Utilizing Clinical Examination in Conjunction with Magnetic Resonance Cartilage Studies for Post-Operative Evaluation of Cartilage Repair: A Case Report

Stefanie Hui Ting Lee*, Cynthia Assimta Peter, Steven Bak Siew Wong, Adriel Guang Wei Goh

Department of Radiology, Sengkang General Hospital, Singapore, Singapore

***Correspondence:** Stefanie Hui Ting Lee, Department of Radiology, Sengkang General Hospital, 110 Sengkang E Wy, Singapore, Singapore, S544886

stefanie.lee@mohh.com.sg

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AUTHORS' CONTRIBUTIONS
Stefanie Hui Ting Lee: Drafting of manuscript, data review, revision of manuscript
Cynthia Assimta Peter: Data review, revision of manuscript
Steven Bak Siew Wong: Conceptualization, revision of manuscript
Adriel Guang Wei Goh: Conceptualization, data review, revision of manuscript

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Yes

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ABSTRACT

Background: Articular cartilage is an essential component of our joints, and cartilage degeneration or injury may impede quality of life. With the advent of cartilage repair techniques first described in 1994, magnetic resonance imaging (MRI) has been the gold standard in evaluating cartilage repairs post-operatively. In particular, compositional MRI techniques such as T2RV (T2 Relaxation Values) mapping are useful in qualitative and quantitative evaluation, due to its sensitivity for water and collagen content.

Case Report: A 58-year-old male presented with left knee pain from a patella chondral defect at our tertiary institution and underwent a cartilage graft repair (HyaloFast; Anika Therapeutics, Italy). However, almost a year later, his left knee pain was noted to have recurred on follow-up. MRI cartilage studies showed features normally associated with graft viability, despite the patient's persistent symptoms of knee pain on clinical examination.

He subsequently underwent a diagnostic arthroscopy, and the orthopedic surgeon noted that the surface of the previous cartilage graft was filled with fibrocartilage rather than hyaline cartilage, and that there was no viable cartilaginous tissue at the site. The patient then had a revision cartilage patch repair surgery performed (ProChondrix CR; Stryker, USA). His left knee pain significantly improved after.

Notably, MRI cartilage T2RV mapping studies before and after the revision surgery were similar in appearance and showed features suggestive of graft viability, despite the clinical examination and history from the patient.

Conclusion: This case report serves to demonstrate how MRI T2RV mapping should not be solely utilized to assess technical success after cartilage repair surgery though it remains as a suitable non-invasive surveillance option. In addition to repeat MRI cartilage studies, a thorough history-taking to assess symptoms as well as physical examinations are critical in the post-operative follow-up.

CASE REPORT

CASE REPORT

A 58-year-old fit and active male presented to the orthopedic department with a history of knee pain that had persisted for a year. Despite a course of conservative management and intra-articular steroid and hyaluronic acid injections, his condition showed only minimal improvement. He continued to experience patellofemoral and medial compartment pain, which was particularly pronounced when climbing stairs and preventing him from squatting.

Imaging Findings

A routine MRI of the left knee demonstrated an International Cartilage Repair Society (ICRS) Grade 3–4a partial to full thickness patella chondral defect, with associated subchondral cysts and marrow edema at the central patellar ridge, measuring 1.5 × 1.1 cm (Figure 1). He subsequently underwent a mini-open cartilage repair one year after his initial presentation. The procedure involved a single-layer hyaluronan-based scaffold (HyaloFast; Anika Therapeutics, Italy) combined with bone marrow aspirate concentrate (BMAC) harvested from the distal femur during the same surgical session and secured with Cartifill glue. In the initial few months post-operatively, he experienced a notable reduction in left knee pain and an improvement in mobility compared to before

However, 11 months after the initial operation, the patient experienced a recurrence of pain in the left knee, which was exacerbated on climbing and squatting. On physical examination, the range of motion was preserved but there was retropatellar tenderness. The patient expressed a desire for further intervention, prompting the performance of an MRI cartilage T2RV mapping study to assess for graft viability.

The MRI revealed a satisfactory position of the cartilage graft, with only a small focal area of separation on the medial margin. There was ingrowth of cartilage into the curetted defect within the subchondral bone. Furthermore, the surface of the cartilage graft exhibited congruence with the native cartilage (Figure 2). There was mild marrow edema underlying the cartilage graft, grossly stable from the pre-operative MRI.

The patellar ridge cartilage graft exhibited heterogeneous mildly decreased signal intensity compared to the native cartilage. On the T2RV colour maps, the cartilage graft had a homogeneous midrange center demonstrating low to mid-range T2RV values (20-50 ms), with minimal higher T2RV values in the deep zone (60-80 ms), suggesting viability of the cartilage graft (Figure 3)

Although the MRI cartilage T2RV mapping study showed no significant abnormalities to suggest graft failure, diagnostic arthroscopy was performed due to worsening knee pain. During surgery, the orthopedic surgeon noted that the surface of the previous cartilage graft was filled with soft tissue and was unable to withstand compression on probing, suggesting that it could be non-viable cartilaginous tissue or fibrocartilage, instead of hyaline cartilage.

