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Original Research

Articular cartilage debridement results in short-term significant improvements in patient-reported outcomes for large areas of cartilage loss of the femur in the setting of mild to moderate knee osteoarthritis

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A R T I C L E I N F O

Keywords:
Articular cartilage
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A B S T R A C T

Introduction: Chondroplasty is a surgical option for chondral defects, but its effect on larger cartilage defects in the setting of knee osteoarthritis remains unclear.
Objectives: This study aims to evaluate patient-reported outcomes (PROs) following chondroplasty in patients with larger chondral defects (≥2 cm^2) of the femur in the setting of osteoarthritis.
Materials and methods: Retrospective review of patients who underwent chondroplasty of the femur. All patients had Kellgren-Lawrence (KL) grades of 2 or 3 and a minimum of 1-year postoperative follow-up. Chondral loss was estimated by arthroscopic measurements and by Magnetic Resonance Imaging (MRI). PROs included the International Knee Documentation Committee, Knee Injury and Osteoarthritis Outcome Score for Joint Replacement, and the Veterans Rand-12 Item. Statistical analysis was performed using paired *t* tests to compare baseline and follow-up data, as well as linear regressions to correlate lesion size with symptom improvement.
Results: 39 patients with 20 KL grade 2 and 19 KL grade 3 knees were included. At both 1- and 2-year follow-ups, significant improvements were noted in International Knee Documentation Committee (34.9 ± 13.5 preoperative, 55.6 ± 18.8 at 2 years, $P = .0025$), Knee Injury and Osteoarthritis Outcome Score for Joint Replacement (56.3 ± 14.7 preoperative, 64.5 ± 17.0 at 2 years, $P = .0243$), and Veterans Rand-12 Item Physical Component Scores (38.0 ± 12.7 preoperative, 43.8 ± 8.6 at 2 years, $P = .0044$). Four (10.3%) conversions to arthroplasty were noted at most recent follow-up.
Conclusions: Articular cartilage debridement for large areas of cartilage loss of the femur in the setting of mild to moderate osteoarthritis results in significant improvements in physical function and knee-specific PROs at 1- and 2-year follow-ups.

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Introduction

Articular cartilage debridement (chondroplasty) is a surgical treatment option for small chondral defects or unstable chondral flaps that have failed nonoperative management and can be performed in any joint.[1] Similar to arthroscopic partial meniscectomy (APM), in which prior randomized controlled trials (RCTs) such as the MeTeOR trial demonstrated no difference between APM and controls in those who were initially randomized, chondroplasty has received tepid recommendations as an isolated surgical treatment option for knee osteoarthritis (KOA).[2] However, one limitation of the MeTeOR trial was the amount of crossover between treatment groups, which may have affected the ability to detect differences between the operative and nonoperative arms. Some prior and recent RCTs have reported no benefit of debridement of unstable cartilage lesions compared to surgical placebo in patients with KOA causing some to question the utility of chondroplasty.[3–6]

However, RCTs, while powerful, can overlook nuances when related to surgical care, including selection bias of patients willing to enroll in a surgical trial, varied indications, placebo effect of control procedures, and crossover.[7] RCTs also overlook individual patient pathologies, goals, and decision-making. One of the more challenging clinical scenarios occurs in patients in their fourth to sixth decade who present with large areas of cartilage loss in the setting of mild to moderate KOA (as defined by Kellgren-Lawrence [KL] grade 2 or 3). When applied to degenerative meniscal tears, Warner et al demonstrated significant improvements in patient-reported outcomes (PROs) following APM in patients with KL grade 3 KOA.[8] Similar to meniscal tears, patients with large areas of chondral loss with mild to moderate KOA will often fail conservative measures including physical therapy and knee joint injections yet wish to achieve symptom relief while avoiding arthroplasty. In this setting, procedures typically used to treat more localized cartilage loss, such as microfracture, matrix-induced autologous chondrocyte implantation (MACI), or osteochondral allograft (OAG) transplantation, have been demonstrated to have inferior outcomes with a lack of clinical response and are associated with prolonged rehabilitation periods.[9–12] Alternatively, arthroplasty performed in patients with mild to moderate KOA and incomplete joint space loss is reported to be less effective than in those with advanced KOA (ie, KL 4) on plain radiographs.[13–15] Younger age has also been associated with a higher risk of infection and mechanical failure in knee arthroplasty.[16]

