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 Sch...

Article *in* The American Journal of Sports Medicine · February 2010

DOI: 10.1177/0363546509352157 · Source: PubMed

CITATIONS
214

READS
308

7 authors, including:

Stig Heir
Martina Hansens Hospital
46 PUBLICATIONS **1,446** CITATIONS
SEE PROFILE

Tor Kjetil Nerhus
Martina Hansens Hospital
12 PUBLICATIONS **304** CITATIONS
SEE PROFILE

Jan Harald Røtterud
Akershus universitetssykehus
32 PUBLICATIONS **580** CITATIONS
SEE PROFILE

Sverre Løken
Oslo University Hospital
45 PUBLICATIONS **1,420** CITATIONS
SEE PROFILE

AJSM PreView, published on December 30, 2009 as doi:10.1177/0363546509352157

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

Stig Heir,*[†‡§] MD, Tor K. Nerhus,[†] MD, Jan H. Røtterud,[‖] MD, Sverre Løken,[‡§¶] MD, Arne Ekeland,[†] MD, PhD, Lars Engebretsen,[‡¶] MD, PhD, and Asbjørn Årøen,[‡§¶] MD, PhD
From the [†]Martina Hansens Hospital, Baerum, Norway, [‡]Oslo Sport Trauma Research Center, Oslo, Norway, [§]Institute of Surgical Research, Rikshospitalet, Oslo, Norway, [‖]Akershus University Hospital, Lorenskog, Norway, and the [¶]Ulleval University Hospital, Oslo, Norway

Background: Patients with focal cartilage defects in the knee may suffer from both pain and functional impairment. Treatment options are often insufficient. It is not known, however, to what extent their complaints affect quality of life, compared with other knee disorders. Knee Injury and Osteoarthritis Outcome Score (KOOS) is a validated global knee score suitable for comparison of patients with knee complaints attributable to different causes.

Hypothesis: Complaints because of localized cartilage defects in the knee reduce quality of life measured by KOOS to a different extent than those due to anterior cruciate ligament deficiency and osteoarthritis, when comparing patients within the working population scheduled for surgery.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: Previously registered KOOS baseline data on patients enrolled in different knee treatment studies were included in the present study; the patients were 18 to 67 years of age (working population) at data registration. The different patient categories were (1) patients with knee osteoarthritis enrolled for knee arthroplasty, (2) patients with knee osteoarthritis enrolled for osteotomies around the knee, (3) patients with focal cartilage lesions enrolled for cartilage repair, and (4) patients with anterior cruciate ligament–deficient knees enrolled for anterior cruciate ligament reconstruction. The KOOS subscale quality of life was the main parameter for comparison of complaints.

Results: At preoperative baseline, patients with focal cartilage defects in the knee scored 27.5 on the KOOS subscale quality of life, not significantly different from the 28.8 and 27.2 in the patients with osteoarthritis enrolled for knee osteotomies and arthroplasties, respectively. For all the subscales of KOOS, the cartilage patients scored significantly lower than the patients with anterior cruciate ligament deficiency.

Conclusion: Patients with focal cartilage lesions have major problems with pain and functional impairment. Their complaints are worse than those of patients with anterior cruciate ligament–deficient knees, and quality of life is affected to the same extent as in patients scheduled for knee replacement.

Keywords: knee; cartilage; osteoarthritis; anterior cruciate ligament (ACL); complaints; comparison; Knee Injury and Osteoarthritis Outcome Score (KOOS)

*Address correspondence to Stig Heir, MD, Department of Orthopaedic Surgery, Martina Hansens Hospital, Box 23, N-1306 Baerum, Norway (e-mail: stighei@online.no).

The authors declared that they had no conflicts of interests in their authorship and publication of this contribution.

The American Journal of Sports Medicine, Vol. XX, No. X
DOI: 10.1177/0363546509352157

Focal cartilage and osteochondral injuries are common in the working population (18-67 years of age)[1,13,40] and they may cause pain and limitations in daily activities, working ability, recreational activities, and sports. In contrast to the success rate in treating some of the other disabilities causing knee complaints, the outcome after surgical treatment of focal cartilage injuries has generally

not been completely successful in relieving symptoms (Løken et al, unpublished data, 2009).[17,22,36] Cartilage injuries generate considerable costs for society.[20] Although data such as incidence, prevalence, and costs suggest the magnitude of the problem, the degree of complaints for the patients with localized cartilage defects in the knee is less well described. Complaints related to other causes of knee disabilities are better known and described (eg, those of patients with anterior cruciate ligament [ACL] ruptures, meniscal injuries, and osteoarthritis demanding surgical intervention). However, comparison of complaints among populations with different causes of knee disability has not been brought to attention in the same manner. Moreover, regardless of cause, knee disabilities may impair the patient's quality of life. The reduction in quality of life caused by localized cartilage defects in the knee has not, to our knowledge, been compared with the reduction in quality of life caused by other knee disabilities, using a verified global knee score as a common instrument for outcome measure. In a younger patient population, reduced score values of quality of life will logically be related to a significant loss of working hours and thereby increased socioeconomic costs.