Management

A mini-open revision osteochondral patch repair with bone grafting and allograft cartilage graft (ProChondrix CR; Stryker, USA) and BMAC was performed. The patient's pain significantly improved following the second surgical procedure. At the 6-week mark, the wound had healed well, and the patient was able to move the joint without experiencing pain. At the 3-month mark, the patient had achieved a smooth and painless range of motion of 120 degrees of the knee joint and was able to resume basic exercises such as swimming. At the 8-month mark, the patient reported good outcomes with 90% improvement of his initial knee pain.

Follow-up

A repeat MRI cartilage T2RV mapping study done almost seven months after the revision operation confirmed stable position of the Prochondrix based patellar cartilage graft with minimal surface irregularity and concavity at the central/lateral aspect and a smooth surface at the medial half (Figure 4). The cartilage graft also demonstrated a larger area of homogeneous low to mid-range T2RV (20-50 ms) in the center of the graft with a narrowed high T2RV deep zone (60-80 ms) compared to previous scan (Figure 5). Overall, appearances were similar to the first post-operative MRI cartilage T2RV mapping study.

DISCUSSION

Articular cartilage is an essential component of our joints, for shock absorption and reducing friction on movement. Age-associated cartilage degeneration or injury may contribute to the loss of articular cartilage, impeding quality of life. However, cartilage is avascular and inherently unable to heal itself after injury or degeneration [1]. This led to the conceptualization of cartilage repair techniques which were first described in 1994 [2].

Since then, various surgical techniques have been developed with the common aim of improving pain and mobility while delaying or preventing the progression of osteoarthritis [3]. However, one challenge is the failure to fully promote hyaline cartilage formation, resulting in a predominance of fibrocartilage in the repair tissue. Fibrocartilage is often considered an unsatisfactory but common outcome, due to inferior durability and mechanical properties, making it prone to deterioration and poorer long-term clinical outcomes [4].

Although arthroscopy has long been considered as the gold standard for evaluating post-operative cartilage repair outcomes, magnetic resonance imaging (MRI) is now favored due to its non-invasive nature [4]. Commonly used techniques include fat-suppressed, 3D, gradient echo, and fast spin-echo sequences [5]. However, compositional MRI techniques such as MRI T2RV mapping are increasingly used for qualitative

and quantitative evaluation of the hyaline articular cartilage, due to its sensitivity for water and collagen content [6]. Hyaline cartilage can be expected to show intermediate signal intensity, while fibrocartilage should have low signal intensity due to lower water content.

Imaging plays a critical role in the pre-operative and post-operative period for cartilage repair. Prior to surgery, MRI is used to evaluate the size and depth of the defect and evaluate the surrounding subchondral bone, to decide on the most suitable surgical technique. After surgery, MRI is used to evaluate the success of the repair via various parameters which have been implemented into scoring systems such as the Magnetic Resonance Observation of Cartilage Repair Tissue (MOCART) [7] or Osteochondral Allograft MRI Scoring System (OCAMRISS) [8]. These parameters largely comprise of the degree of defect filling, osseous integration at the host-graft junction, surface congruity of the repair tissue, cartilage graft signal intensity, subchondral bone changes, and marrow edema.

MRI T2RV mapping has also been used to evaluate cartilage graft viability and integration following implantation of acellular scaffolds [9]. This technique calculates T2RV of articular cartilage, including native articular cartilage and cartilage grafts, and generates a color-coded map using post-processing software such as Cartigram (GE Healthcare), allowing analysis and calculation of T2RV in milliseconds. Healthy cartilage grafts generally have a homogeneous T2RV color distribution, T2RV ranges of 20-40 ms, smooth surfaces, congruent and continuous edges flushed with the surrounding native cartilage, and no internal layer formation [9, 10].

Worrisome features for poor graft uptake include persistent marrow edema beyond 12 months, loss of articular surface congruity or collapse, persistent fluid signal intensity within the graft, or poor cartilage or osseous integration at the host-graft junction. Signs of graft rejection or immune response included abnormal host marrow edema, thickening at the graft-host interface, and abnormal graft marrow signal intensity [11].

Etiology and Demographics

In this case report, the patient was an active middle-aged male with a patella chondral defect who initially received a cartilage graft repair with a single-layer hyaluronan-based scaffold. The main advantage of using scaffolds for cartilage repair was the ability to do a single-stage procedure and avoid risks of infection from allograft tissue compared to other techniques like osteochondral auto- and allo-grafting techniques [5]. Unfortunately, almost a year later, his left knee pain recurred on follow-up, and a revision cartilage patch repair was done. It was discovered intra-operatively that the surface of the previous cartilage patch was filled with soft tissue possibly non-viable cartilaginous tissue or fibrocartilage, instead of hyaline cartilage.

Clinical and Imaging Findings

However, in our patient, the initial post-operative MRI lacked features to suggest abnormal graft integration or uptake. The cartilage graft had heterogeneous T2RV distribution and low to mid-range T2RV values (20-50 ms) similar to native cartilage, congruent articular surface, and a continuous internal matrix, which have been reported as radiological features of cartilage graft viability [9].