Both mechanical and radiofrequency chondroplasty have been demonstrated to provide significant improvements in PROs in both retrospective cohort studies and systematic reviews of high levels of evidence for the treatment of isolated chondral defects in patients with only mild radiographic KOA (ie, KL 0 and 1).[17–19] Arthroscopic debridement of chondral lesions has a low complication risk profile, reduced morbidity, and a more rapid rehabilitation compared to more invasive chondral restoration procedures and can allow for a high return to sport rate, even in professional athletes.[20] Multiple studies have also demonstrated that following initial knee arthroscopy and chondroplasty for focal chondral defects, there is a relatively low rate of conversion to the second stage MACI or OCA as up to 50% of patients will demonstrate symptomatic improvement following the initial debridement procedure.[21,22] However, there is a paucity of research analyzing the effect of chondroplasty on areas of cartilage loss that are larger than 2 cm^2 in the osteoarthritic knee as most investigations focus only on smaller, localized lesions. Multiple systematic reviews on the subject have indicated that the quality of existing research on articular cartilage debridement in moderate to severe osteoarthritis and large areas of chondral loss is low, especially as it pertains to long-term outcomes.[19,23]

The purpose of this study was to evaluate if there is significant symptom improvement following isolated chondroplasty in patients with large areas of cartilage loss (2-9 cm^2) of the femur with mild to moderate KOA (KL 2 and 3). In these patients in which conservative measures have been exhausted, cartilage restoration procedures such as microfracture, MACI, or OAG provide sub-optimal outcomes at the expense of added morbidity and significantly prolonged rehabilitation. Our hypothesis is that while chondroplasty may still result in conversions to arthroplasty or a subsequent surgical procedure, there will be a significant improvement in pain and PROs in the short-term follow-up period following arthroscopic debridement of articular cartilage or chondroplasty.

Materials and methods

Study design and patient inclusion

A retrospective review was completed of a prospectively maintained database of patients who underwent arthroscopic articular cartilage debridement, or chondroplasty, for areas of cartilage loss of the knee from January 2019 to September 2023. Institutional Review Board approval was obtained (blinded for review). Inclusion criteria were (1) adult patients who underwent chondroplasty for large areas of chondral loss (2-9 cm^2) of the femur (femoral condyle or trochlea), (2) in the setting of mild to moderate KOA, defined by KL grades 2 or 3 on anteroposterior weight-bearing extension knee radiographs, (3) failed extensive nonoperative management including oral analgesics, physical therapy, and injection therapy, and (4) a minimum postoperative follow-up of 1 year with relevant PROs. Large chondral defects were defined as having a total sum chondral defect area (by either Magnetic Resonance Imaging (MRI) or arthroscopic estimate of 1 of 3 reviewers) between 2 and 9 cm^2 on the femur. Patients who underwent significant concomitant procedures (ligamentous reconstruction, osteotomy, or other site cartilage restoration such as salvage MACI/knee osteoarthritis) were excluded.

Patient demographics and lesion characteristics

Demographic information, such as age, sex, body mass index (BMI), and race, was recorded for each patient. Relevant lesion variables, such as laterality, number and locations of debrided chondral defects, and concomitant procedures, were recorded from

operative reports. These defect locations were noted for further review on MRI. Any salvage procedure, such as arthroplasty or cartilage restoration, that occurred after chondroplasty during the follow-up period was recorded.

Radiologic and arthroscopic measurements

Preoperative radiographs for each patient including extension weight-bearing anteroposterior, lateral, patellofemoral, and posteroanterior (PA) flexion weight-bearing views were reviewed to assess for KL grade. Although some recent literature suggests posteroanterior flexion views to measure KL, the original publication recommended anteroposterior weight-bearing extension radiographs, and several studies have demonstrated moderate to excellent reliability with this measurement technique.[24,25] Dimensions of chondral defects were measured on preoperative MRI independently by 2 musculoskeletal fellowship-trained radiologists (blinded for review). Chondral lesions greater than 50% cartilage depth, corresponding to International Cartilage Regeneration & Joint Preservation Society grade 3 or 4[26], were measured in craniocaudal dimensions on sagittal images and transverse dimensions on coronal or axial images depending on lesion location. As is customary for articular cartilage defect sizing, areas were calculated as the length $\times$ width in cm^2. For patients with multiple chondral defects on the femoral condyles or trochlea, the estimated areas were summed. Intraoperative arthroscopic estimates of chondral defect area were also calculated in a similar manner and recorded from operative reports when available.

