.1 mm to 1.5 mm. In addition, in 1 study, the KT-2000 arthrometer was used<sup>14</sup>. The preoperative mean anteroposterior laxity was significantly improved from 7.1 mm to 1.2 mm. In another study, anterior knee translation side-to-side difference was evaluated on stress radiographs using the Telos device (Type SE 2000)<sup>4</sup>. It was reported to improve from the preoperative mean of 8.1 mm to postoperative 2.4 mm.

Return to sport rate was reported in 2 studies<sup>9,14</sup>. The return to sports rate was reported as 84.7% and 57%<sup>9,14</sup>. The time to return to sport was reported in one study<sup>9</sup>. In this study, the level of sports was reported as 29 level 1 (Football and basketball) and 4 level 2 (combat sports) sports. The mean time to return to sport was 11.1 months. The level of return to sport was the same in 89.3% of patients while the lower level in 10.7%.

The mean modified Coleman score was  $71.8 \pm 9.9$  (Table III).

## DISCUSSION

The results obtained in this systematic review are based on only six studies, with only one being prospective and the others retrospective. Therefore, the level of evidence is low. The diagnosis and treatment of medial meniscus ramp lesions have become popular in recent years. Understanding the effect of meniscus ramp lesions on knee stability and anterior cruciate ligament reconstruction results was effective in this case. While there is consensus on repair in the treatment of unstable ramp lesions, there is no consensus on repairing stable ramp lesions or leaving them to heal without repair. In this systematic review, we showed similar functional outcome scores, healing rates, knee stability, and return to sports rates in 186 medial meniscus stable ramp lesions with left unrepaired, repaired or no ramp lesions. However, the time to return to sports was reported significantly higher than no ramp lesion patients.

**Table III.** — Modified Coleman methodology scores of each study

Study	Study size	Follow up	Surgical approach	Type of study	Description of diagnosis	Description of surgical technique	Description of post-operative rehabilitation <sup>5</sup>	Outcome criteria	Outcome assessment	Description of patient selection process <sup>15</sup>	Total
Yang	4	5	7	0	5	5	5	7	11	10	69
Hatayama	4	5	7	0	5	5	5	7	11	10	69
Liu	4	5	7	15	5	5	5	7	11	10	84
Albayrak	4	5	7	0	5	5	5	7	11	10	69
Balazs	4	2	7	10	5	0	0	7	11	10	61
Tuphe	4	10	7	0	5	5	5	7	11	5	59

1: Study size-number of patients<sup>10</sup>, 2: Mean follow-up (months)<sup>10</sup>, 3: No of different treatment procedures included in each reported outcome<sup>10</sup>, 4: Type of study<sup>15</sup>, 5: Diagnostic certainty<sup>5</sup>, 6: Description of procedure stated<sup>5</sup>, 7: Description of postoperative rehabilitation<sup>5</sup>, 8: Outcome criteria<sup>10</sup>, 9: Procedures for assessment of outcomes<sup>15</sup>, 10: Description of patient selection process<sup>15</sup>.

The most common functional outcome assessment tools were Lysholm and IKDC scores in the included studies. Both were used in 5 out of 6 studies. In 5 studies, there was a significant pre to postoperative improvement in functional outcome scores. Also, there was no significant difference between repaired and nonrepaired patients, and stable ramp existed and no ramp lesion patients regarding postoperative functional outcome scores. In one study, only postoperative functional outcome was compared between repaired and nonrepaired patients<sup>4</sup>. Minimal clinically important difference (MCID) was reported in 3 studies<sup>9,10,14</sup>. In 2 studies, 97% of patients reached MCID values. However, in 1 study reported the long term outcomes, only 71% of patients reached MCID values for Lysholm score. SF-12 score was used as the HRQoL in 2 studies reporting the outcomes of stable ramp existed and no ramp lesion patients<sup>9,10</sup>. In both studies, physical and mental health composite scores were significantly increased in stable ramp lesion patients and no ramp lesion patients. No significant difference was reported between the 2 groups.