Treatment and Prognosis

This patient received a revision repair with a bioscaffold (ProChondrix CR; Stryker, USA) and BMAC, with subsequent improvement in pain. This case was an example of how MRI imaging alone could not optimally assess technical success post-operatively. As mentioned earlier, one of the undesired outcomes of cartilage repair is the formation of fibrocartilage instead of hyaline cartilage [12]. The pre- and post-revision surgery MRI cartilage studies in this case exhibited comparable signal intensities, T2RV values and color distribution, unconvincing for fibrocartilage formation. Nevertheless, this conflicted with the persistent symptoms and presence of fibrocartilage seen intra-operatively and echoes the limitations of MRI from the literature, where hyaline cartilage-like profiles have been observed even when fibrocartilage predominated histologically [13].

Furthermore, this case demonstrates that persistent symptoms, rather than imaging, were a reliable indicator of failed repair, ultimately influencing the decision for revision surgery. Subsequently, the patient improved clinically and symptomatically even though imaging remained grossly unchanged. This underscores how functional improvement can occur independently of MRI appearance — a scenario consistent with studies showing limited association between MRI findings and functional outcomes post-cartilage repair [14].

Differential Diagnoses

Many possible reasons for the discordance have been put forth by various studies. Some have suggested that the magic angle effect due to differing fiber orientation in the cartilage may confound T2 values [15]. The asymmetric and/or irregular outline of repair cartilage tissues may also lead to partial volume effects and changes in the fibre orientation [16]. Furthermore, interobserver variability may also influence measurement of T2 values [16]. Salzmann et al reported a poor correlation between quantitative data (T2 mapping) and clinical function and found that qualitative data (MOCART score) offered better correlation with functional outcomes [17]. Overall, the consensus on optimal post-cartilage repair assessment remains mixed, emphasizing a continued need for clinical assessment and, where indicated, arthroscopy for patients with persistent pain.

Future Prospects

Newer imaging modalities may be able to complement T2RV

mapping. T1ρ mapping, Delayed Gadolinium-Enhanced MRI of Cartilage (dGEMRIC), and Sodium MRI may better differentiate hyaline cartilage from fibrocartilage after cartilage repair by assessing key biochemical components. T2RV mapping reflects changes in water content and collagen organization, it is less specific for proteoglycan loss and GAG content. Conversely, T1ρ mapping is sensitive to proteoglycan content, a key component of healthy hyaline cartilage, with promising results for detecting cartilage degeneration compared to T2RV mapping [18]. dGEMRIC can quantify glycosaminoglycan (GAG) concentration with gadolinium enhancement to distinguish hyaline-like cartilage from fibrocartilage or non-viable tissue [19]. Sodium MRI detects sodium ion concentration which directly correlates with GAG levels, providing another non-invasive method to evaluate cartilage matrix composition [20]. Together, these techniques offer complementary, quantitative assessment beyond traditional MRI. Most of these modalities are not yet part of routine imaging, but as research and technology advance, may be implemented into clinical practice.

TEACHING POINT

A multimodal approach to post-operative assessment — including imaging, clinical symptoms, and, when necessary, tissue evaluation — is critical for effective follow-up after cartilage repair surgery. Clinical assessment should be utilized in conjunction with MRI imaging with T2RV-mapping, which remains a good method for non-invasive post-surgical surveillance.

QUESTIONS

Q1. Which of the following statements about cartilage are true?

A. Articular cartilage is able to regenerate over time.

B. Fibrocartilage has inferior load-bearing and shock-absorbing capacity compared to hyaline cartilage. (applies)

C. Fibrocartilage is biomechanically and structurally equivalent to hyaline cartilage.

D. Articular cartilage is an essential part of the knee joint for movement. (applies)

E. Fibrocartilage is considered a less favourable repair outcome in cartilage defect surgeries. (applies)

Explanation:

A. Articular cartilage is avascular and unable to regenerate, hence the conception of cartilage repair techniques. [However, cartilage is avascular and inherently unable to heal itself after injury or degeneration.]

B. Fibrocartilage is an unsatisfactory outcome of cartilage repair due to the poorer load and shock-absorbing tolerance, both of which are crucial mechanical properties. [Fibrocartilage is often considered an unsatisfactory but common outcome, due to inferior durability and mechanical properties, making it prone to deterioration and poorer long-term clinical outcomes.]

C. Fibrocartilage has inferior durability compared to hyaline cartilage. [Fibrocartilage is often considered an unsatisfactory but common outcome, due to inferior durability and mechanical properties, making it prone to deterioration and poorer long-term clinical outcomes]

D. Articular cartilage is critical for smooth movement and shock absorption. [Articular cartilage is an essential component of our joints, for shock absorption and reducing friction on movement.]

E. Hyaline cartilage production is the desired outcome. [However, one challenge is the failure to fully promote hyaline cartilage formation, resulting in a predominance of fibrocartilage in the repair tissue.]

Q2. What diagnostic imaging technique was used to assess the cartilage pre- and post-revision surgery?

A. X-ray imaging

B. Ultrasound exam

C. MRI with T2 relaxation value mapping (applies)

D. CT scan

E. PET scan

Explanation:

A. X-ray imaging would not be able to visualise soft tissue and cartilage.

B. Ultrasound can provide some information on cartilage but is limited by poor penetration of the adjacent bone, which can restrict its utility in assessing the entire cartilage.