Patient-reported outcomes

PROs included the International Knee Documentation Committee (IKDC), Knee Injury and Osteoarthritis Outcome Score for Joint Replacement (KOOS JR), and the Veterans Rand-12 Item (VR-12) (both physical and mental components). These assessments were administered through a patient portal (PatientIQ) preoperatively and postoperatively at regular time intervals. At 6-month, 1-year, and 2-year follow-ups, patients were contacted by email to complete follow-up assessments or offered these assessments in clinic by research personnel during their follow-up appointments. Any patient who did not respond at a minimum 1-year postoperative was not included in this analysis and considered lost to follow-up. Minimal Clinically Important Difference (MCID) for each PRO was obtained from previously validated literature, all of which were calculated based on either an anchor- or distribution-based method.[27–29]

Statistical analysis

Intraclass correlation coefficients were calculated to estimate interobserver reliability between all sets of measurements. A Bland-Altman plot was constructed to compare the level of variation between average radiographic and arthroscopic measurements.[30] Student's paired *t* tests were used to compare baseline with 6-month, 1-year, and 2-year follow-up data. Linear regressions were performed to find any correlation between lesion size and symptom improvement. Statistical analysis was performed using Microsoft Excel Version 2308.

Results

A total of 39 patients met all inclusion criteria for the study. A majority of patients were female (51.3%) and White (66.7%). There was a mean age of 51.6 $\pm$ 11.5 years and BMI of 31.2 $\pm$ 7.0, with a mean follow-up of 18.5 $\pm$ 6.00 months (Table 1). Exactly 38.6% of all patients who underwent chondroplasty and completed baseline PROs in our database did not complete 1- or 2-year outcomes, and were therefore considered lost to follow-up.

The mean KL grade for all included patients was 2.49 $\pm$ 0.51 with 20 KL grade 2 and 19 KL grade 3 knees (Table 2). The mean number of lesion areas debrided per patient was 1.33 $\pm$ 0.53. The most common areas for large areas of cartilage loss were the Medial Femoral Condyle (25), trochlea (16), and Lateral Femoral Condyle (11). The mean sum chondral defect area was 4.59 $\pm$ 3.59 cm^2 measured by MRI. Thirty-three of 39 patients had intraoperative arthroscopic estimates of chondral defect dimensions noted. Mean sum chondral defect area estimated arthroscopically was 4.12 $\pm$ 1.89 cm^2. Twenty-seven (69.2%) patients underwent concomitant procedures, of which 22 (54.7%) were concomitant partial meniscectomies. Four patients (10.2%) had a conversion to arthroplasty at most recent follow-up, with 1 total knee arthroplasty and 3 unicompartmental knee arthroplasties. Seven patients (17.9%) had a conversion to OAG at most recent follow-up.

Inter-rater reliability of chondral defect area estimates

The intraclass correlation coefficient between the MRI measurements of radiologists A and B was 0.667, indicating a moderate interobserver reliability. The intraclass correlation coefficient between both radiologists' estimates and intraoperative arthroscopic measurements was 0.354, indicating poor reliability. Analyzing further, creating a Bland-Altman plot with regression limits of agreement comparing the average MRI estimate with arthroscopic estimates (Fig. 1) gives a slope with a 95% confidence interval (0.65, 1.75) that does not include 0, suggesting proportional bias. The degree of difference between arthroscopic and MRI estimates increases the larger the estimate is. However, performing a paired *t* test between MRI and arthroscopic measurements within our sample demonstrates no significant difference between the 2 values ($P = .491$).

Table 1
Baseline demographic characteristics of cohort.

Characteristic	Total ($N = 39$)
Age (y)	51.6 ± 11.5
BMI	31.2 ± 7.0
Sex	
Male	19 (48.7%)
Female	20 (51.3%)
Race	
White	26 (66.7%)
Asian American/Pacific Islander	3 (7.7%)
Black or African American	1 (2.6%)
Other race	5 (12.8%)
Unknown	4 (10.3%)
Maximum follow-up	
Mean	18.5 ± 6.0
24-month follow-up	18 (46.2%)
12-month follow-up	21 (53.8%)
Laterality	
Right	18 (46.2%)
Left	21 (53.8%)
Mean number of lesions	1.33 ± 0.53
Concomitant procedures	27 (69.2%)
Meniscectomy	22 (56.4%)
Medial	9 (23.1%)
Lateral	6 (15.4%)
Medial and lateral	7 (17.9%)
Meniscal root repair	3 (7.7%)
Internal fixation	2 (5.1%)
Loose body removal	1 (2.6%)

Table 2
Lesion characteristics as measured on preoperative MRI and intraoperative arthroscopic evaluation.

