


The Effect of Lesion Size on Pain and Function in Patients Scheduled for Cartilage Surgery of the Knee

CARTILAGE
April-June 2022: 1–7
© The Author(s) 2022
DOI: 10.1177/19476035221109242
journals.sagepub.com/home/CAR


Per-Henrik Randsborg¹ , Asbjørn Årøen^{1,2},
and Christian Owesen¹

Abstract

Objective. Despite an increased interest in treatment options for cartilage lesions of the knee, the relationship between lesion characteristics and the symptoms they elicit is not well understood. We evaluated the relationship between lesion characteristics and the patient-reported outcome measures (PROMs) and compared this with symptoms reported by patients scheduled for knee ligament reconstruction and knee arthroplasty. **Design.** Preoperative data, including Lysholm score and The Knee Injury and Osteoarthritis Outcome Score (KOOS), in 90 consecutive patients scheduled for surgery for symptomatic isolated cartilage lesions were prospectively collected. **Result.** The patients had a mean age of 33.2 years. There were 62 (69%) males. There was no statistically significant difference in PROMs between patients with cartilage lesions smaller or larger than 2 cm², except for the KOOS subscale symptoms, with patients with smaller lesions reporting higher scores, 62.8 (95% confidence interval [CI] 58.3–67.3) vs. 51.9 (95% CI 45.5–58.4), $P = 0.005$. There was a small correlation between lesion size and Lysholm score. However, when adjusted for age, sex, body mass index, and lesion localization, this effect was not statistically significant. The International Cartilage Regeneration & Joint Preservation Society grade did not affect preoperative PROMs. Cartilage patients reported worse preoperative symptoms than patients scheduled for knee ligament reconstruction, and approaching the symptoms reported by patients scheduled for knee arthroplasty. **Conclusion.** The size, depth, and location of cartilage lesions have little impact on the symptoms experienced by the patients. Cartilage patients have comparable symptoms to patients scheduled for knee arthroplasty.

Keywords

articular cartilage injury, ACL, MPFL, arthroscopy, PROM

Introduction

Focal cartilage lesions of the knee remain a challenging condition for patients as well as orthopedic surgeons. However, the relationship between the cartilage lesions and symptoms is not fully understood. Some studies have found a lack of clear relationship between intraarticular knee pathology and patient-reported symptoms,^{1,2} while others have reported that such a relationship exists.^{3,4}

The etiology of a focal cartilage lesion may be trauma, osteochondritis dissecans or osteonecrosis. Some lesions give no or little symptoms,⁴ whereas other lesions lead to disabling pain and loss of function in daily activities. Symptoms may be related to size, depth, or location of the lesion. Symptoms may also be affected by other factors, such as sex, body mass index (BMI), activity level, and age. Further understanding of the impact on lesion size and symptoms is important to advance our understanding of

this difficult injury. Despite the fact that the lesion size influences the choice of management,^{5,6} there is little data in the literature on the effect of lesion size and location on function and patient-reported symptoms. Although attempts have been made to outline this previously,⁷ the current manuscript delineate a more complete outline of this particular knee injury in comparison to other common knee conditions subjected to surgery.

In the present study, we look closer at patients scheduled for surgery of a focal cartilage lesion in a symptomatic

¹Department of Orthopedic Surgery, Akershus University Hospital, Lørenskog, Norway

²Institute of Clinical Medicine, University of Oslo, Lørenskog, Norway

Corresponding Author:

Per-Henrik Randsborg, Department of Orthopedic Surgery, Akershus University Hospital, Sykehusveien, 1478 Lørenskog, Norway.
Email: pran@ahus.no



Table 1. Inclusion and Exclusion Criteria.

Inclusion Criteria	Exclusion Criteria
Age 18–50 years old	Osteoarthritis or systemic arthritis
Single symptomatic cartilage defect on a femoral condyle or trochlea	Malalignment >5° measured on HKA images
Lysholm score < 75	Obesity (body mass index > 30)
Lesion graded ICRS 3-4	Comorbidities that may influence surgery or rehabilitation
Ligamentous stable knee	Pregnancy
Acceptable range of motion (5°-105°)	Inability to complete questionnaires or rehabilitation
> 50% intact meniscus	Serious alcohol or drug abuse
Informed consent	Previous surgery to the defect except OCD surgery

HKA = hip-knee-ankle; ICRS = International Cartilage Regeneration & Joint Preservation Society; OCD = osteochondritis dissecans.

knee. The aims of this study were to investigate how lesion size, location, or depth relate to the patient's preoperative symptoms and if factors such as age, sex, BMI, or activity level are related to the preoperative symptoms experienced by the patients. We also wanted to investigate how these symptoms correlate to symptoms from other knee conditions such as anterior cruciate ligament (ACL) injuries, recurrent patella dislocations, and osteoarthritis.