C. MRI is now favoured for cartilage assessment in the knee. [Although arthroscopy has long been considered as the gold standard for evaluating post-operative cartilage repair outcomes, MRI is now favoured due to its non-invasive nature.]

D. CT scans have poorer soft-tissue contrast than MRI and are limited in evaluating cartilage.

E. PET scans have inferior spatial resolution for anatomical details like cartilage compared to MRI.

Q3. What limitation of MRI for cartilage assessment was highlighted in this case?

A. It cannot provide multiplanar assessment of the knee joint.

B. It may not reliably differentiate between fibrocartilage and hyaline-like repair tissue. (applies)

C. It is not able to accurately assess lesion size compared to arthroscopy.

D. It cannot detect subchondral bone changes.

E. It cannot reliably detect cartilage graft viability.

Explanation:

A. MRI is able to assess the knee joint and cartilage in multiple planes.

B. In this case, the patient's pre- and post-revision surgery MRI cartilage studies exhibited comparable signal intensities and T2RV values, unconvincing for fibrocartilage formation. [Nevertheless, this conflicted with the persistent symptoms and presence of fibrocartilage seen intra-operatively and echoes the limitations of MRI from the literature, where hyaline cartilage-like profiles have been observed even when fibrocartilage predominated histologically.]

C. MRI tends to underestimate the lesion size compared to arthroscopy, but this is not the limitation of MRI highlighted in

our case. [Prior to surgery, MRI is used to evaluate the size and depth of the defect and evaluate the surrounding subchondral bone, to decide on the most suitable surgical technique.]

D. MRI is sensitive to the changes in the adjacent subchondral bone. [Prior to surgery, MRI is used to evaluate the size and depth of the defect and evaluate the surrounding subchondral bone, to decide on the most suitable surgical technique.]

E. MRI can be used to assess post-repair graft viability with unique methods such as T2 Relaxation Values (T2RV) mapping, generating a color-coded map using post-processing software. [MRI T2-mapping has also been used to evaluate cartilage graft viability and integration following implantation of acellular scaffolds.]

Q4. In evaluating post-operative outcomes of cartilage repair procedures, which of the following are non-invasive complementary assessments beyond MRI?

A. Clinical symptom scoring (applies)

B. CT-based cartilage thickness mapping

C. Functional assessment of return to activity. (applies)

D. Thorough history taking, including symptoms of persistent or worsening pain. (applies)

E. Ultrasound cartilage imaging

Explanation:

A. Clinical symptom scoring can provide a standardized assessment method for post cartilage repair patients. [Clinical assessment should be utilized in conjunction with MRI imaging with T2RV mapping, which remains a good method for non-invasive post-surgical surveillance.]

B. There is limited evidence for CT-based cartilage thickness mapping in cartilage graft repair.

C. Functional improvement is a reliable indicator where MRI is ambiguous. [This underscores how functional improvement can occur independently of MRI appearance — a scenario consistent with studies showing limited association between MRI findings and functional outcomes post-cartilage repair.]

D. Persistent or worsening pain should be paid attention to, as it may be a sign of a failed repair. [Furthermore, this case demonstrates that persistent symptoms, rather than imaging, were a reliable indicator of failed repair, ultimately influencing the decision for revision surgery.]

E. There is limited evidence for ultrasound imaging of cartilage graft repair.

Q5. What does this case primarily illustrate about MRI T2 relaxation values (T2RV) mapping for cartilage assessment?

A. MRI with T2RV mapping is the gold standard and always sufficient for post-operative assessment.

B. MRI with T2RV mapping can always identify hyaline cartilage formation in post-operative cartilage repair.

C. MRI can replace the need for follow-up arthroscopy.

D. MRI findings alone may not correlate well with clinical symptoms and intra-operative findings. (applies)

E. MRI should be combined with clinical evaluation and other diagnostic methods for optimal post-operative assessment. (applies)

Explanation:

A. Although MRI with T2RV mapping is a good non-invasive option, it still requires clinical correlation and functional assessment for a holistic evaluation. [Clinical assessment should be utilized in conjunction with MRI imaging with T2RV mapping, which remains a good method for non-invasive post-surgical surveillance.]

B. There are rare cases where imaging appearances of hyaline cartilage on MRI were discordant with intraoperative findings and functional outcomes. [Nevertheless, this conflicted with the persistent symptoms and presence of fibrocartilage seen intra-operatively and echoes the limitations of MRI from the literature, where hyaline cartilage-like profiles have been observed even when fibrocartilage predominated histologically.]

C. Follow-up arthroscopy can still play a role in such cases where MRI findings are discordant with symptoms in post cartilage repair patients. [Overall, the consensus on optimal post-cartilage repair assessment remains mixed, emphasizing a continued need for clinical assessment and, where indicated, arthroscopy for patients with persistent pain.]

D. Various reasons cause discordance of MRI findings with clinical symptoms and intra-operative findings, such as the magic angle effect, partial volume effects, and interobserver variability. [Overall, the consensus on optimal post-cartilage repair assessment remains mixed, emphasizing a continued need for clinical assessment and, where indicated, arthroscopy for patients with persistent pain.]

E. Ideally imaging, functional assessment, and thorough history taking should be employed together for a holistic post-operative evaluation of the patient. [A multimodal approach to post-operative assessment — including imaging, clinical symptoms, and, when necessary, tissue evaluation — are critical for effective follow-up after cartilage repair surgery.]

