

Articular Cartilage Defects in 1,000 Knee Arthroscopies

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Purpose: Focal chondral or osteochondral defects can be painful and disabling, have a poor capacity for repair, and may predispose patients for osteoarthritis. New surgical procedures that aim to reestablish hyaline cartilage have been introduced and the results seem promising. The purpose of this study is to provide reliable data on chondral and osteochondral defects in patients with symptomatic knees requiring arthroscopy and to calculate the prevalence of patients who might benefit from cartilage repair surgery. **Type of Study:** Prospective study. **Methods:** One thousand consecutive knee arthroscopies were included in this study. Immediately after each arthroscopy, the surgeon completed a questionnaire providing detailed information about the findings. Chondral and osteochondral lesions were classified in accordance with the system recommended by the International Cartilage Repair Society (ICRS). **Results:** Chondral or osteochondral lesions (of any type) were found in 61% of the patients. Focal chondral or osteochondral defects were found in 19% of the patients. In these patients, 61% related their current knee problem to a previous trauma, and a concomitant meniscal or anterior cruciate ligament injury was found in 42% (n = 81) and 26% (n = 50), respectively. The mean chondral or osteochondral total defect area was 2.1 cm² (range, 0.5 to 12; standard deviation [SD], 1.5). The main focal chondral or osteochondral defect was found on the medial femoral condyle in 58%, patella in 11%, lateral tibia in 11%, lateral femoral condyle in 9%, trochlea in 6%, and medial tibia in 5%. It has been suggested that cartilage repair surgery may be most suitable in patients younger than 40 to 50 years old. A single, well-defined ICRS grade III or IV defect with an area of at least 1 cm² in a patient younger than 40, 45, or 50 years accounted for 5.3%, 6.1%, and 7.1% of all arthroscopies, respectively. **Conclusions:** Our study supports the contention that articular cartilage defects are common. It has the advantages of a prospective design and use of a new classification system recommended by the ICRS. This modern system focuses on objectively measurable parameters of the lesion's extent and not its surface appearance. **Key Words:** Arthroscopy—Prospective study—Articular cartilage injury.

Focal chondral or osteochondral defects can be painful and disabling, have a poor capacity for repair, and may predispose patients for osteoarthritis.¹⁻⁶ The long-term results of traditional methods for treating these lesions have been disappointing, and

new surgical procedures that aim to reestablish hyaline cartilage have been introduced, including autologous chondrocyte transplantation⁷⁻⁹ and mosaicplasty.^{10,11} These methods seem promising, but results of randomized studies have not yet been published. Chondral or osteochondral defects are difficult to diagnose clinically¹²⁻¹⁴; Zamber et al.¹⁴ concluded that, "... despite detailed, pertinent questioning regarding each patient's symptoms, we found no reliable correlation between clinical symptoms and articular cartilage status." Although improved magnetic resonance imaging (MRI) techniques make it possible to diagnose an increasing number of chondral defects,¹⁵ most of these lesions are still diagnosed using arthroscopy, which is regarded as the gold standard for assessment of articular cartilage.¹⁶ To provide reliable data on

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chondral and osteochondral defects and to calculate the prevalence of patients who might benefit from cartilage repair surgery, we conducted a prospective study of cartilage lesions in 1,000 consecutive knee arthroscopies.

METHODS

From January 1997 to November 1999, 1,000 consecutive knee arthroscopies performed at the Deaconess University Hospital were included in a prospective study of articular cartilage lesions. Preplanned cartilage repair surgery in patients with an established diagnosis of cartilage defect was not included. During our study, 90 such procedures (microfracture, autogenous chondrocyte transplantation, and mosaicplasty) were performed. We recorded the age and gender of the patients and asked if the patient believed that the current knee problem was related to a previous trauma (answered by "yes" or "no"). Five orthopedic surgeons who had practiced arthroscopic surgery for at least 7 years performed the arthroscopies. Immediately after each arthroscopy, the surgeon completed a questionnaire that provided detailed information about the findings, including range of motion of the knee, joint laxity tests, patellar tracking, effusion, synovitis, loose bodies, articular cartilage lesions, meniscus lesions, and cruciate ligament pathology.

As recommended by the International Cartilage Repair Society (ICRS),^{17,18} we considered the following characteristics:

1. The location of the lesions on 1 or more of the 6 articular surfaces of the knee (patella, trochlea, medial femoral condyle, lateral femoral condyle, medial tibia, and lateral tibia) was identified.
2. The area of the lesion was calculated as centimeters squared after measuring the length and width using a meniscal probe.
3. The depth of the lesion was classified as (1) superficial, which was a soft indentation or superficial fissures and cracks (ICRS grade I), (2) lesion extending to less than half of the cartilage depth (ICRS grade II), (3) lesion extending half or more of the cartilage depth, but not into the subchondral bone (ICRS grade III), or (4) osteochondral lesion (ICRS grade IV).^{17,18}
4. Focal chondral or osteochondral defects were defined as 3 or fewer well-defined lesions surrounded and opposed by normal-appearing cartilage (evaluated visually and by palpation with

the meniscal probe), excluding kissing lesions and typical chondromalacia patellae. If more than 3 lesions were found or the lesions were situated on opposing surfaces (kissing lesions), the finding was classified as osteoarthritis.