The aim of this study was to evaluate the complaints of patients having localized cartilage defects in the knee by the Knee Injury and Osteoarthritis Outcome Score (KOOS)[33] and compare the extent to which they impair quality of life with other groups of patients with knee disabilities within the working population.

The hypothesis of the current study was that complaints because of localized cartilage defects in the knee reduce quality of life measured by KOOS to a different extent than those due to ACL deficiency and osteoarthritis, when comparing patients within the working population scheduled for surgery.

MATERIALS AND METHODS

Patient Data

Previously registered KOOS baseline data from patients enrolled in different knee treatment studies at 3 cooperating hospitals were included in the study and compared. The patients were 18 to 67 years of age, defined as the working population at data registration. All patients had consented to participate in the different studies. By "baseline data," we mean data registered at the time the patients were included in the different studies, before any specific treatment was initiated. The data being compared were recruited from 4 different knee patient categories. In addition to the KOOS data, gender, age, and some category-specific data were registered.

Patient Category 1: Patients With Knee Osteoarthritis Enrolled for Knee Arthroplasty. Patients in this category were previously included in 1 of 2 ongoing studies on functional results after knee replacement evaluated by KOOS. One was a case series study assessing the results after unicompartmental arthroplasty (n = 45; 22 men, 23 women; mean age 60.9 years, standard deviation [SD] 4.0) for medial osteoarthritis (OA),[27] and the other was an almost identical study assessing the results after total knee arthroplasty (n = 19; 7 men, 12 women; mean age 60.5 years, SD 5.9).[28] The low number of total knee arthroplasties was due to the maximum age limit of 67 years. Basic inclusion criteria for the 2 studies were identical: Despite nonoperative treatment, the patients had clinical symptoms of OA, verified radiologically, to such an extent that surgery was indicated, meaning that the patient could not cope with the pain the OA was causing. Patients with unicompartmental medial OA were scheduled for unicompartmental medial knee replacement if the criteria for osteotomy were not fulfilled. The KOOS recruited for the current study was obtained the day before surgery.

Patient Category 2: Patients With Knee Osteoarthritis Enrolled for Osteotomies Around the Knee. Patients in this second category were previously included in 1 of 3 ongoing studies on functional results after osteotomies on the distal femur or the proximal tibia evaluated by KOOS—1 being a case series study assessing the results after opening-wedge proximal tibia osteotomy for medial OA (n = 53; 32 men, 21 women; mean age 47.4 years, SD 8.1),[8] 1 being a case series study assessing the results after opening-wedge distal femur osteotomy for lateral OA (n = 23; 12 men, 11 women; mean age 48.5, SD 7.0),[7] and 1 being a randomized control trial (RCT) study comparing the results after opening-wedge and closing-wedge proximal tibia osteotomies for medial OA (n = 25; 17 men, 8 women; mean age 49.3 years, SD 7.0) (Nerhus et al, unpublished data, 2009). The low number of patients in the latter 2 studies was because of the still-ongoing inclusion period. Basic inclusion criteria for the 3 studies were identical: Despite conservative treatment, the patients had clinical symptoms of OA, verified radiologically, to such an extent that surgery was indicated, meaning that the patient could not cope with the pain the OA was causing. Patients were recruited for osteotomies around the knee if malalignment allowed a correction angle of 5° or more and bone health was sufficient. The KOOS was completed the day before surgery. Additionally, the preoperative Lysholm score was also recorded from the third study.

Patient Category 3: Patients With Focal Cartilage Lesions Enrolled for Cartilage Surgery. Patients in this third category were previously included in 1 of 2 ongoing studies on functional results following surgical repair of full-thickness cartilage defects in the joint surfaces of the distal femur. One was an RCT comparing the results of microfracture technique versus mosaicplasty, the defect size being 2 to 6 cm^2 (n = 28; 17 men, 11 women; mean age 31.7 years, SD 7.9), and the second was an ongoing RCT comparing implanted autologous chondrocytes versus mesenchymal stem cells in defects 1.5 to 6.0 cm^2 or TruFit (Smith & Nephew, Andover, Massachusetts) versus microfracture technique in defects less than 20 mm in diameter (n = 38; 27 men, 11 women; mean age 34.0 years, SD 9.5). For both these studies, the age range was limited to 18 to 50 years. Basic inclusion criteria for both studies were unacceptable complaints due to the cartilage lesion, which was verified by arthroscopy, and a Lysholm score less than 80. The KOOS was completed

at enrollment in the initial studies. The preoperative Lysholm score was also recorded.