REFERENCES

[1] 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): 889–895. PMID: 8078550.

[2] Mankin HJ. The Response of Articular Cartilage to Mechanical Injury. *J Bone Joint Surg Am*. 1982; 64(3): 460–466. PMID: 6174527.

[3] Hayashi D, Li X, Murakami AM, Roemer FW, Trattnig S, Guermazi A. Understanding Magnetic Resonance Imaging of Knee Cartilage Repair: A Focus on Clinical Relevance. *Cartilage.* 2018; 9(3): 223–236. PMID: 28580842.

[4] Liu YW, Tran MD, Skalski MR, et al. MR imaging of cartilage repair surgery of the knee. *Clin Imaging.* 2019; 58: 129–139. PMID: 31325895.

[5] Chang G, Sherman O, Madelin G, Recht M, Regatte R. MR Imaging Assessment of Articular Cartilage Repair Procedures. *Magn Reson Imaging Clin N Am.* 2011; 19(2): 323–337. PMID: 21665093.

[6] Mosher TJ, Dardzinski BJ. Cartilage MRI T2 Relaxation Time Mapping: Overview and Applications. *Semin Musculoskelet Radiol*. 2004; 08(04): 355–368. PMID: 15643574.

[7] Schreiner MM, Raudner M, Marlovits S, et al. The MOCART (Magnetic Resonance Observation of Cartilage Repair Tissue) 2.0 Knee Score and Atlas. *Cartilage.* 2021; 13(1_suppl): 571S-587S. PMID: 31422674.

[8] Chang EY, Pallante-Kichura AL, Bae WC, et al. Development of a Comprehensive Osteochondral Allograft MRI Scoring System (OCAMRISS) With Histopathologic, Micro–Computed Tomography, and Biomechanical Validation. *Cartilage.* 2014; 5(1): 16–27. PMID: 24489999.

[9] Ow ZGW, Wang D, Zhang EJX, et al. Assessing acellular scaffold viability with T2-weighted relaxation time value imaging: imaging variables and early clinical associations at 6 months following patellofemoral cartilage repair. *Journal of Cartilage & Joint Preservation.* 2024; 4(2): 100185.

[10] Zheng Y, Wong SBS, Peter CA, Ho JXM, Goh AGW. Evaluation of the patella following cartilage repair on conventional magnetic resonance imaging and T2 mapping. *Clin Radiol.* 2025; 88: 107006. PMID: 40695009.

[11] Sirlin CB, Brossmann J, Boutin RD, et al. Shell Osteochondral Allografts of the Knee: Comparison of MR Imaging Findings and Immunologic Responses. *Radiology.* 2001; 219(1): 35–43. PMID: 11274532.

[12] Li K, Zhang C, Qiu L, Gao L, Zhang X. Advances in Application of Mechanical Stimuli in Bioreactors for Cartilage Tissue Engineering. *Tissue Eng Part B Rev.* 2017; 23(4): 399–411. PMID: 28463576.

[13] White LM, Sussman MS, Hurtig M, Probyn L, Tomlinson G, Kandel R. Cartilage T2 Assessment: Differentiation of Normal Hyaline Cartilage and Reparative Tissue after Arthroscopic Cartilage Repair in Equine Subjects. *Radiology.* 2006; 241(2): 407–414. PMID: 17057068.

[14] Lineham B, Wijayathunga H, Moran E, et al. A systematic review demonstrating correlation of MRI compositional parameters with clinical outcomes following articular cartilage repair interventions in the knee. *Osteoarthr Cartil Open.* 2023; 5(3): 100388. PMID: 37560388.

[15] Mosher TJ, Zhang Z, Reddy R, et al. Knee Articular Cartilage Damage in Osteoarthritis: Analysis of MR Image Biomarker Reproducibility in ACRIN-PA 4001 Multicenter Trial. *Radiology.* 2011; 258(3): 832–842. PMID: 21212364.

[16] Banitalebi H, Owesen C, Årøen A, Tran HT, Myklebust TÅ, Randsborg PH. Is T2 mapping reliable in evaluation of native and repair cartilage tissue of the knee? *J Exp Orthop.* 2021; 8(1): 34. PMID: 33913035.

[17] Salzmann GM, Erdle B, Porichis S, et al. Long-term T2 and Qualitative MRI Morphology After First-Generation Knee Autologous Chondrocyte Implantation. *Am J Sports Med.* 2014; 42(8): 1832–1840. PMID: 2493658.

[18] Takayama Y, Hatakenaka M, Tsushima H, et al. T1ρ is superior to T2 mapping for the evaluation of articular cartilage denaturalization with osteoarthritis: Radiological–pathological correlation after total knee arthroplasty. *Eur J Radiol.* 2013; 82(4): e192– e198. PMID: 23265927.

[19] Wiener E, Hodler J, Pfirrmann CW. Delayed gadolinium-enhanced MRI of cartilage (dGEMRIC) of cadaveric shoulders: Comparison of contrast dynamics in hyaline and fibrous cartilage after intraarticular gadolinium injection. *Acta Radiol.* 2009; 50(1): 86–92. PMID: 19031166.