Method

Patients

The inclusion criteria were men and women aged 18 and 50 years scheduled for surgery due to an isolated focal cartilage lesion of the femoral condyle or the trochlea diagnosed on magnetic resonance imaging (MRI), without malalignment of the lower extremities, no previous cartilage surgery, a ligamentous stable knee, and no radiographic evidence of osteoarthritis (**Table 1**).

Ninety consecutive patients scheduled for cartilage surgery due to symptomatic lesions of the femoral condyle or trochlea were included in the study (**Fig. 1**). The patients had a mean age of 33.2 (SD = 9.3) years at the time of inclusion. There were 62 (69%) males. The lesion size, depth, and location were verified and measured preoperatively after debridement using a chondral measuring ruler and an arthroscopic hook. Most patients (53, 59%) had a cartilage lesion smaller than 2 cm², most frequently located on the medial femoral condyle. The distribution of the patient characteristics and cartilage lesions are presented in **Table 2**.

Patient-Reported Outcome Measures

The patients completed the following validated patient-reported outcome scores prior to surgery:

Lysholm score. Lysholm score is a knee-specific outcome score containing 8 domains: limp, locking, pain, stairclimbing, use of support, instability, swelling, and squatting.⁸ The Lysholm score quantifies the knee function on a scale from

0 to 100 (best) and has been recommended as an outcome measure in knee cartilage injuries.⁹

The Knee Injury and Osteoarthritis Outcome Score (KOOS). The KOOS score is a widely used questionnaire, which assesses 5 patient-reported domains: pain, symptoms, activity of daily living, sport and recreational function, and knee-related quality of life. A score from 0 to 100 (best) is calculated for each subscale which are independently used in all outcome comparisons, as recommended by Roos *et al.*¹⁰

Visual analog scale (VAS) score. A VAS for pain was used, where 0 represents no pain and 10 represents the worst pain imaginable. VAS was provided for sitting and standing separately.

The patient-reported outcomes were compared with the symptoms reported by patients scheduled for ACL reconstruction reported to the Norwegian Knee Ligament Register,¹¹ patients scheduled for medial patellofemoral ligament (MPFL) reconstruction due to patella instability,¹² and patients scheduled for knee arthroplasty reported to the Norwegian arthroplasty registry.¹³

Statistics

Continuous variables are presented as mean, median, 95% confidence interval (CI), range, and standard deviation (SD), while categorical data are presented in frequencies. Nonparametric variables were compared using the Mann-Whitney *U* test, while normally distributed variables were compared using Student *t* test. Categorical data were compared using the chi-squared test. Linear regression analysis was performed with adjustment for age, gender, and body mass index (BMI). A *P* value of <0.05 was considered significant. The analysis was performed using the Statistical Package for Social Sciences (SPSS) version 25 (IBM Corp, Armonk, NY, USA).

Results

There was no statistically significant difference in patient-reported symptoms at the time of inclusion between patients with cartilage lesions smaller or larger than 2 cm², except