Patient Category 4: Patients With ACL-Deficient Knees Enrolled for Reconstruction. Patients in this fourth category were enrolled for ACL reconstruction at 2 of the collaborating hospitals in 2008–2009. As a routine, they consented to have their data archived at the Norwegian National Knee Ligament Registry available for future studies. Only patients 18 to 67 years of age undergoing a primary reconstruction were recruited for the current study. Data from patients with additional ligament injuries were excluded. From the National Registry, data concerning additional injuries to the knee (ie, cartilage injuries and meniscal injuries) were obtained. Statistical analyses showed no differences in complaints regarding isolated ACL injuries compared with the different combinations of these additional injuries; thus the data from these subgroups of patients were included as 1 category (n = 160; 98 men, 62 women; mean age 31.0 years, SD 9.6). The indications for primary ACL reconstruction at the 2 hospitals were identical: despite conservative treatment focusing on stability training, the patients had repetitive "giving way" due to the ACL deficiency. The KOOS was completed the day before surgery. Additionally, time from injury to ACL reconstruction was recorded.

Method

The KOOS is well described in the literature.[29,30,33] The KOOS is a 42-item self-administered, self-explanatory knee-specific questionnaire with 5 separate outcome subscales, assessing pain (9 items), other symptoms (7 items), activities of daily living (ADL) (17 items), sport and recreational function (Sport/Rec) (5 items), and knee-related quality of life (QoL) (4 items). For each item, 5 standardized answer options are given in Likert boxes of which 1 is to be marked. The answers are rated with scores from 0 to 4. Total subscale scores are calculated and missing data handled according to the users' guide (http://www.koos.nu). The subscale scores are presented separately, ranging from 0 to 100, where 100 is the best possible result to be obtained. According to the KOOS users' guide, missing data for each subscore is handled separately, thus the number of patients may vary between subscores (Table 1). The KOOS has been validated for patients undergoing ACL reconstruction,[33] meniscectomy,[32] and total knee replacement.[34] Recently, the KOOS has also been validated for the treatment of focal cartilage lesions.[2] The Western Ontario and McMaster Universities Osteoarthritis Index (version LK 3.0)[3] items are included in the first 3 KOOS subscales. The KOOS has been considered reliable and responsive for assessment of knee complaints in a comparative review of knee-specific outcome measures.[10] In a study comparing the degree to which different knee-specific outcome instruments included items to detect symptoms and disabilities most important to the patients, the KOOS was identified as 1 of the top 2 general knee quality-of-life instruments ensuring that the patient's perspective was considered.[38] Patient-reported outcomes assessing knee problems do, however, vary with age and gender in the general population.[6,16] Therefore, KOOS reference data from a "normal" Scandinavian population was established,[30] making it possible to correct the subscales for age and gender.

The complaints of the 4 patient categories were compared in regard to each of the 5 subscales of the KOOS obtained at baseline. To evaluate to what extent the other subscales relatively affected the quality of life of the patients within each patient category, the parameter QoL was correlated to the other 4 subscales. The mean age of each category was compared. Mean Lysholm scores for the cartilage patients and the osteotomy patients were compared. The mean time from initial symptoms in the cartilage patients and mean time from injury in the ACL-deficient patients are given as descriptive information. Differences in the mean KOOS subscale QoL between groups was the primary parameter in comparing the complaints of the 4 patient categories.

Statistics

For the statistical analysis, we used SPSS version 15.0 (SPSS Inc, Chicago, Illinois). One-way analysis of variance was used for comparison of mean age between the patient categories. The data obtained from KOOS are ordinal rather than continuous. However, the sample size in each group was considered large enough to apply the central limit theorem with normally distributed sample means. One-way analysis of variance was applied for comparison between groups, supplied by post hoc Bonferroni tests due to multiple comparisons.[30] Knee-related quality of life, with the smallest number of items to be answered, was controlled by nonparametric tests that were in agreement with the analysis of variance test. Thus, the results within each subscale are given as mean values for each category supplied by the SD, and the differences between the categories as mean differences supplied by the standard error of the mean, the 95% confidence interval, and P values. The correlation between QoL and the other 4 subscales was performed by linear regression analyses. The results are given as R^2 and the corresponding P value. The comparison of Lysholm scores between the cartilage patients and the osteotomy patients was performed by an independent-sample t test.