[20] Zaric O, Juras V, Szomolanyi P, et al. Frontiers of Sodium MRI Revisited: From Cartilage to Brain Imaging. *Journal of magnetic resonance imaging : JMRI.* 2021; 54(1): 58–75.

FIGURES

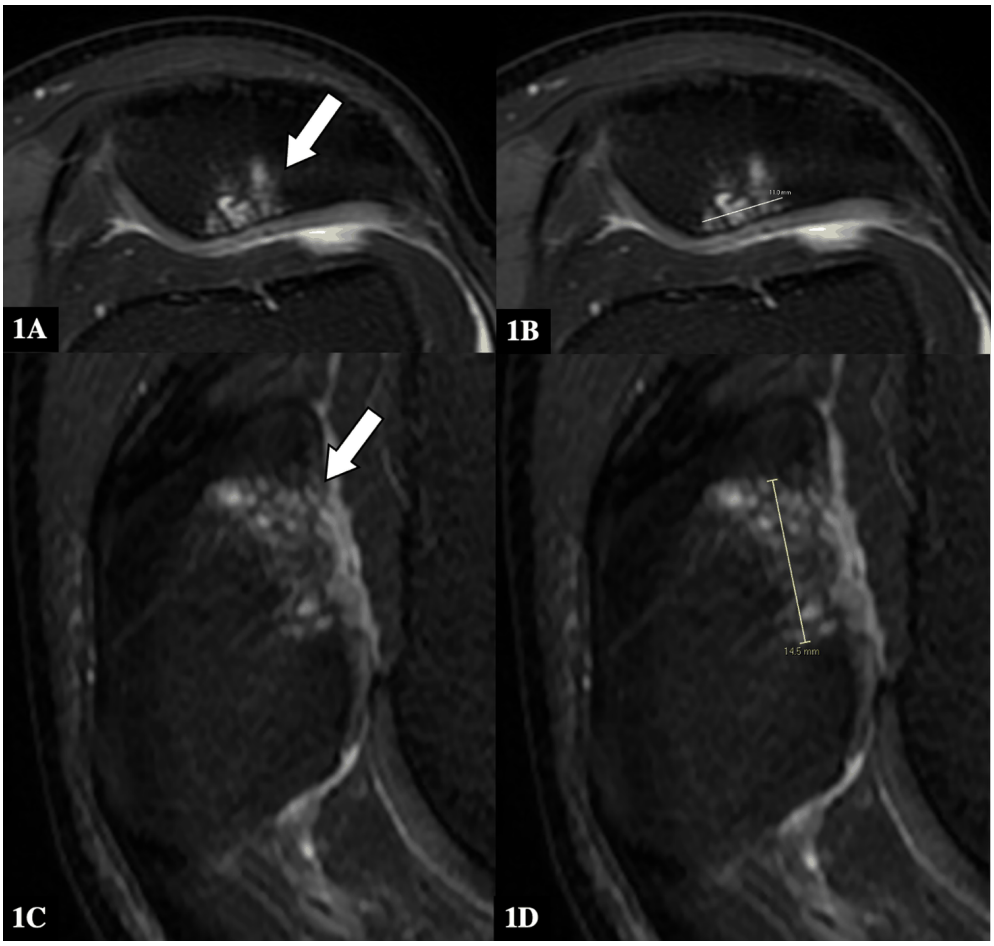

Figure 1: 58-year-old male with a patellar chondral defect.
FINDINGS: Pre-operative unenhanced MRI of the left knee demonstrates a 1.5 x 1.1 cm partial to full thickness chondral defect (arrow) in the patellar ridge with subchondral cysts and bone marrow edema. TECHNIQUE: 1a, 1b) Axial proton density fast spin echo fat suppression sequence on 3T. 1c, 1d) Sagittal oblique T2-weighted fat suppression sequence on 3T.

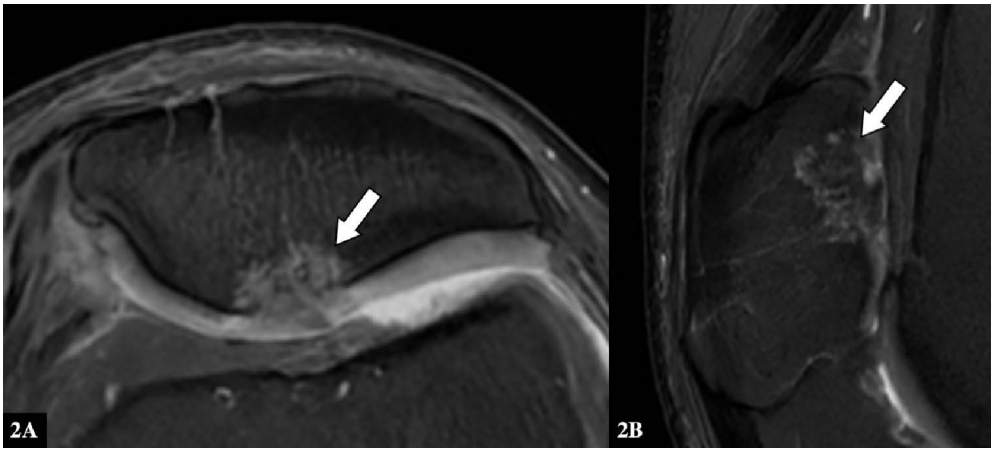

Figure 2: The same 58-year-old male after patellar ridge repair.
FINDINGS: Initial post-operative unenhanced MRI of the left knee showing ingrowth of the patellar repair patch (arrow) into the curetted subchondral bone, with surface congruent with the native articular cartilage. TECHNIQUE: 2a) Axial proton density fast spin echo fat suppression sequence on 3T, 2b) Sagittal oblique T2-weighted fat suppression sequence on 3T.

