acta orthopaedica belgica, 2025, 91, 39-43

CASE REPORT — KNEE

doi.org/10.52628/91.1.041025

Long Term Outcome of an Osteochondral Defect of the Knee treated with SaluCartilage™ Implant

A. RUZICKA[1], R.ARORA[1], L. A. HOLZER[1,2]

[1]Department of Orthopaedics and Traumatology, Medical University of Innsbruck, Innsbruck, Austria; [2]Sonderkrankenanstalt für Orthopädie Warmbad-Villach, Villach, Austria.

Correspondence at: Lukas A. Holzer, Sonderkrankenanstalt für Orthopädie Warmbad-Villach, Villach, Austria.
Email: lukas.holzer@warmbad.at

Osteochondral Defects of the knee joint are a common diagnosis. We report a case in which such a lesion was treated by using a polyvinylalcohol cylinder (SaluCartilage™, SaluMedica, Atlanta, USA) presented with increasing complaints 22 years after implantation. During workup the cylinder was shown to be completely dislodged from its implant site. Despite these findings, the patient remained mobile and active. Arthroscopic extraction of the cylinder and inspection of the joint was performed, which revealed fibrous repair of the lesion. During follow up, the patient reported minor discomfort on activity, but is satisfied with the outcome.

Keywords: Osteochondral lesions, artificial cartilage repair, osteoarthritis, fibrous repair, knee pain.

INTRODUCTION

Osteochondral defects (OCD) of the knee joint are a common diagnosis in clinical practice, especially in young and active patients[1]. Numerous techniques have been described for the treatment of OCD. One major problem is the missing potential of regeneration of articular hyaline cartilage. While arthroscopic debridement may lead to short-term decrease of pain, in the long-term an increase in symptoms and progression of osteoarthritis (OA) has to be expected[2].

Commonly applied techniques during arthroscopy, such as microfracturing and debridement result in fibrotic substitute tissue which shows failure in the long-term[3,4].

Autologous Chondrocyte Transfer (ACT) techniques and Osteochondral Cylinder Transplants (OCT) have established themselves as direct repair options with good clinical outcomes[5-7], but histology shows generation of fibrous and hyaline-like cartilage, with potential detrimental effects on long-term stability of the repair. Additional concerns regarding OCT is limited availability of suitable autologous material and the risk of non-integration of the transplant[7]. In a similar way, osteochondral allograft transplantation has the same risks for complications, but also surgeons face difficulties in procuring and storage of suitable donor material[8-10].

Due to the previously mentioned reasons, the idea of artificial cartilage substitutes is an enticing possibility. Without the risks for complications during chondrocyte harvesting and donor site morbidity, artificial repairs promise shorter rehabilitation periods[11,12]. Currently, there a large number of such products for cartilage repair applications available on the market[13,14]. Examples include collagen-based matrices (e.g. Novocart Basic™, MaioRegen™), hyaluronic acid-based scaffolds (e.g. Chondrotissue™, Hyalofast™), yet despite good initial results, long-term outcomes are inferior to biological repairs. Another such artificial implant was made from a polyvinylalcoholhydrogel (SaluCartilage™, SaluMedica, Atlanta, USA). In a prospective phase 2 study, 18 patients (11 women, 7 men) were treated with one or more SaluCartilage™ cylinders for osteochondral defects of the knee joint[11].

While initial results showed a postoperative improvement in the McDermott-Score at 3 and 6 months after operation, at 12 months a decrease in objective and patient reported scores were found. Magnet resonance imaging (MRI) showed an inflammatory response, as well as bone oedema around the implant. 14 out of 18 patients underwent revision arthroscopy due to activity related pain and recurrent joint effusions. In all these patients non-integration of the cylinders could be seen, which

presented as rotational instability of the implant. In addition 21 of the implanted cylinders presented with a tendency to dislocate. In 2 cases, a second revision arthroscopy was indicated due to permanent pain and blocking symptoms, which was treated with extraction of the implant and total knee arthroplasty at the same time[15].

A case series evaluating the results of treatment of focal defects of the knee cartilage using PVA-H cylinders (Cartiva™) reported good pain reduction and retention of mobility over 5 to 8 years[16].