RESULTS

The mean age and the SDs for the different patient categories are shown in Figure 1. One-way analysis of variance revealed a significant difference in mean age between the groups. Post hoc Bonferroni tests showed significant differences to be present among all groups except between the patients with focal cartilage defects and those with ACL deficiency. The mean age in the cartilage patient category was 33.0 (95% confidence interval, 30.8-35.2).

The values of the 5 KOOS subscales for the different patient categories are shown in Figure 2.

TABLE 1
Results of Post Hoc Bonferroni Tests Comparing the Mean KOOS Subscales Values in Patients With Focal Cartilage Defects to the Other Knee Disability Patient Groups[a]

	Versus Group	Mean Difference (SEM)	*P* Value
Pain[b]			
	Knee arthroplasties	8.5 (2.9)	.021
	(n = 64)	95% CI 0.8, 16.1	
Focal cartilage	Knee osteotomies	1.7 (2.6)	1.000
defects (n = 66)	(n = 101)	95% CI –5.2, 8.6	
	ACL reconstructions	–18.5 (2.4)	<.001
	(n = 158)	95% CI –25.0, –12.1	
Symptoms[c]			
	Knee arthroplasties	6.8 (3.0)	.157
	(n = 64)	95% CI –1.3, 14.8	
Focal cartilage	Knee osteotomies	4.8 (2.7)	.485
defects (n = 65)	(n = 101)	95% CI –2.5, 12.1	
	ACL reconstructions	−13.0 (2.5)	<.001
	(n = 160)	95% CI –19.7, –6.3	
Activities of Daily Living[d]			
	Knee arthroplasties	14.1 (3.1)	<.001
	(n = 64)	95% CI 5.8, 22.4	
Focal cartilage	Knee osteotomies	5.3 (2.8)	.370
defects (n = 65)	(n = 101)	95% CI –2.2, 12.8	
	ACL reconstructions	–12.4 (2.6)	<.001
	(n = 157)	95% CI –19.3, –5.4	
Sports/Recreation[e]			
	Knee arthroplasties	11.8 (4.0)	.019
	(n = 64)	95% CI 1.3, 22.4	
Focal cartilage	Knee osteotomies	3.6 (3.6)	1.000
defects (n = 65)	(n = 101)	95% CI –5.9, 13.2	
	ACL reconstructions	–14.5 (3.3)	<.001
	(n = 155)	95% CI –23.4, –5.6	
Quality of Life[f]			
	Knee arthroplasties	0.3 (2.7)	1.000
	(n = 64)	95% CI –6.9, 7.4	
Focal cartilage	Knee osteotomies	–1.3 (2.4)	1.000
defects (n = 64)	(n = 101)	95% CI –7.8, 5.2	
	ACL reconstructions	–8.6 (2.3)	.001
	(n = 159)	95% CI –14.6, –2.6	

[a]KOOS, Knee Injury and Osteoarthritis Outcome Score; SEM, standard error of the mean; CI, confidence interval; ACL, anterior cruciate ligament.
[b]Levene test of homogeneity of variances: $P = .072$; analysis of variance: $P < .001$.
[c]Levene test of homogeneity of variances: $P = .857$; analysis of variance: $P < .001$.
[d]Levene test of homogeneity of variances: $P = .109$; analysis of variance: $P < .001$.
[e]Levene test of homogeneity of variances: $P = .001$; analysis of variance: $P < .001$.
[f]Levene test of homogeneity of variances: $P = .003$; analysis of variance: $P < .001$.

One-way analysis of variance tests revealed significant differences between the patient categories for all subscales, including the QoL. The results of the post hoc Bonferroni tests comparing the different KOOS subscales of the patients with focal cartilage defects to the other patient categories are shown in Table 1. According to the Bonferroni tests, the cartilage patients' quality of life was affected to the same extent as those of the patients with osteoarthritis enrolled for arthroplasties and osteotomies. The cartilage patients scored significantly worse ($P \leq .001$) for all subscales of KOOS compared with the ACL-deficient patients. The mean time from initial symptoms to the KOOS obtained in the cartilage patient category was 70.0 months (SD 73.7), whereas the mean time from injury to surgery for the ACL-deficient patients was 26.1 months (SD 48.6). Among the ACL patient category, 12.6% had International Cartilage Repair Society (ICRS) grade 3 or 4 focal cartilage lesions in their knees.

The subscale QoL correlated significantly to all the other 4 subscales of KOOS in all patient categories except to Symptoms in the patient category of arthroplasties ($R^2 = .065$; $P = .021$) (Table 2). The QoL of the cartilage patients showed an equally high value of R^2 in the correlation with ADL, Sport/Rec, and pain. The QoL in ACL patients and osteotomy patients showed the highest value of R^2 in correlation with Sport/Rec, whereas the QoL in arthroplasty patients showed the highest value of R^2 in correlation with ADL (Table 2).