Characteristic	
Kellgren-Lawrence grade	
Mean	2.49 ± 0.51
Grade 2	20 (51.3%)
Grade 3	19 (48.7%)
Mean number of lesions	1.33 ± 0.53
Lesion location	
Medial femoral condyle	25
Trochlea	16
Lateral femoral condyle	11
Estimated sum chondral defect area (cm^2)	
Arthroscopic	4.12 ± 1.89
Range*	1.44-8.29
Interquartile range	2.56-4.95
Radiologist A and B average	4.59 ± 3.85
Range	1.43-22.68
Interquartile range	2.39-5.64
Radiologist A	5.44 ± 5.22
Range	0.12-26.91
Interquartile range	2.09-7.32
Radiologist B	3.79 ± 2.97
Range	0.80-18.44
Interquartile range	2.22-4.43

* Methods of area estimation have a high degree of variability and often do not agree. If a patient had an area between 2 and 9 cm^2 from any of the 3 sets of estimates, they were included in this study. In some cases, one or both of the other estimates were outside 2-9 cm^2. This accounts for any discrepancies in range.

Patient-reported outcomes

At 6-month, 1-year, and 2-year follow-ups, significant improvements were noted in IKDC and KOOS JR compared to preoperative outcome assessment. VR-12 Physical Component Scores also improved significantly at 1- and 2-year follow-ups, but there was no

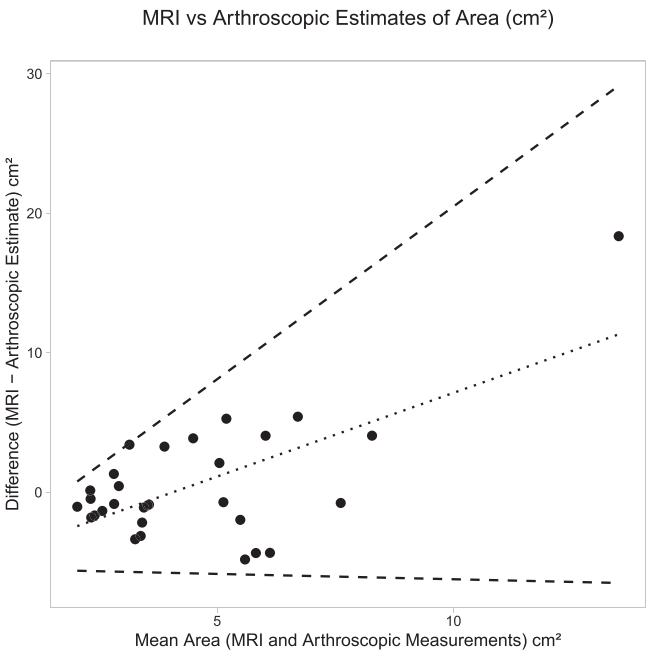

Fig. 1. Bland-Altman plot comparing arthroscopic measurements and average measurement of both radiologists.

statistically significant change in VR-12 Mental Scores. All 3 increases in IKDC, KOOS JR, and VR-12 physical scores at 1-year follow-up exceeded previously reported MCID for these outcomes (Table 3).

Figure 2 demonstrates improvements in PROs in IKDC, KOOS JR, and VR-12 physical function in patients who have both preoperative and 2-year postoperative outcomes. Figure 3 highlights this relationship over time.

Table 3
Comparisons between mean patient-reported outcome scores preoperatively, 6-month, 1-year, and 2-year follow-ups.

Time	Preoperative	6 months	1 year	2 years
IKDC				
N	35	29	35	21
Mean*	34.9 ± 13.5	50.1 ± 21.7	52.9 ± 20.7	55.6 ± 18.8
Mean change from preoperative†		+16.4	**+19.5**	+20.8
MCID—Chahal et al[27]			**+9.1**	
P-value		**< .0001**‡	**< .0001**‡	**.0025**‡
KOOS JR				
N	35	29	35	18
Mean	56.3 ± 14.7	65.1 ± 19.4	66.0 ± 19.5	64.5 ± 17.0
Mean change from preoperative		+11.9	**+10.7**	+12.4
MCID—Emara et al[28]			**+6.7**	
P-value		**< .0001**‡	**.0046**‡	**.0243**‡
VR-12 Mental Component				
N	37	30	29	19
Mean	52.3 ± 12.6	55.5 ± 12.0	52.0 ± 14.8	53.5 ± 10.1
Mean change from preoperative		+3.4	−3.2	+4.2
P-value		.1711	.2868	.2456
VR-12 Physical Component				
N	37	29	33	16
Mean	38.0 ± 12.7	40.7 ± 12.8	44.1 ± 13.4	43.8 ± 8.6
Mean change from preoperative		+2.6	**+6.1**	+7.3
MCID—Molino et al[29]			**+2.46**	
P-value		.2234	**.0055**‡	**.0435**‡

IKDC, International Knee Documentation Committee; KOOS JR, Knee Injury and Osteoarthritis Outcome Score for Joint Replacement, MCID, Minimal Clinically Important Difference; PRO, patient-reported outcome; VR-12, Veterans Rand-12 Item.