5. To estimate the proportion of cases in which cartilage repair surgery may be indicated, we identified the patients younger than 40, 45, or 50 years old who had a single well-defined ICRS grade III or IV defect with an area of at least 1 cm².

Statistics

Data were stored in a Microsoft Access database (Microsoft, Redmond, WA). The statistical analyses were made using the Statistical Package for the Social Sciences (SPSS, Chicago, IL) on a personal computer. As measures of central location and spread of data, mean and standard deviation (SD) were calculated.

RESULTS

The study included 623 male and 377 female patients with a mean age of 39 years (SD, 14; range, 13 to 96). Of these patients, 38% remembered having sustained an acute trauma of the knee that they related to their present complaint. Meniscus lesions were found in 57% of the patients, synovitis in 35%, anterior cruciate ligament (ACL) injury in 17%, pathology of the synovial plica in 6%, corpus liberum in 6% and no intra-articular pathology in 4%. Chondral or osteochondral lesions (of any type) were found in 61% of the patients. These lesions (n = 606) were classified as osteoarthritis (44%), chondromalacia patellae (23%), focal chondral lesions (28%), osteochondritis dissecans (2%), or other types (3%).

Focal chondral or osteochondral defects (excluding chondromalacia patellae, n = 135) were found in 19% (n = 193) of the arthroscopies. Of these defects, 80% were single. Two chondral or osteochondral defects were found in 12%, and 3 defects were found in 8%. The mean chondral or osteochondral total defect area was 2.1 cm² (range, 0.5-12; SD, 1.5). In 19% (n = 36) of the chondral or osteochondral defects the total area was less than 1 cm²; in 26% (n = 51) the area was from 1 to 2 cm²; in 42% (n = 82) the area was from 2 to 4 cm²; and in 12% (n=24) the total defect area was more than 4 cm².

The main focal chondral or osteochondral defect, defined as the largest when more than one lesion was present, was found on the medial femoral condyle in

58%, patella in 11%, lateral tibia in 11%, lateral femoral condyle in 9%, trochlea in 6%, and medial tibia in 5%. Fourteen percent ($n = 27$) of the main focal defects were ICRS grade I (superficial lesions), 26% ($n = 50$) were grade II (lesions extending to less than half of the cartilage depth), 55% ($n = 106$) were grade III (extending more than half of the cartilage depth, but not into the subchondral bone), and 5% ($n = 10$) were grade IV (osteochondral defects). In the cases of focal chondral or osteochondral defects, a concomitant meniscal or anterior cruciate ligament injury was found in 42% ($n = 81$) and 26% ($n = 50$), respectively. Concomitant injury of both meniscus and anterior cruciate ligament injury was found in 12% ($n = 23$). Of the patients with focal chondral or osteochondral defects, 61% remembered sustaining an acute trauma of the knee that they related to their present complaints. Cases of single, well-defined ICRS grade III or IV defects with an area of at least 1 cm^2 in patients younger than 40, 45, or 50 years of age accounted for 5.3%, 6.1%, and 7.1% of all arthroscopies, respectively, or 10.0%, 9.1%, and 9.2% of the arthroscopies in the respective age groups.

DISCUSSION

Although focal chondral lesions of the knee were previously believed to be a seldom-encountered diagnosis,¹⁹ a recent study has proved them to be a common problem. In a large retrospective study involving 136 surgeons, Curl et al.²⁰ found Outerbridge grade IV lesions in 19% of 31,516 patients who underwent an arthroscopy of the knee. Our study supports the contention that articular cartilage defects are common in patients with symptomatic knees requiring arthroscopy and, although it includes fewer patients, it has the advantages of a prospective design, using the classification system recommended by the ICRS,^{17,18} and involving a small number of experienced arthroscopic surgeons.

Some previous studies of cartilage lesions have focused on the visual appearance of the surface of the lesion.^{4,21-23} Outerbridge,²¹ in an effort to classify different grades of chondromalacia patellae, described 4 types of lesion: grade I, softening and swelling; grade II, fragmentation and fissuring of 0.5 in or less; grade III, fragmentation and fissuring greater than 0.5 in; and grade IV, erosion of cartilage to the subchondral bone. Based on a study of 167 chondral lesions in 140 knees, Bauer and Jackson⁴ discriminated between 6 different types of chondral lesions of the femoral condyles: type I, linear crack; type II, stellate fracture;

type III, flap; type IV, crater; type V, fibrillated; and type VI, deggrading. The lesions were found predominantly on the weight-bearing parts of the surfaces. Types I through IV were presumed to be of acute traumatic origin, whereas types V and VI were believed to be associated with degenerative processes.