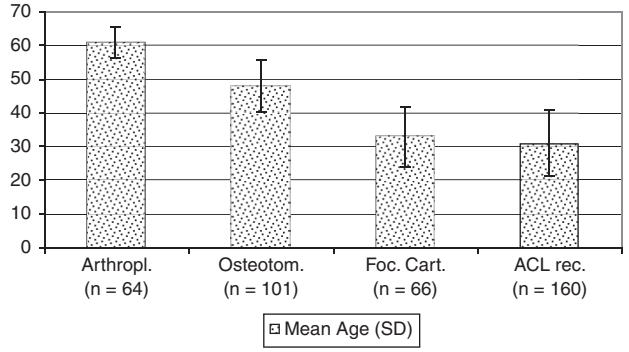

Figure 1. The mean age within each patient category and the standard deviation (SD).

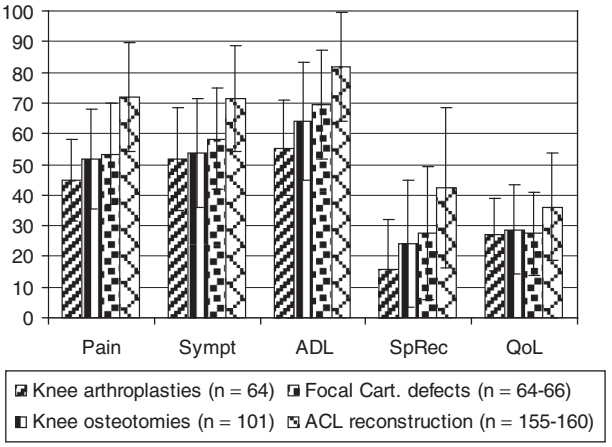

Figure 2. The subscales of the Knee Injury and Osteoarthritis Outcome Score (KOOS) for the different patient categories. ADL, activities of daily living; SpRec, sports and recreational function; QoL, knee-related quality of life.

The mean Lysholm score of patients with focal cartilage defects was 49.5 (SD 13.9), not significantly different from the 47.6 (SD 15.6) registered in the osteotomy patient category.

DISCUSSION

The current study showed that the quality of life of patients with focal cartilage defects in the knee is significantly affected. In fact, the patients enrolled for cartilage surgery have score values on the KOOS QoL equal to older patients with osteoarthritis signed up for knee replacement. To our knowledge, this has not been documented previously. Moreover, the cartilage patients had similar low scores on all 5 subscales of the KOOS, the scores being equal to those of the osteoarthritic patients enrolled for osteotomies around the knee. The similarity between these 2 patient categories was confirmed by the Lysholm score. Anterior cruciate ligament–deficient patients scheduled for surgical treatment, on the other hand, scored significantly higher than cartilage patients according to all 5 subscales.

Based on the correlation analyses performed, the reduction in the subscales pain, ADL, and Sport/Rec contributed equally to the reduction in QoL of the cartilage patients. For the osteotomy patients, as well as for the ACL-deficient patients, the impairment of Sport/Rec function contributed the most, whereas for the arthroplasty patient category, impaired ADL contributed most to the reduced QoL.

The patients included in this study were all scheduled for surgical interventions because of their clinical complaints. Thus, the different patient groups probably do not reflect the overall quality of life of all patients with the respective diagnoses. For example, many patients with focal cartilage defects do well and are not scheduled for surgery. The same phenomenon is valid for the other diagnoses as well, but the percentage of patients within each diagnosis enrolled for surgery may differ. We therefore would like to emphasize that the results in this study concern patients already enrolled for surgery only. One weakness of the study, however, is that the threshold of offering patients surgical treatment may vary from one type of disability to another—mainly dependent on the expected "cost-benefit analysis" outcome for that particular treatment. Patient populations with knee complaints such as ligament injuries and osteoarthritis are offered surgical procedures that have a high success rate in relieving symptoms, that is, ligament reconstruction for ACL injuries[31] and either osteotomies in the middle-aged patients[5,7,8] or joint replacement[27-29] in the elderly suffering from osteoarthritis. The results of surgical treatment for patients with localized cartilage defects in the knee (ie, cartilage repair) have been subject to controversies[22] and have not been equally successful.[11,17,21,24,25,35] In a study by Bekkers et al,[2] 40 patients were evaluated by KOOS 32 months after either microfracture or autologous chondrocyte implantation (ACI). The mean KOOS subscale QoL was 49 in both groups of patients. Moreover, despite a number of randomized controlled studies,[4,11,15,18,36] there is no consensus on a surgical technique being superior to the others—or to nonoperative treatment (Løken et al, unpublished data, 2009).[23,37] In a previous arthroscopic study, 64 of 997 knees had ICRS grade 3 or 4 chondral defects.[1] Although we know that this group is heterogeneous in regard to symptoms, a 6-year follow-up study showed that these patients still have knee problems, whether they undergo cartilage surgery or not (Løken et al, unpublished data, 2009). The results are, however, claimed to be encouraging in younger patients.[11,17,25] In the present study, the mean age of the cartilage patient population was 33.0 years (95% confidence interval, 30.8-35.2 years). In the work of Knutsen et al[17,18] comparing microfracture technique to ACI, there were significantly better results in patients below 30 years of age both at 2 and 5 years of follow-up, regardless of treatment. Best results after ACI have been shown in young, active patients with a high preoperative score, a single defect, and symptoms for less than 2 years.[19] The mean time from initial symptoms to completing the KOOS in the current study was 70.0 months (SD 73.7), whereas the median time was 37.5 months. The information on duration of symptoms before surgery is generally sparse, but in 1 RCT, the mean duration was 36 months.[18]