* Mean change of differences between the follow-up time period and preoperative PROs when both values exist. Only patients with PROs at both time periods are included, ie, a patient with baseline PROs, but no 2-year PROs would be excluded.

† *P*-value for 2-tailed paired *t* test between follow-up time period and preoperative PROs when both values exist.

‡ Statistically significant, p < .05

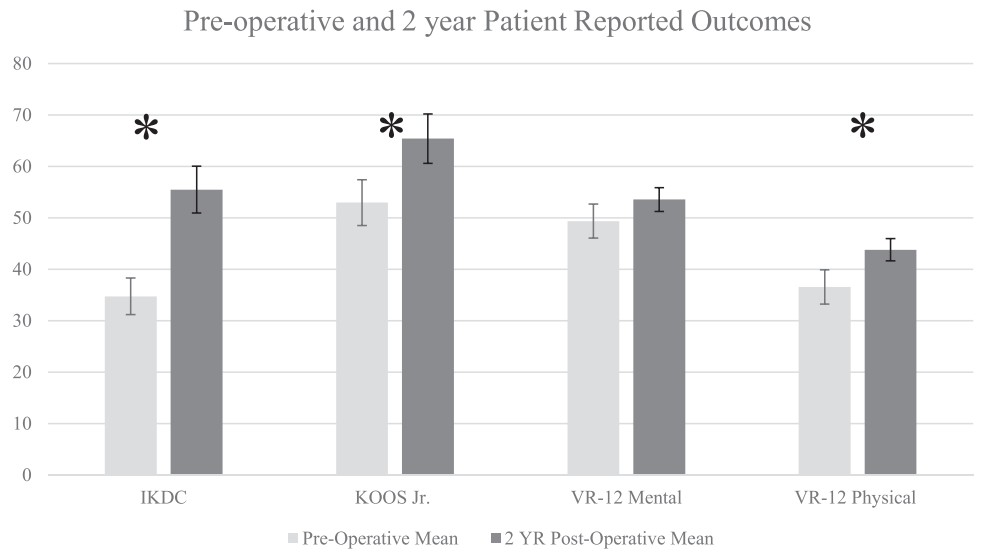

Fig. 2. Comparison between preoperative and 2-year follow-up patient-reported outcomes. IKDC, International Knee Documentation Committee; KOOS JR, Knee Injury and Osteoarthritis Outcome Score for Joint Replacement, VR-12, Veterans Rand-12 Item.

There was no correlation between lesion size and degree of improvement in IKDC, KOOS JR, or VR-12 (Table 4). There is no evidence to suggest that patients with larger areas of femoral condyle involvement received any less benefit from articular cartilage debridement.

Further exploring the topic of lesion size and symptom improvement, analyzing IKDC scores for large lesions assessed by MRI (as defined as mean chondral defect size $> 5\ cm^2$ as assessed by either radiologist) found significant increases compared to baseline at 6-month, 1-year, and 2-year follow-ups (Table 5). The increases in IKDC at 6 months, 1 year, and 2 years in the large lesions cohort (14.3, 20.0, and 21.0) were similar to the overall cohort (16.4, 19.5, and 20.8, respectively).

Discussion

The main finding of this study is that patients with large areas of cartilage loss of the femur in the setting of mild to moderate Osteoarthritis (OA) according to the KL grading system benefit at a minimum 1-year follow-up with arthroscopic debridement and chondroplasty confirming our hypothesis that chondroplasty can provide significant improvements in PROs in the short-term in patients with areas of cartilage loss and KOA.