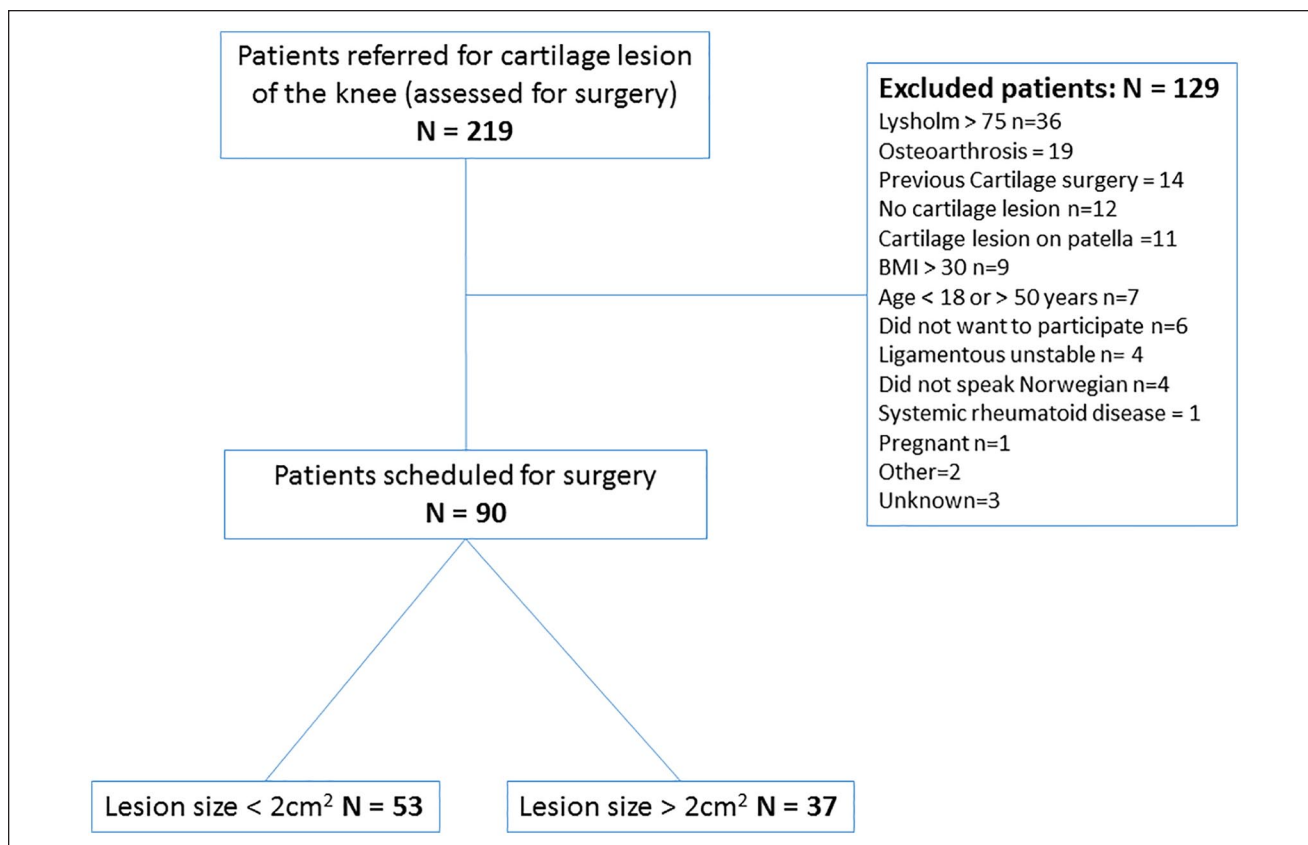


Figure 1. Flowchart of included patients.

Table 2. Demographics and Patient Characteristics in 90 Patients with Full Thickness Isolated Cartilage Lesions of the Knee Scheduled for Surgery.

	All (N = 90)	Lesion < 2 cm ² (n = 53)	Lesion ≥ 2 cm ² (n = 37)	P value
Age (years) mean (SD)	33.2 (9.3)	31.8 (9.5)	35.2 (8.7)	0.086
Males, n (%)	62 (69%)	38 (71.7 %)	24 (64.9 %)	0.5
BMI (kg/m ²), mean (SD)	25.9 (3.6)	25.8 (3.3)	26.0 (4.1)	0.8
Area (cm ²), mean (SD)	2.35 (1.8)	1.2 (0.42)	4.1 (1.6)	
ICRS				0.007
Grade 3, n (%)	54 (60%)	38 (71.7%)	16 (43.2%)	
Grade 4, n (%)	36 (40%)	15 (28.3%)	21 (56.8%)	
Localization				0.1
MFC	51 (56.7%)	27 (50.9%)	24 (64.9%)	
Trochlea	17 (18.9%)	10 (18.9%)	7 (18.9%)	
LFC	22 (24.4%)	16 (30.2%)	6 (16.2%)	
Tegner				
Median (range)	3.0 (0-10)	3.0 (0-10)	3.0 (0-7)	0.8 ^a

SD = standard deviation; BMI = body mass index; ICRS = International Cartilage Regeneration & Joint Preservation Society; MFC = medial femoral condyle; LFC = lateral femoral condyle.

^aMann-Whitney U test.

for the KOOS subscale symptoms, with patients with smaller lesions reporting higher scores, 62.8 (58.3-67.3) vs. 51.9 (45.5-58.4), $P = 0.005$, **Table 3**. There was a small

correlation between lesion size and Lysholm score, with patients with larger lesions reporting slightly lower Lysholm scores (**Fig. 2**). However, when adjusted for age, sex, BMI,

Table 3. Preoperative Patient-Reported Outcome Measures in 90 Patients Scheduled for Surgery due to Symptomatic Isolated Cartilage Lesions of the Femur.