Thirteen percent of the ACL patient population had ICRS grade 3 or 4 cartilage injuries. Our statistical analyses

TABLE 2
R^2 and P Values in Correlating the QoL Subscale to the Other Subscales of KOOS in the Different Patient Categories[a]

	Versus Pain	Versus Symptoms	Versus ADL	Versus Sport/Rec
Arthroplasties	.206	.065	.375	.278
	$P < .001$	$P = .021$	$P < .001$	$P < .001$
Osteotomies	.294	.129	.345	.475
	$P < .001$	$P < .001$	$P < .001$	$P < .001$
Focal cartilage defects	.337	.235	.348	.339
	$P < .001$	$P < .001$	$P < .001$	$P < .001$
ACL deficiency	.354	.206	.251	.388
	$P < .001$	$P < .001$	$P < .001$	$P < .001$

[a]QoL, knee-related quality of life; KOOS, Knee Injury and Osteoarthritis Outcome Score; ADL, activities of daily living; Sport/Rec, sports and recreational function; ACL, anterior cruciate ligament.

revealed no influence of these lesions on the quality of life of the patients in this group. This is in agreement with the findings of Hjermundrud et al.[14] Moreover, focal cartilage defects have been shown not to influence the outcome following ACL reconstructions.[12,37,39] These findings suggest that cartilage defects may play a minor role in ACL-deficient and ACL-reconstructed knees, the mechanisms of which are not clear.

Because of the degree of complaints and reduced quality of life the cartilage patients have, an alternative treatment option could be joint arthroplasty, either as unicompartmental or total knee replacement. However, despite good results in the elderly, the results of knee replacement in the younger knee-active population are less favorable and not recommended.[9] In the current study, the patients in the cartilage category were a mean 28 years younger than the patients in the arthroplasty category, and a mean 15 years younger than the patients in the osteotomy category. In an article by Paradowski et al,[30] all the subscales of KOOS were found to be age-dependent in a "normal" Scandinavian population, the values of QoL declining significantly with age. In that respect, the cartilage patients are relatively even worse compared with the patients in the arthroplasty and osteotomy categories.

A major advantage of the current study is that the data were recruited from recently performed or ongoing clinical studies that ensured that the system of data collection was similar. Additionally, the same instrument was used as an evaluation measure for all patient categories. The KOOS is validated in respect to several knee disabilities. Reference data for each of the 5 subscales regarding age and gender is established. We therefore believe the KOOS is suitable for the purpose of comparing complaints of different knee patient groups. To our knowledge, the KOOS has previously never been used in such a comparison. The main purpose of this study was to determine and compare how the severity of symptoms and functional limitations together affected the different population's quality of life. Thus, in selecting 1 of the subscales as a primary outcome instrument for comparison between groups, the natural choice was QoL. The importance of using validated disease-specific quality-of-life measures in evaluating knee patients has been emphasized by other authors as well.[26]

CONCLUSION

According to the current study, patients with focal cartilage lesions have major problems with pain and functional impairment. Their complaints are worse than those of ACL-deficient patients, and quality of life is affected to the same extent as in patients scheduled for knee replacement. On the basis of the literature, we conclude that the treatment options for cartilage patients are generally still not sufficient, implying that a number of these patients will have to cope with their complaints even after surgical cartilage repair—with the expectations of an even less favorable result if reoperations are to be performed.[19,24] Based on the substantial number these patients represent and the degree of complaints they have, we suggest that improved treatment methods are clearly needed.

ACKNOWLEDGMENT

The authors thank Ingar Holme, PhD, for statistical advice and Tor Egil Sørås, computer engineer at the Norwegian National Knee Ligament Registry, for assistance in making data available. The study was supported by grants from Oslo Sports Trauma Research Centre (OSTRC). The centre is financed by the South-Eastern Norway Regional Health Authority, the Royal Norwegian Ministry of Education and Research, the Norwegian Olympic Committee, and the Confederation of Sport and Norsk Tipping.