The degree of improvement at 1 year in IKDC (19.5), KOOS JR (10.7), and VR-12 Physical Component summary (6.1) exceeded previously established thresholds for MCID for these outcomes. A 2021 investigation by Chahal et al reported a value of 9.1 for IKDC at 1 year using an anchor-based method on patients undergoing cartilage restoration procedures of the knee[27]. A 2024 study by Emara et al reported an MCID of 6.7 for KOOS JR in patients with KOA using a distribution-based approach.[28] A 2022 study by Molino et al, investigating a number of MCIDs for knee-specific PROs, established an MCID of 2.46 for the VR-12 PCS at 1 year using an anchor-based method.[29]

This finding is in contrast to 2 recent RCTs performed by Bisson et al as part of the Chondral Lesions and Meniscus Procedures (CHaMP) trial.[3,4] In their studies, they randomized patients undergoing APM who had unstable chondral lesions to either mechanical debridement or observation. Notably, however, they excluded unstable chondral lesions that were minimally attached to native cartilage and appeared to be an "imminent loose body" representing patients who would likely derive the most benefit from surgery. They demonstrated a mean age of 54, similar to our study, and at a mean follow-up of 61.2 months with significant improvements in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), KOOS, and visual analog scale (VAS) scores in both groups, but no significant differences between groups.[4] Notably, patients who enroll in randomized controlled surgical trials are often affected by the fact that they are part of a formal clinical study leading to contextual bias rather than true physiologic differences attributed to the interventions. Similar to the MeTeOR trial, the CHaMP trial also had significant crossover between treatment arms, perhaps contributing to the fact that they also did not demonstrate significant differences. The 61-month follow-up period in the CHaMP trial is also of note. In clinical practice, patients are aware of the fact that interventions, such as APM or chondroplasty, are not long-term curative solutions for underlying degenerative joint disease. Such a long-term follow-up could mask short-term benefits. In fact, the CHaMP trial found lower WOMAC pain scores in the chondroplasty arm at 6 weeks postoperatively, and this difference disappeared at longer-term follow-up. Our study demonstrated a similarly significant improvement in KOOS scores, as well as IKDC and VR-12 physical scores highlighting the difficulty of interpreting RCTs in surgical patients; while it might be generalized that the CHaMP trial indicates that chondroplasty has no benefit, patients still significantly improved with APM and chondroplasty.