However, as far as we know, the clinical significance of the surface appearance has not been documented. In our clinical practice, we have found full-thickness chondral lesions, where the meniscus probe reaches the subchondral bone, to have different appearances, including "crab meat-like" softened and partially eroded tissue; deep clefts or fissures; loose flaps; undermined cartilage broken loose from the subchondral bone; and craters, often with the bottom covered with moss-like cartilage remnants or whitish fibrocartilage repair tissue. Some of these appearances may fit poorly into earlier published classification systems. In some cases, the whole thickness of the cartilage is pathologically softened and sometimes loosened from the subchondral bone, but the surface still has a normal or near normal appearance. Classification of the appearance is highly subjective; the data is purely qualitative, and the etiologic, therapeutic, and prognostic values of the different groups are uncertain. Furthermore, although some of these classification systems are supposed to reflect different grades or stages of the lesion, it has not been proven that the grades represent a continuum of the severity of lesion, the symptoms caused, the responsible force of trauma, or the duration of disability.

In recent years, new methods that aim to restore hyaline-like articular cartilage have become available, including autologous chondrocyte transplantation⁷⁻⁹ and mosaicplasty.^{10,11} When planning and performing such cartilage repair procedures, which are usually indicated only for symptomatic articular cartilage defects, the important defect parameters are the location, depth, and area of the lesions as well as the status of the surrounding cartilage. Thus, newer classification systems that focus more on objectively measurable parameters of the extent of the lesion and less on its surface appearance have been developed.^{17,24-26} The classification system used in the current study conforms to the system recommended by the ICRS, which was first published in 1998¹⁷ and recently revised.¹⁸

In the current study, articular cartilage lesions were found in 61% of patients. This is in concordance with the results of Curl et al.,²⁰ who found chondral lesions in 63%. We classified a large proportion of the articular cartilage lesions as osteoarthritis (44%, including kissing lesions) or chondromalacia patellae (23%),

which are conditions for which most cartilage repair techniques are currently not recommended. Focal chondral or osteochondral defects, defined as 1 to 3 well-defined lesions surrounded and opposed by cartilage of normal appearance (excluding kissing lesions and typical chondromalacia patellae) were found in 19% of patients. Our results confirm that concomitant lesions occur frequently in articular cartilage defects; we found a concomitant meniscal or ACL injury in 42% (n = 81) and 26% (n = 50), respectively. Concomitant injury of both meniscus and ACL was found in 12% (n = 23). Curl et al.²⁰ found associated ligamentous or meniscal pathology in 63% of the Outerbridge grade IV chondral lesions.

Traumatic chondral lesions generally occur as a result of compression and rotational shearing forces,²⁷ and the size of the lesion will probably correspond to the contact area with the opposing chondral surface. The high proportion of single defects (80% of the focal defects) and their moderate size (mean area of 2.1 cm²; 88% were less than 4 cm²) in our study may suggest a traumatic origin, although 39% of the patients with focal chondral or osteochondral defects could not remember having sustained a trauma that they held responsible for their knee trouble. Larger defects may be the result of repeated minor traumas or, perhaps more commonly, secondary degenerative changes. In the latter cases, the surrounding cartilage becomes thin and soft, and the lesion is then no longer focal. Eventually, kissing lesions occur.

The potential for cartilage repair seems to be better in young individuals^{28,29} and it has been stated that the ideal patient for cartilage repair surgery is younger than 45 years old and has a symptomatic isolated chondral or osteochondral lesion with no evidence of osteoarthritis.³⁰ However, the guidelines regarding ideal patient age and lesion size vary according to the cartilage repair method discussed. Unfortunately the different views have little scientific support currently. It is believed that small lesions, less than 1 cm², have a better prognosis and that debridement is the procedure of choice in these cases.³¹⁻³³ Dzioba²⁸ noted better results for debridement and drilling in chondral lesions of 1 to 3 cm² in patients younger than 45 years performed within 3 weeks of injury. For autologous chondrocyte implantation with cells cultured by Genzyme (Cambridge, MA), it is recommended that the defect area be between 1 and 10 cm² and that the patient be between 15 and 55 years old.³⁴ For best results with mosaicplasty, an upper patient age limit of 50 years is recommended.¹⁰

In the present study, cases of single, well-defined

ICRS grade III or IV chondral or osteochondral defects of at least 1 cm² in patients younger than 40, 45, or 50 years were found in 5.3%, 6.1%, and 7.1% of all arthroscopies, respectively, or 10.0%, 9.1%, and 9.2% of the arthroscopies in the respective age groups. Our results seem to agree with those of Curl et al.,²⁰ who found a single Outerbridge grade IV (full-thickness) cartilage lesion in patients 40 years or younger in 4% of the arthroscopies.

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