REFERENCES

1. Aroen A, Loken S, Heir S, et al. Articular cartilage lesions in 993 consecutive knee arthroscopies. *Am J Sports Med*. 2004;32(1):211-215.
2. Bekkers JE, de Windt TS, Raijmakers NJ, Dhert WJ, Saris DB. Validation of the Knee Injury and Osteoarthritis Outcome Score (KOOS) for the treatment of focal cartilage lesions. *Osteoarthritis Cartilage*. 2009;17(11):1434-1439.
3. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol*. 1988;15(12):1833-1840.
4. Bentley G, Biant LC, Carrington RW, et al. A prospective, randomised comparison of autologous chondrocyte implantation versus mosaicplasty for osteochondral defects in the knee. *J Bone Joint Surg Br*. 2003;85(2):223-230.
5. Birmingham TB, Giffin JR, Chesworth BM, et al. Medial opening wedge high tibial osteotomy: a prospective cohort study of gait, radiographic, and patient-reported outcomes. *Arthritis Rheum*. 2009;61(5):648-657.
6. Demirdjian AM, Petrie SG, Guanche CA, Thomas KA. The outcomes of two knee scoring questionnaires in a normal population. *Am J Sports Med*. 1998;26(1):46-51.
7. Ekeland A, Heir S, Dimmen S, Nerhus TK. Correction of valgus knees by opening wedge osteotomy. *Knee Surg Sports Traumatol Arthrosc*. 2008;16(Suppl 1):62.