	All	Lesion < 2 cm ²		Lesion ≥ 2 cm ²		P value
	(N = 90)	(n = 53)	95% CI	(n = 37)	95% CI	
Lysholm, mean (SD)	52.44 (14.3)	53.9 (12.6)	50.4-57.3	50.4 (16.5)	44.9-55.9	0.3
VAS						
Standing, median (range)	4.1 (0-9.5)	4.9 (0-8.4)	3.4-4.8	3.5 (0.5-9.5)	3.3-5.1	0.96 ^a
Sitting, median (range)	2.2 (0-9.5)	2.1 (0-8.4)	1.9-3.1	2.3 (0.1-9.5)	2.2-3.6	0.3 ^a
KOOS symptoms, mean (SD)	58.3 (18.3)	62.8 (16.4)	58.3-67.3	51.9 (19.3)	45.5-58.4	0.005
KOOS pain, mean (SD)	53.7 (19.1)	54.5 (19.0)	49.3-59.8	52.6 (19.3)	46.2-59.1	0.6
KOOS ADL, mean (SD)	66.9 (20.0)	68.2 (18.3)	63.1-73.3	64.9 (22.4)	57.5-72.4	0.5
KOOS sports&rec, mean (SD)	30.8 (24.1)	31.3 (23.4)	24.7-37.8	30.3 (25.2)	21.9-38.7	0.9
KOOS QoL, mean (SD)	28.0 (13.8)	29.4 (13.5)	25.7-33.2	26.0 (14.0)	21.3-30.7	0.3

SD = standard deviation; CI = confidence interval; VAS = visual analog scale; KOOS = Knee Injury and Osteoarthritis Outcome Score; ADL = activity of daily living; sports&rec = sports and recreation; QoL = quality of life.

^aMann-Whitney *U* test.

and lesion localization, this effect was not statistically significant (**Table 4**). The ICRS grade (3 or 4) did not affect preoperative patient-reported symptoms (**Fig. 3**).

The cartilage patients reported worse preoperative symptoms compared with patients scheduled for ACL reconstruction or MPFL reconstruction, and approaching the symptoms reported by patients scheduled for total knee replacement (**Fig. 4**).

Discussion

The main finding of this study is that the size of the cartilage lesions has little effect on the level of pain and function in patients scheduled for cartilage surgery of the knee. Location of the lesion in the knee also did not substantially affect the level of symptoms reported by the patient preoperatively. However, the pain and disability reported by patients with isolated cartilage lesions approach the values reported by patients scheduled for knee arthroplasty.

We could not demonstrate any substantial effect of the lesions size or ICRS grade on the level of pain reported at the time of surgery. Our results are supported by Solheim *et al.* who evaluated patient-reported symptoms in 570 patients with chondral or osteochondral lesions of the knee and found that size and location had little influence on patient-reported symptoms.⁷ It is clear that the etiology of the pain and symptoms caused by the lesions is not well understood. It seems that even small lesions can give symptoms severe enough to warrant surgery. Cartilage itself is aneural and cartilage defects alone do not elicit pain. Cartilage lesions regardless of size may instigate the same response to the joint through synovitis, leading to similar degree of symptoms. This may also explain why symptoms of cartilage patients are different from those suffering ligament instability, and more similar to those reported by osteoarthritic patients. At the same time, up to

69% of asymptomatic individuals can have full thickness cartilage lesions diagnosed on MRI scans.^{1,2,14} It is therefore difficult to ascertain that it is indeed the cartilage lesion identified on the MRI that is causing the symptoms.

There is no consensus regarding what constitutes the best treatment for symptomatic cartilage lesions. There has been a great focus on various surgical methods to treat these lesions, but without understanding the basic pathophysiology of the condition, it is unlikely that an ideal surgical treatment will be found. Surgical treatment options include debridement,¹⁵ microfracture,¹⁶ mosaicplasty,¹⁷ osteochondral allograft transplantation (OAT),¹⁸ and cell-based therapies, such as autologous chondrocyte implantation (ACI).¹⁹ Surgical treatment is often dictated by lesion size and location, and the patient's age, general health, activity level, and symptoms. There is general agreement in the literature that microfracture is not effective in larger lesions, and a cutoff of 2 cm² is often cited.^{5,6,20} ACI or OAT is commonly offered patients with larger lesions.^{6,18-20} The literature has an abundance of case series evaluating the effect of various type of cartilage surgeries, but there is a lack of high-level prospective trials with a true control group. It is reported that up to 75% of patients with a focal cartilage defect of the knee has good to excellent results following a regimen of conservative treatment.^{21,22} Future clinical studies need to include a conservative control group (non-operative or sham-surgery).^{23,24}