Healing and reoperation rates were reported in 6 studies. The healing rate was ranging between 58% and 87.8%. However, MRI confirmed healing status was reported in 3 studies<sup>4,8,11</sup>. Other studies reported only clinical healing or symptom based MRI investigation. In the total 186 patients reported, 13.9% of patients (26 patients) underwent reoperation due to partially healing, nonhealing or failure. In 22 patients, secondary surgeries were reported as 13 refreshments and 9 partial meniscectomies. The treatment applied to the 4 menisci that did not heal was not specified.

Preoperative and postoperative pivot shift and Lachman test grade changes were reported in the knee stability assessment. The Pivot shift and Lachman test results were reported to be significantly improved from grades 1 and 2 to grades 0 to 1 in 3 studies. Postoperative pivot shift and Lachman test results were similar

between both the repaired and nonrepaired groups and the ramp lesion existed and no ramp lesion patients. In 1 study conducted by Liu et al.<sup>8</sup>, the preoperative mean anteroposterior laxity measured by the KT-1000 tool was significantly improved from 7.1 mm to 1.5 mm, postoperatively. In another study, the preoperative mean anteroposterior laxity measured by the KT-1000 tool was significantly improved from 7.1 mm to 1.2 mm, postoperatively. In addition, in their study, Hatayama et al.<sup>4</sup> reported improved anterior knee translation side-to-side difference from the preoperative mean of 8.1 mm to postoperative 2.4 mm.

Return to sports after meniscal ramp repair or leaving ramp lesion unrepaired has been poorly reported. There has been no comparative study evaluating return to sport after stable ramp lesion repair and no repair. Return to sport rate was reported in 2 studies<sup>9,14</sup> and time to return to sport was reported in only one study conducted by Albayrak et al. comparing stable ramp lesion and no ramp lesion groups<sup>9</sup>. In this study, there were 29 level 1 (Football and basketball) and 4 level 2 (combat sports) sports players. The return to sports rate at the 3-year follow-up was reported at 84.7%. The mean time to return to sport was 11.1 months. The level of return to sport was the same in 89.3% of patients while lower in 10.7%.

Neglect of the meniscocapsular lesions of the posterior horn of the medial meniscus has been associated with ACL graft failure<sup>14</sup>. In this systematic review, we showed that leaving stable ramp lesions unrepaired does not seem to significantly increase the risk of ACL graft rupture in the short postoperative term. It is possibly associated with high spontaneous healing rates in stable ramp lesions. But, in the long-term, it may be changing. Further long-term follow up studies are needed.

There are several limitations in this systematic review. Included studies included heterogenous comparative groups. Therefore, it is difficult to reach a

generalized conclusion. Healing rates and reoperations were heterogeneously investigated and reported. MRI and clinical improvement have been reported, while second-look arthroscopic evaluation was not available. There was only 1 prospective randomized controlled study. Most of the studies were retrospective case-control studies which decreases the overall quality of studies on this topic. This indicates that more prospective studies are needed in this specific patient population.

The most important strength of this systematic review is that this is the first systematic review focusing on functional outcome, healing rate and reoperations, knee stability, and return to sports in patients with stable medial meniscal ramp lesions and left unrepaired.

## CONCLUSION

Improved functional outcome scores, similar healing rates, knee stability, and return to sports rates can be obtained between repair and no repair, and ramp lesion and no ramp lesion groups when the stable ramp lesions are left unrepaired. The time to return to sports is significantly higher than no ramp lesion patients. Prospective randomized controlled studies with larger numbers of patients and investigating return to sports are needed for the treatment of stable medial meniscus ramp lesions.

*Funding:* This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

*Conflict of interest:* All authors declare no competing interests.