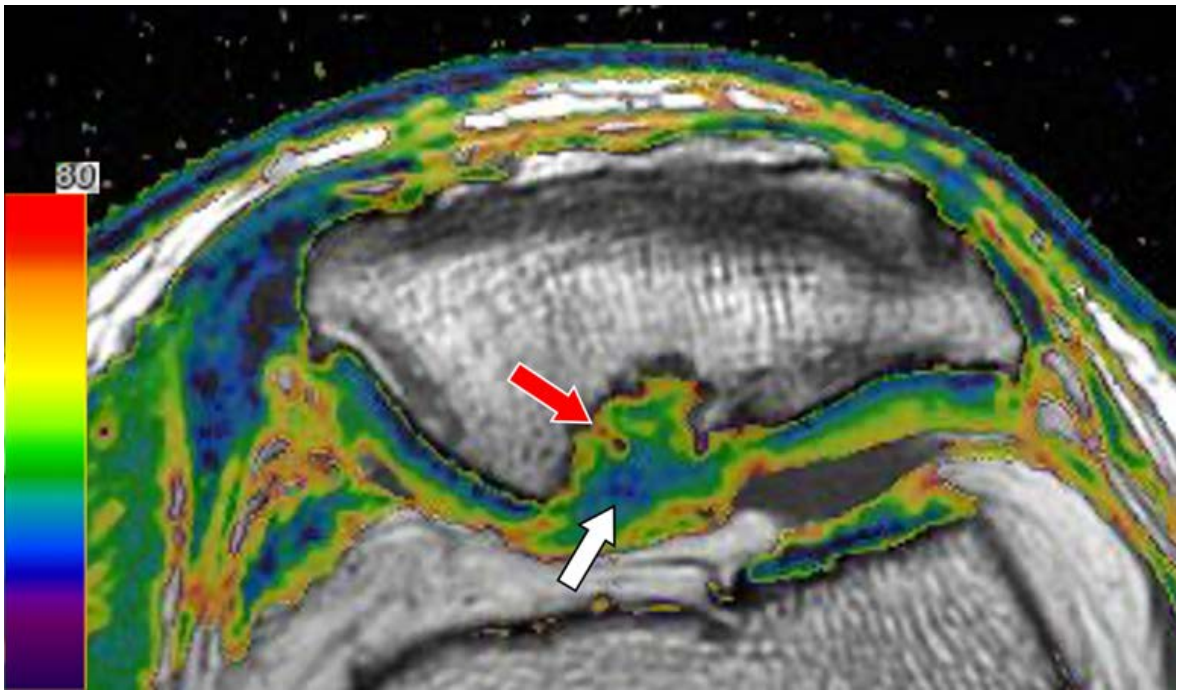

Figure 3: The same 58-year-old male after patellar ridge repair.
FINDINGS: MRI T2RV mapping of the left knee demonstrated low to mid-range T2RV values (20-50 ms) in the superficial and intermediate zones (white arrow) with minimal higher T2RV values in the deep zone (60-80 ms) (red arrow), suggesting viability of the cartilage graft. TECHNIQUE: Axial T2RV map with color-coded scale on the left showing a lower limit of 0 ms and an upper limit of 80 ms.