Over a decade ago, Heir *et al.* compared 60 patients scheduled for surgery for an isolated cartilage lesion of the knee with 64 patients scheduled for total knee arthroplasty (TKA). They found that patients enrolled for cartilage surgery have score values on the KOOS quality of life subscale equal to patients scheduled for TKA.²⁵ Our study confirms this finding in a larger cohort of cartilage patients. We demonstrate that cartilage lesions of the knee is a severe condition with detrimental effect on pain and function. In fact, patients scheduled for

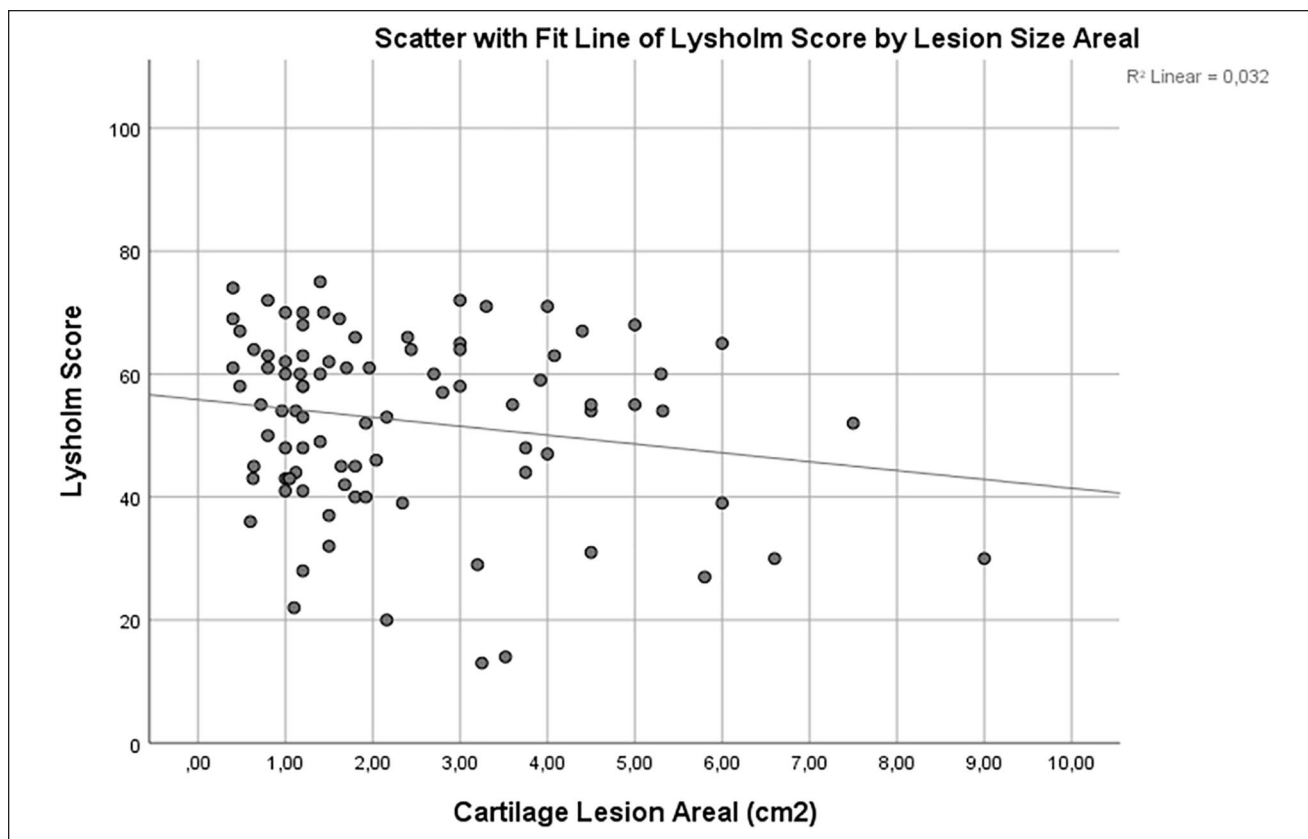


Figure 2. Preoperative Lysholm score stratified by lesion size in 90 patients scheduled for cartilage surgery of the knee.