## REFERENCES

- DePhillipo NN, Moatshe G, Chahla J, Aman ZS, Storaci HW, Morris ER, et al. Quantitative and Qualitative Assessment of the Posterior Medial Meniscus Anatomy: Defining Meniscal Ramp Lesions. *Am J Sports Med.* 2019 Feb;47(2):372-8.
- Balazs GC, Greditzer HG 4th, Wang D, Marom N, Potter HG, Marx RG, et al. Ramp Lesions of the Medial Meniscus in Patients Undergoing Primary and Revision ACL Reconstruction: Prevalence and Risk Factors. *Orthop J Sports Med.* 2019 May;7(5):2325967119843509.
- Chahla J, Dean CS, Moatshe G, Mitchell JJ, Cram TR, Yacuzzi C, et al. Meniscal Ramp Lesions: Anatomy, Incidence, Diagnosis, and Treatment. *Orthop J Sports Med.* 2016 Jul;4(7):2325967116657815.
- Hatayama K, Terauchi M, Saito K, Takase R, Higuchi H. Healing Status of Meniscal Ramp Lesion Affects Anterior Knee Stability After ACL Reconstruction. *Orthop J Sports Med* 2020 May;8(5):2325967120917674.
- Sonnery-Cottet B, Serra Cruz R, Vieira TD, Goes RA, Saithna. Ramp Lesions: An Unrecognized Posteromedial Instability? *Clin Sports Med.* 2020 Jan;39(1):69-81.
- Naendrup JH, Pfeiffer TR, Chan C, Nagai K, Novaretti JV, Sheean AJ, et al. Effect of Meniscal Ramp Lesion Repair on Knee Kinematics, Bony Contact Forces, and In Situ Forces in the Anterior Cruciate Ligament. *Am J Sports Med.* 2019 Feb;47(13):3195-202.
- Pujol N, Beaufils P. Healing results of meniscal tears left in situ during anterior cruciate ligament reconstruction: a review of clinical studies. *Knee Surg Sports Traumatol Arthrosc.* 2009 Apr;17(4):396-401.
- Liu X, Zhang H, Feng H, Hong L, Wang XS, Song GY. Is It Necessary to Repair Stable Ramp Lesions of the Medial Meniscus During Anterior Cruciate Ligament Reconstruction? A Prospective Randomized Controlled Trial. *Am J Sports Med.* 2017 Apr;45(5):1004-11.
- Albayrak K, Buyukkusu MO, Kurk MB, Kaya O, Kulduk A, Misir A. Leaving the stable ramp lesion unrepaired does not negatively affect clinical and functional outcomes as well as return to sports rates after ACL reconstruction. *Knee Surg Sports Traumatol Arthrosc.* 2021 Nov;29(11):3773-81.
- Balazs GC, Greditzer HG 4th, Wang D, Marom N, Potter HG, Rodeo SA, et al. Non-treatment of stable ramp lesions does not degrade clinical outcomes in the setting of primary ACL reconstruction. *Knee Surg Sports Traumatol Arthrosc.* 2020 Nov;28(11):3576-86.
- Yang J, Guan K, Wang JZ. Clinical study on the arthroscopic refreshing treatment of anterior cruciate ligament injury combined with stable medial meniscus ramp injury. *J Musculoskelet Neuronal Interact.* 2017 Jun;17(2):108-13.
- Di Vico G, Di Donato SL, Balato G, Correria G, D'Addona A, Maffulli N, et al. Correlation between time from injury to surgery and the prevalence of ramp and hidden lesions during anterior cruciate ligament reconstruction. A new diagnostic algorithm. *Muscles Ligaments Tendons J.* 2018 Jan;7(3):491-7.
- Coleman BD, Khan KM, Maffulli N, Cook JL, Wark JD. Studies of surgical outcome after patellar tendinopathy: clinical significance of methodological deficiencies and guidelines for future studies. *Victorian Institute of Sport Tendon Study Group. Scand J Med Sci Sports.* 2000 Feb;10(1):2-11.
- Tuph  P, Foissey C, Unal P, Vieira TD, Chambat P, Fayard JM, Thaunat M. Long-term Natural History of Unrepaired Stable Ramp Lesions: A Retrospective Analysis of 28 Patients with a Minimum Follow-up of 20 Years. *Am J Sports Med.* 2022 Oct;50(12):3273-9.