CASE PRESENTATION

History

A 74 year-old male patient presented in our knee clinic, complaining about pain and recurrent joint effusions of the right knee. Additionally, he reported about increasing pain related to activity, as well as intermitting blocking symptoms of the knee joint. No trauma or infection in relation to the onset of the symptoms could be found. The patient is physically active as a cyclist and hiker. His medical history revealed that he had been treated with a 1 x 1.5 cm SaluCartilage™ cylinder for a case of chondromalacia (Grade IV) of the medial femoral condyle 22 years prior at our centre in 2002. At the same time, arthroscopic partial resection of the medial and lateral meniscus due to degenerative tears, as well as debridement and microfracturing of the femoropatellar compartment has been performed. Up until now, the patient was satisfied with the results of the procedure and had only noticed increasing pain and especially blocking symptoms while gardening in recent months.

Physical Examination

The patient presented with a palpable joint effusion, range of motion of 0-120°, pain over the medial compartment, but no signs of inflammation of the knee joint. No ligamentous instability could be detected, neither were there any distal motoric, sensory or perfusion related issues. Full weight bearing was possible with a normal gait pattern. One particular finding was a palpable foreign body located laterally in the suprapatellar recess.

Radiological Assessments

X-rays in a.p., lateral and skyline view of the knee showed signs of osteoarthritis in medial and femoropatellar joint compartment (Figure 1). There were no signs of a radiolucent foreign body.

MRI confirmed the findings of degenerative changes, showed intact cruciate and collateral ligaments. A foreign body of cylindrical shape and a maximal size of about 1.5cm was detected. Further findings on MRI were a grade 3 chondropathic lesions on the articular surface of the medial femoral condyle, with a corresponding grade 2 to 3 defect zone on the medial tibia plateau. Additionally, third grade chondropathic lesions were found in the trochlea, as well as second grade lesions of the femoral condyle and tibia on the lateral side (Figure 2).

Treatment

Due to the increasing complaints and radiological findings, we recommended arthroscopic extraction of the cylinder and partial chondral debridement.

Intraoperatively, focal grade IV chondral lesions in all compartments, with more severe findings femoro-

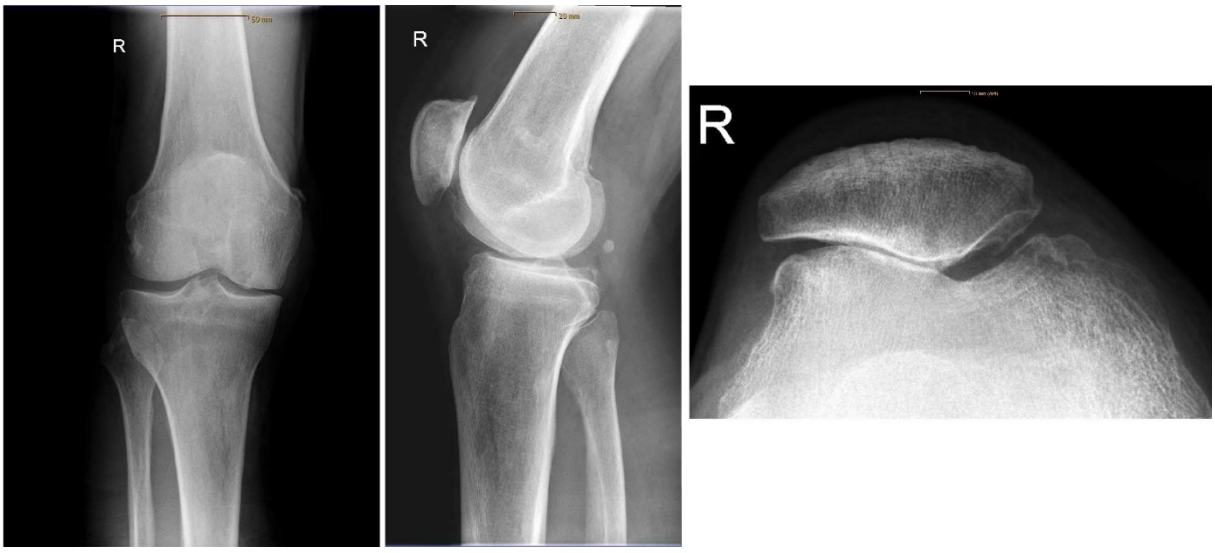

Fig. 1 — Preoperative ap, lateral, and axial patella views.