Table 4. Multivariate Linear Regression Analysis of the Effect on ICRS Grade 3 (Reference) or 4, Lesions Size (cm²), and Lesion Localization on Lysholm Score in 90 Patients with an Isolated Cartilage Lesion of the Knee.

	Regression Coefficient	95 % CI	P value
ICRS	-1.11	-8.13 to 5.91	0.75
Lesion size	-1.11	-3.11 to 0.88	0.27
MFC	3.70	-4.23 to 11.62	0.36
Trochlea	0.36	-7.52 to 8.24	0.93
LFC	-0.48	-8.71 to 7.56	0.91

Adjusted for age, sex, and body mass index.

ICRS = International Cartilage Regeneration & Joint Preservation Society; CI = confidence interval; MFC = medial femoral condyle; LFC = lateral femoral condyle.

cartilage surgery are closer in age to patients scheduled for ACL and MPFL reconstruction, but have KOOS scores approaching that of older patients scheduled for knee arthroplasty.

Limitations

Our study was conducted in a specialist center in one country and may have limited external validity. A Lysholm score

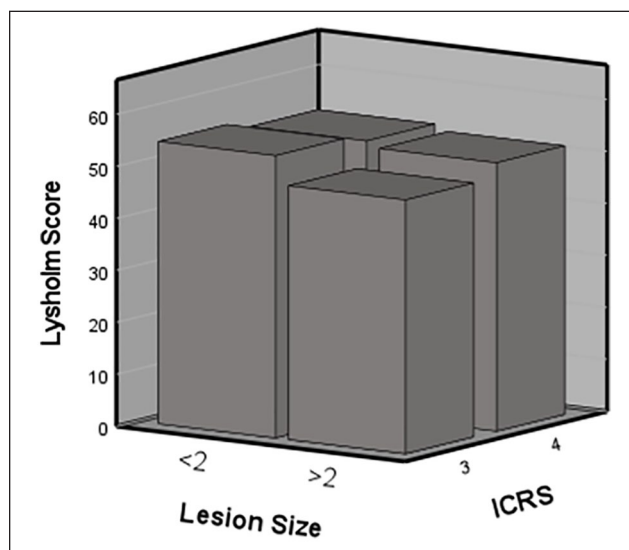


Figure 3. Preoperative Lysholm score according to International Cartilage Regeneration & Joint Preservation Society (ICRS) grade and lesions size smaller or larger than 2 cm² in 90 patients scheduled for cartilage surgery of the knee.

below 75 was an inclusion criterion for this study. This introduces a selection bias that may influence our results.