8. Ekeland A, Heir S, Dimmen S, Nerhus TK. Correction of varus knees by opening wedge osteotomy. *Knee Surg Sports Traumatol Arthrosc*. 2008;16(Suppl 1):184.
9. Furnes O, Espehaug B, Lie SA, Vollset SE, Engesaeter LB, Havelin LI. Failure mechanisms after unicompartmental and tricompartmental primary knee replacement with cement. *J Bone Joint Surg Am*. 2007;89(3):519-525.
10. Garratt AM, Brealey S, Gillespie WJ; DAMASK Trial Team. Patient-assessed health instruments for the knee: a structured review. *Rheumatology (Oxford)*. 2004;43(11):1414-1423.
11. Gudas R, Stankevicius E, Monastyreckiene E, Pranys D, Kalesinskas RJ. Osteochondral autologous transplantation versus microfracture for the treatment of articular cartilage defects in the knee joint in athletes. *Knee Surg Sports Traumatol Arthrosc*. 2006;14(9):834-842.
12. Hanypsiak BT, Spindler KP, Rothrock CR, et al. Twelve-year follow-up on anterior cruciate ligament reconstruction: long-term outcomes of prospectively studied osseous and articular injuries. *Am J Sports Med*. 2008;36(4):671-677.
13. Hjelle K, Solheim E, Strand T, Muri R, Brittberg M. Articular cartilage defects in 1,000 knee arthroscopies. *Arthroscopy*. 2002;18(7):730-734.
14. Hjermundrud V, Bjune TK, Risberg MA, Engebretsen L, Arøen A. Full-thickness cartilage lesion do not affect knee function in patients with ACL injury. *Knee Surg Sports Traumatol Arthrosc*. 2009 Sep 4. [Epub ahead of print].
15. 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):185-192.
16. Jinks C, Jordan K, Croft P. Measuring the population impact of knee pain and disability with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). *Pain*. 2002;100(1-2):55-64.
17. Knutsen G, Drogset JO, Engebretsen L, et al. A randomized trial comparing autologous chondrocyte implantation with microfracture: findings at five years. *J Bone Joint Surg Am*. 2007;89(10):2105-2112.
18. Knutsen G, Engebretsen L, Ludvigsen TC, et al. Autologous chondrocyte implantation compared with microfracture in the knee: a randomized trial. *J Bone Joint Surg Am*. 2004;86(3):455-464.
19. Krishnan SP, Skinner JA, Bartlett W, et al. Who is the ideal candidate for autologous chondrocyte implantation? *J Bone Joint Surg Br*. 2006;88(1):61-64.
20. Lindahl A, Brittberg M, Peterson L. Health economics benefits following autologous chondrocyte transplantation for patients with focal chondral lesions of the knee. *Knee Surg Sports Traumatol Arthrosc*. 2001;9(6):358-363.
21. Løken S, Høysveen T, Ludvigsen TC, Holm I, Engebretsen L, Reinholt FP. Autologous chondrocyte implantation to repair knee cartilage injury: ultrastructural evaluation at 2 years and long term follow up including muscle strength measurements. *Knee Surg Sports Traumatol Arthrosc*. 2009 Jul 2. [Epub ahead of print].
22. Messner K, Gillquist J. Cartilage repair: a critical review. *Acta Orthop Scand*. 1996;67(5):523-529.
23. Messner K, Maletius W. The long-term prognosis for severe damage to weight-bearing cartilage in the knee: a 14-year clinical and radiographic follow-up in 28 young athletes. *Acta Orthop Scand*. 1996;67(2):165-168.
24. Minas T, Gomoll AH, Rosenberger R, Royce RO, Bryant T. Increased failure rate of autologous chondrocyte implantation after previous treatment with marrow stimulation techniques. *Am J Sports Med*. 2009;37(5):902-908.
25. Mithofer K, Minas T, Peterson L, Yeon H, Micheli LJ. Functional outcome of knee articular cartilage repair in adolescent athletes. *Am J Sports Med*. 2005;33(8):1147-1153.
26. Mohtadi N. Development and validation of the quality of life outcome measure (questionnaire) for chronic anterior cruciate ligament deficiency. *Am J Sports Med*. 1998;26(3):350-359.
27. Nerhus TK, Heir S, Skråmm I, Jervidalo T, Svege I, Ekeland A. Time-dependent improvement of functional outcome following Oxford medial UCA—a prospective longitudinal multicenter study with repetitive measures prior to surgery, and 6 weeks, 3 months, 6 months, 1 year and 2 years after surgery. *Knee Surg Sports Traumatol Arthrosc*. 2008;16(Suppl 1):209-210.
28. Nerhus TK, Heir S, Thornes E, Ekeland A. Time-dependent improvement of functional outcome following TKR—a prospective longitudinal study with repetitive measures prior to surgery, and 6 weeks, 3 months, 6 months, 1 year, 2 year and 4 years after surgery. *Knee Surg Sports Traumatol Arthrosc*. 2008;16(Suppl 1):S208.
29. Nilsdotter AK, Toksvig-Larsen S, Roos EM. A 5 year prospective study of patient-relevant outcomes after total knee replacement. *Osteoarthritis Cartilage*. 2009;17(5):601-606.
30. Paradowski PT, Bergman S, Sunden-Lundius A, Lohmander LS, Roos EM. Knee complaints vary with age and gender in the adult population: population-based reference data for the Knee injury and Osteoarthritis Outcome Score (KOOS). *BMC Musculoskelet Disord*. 2006;7:38.
31. Pinczewski LA, Lyman J, Salmon LJ, Russell VJ, Roe J, Linklater J. A 10-year comparison of anterior cruciate ligament reconstructions with hamstring tendon and patellar tendon autograft: a controlled, prospective trial. *Am J Sports Med*. 2007;35(4):564-574.
32. Roos EM, Roos HP, Ekdahl C, Lohmander LS. Knee injury and Osteoarthritis Outcome Score (KOOS)—validation of a Swedish version. *Scand J Med Sci Sports*. 1998;8(6):439-448.
33. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon 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.
34. Roos EM, Toksvig-Larsen S. Knee injury and Osteoarthritis Outcome Score (KOOS)—validation and comparison to the WOMAC in total knee replacement. *Health Qual Life Outcomes*. 2003;1:17.
35. Rosenberger RE, Gomoll AH, Bryant T, Minas T. Repair of large chondral defects of the knee with autologous chondrocyte implantation in patients 45 years or older. *Am J Sports Med*. 2008;36(12):2336-2344.
36. Saris DB, Vanlauwe J, Victor J, et al. Characterized chondrocyte implantation results in better structural repair when treating symptomatic cartilage defects of the knee in a randomized controlled trial versus microfracture. *Am J Sports Med*. 2008;36(2):235-246.
37. Shelbourne KD, Jari S, Gray T. Outcome of untreated traumatic articular cartilage defects of the knee: a natural history study. *J Bone Joint Surg Am*. 2003;85(Suppl 2):8-16.
38. Tanner SM, Dainty KN, Marx RG, Kirkley A. Knee-specific quality-of-life instruments: which ones measure symptoms and disabilities most important to patients? *Am J Sports Med*. 2007;35(9):1450-1458.
39. Widuchowski W, Widuchowski J, Koczy B, Szyluk K. Untreated asymptomatic deep cartilage lesions associated with anterior cruciate ligament injury: results at 10- and 15-year follow-up. *Am J Sports Med*. 2009;37(4):688-692.
40. Widuchowski W, Widuchowski J, Trzaska T. Articular cartilage defects: study of 25,124 knee arthroscopies. *Knee*. 2007;14(3):177-182.