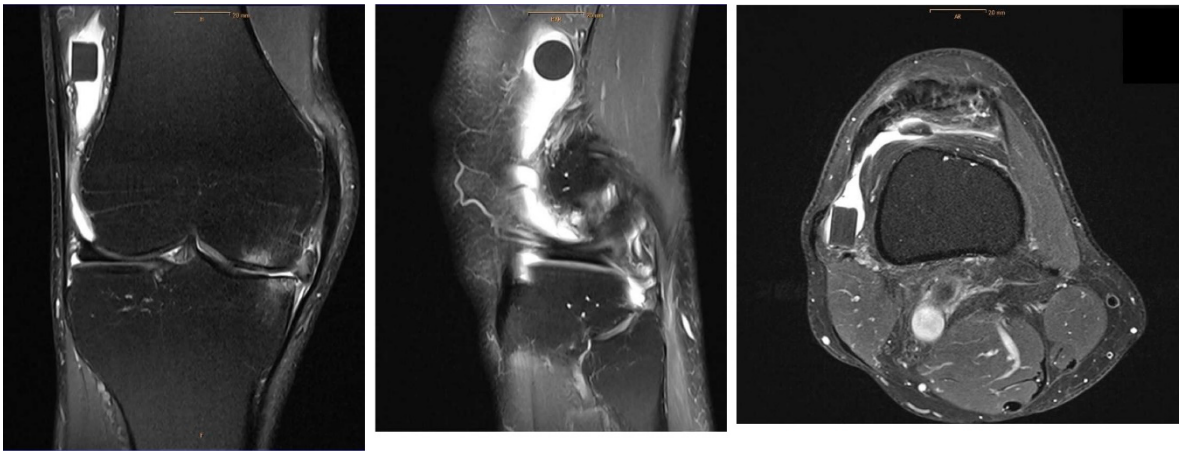

Fig. 2 — Preoperative MR imaging of lesion and foreign body.

tibial medially and in the femoropatellar joint could be seen. The previous defect at the medial condyle was fully covered with fibrous cartilage (Figure 3). Extraction of the foreign body was done through the lateral aspect of the suprapatellar recess and proved to be difficult due to the viscosity and translucency of the material (Figure 4). The cylinder could be removed in toto using forceps through a slightly

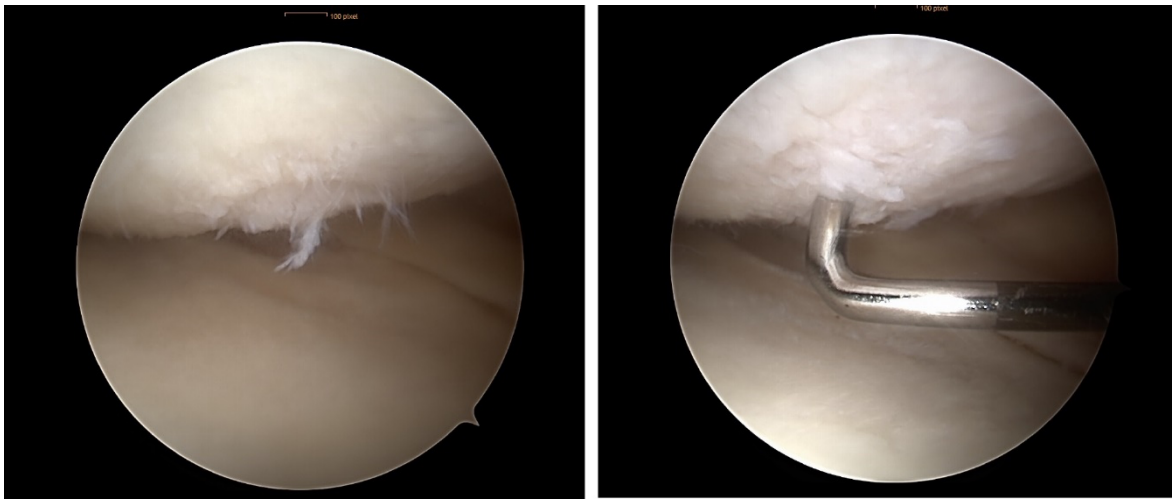

Fig. 3 — Arthroscopic view of the defect of the medial condyle.