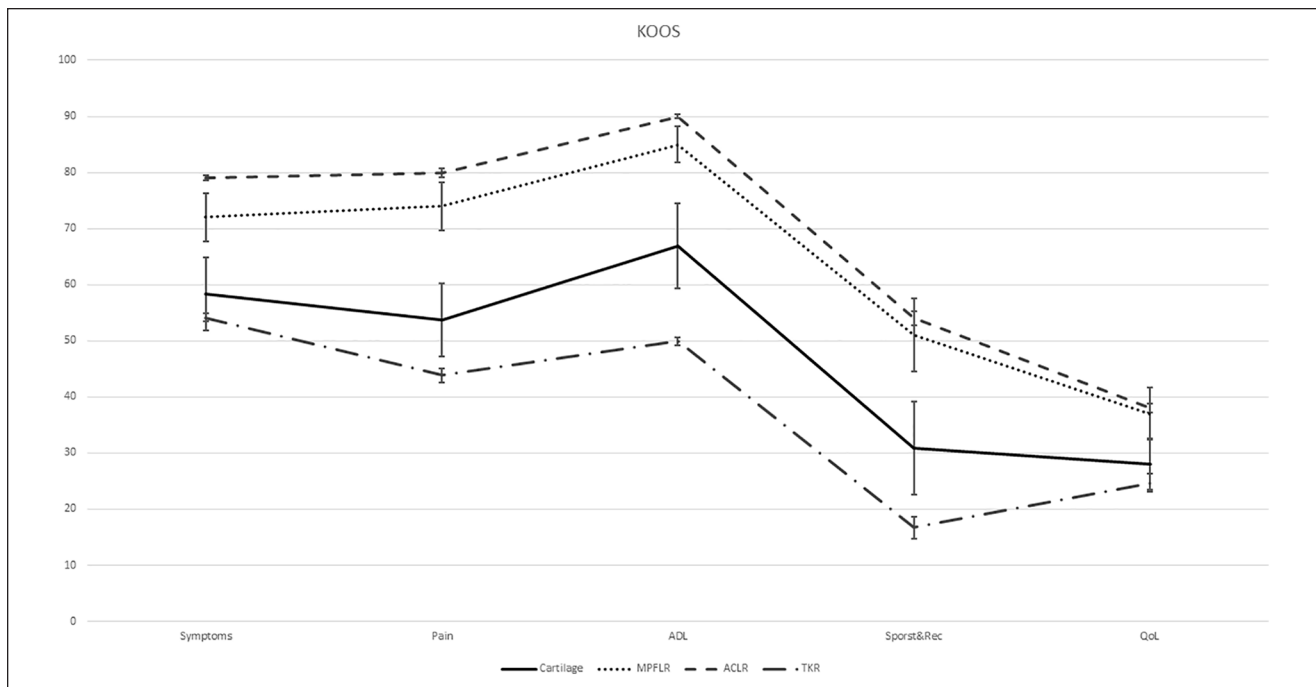


Figure 4. Preoperative Knee Injury and Osteoarthritis Outcome Score (KOOS) scores in patients scheduled for anterior cruciate ligament reconstruction (ACLR), medial patellofemoral ligament reconstruction (MPFLR), cartilage surgery and total knee replacement (TKR). Brackets represent 95% confidence intervals.

The patients in this study are patients scheduled for surgery—Whether the same findings apply to patients treated non-operatively cannot be answered by our study. As a majority of the patients had a lesion on the medial femoral condyle, it might be that other locations respond better to non-surgical treatment.

Conclusion

The size, depth, and location of cartilage lesions have little impact on the pain and symptoms experienced by the patients.

Authors' Note

The work was conducted at Akershus University Hospital, Norway.

Acknowledgments and Funding

The authors thank Heidi Andreassen Hanvold, PT, for help in data management. They thank Tommy Frøseth Aae, Øystein Lian, Håvard Visnes, and Thomas Birkenes for including patients. The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The study was funded by research grants awarded from the Research Council of Norway, Grant 243818.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics

This study was approved by the Regional Committee for Medical and Health Research Ethics, North-Norway (2015/2200 and 2015/2202). The study was conducted in accordance with the Declaration of Helsinki and conformed to the International Committee of Medical Journal Editors recommendations for protection of research participants. All included patients provided written informed consent.

ORCID iD

Per-Henrik Randsborg  <https://orcid.org/0000-0002-7674-1572>

References

1. Culvenor AG, Oiestad BE, Hart HF, Stefanik JJ, Guermazi A, Crossley KM. Prevalence of knee osteoarthritis features on magnetic resonance imaging in asymptomatic uninjured adults: a systematic review and meta-analysis. *Br J Sports Med.* 2019;53(20):1268-78.
2. Horga LM, Hirschmann AC, Henckel J, Fotaiadou A, Di Laura A, Torlasco C, *et al.* Prevalence of abnormal findings in 230 knees of asymptomatic adults using 3.0 T MRI. *Skeletal Radiol.* 2020;49(7): 1099-107.
3. Baum T, Joseph GB, Arulanandan A, Nardo L, Nevitt MC, Link TM, *et al.* Association of magnetic resonance imaging-based knee cartilage T2 measurements and focal knee lesions with knee pain: data from the Osteoarthritis Initiative. *Arthritis Care Res (Hoboken).* 2012;64(2): 248-55.
4. Bezuglov EN, Lyubushkina AV, Khaitin VY, Tokareva AV, Goncharov EN, Gorinov AV, *et al.* Prevalence of asymptomatic