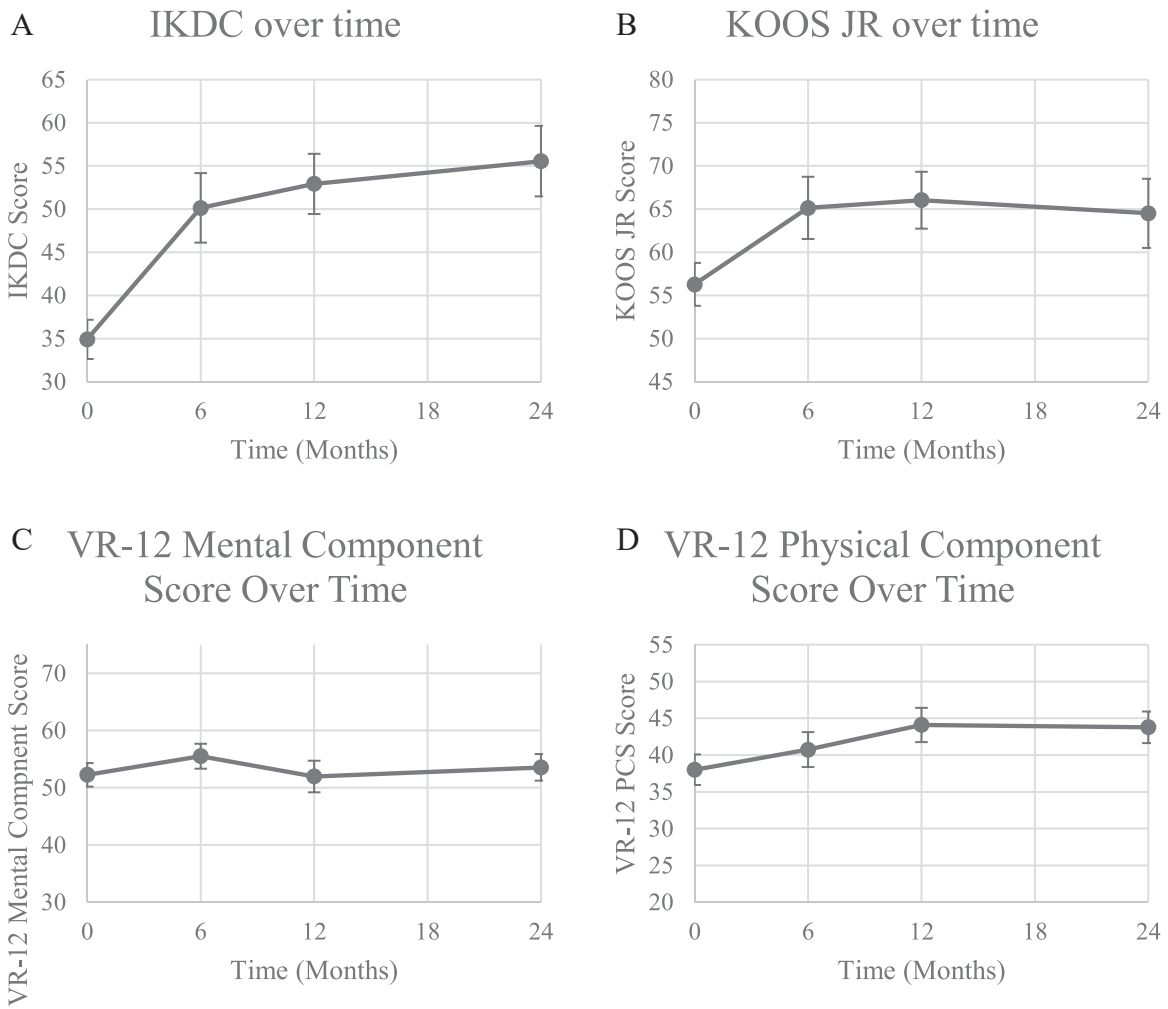

Fig. 3. A-D, Change over time in patient-reported outcome scores in IKDC (**A**), KOOS JR (**B**), VR-12 Mental Component Score (**C), and** VR-12 Physical Component Score (**D**). IKDC, International Knee Documentation Committee; KOOS JR, Knee Injury and Osteoarthritis Outcome Score for Joint Replacement, VR-12, Veterans Rand-12 Item.

Table 4
Linear regression analysis of correlation between lesion size and patient-reported outcomes.

Patient-reported outcome	R^2	F-statistic	*P*-value
IKDC	0.0019	0.0521	.8211
KOOS JR	0.0157	0.4456	.5099
VR-12 Mental	0.0004	0.0103	.9199
VR-12 Physical	0.0017	0.0488	.8268

IKDC, International Knee Documentation Committee; KOOS JR, Knee Injury and Osteoarthritis Outcome Score for Joint Replacement, VR-12, Veterans Rand-12 Item.

Anderson et al published a similar retrospective cohort of 56 patients with mean age of 37.3 years and mean 31.5 month follow-up, demonstrating improvements in KOOS, IKDC, WOMAC, and VR-12 scores with mechanical chondroplasty for focal cartilage lesions of the knee.[18] They similarly found no relationship between lesion size and symptom improvement; however, their cohort excluded any patients with KOA. Cotter et al included all patients with KL grades 1 to 3 who underwent mechanical chondroplasty in a recent systematic review of 8 studies and 773 patients.[19] Their mean ages were most commonly between 55 and 65, similar to our study, and they similarly found improvements in the above PROs at a minimum of 1- to 4-year follow-ups. Defect sizes were not included as part of their analysis.

Similar discrepancies between RCTs and cohort studies exist in the literature regarding APM in the setting of mild to moderate KOA. Prior RCTs in the literature by Katz et al (MeTeOR trial) and Moseley et al have reported no clinical benefits of APM in the

Table 5
IKDC scores in patients with large lesions (sum $> 5\,cm^2$) by MRI.

Time	Preoperative	6 months	1 year	2 years
IKDC				
N	15	12	14	11
Mean*	32.0 ± 13.4	46.5 ± 18.9	52.3 ± 18.6	55.7 ± 21.0
Mean change from preoperative†		+14.3	**+20.0**	+21.0
MCID—Chahal et al[27]			**+9.1**	
P-value		**.0120**‡	**.0011**‡	**.0106**‡

‡Statistically significant, $p < .05$.
IKDC, International Knee Documentation Committee; MCID, Minimal Clinically Important Difference; PRO, patient-reported outcome.
* Mean change of differences between the follow-up time period and preoperative PROs when both values exist. Only patients with PROs at both time periods are included, ie, a patient with baseline PROs, but no 2-year PROs would be excluded.
† *P*-value for 2-tailed paired *t* test between follow-up time period and preoperative PROs when both values exist.