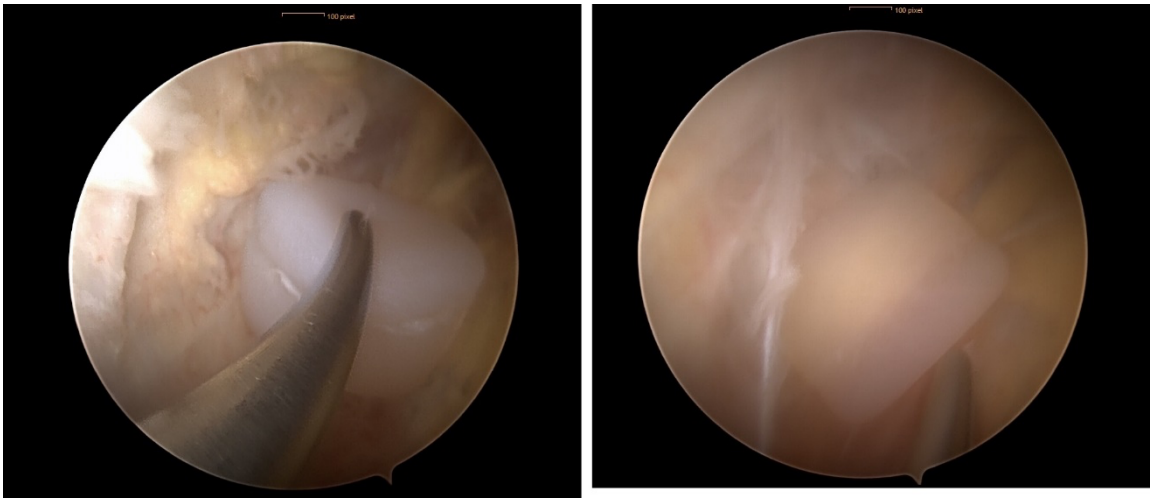

Fig. 4 — Extraction of foreign body.

enlarged anterolateral portal in its entirety (Figure 5). The patient was discharged the following day with regular wound care and under full weight bearing. At follow-up after 6 weeks, the patient presented with some anterior knee pain on activity, as well as slight tenderness at the scar at the site of the anterolateral arthroscopy portal. Postoperatively there were no wound related complications. Postoperative range of motion showed no limitations at 0-120°. The Patient was satisfied with the outcome. No further surgical interventions for OA were considered.

DISCUSSION

Unlike other tissues, articular cartilage has no capabilities of repair resulting in fibrous repair which is associated with diminished biological and mechanical properties. This poses a common challenge in Orthopaedic surgery as OCD of the knee is a frequent finding[17].

Microfracturing and abrasive arthroplastic techniques can induce defect coverage with fibrous cartilage, which has been shown to lead to an initial improvement of symptoms. However the progression of OA due to inferior mechanical properties of the tissue cannot be prevented. One attempt to increase the quality of the tissue is ACT which requires multiple operations. Transfer of autologous osteochondral grafts is widely practiced, but the restrictions in size of the graft is limiting. Another option is the use osteochondral allografts. The suitable donor material is often difficult to obtain, the viability of the chondrocytes limited as well as it is an expensive technique and associated with a considerable risk of complications[18].

Here we present a case which was treated with an artificial cartilage substitute SaluCartilage™ 22 years ago and present our experience with the revision intervention after this long time period. SaluMedica offered this product from 2004 to 2005, but it was discontinued due to reports of dislocation of the implant[15,19].

The polyvinylalcoholhydrogel used has initially shown good biocompatibility in animal experiments without implant dislocation, despite lacking osteointegration[11,12,20,21]. In a report following up 18 patients who had been treated with SaluCartilage™ cylinders for grade 4 osteochondral lesions by Lange et al, initial improvement in patient reported metrics (McDermott Score increased on average from 55 to 75, subjective scores from 29 to 42, and objective score from 27 to 33 after 3 months, and further increases to a total score of 80, 45 for subjective and 35 for objective criteria respectively after 6 months) were mainly attributed to the implant acting as a placeholder. At 12 months total McDermott Scores fell to 69 points, subjective parameters to 40, and objective parameters to 29. Radiological findings were synovialitis with joint effusions and bone oedema adjacent to the implant site. Treatment consisted of arthroscopic revision to remove the cylinder, as well as total knee arthroplasty in 2 cases[15].

PVA-H implants have been used for other indications. Limited recommendations for its use have been given in the treatment of Hallux rigidus[22] with promising short term results[23], and to a lesser extent as treatment for OA of the second metatarsophalangeal joint[24].