- intra-articular changes of the knee in adult professional soccer players. *Orthop J Sports Med.* 2019;7(11): 1-7.
5. Dekker TJ, Aman ZS, DePhillipo NN, Dickens JF, Anz AW, LaPrade RF. Chondral lesions of the knee: an evidence-based approach. *J Bone Joint Surg Am.* 2021;103(7): 629-45.
 6. 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.
 7. Solheim E, Krokeide AM, Melteig P, Larsen A, Strand T, Brittberg M. Symptoms and function in patients with articular cartilage lesions in 1,000 knee arthroscopies. *Knee Surg Sports Traumatol Arthrosc.* 2016;24(5): 1610-6.
 8. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *Clin Orthop Relat Res.* 1985(198): 43-9.
 9. Smith HJ, Richardson JB, Tennant A. Modification and validation of the Lysholm Knee Scale to assess articular cartilage damage. *Osteoarthritis Cartilage.* 2009;17(1): 53-8.
 10. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)—development of a self-administered outcome measure. *J Orthop Sports Phys Ther.* 1998;28(2): 88-96.
 11. NKL. Norwegian knee ligament register; 2020 [cited 2022 Jan 24]. Available from: https://helse-bergen.no/seksjon/Nasjonalt_kompetansetjeneste_leddproteser_hoftebrudd/Share%20point%20Documents/Rapport/Rapport%202021.pdf
 12. Straume-Naesheim TM, Randsborg PH, Mikaelson JR, Sivertsen EA, Devitt B, Granan L, et al. Recurrent lateral patella dislocation affects knee function as much as ACL deficiency—however patients wait five times longer for treatment. *BMC Musculoskelet Disord.* 2019;20(1): 318.
 13. NAR. Norwegian Arthroplasty Register. Annual Report. Available from: <http://nrlweb.ihelse.net/2020>
 14. Guermazi A, Niu J, Hayashi D, Aliabadi P, Felson DT. Prevalence of abnormalities in knees detected by MRI in adults without knee osteoarthritis: population based observational study (Framingham Osteoarthritis Study). *BMJ.* 2012;345:e5339.
 15. Totlis T, Marin Fermin T, Kalifis G, Terzidis I, Maffulli N, Papakostas E. Arthroscopic debridement for focal articular cartilage lesions of the knee: a systematic review. *Surgeon.* 2021;19(6): 356-64.
 16. Kim JH, Heo JW, Lee DH. Clinical and radiological outcomes after autologous matrix-induced chondrogenesis versus microfracture of the knee: a systematic review and meta-analysis with a minimum 2-year follow-up. *Orthop J Sports Med.* 2020;8(11): 1-15.
 17. Solheim E, Hegna J, Strand T, Harlem T, Inderhaug E. Randomized study of long-term (15-17 years) outcome after microfracture versus mosaicplasty in knee articular cartilage defects. *Am J Sports Med.* 2018;46(4): 826-31.
 18. Familiari F, Cinque ME, Chahla J, Godin JA, Olesen ML, Moatshe G, et al. Clinical outcomes and failure rates of osteochondral allograft transplantation in the knee: a systematic review. *Am J Sports Med.* 2018;46(14): 3541-9.
 19. Gou GH, Tseng FJ, Wang SH, Chen P-J, Shyu J-F, Wenf C-F et al. Autologous chondrocyte implantation versus microfracture in the knee: a meta-analysis and systematic review. *Arthroscopy.* 2020;36(1): 289-303.
 20. Ozmeric A, Alemdaroglu KB, Aydogan NH. Treatment for cartilage injuries of the knee with a new treatment algorithm. *World J Orthop.* 2014;5(5): 677-84.
 21. Messner K, Gillquist J. Cartilage repair. A critical review. *Acta Orthop Scand.* 1996;67(5): 523-9.
 22. Wondrasch B, Aroen A, Rotterud JH, Hoysveen T, Bolstad K, Risberg MA. The feasibility of a 3-month active rehabilitation program for patients with knee full-thickness articular cartilage lesions: the Oslo Cartilage Active Rehabilitation and Education Study. *J Orthop Sports Phys Ther.* 2013;43(5): 310-24.
 23. Aae TF, Randsborg PH, Breen AB, Visnes H, Vindfeld S, Sivertsen EA, et al. Norwegian Cartilage Project—a study protocol for a double-blinded randomized controlled trial comparing arthroscopic microfracture with arthroscopic debridement in focal cartilage defects in the knee. *BMC Musculoskelet Disord.* 2016;17:292.
 24. Randsborg PH, Brinchmann J, Loken S, Hanvold HA, Aae TF, Aroen A. Focal cartilage defects in the knee—a randomized controlled trial comparing autologous chondrocyte implantation with arthroscopic debridement. *BMC Musculoskelet Disord.* 2016;17:117.
 25. Heir S, Nerhus TK, Rotterud JH, Loken S, Ekeland A, Aroen A, et al. Focal cartilage defects in the knee impair quality of life as much as severe osteoarthritis: a comparison of knee injury and osteoarthritis outcome score in 4 patient categories scheduled for knee surgery. *Am J Sports Med.* 2010;38(2): 231-7.