setting of mild to moderate KOA when compared against physical therapy and placebo surgery, respectively.[2,6] However, in the MeTeOR trial, over 30% of patients in the nonoperative group crossed over to surgery due to failure of nonoperative management, and in Moseley et al's RCT, there were significant improvements in both APM and placebo surgery, demonstrating the clinical benefits of surgical treatment in general in this patient population. A 2024 recent 10-year follow-up RCT study by Sonesson et al demonstrated no differences in radiographic or symptomatic OA progression or conversion to arthroplasty between APM and nonoperative treatment, showing APM provides short-term significant improvements at a low complication risk profile.[31] Warner et al also reported this year on 82 patients with mean age of 53.1 and KL grade 3 knees, demonstrating statistically and clinically significant improvements in short-term KOOS and VAS with APM, again supporting the argument that while large scale, "bird's eye view" RCTs may miss the significant benefit of APM or arthroscopic debridement in "gray area" patients with mild to moderate KOA, a closer look reveals their clinical utility.[8]

There are few studies in the literature that utilize arthroscopic debridement, or chondroplasty, as the control group in comparative studies for large areas of chondral loss in the setting of KOA which are outnumbered by the number of studies that utilize microfracture as the control group.[32–39] This is despite microfracture demonstrating short-lived improvements in PROs with significant declines after 2 years and questionable responsiveness in patients with larger areas of cartilage loss which is directly correlated with radiographic findings of KL 2 and 3.[38–40] In addition, following microfracture, future cartilage restoration procedures demonstrate significantly increased failure rates and inferior PROs when compared to cartilage restoration procedures without prior microfracture.[41–43] In contrast, chondroplasty demonstrates no such deleterious effects on future MACI or OAG procedures and has an extremely low complication rate profile, with only rare cases of osteonecrosis or subchondral insufficiency fractures reported in the literature.[44]

We found moderate reliability in assessing the size of chondral defects via MRI between radiologists and poor reliability between MRI and intraoperative arthroscopic measurements. This discrepancy has been noted in prior studies on MRI evaluations of chondral defects.[45] An interesting finding in our study that contrasted prior studies is that MRI measurements did not underestimate chondral defect size compared to arthroscopy. Studies by Gomoll et al, Campbell et al, and Bi et al have all found that MRI consistently underestimated the size of chondral lesions in the knee when compared to arthroscopy.[46–48] However, these studies all report on chondral defects of sizes ranging from 1.6 to $3.6\,cm^2$, smaller than our study which focused on larger areas of cartilage loss which suggests that the MRI underestimation of chondral defect size may be mitigated in the setting of larger chondral lesions.

Limitations

There are several limitations to this study. This was a relatively small cohort without a comparative control group, which in this case would ideally be a nonoperatively managed randomized or matched cohort. Notably, most of these patients had failed nonsurgical treatment which included corticosteroid and or hyaluronic acid injections with or without physical therapy. Therefore, while we can interpret that arthroscopic chondroplasty provides improvement in short-term PROs in patients with large areas of cartilage loss of the femur in the setting of mild to moderate KOA on radiographs, we cannot state that it provides greater improvement than sham surgery, or injection therapy implemented in a randomized controlled and blinded environment. The small cohort was a result of strict inclusion criteria; KL grade 2 and 3 knees, large ($\geq 2\,cm^2$) areas of articular cartilage degeneration, and a minimum follow-up with PROs of 1 year.

Conclusions

Articular cartilage debridement, or chondroplasty, for large ($2\text{-}9\,cm^2$) areas of cartilage loss of the femur in the setting of mild to moderate KOA (KL grade 2 or 3) results in significant improvements in physical function and knee-specific PROs at 1- and 2-year follow-ups.

Ethics approval

This study was approved by the Institutional Review Board (IRB) at Rush University Medical Center under an "Exempt" status (with a waiver of informed consent). Approval was obtained on July 31, 2024, Approval—ORA #: 24072312-IRB01. This study was given exempt status from the issuing IRB.

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Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Corresponding author—Aesculap/B.Braun: research support (B.J.C.), Medipost Inc: research support (B.J.C.), American Journal of Sports Medicine: editorial or governing board (B.J.C.), Arthrex Inc: IP royalties, paid consultant, research support (B.J.C.), Bandgrip Inc: stock or stock options (B.J.C.), Elsevier Publishing: IP royalties, publishing royalties, financial or material support (B.J.C.), Journal of the American Academy of Orthopedic Surgeons: editorial or governing board (B.J.C.), JRF Ortho: other financial or material support (B.J.C.), National Institutes of Health (NIAMS and NICHD): research support (B.J.C.), Ossio: stock or stock options (B.J.C.). The other authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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