A noteworthy observation in the presented case is the extent of fibrous repair in and around the defect zone of the medial compartment. Factors that are associated with good fibrous covering of articular surface defects include young patient age, genetic predisposition and course of the inflammatory process, however the course of healing cannot be predicted easily[25]. Similar to the stimulation of physiological repair mechanisms through microfracturing, in this case coverage of the defects with fibrous repair tissue was experienced. While such repair tissue is well established to provide improvement in clinical scores in the short term, the fibrous substitute is seen as inferior and leads to the return of complaints long term[26,27]. In this case the patient presented with good

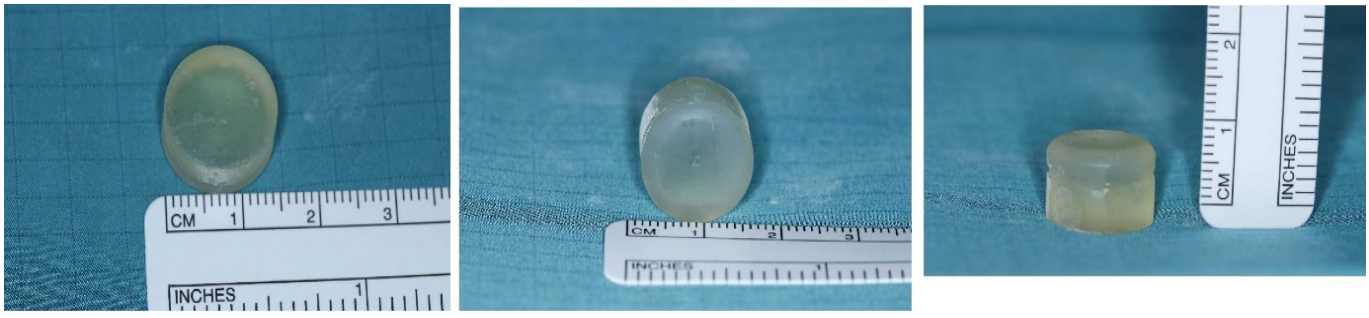

Fig. 5 — Extracted foreign body.

clinical function and a high degree of physical activity despite the patient's age.

CONCLUSION

This case shows complete failure of the articular cartilage substitute Salucartilage in the treatment of OCD of the knee. A dislocated Salucatilage cylinder could be indentified on MRI. However, due to physiological repair mechanisms the patient had a good clinical function and high degree of physical activity despite a large defect zone. The treatment of OCDs of the knee continues to be challenging and requires more research into biomaterials, tissue integration, and regeneration mechanisms.

Article Information: The authors declare no conflict of interest.