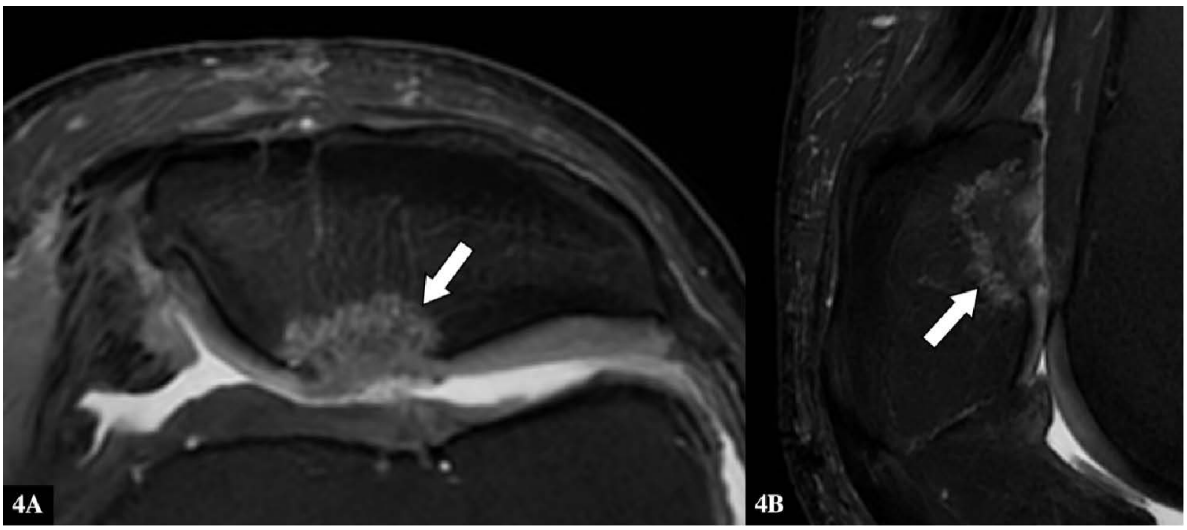

Figure 4: The 58-year-old male after the revision osteochondral patch repair.
FINDINGS: Unenhanced MRI of the left knee showing the new patellar graft (arrow) in stable position with a mild surface irregularity at the central/lateral aspect but smooth surface at the medial half. TECHNIQUE: 4a) Axial proton density fast spin echo fat suppression sequence on 3T, 4b) Sagittal oblique T2-weighted fat suppression sequence on 3T.

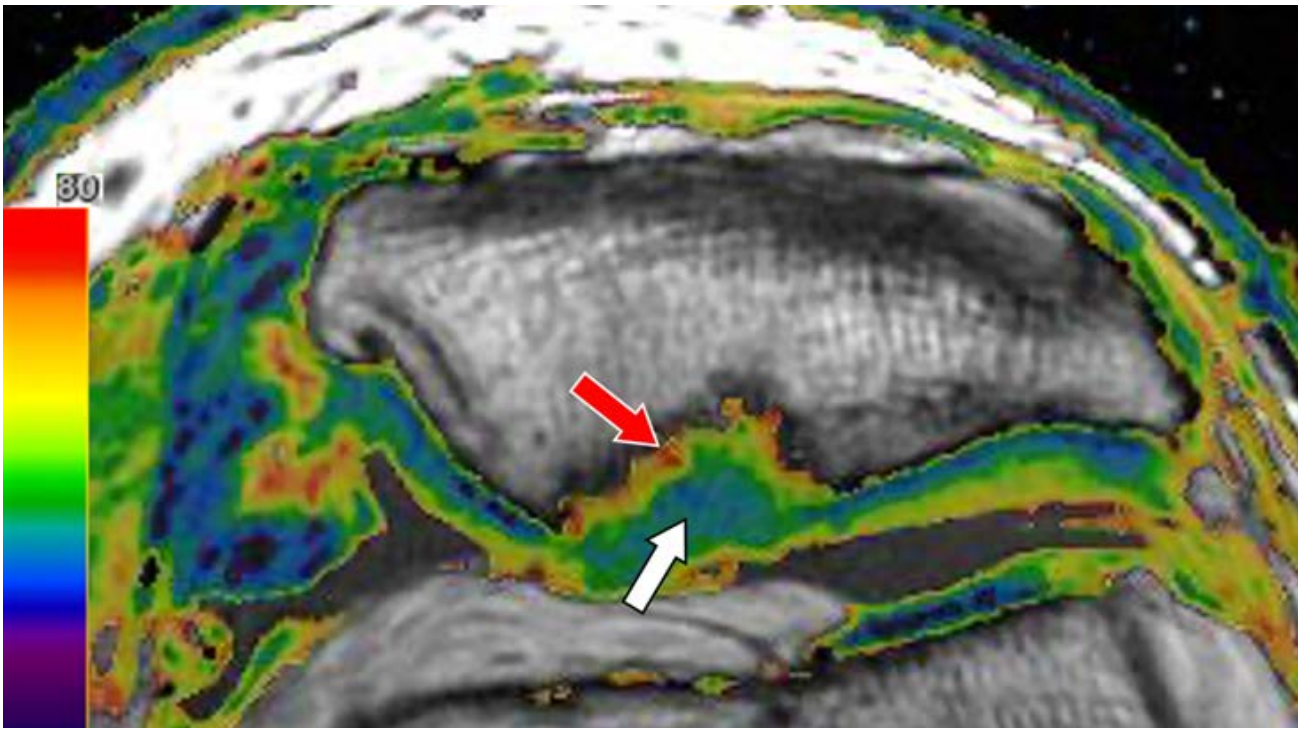

Figure 5: The 58-year-old male seven months after the revision osteochondral patch repair
FINDINGS: MRI T2RV mapping of the left knee shows a larger area of homogeneous low to mid-range T2RV (20-50 ms) in the superficial and intermediate zones (white arrow) with a small region of high T2RV in the deep zone (60-80 ms) (red arrow), overall similar in appearance with the first post-operative MRI Cartilage study. TECHNIQUE: Axial T2RV map with color-coded scale on the left showing a lower limit of 0 ms and an upper limit of 80 ms.

KEYWORDS

Knee Injuries; Cartilage Diseases; Cartilage Repair; Magnetic Resonance Imaging; Cartilage Articular

ABBREVIATIONS

MRI = Magnetic Resonance Imaging
T2RV = T2 Relaxation Values
BMAC = Bone Marrow Aspirate Concentrate
ICRS = International Cartilage Repair Society
MOCART = Magnetic Resonance Observation Of Cartilage Repair Tissue
OCAMRISS = Osteochondral Allograft MRI Scoring System`