REFERENCES

1. Grimm NL, Weiss JM, Kessler JI, Aoki SK. Osteochondritis dissecans of the knee: pathoanatomy, epidemiology, and diagnosis. Clin Sports Med. 2014;33(2):181-8.
2. Willers C, Wood DJ, Zheng MH. A current review on the biology and treatment of articular cartilage defects (part I & part II). Journal of Musculoskeletal Research. 2003;7(03n04):157-81.
3. Krych AJ, Saris DBF, Stuart MJ, Hacken B. Cartilage Injury in the Knee: Assessment and Treatment Options. J Am Acad Orthop Surg. 2020;28(22):914-22.
4. Gracitelli GC, Moraes VY, Franciozi CE, Luzo MV, Belloti JC. Surgical interventions (microfracture, drilling, mosaicplasty, and allograft transplantation) for treating isolated cartilage defects of the knee in adults. Cochrane Database Syst Rev. 2016;9(9):Cd010675.
5. Brittberg M. Treatment of knee cartilage lesions in 2024: From hyaluronic acid to regenerative medicine. Journal of Experimental Orthopaedics. 2024;11(2):e12016.
6. Brittberg M, Lindahl A, Nilsson A, Ohlsson C, Isaksson O, Peterson L. Treatment of deep cartilage defects in the knee with autologous chondrocyte transplantation. N Engl J Med. 1994;331(14):889-95.
7. Horas U, Pelinkovic D, Herr G, Aigner T, Schnettler R. Autologous chondrocyte implantation and osteochondral cylinder transplantation in cartilage repair of the knee joint. A prospective, comparative trial. J Bone Joint Surg Am. 2003;85(2):185-92.
8. Chahal J, Gross AE, Gross C, Mall N, Dwyer T, Chahal A, et al. Outcomes of osteochondral allograft transplantation in the knee. Arthroscopy. 2013;29(3):575-88.
9. Cook JL, Rucinski K, Crecelius C, Fenkell B, Stannard JP. Assessment of Outcomes After Multisurface Osteochondral Allograft Transplantations in the Knee. Orthop J Sports Med. 2022;10(6):23259671221102452.
10. Sherman SL, Garrity J, Bauer K, Cook J, Stannard J, Bugbee W. Fresh osteochondral allograft transplantation for the knee: current concepts. J Am Acad Orthop Surg. 2014;22(2):121-33.
11. Beyerlein J, Imhoff AB. SaluCartilage™—ein neuer künstlicher Knorpelersatz für die arthroskopische Behandlung der fokalen Osteonekrose. Arthroskopie. 2003;16(1):34-9.
12. Bosch U, Meller R, Tröger HJ, Zeichen J. SaluCartilage™—ein künstlicher Knorpelersatz für die minimal-invasive Behandlung osteochondraler Defekte. Arthroskopie. 2003;16(1):40-3.
13. Wang L, Guo X, Chen J, Zhen Z, Cao B, Wan W, et al. Key considerations on the development of biodegradable biomaterials for clinical translation of medical devices: With cartilage repair products as an example. Bioact Mater. 2022;9:332-42.
14. Nordberg RC, Bielajew BJ, Takahashi T, Dai S, Hu JC, Athanasiou KA. Recent advancements in cartilage tissue engineering innovation and translation. Nature Reviews Rheumatology. 2024;20(6):323-46.
15. Lange J, Follak N, Nowotny T, Merk H. [Results of SaluCartilage implantation for stage IV chondral defects in the knee joint area]. Unfallchirurg. 2006;109(3):193-9.
16. Sciarretta FV. 5 to 8 years follow-up of knee chondral defects treated by PVA-H hydrogel implants. Eur Rev Med Pharmacol Sci. 2013;17(22):3031-8.
17. Campbell CJ. The healing of cartilage defects. Clin Orthop Relat Res. 1969;64:45-63.
18. Kluyskens L, Debieux P, Wong KL, Krych AJ, Saris DBF. Biomaterials for meniscus and cartilage in knee surgery: state of the art. J isakos. 2022;7(2):67-77.
19. Meyer C, Horas U, Hörbelt R, Schnettler R. [Dislocation of artificial cartilage (SaluCartialge)]. Unfallchirurg. 2005;108(2):163-6.
20. Chang YS, Oka M, Gu HO, Kobayashi M, Toguchida J, Nakamura T, et al. Histologic comparison of tibial articular surfaces against rigid materials and artificial articular cartilage. J Biomed Mater Res. 1997;37(1):51-9.
21. Noguchi T, Yamamuro T, Oka M, Kumar P, Kotoura Y, Hyon S, et al. Poly(vinyl alcohol) hydrogel as an artificial articular cartilage: evaluation of biocompatibility. J Appl Biomater. 1991;2(2):101-7.
22. Smyth NA, Murawski CD, Hannon CP, Kaplan JR, Aiyer AA. The Use of a Synthetic Cartilage Implant for Hallux Rigidus: A Systematic Review. Foot Ankle Spec. 2021;14(4):366-71.
23. Engasser WM, Coetzee JC, Ebeling PB, Den Hartog BD, Seybold JD, Holthusen SM, et al. Patient-Reported Outcomes and Early Complications After Synthetic Cartilage Device Implantation. Foot & Ankle Orthopaedics. 2020;5(3):2473011420930691.
24. Chopra A, Fletcher AN, Madi NS, Parekh SG. Clinical Outcomes of Synthetic Cartilage Implant for Second Metatarsophalangeal Joint Arthritis. Foot & Ankle Orthopaedics. 2022;7(4):2473011421S00624.
25. Steadman JR, Rodkey WG, Briggs KK. Microfracture to treat full-thickness chondral defects: surgical technique, rehabilitation, and outcomes. J Knee Surg. 2002;15(3):170-6.
26. Mithoefer K, McAdams T, Williams RJ, Kreuz PC, Mandelbaum BR. Clinical efficacy of the microfracture technique for articular cartilage repair in the knee: an evidence-based systematic analysis. Am J Sports Med. 2009;37(10):2053-63.
27. Welton KL, Logterman S, Bartley JH, Vidal AF, McCarty EC. Knee Cartilage Repair and Restoration: Common Problems and Solutions. Clinics in Sports Medicine. 2018;37(2):307-30.