Cartilage Injuries: A Review of 31,516 Knee Arthroscopies

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Summary: Although articular cartilage injuries of the knee are common, injured cartilage has a limited ability to heal. Recent data suggest that articular cartilage grafting may provide treatment for these injuries. To define the patient population that might benefit from cartilage grafting, 31,516 knee arthroscopies were reviewed. Between June 1991 and October 1995, 53,569 hyaline cartilage lesions were documented in 19,827 patients. The majority were articular cartilage lesions; grade III lesions of the patella were the most common. Grade IV lesions were predominantly located on the medial femoral condyle. Patients under 40 years of age with grade IV lesions accounted for 5% of all arthroscopies; 74% of these patients had a single chondral lesion (4% of the arthroscopies). No associated ligamentous or meniscal pathology was found in 36.6% of these patients. **Key Words:** Knee—Cartilage injury—Arthroscopy—Articular cartilage—Chondral lesion.

The articular surface of the knee is frequently injured, and the difficulty in treating such injuries has been recognized since the 18th Century.[1] Current treatment, including abrasion, drilling, and debridement, can yield unpredictable outcomes with regard to function. In the best of cases, the injured cartilage is replaced by fibrocartilage ingrowth. Despite the resulting reduction in symptoms, the biomechanical properties of this fibrocartilage ingrowth tissue are markedly different from those of the normal joint surface.

Recent studies have focused on the implantation or transplantation of hyaline cartilage into the area of injured cartilage in an effort to form a more anatomically normal joint surface. To date, both animal and human studies have shown promise that these procedures will result in replacement of the defects by viable hyaline cartilage. The purpose of this study is to describe the types and numbers of patients who might benefit from such a procedure by reporting the prevalence of chondral injuries documented at arthroscopy, the location of those lesions, and the pathological changes associated with them.

METHODS AND MATERIALS

Data for this study were retrieved from the Surgical Data Management database located in Richmond, Virginia. Surgical Data Management computer software is used at academic centers and private orthopaedic offices throughout the United States to record standardized information describing knee and shoulder arthroscopic procedures. The database query included arthroscopy data on patients provided by 136 surgeons; 13% of the surgeons providing data were affiliated with academic centers and the remaining 87% of the surgeons providing data were in private practice. The Surgical Data Management data forms are designed to collect information on demographics, the type of procedure performed, the lesion(s) found, and the treat-

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TABLE 1. *Modified Outerbridge Scale for Grading Cartilage Lesions*

Grade	Abbreviation	Description
Grade I	GI CM	Softening of the articular cartilage
Grade II	GII CM	Fibrillation or superficial fissures of the cartilage
Grade III	GIII CM	Deep fissuring of the cartilage without exposed bone
Grade IV	CIV CM	Exposed bone

ment for a specific knee arthroscopy. Therefore, patients included in this study may have undergone arthroscopy on one or both knees or may have undergone repeat arthroscopic knee procedures. For arthroscopy of the knee, the recorded lesions include chondral injury, meniscal injury, and ligament injury. Chondral injury is subdivided into osteochondritis dessicans (OCD), articular fractures, and chondromalacia (CM). Osteochondritis dessicans is further subdivided by whether the fragment is displaced or undisplaced. Lesions are classified as fractures only when there are linear cracks in the articular surface, and these lesions have not been subdivided. All remaining lesions are subdivided as to grade of chondromalacia based on a modification of the Outerbridge scale (Table 1). Each lesion is further described in the database by location and treatment, and information is collected on associated meniscal and ligamentous injuries. All of the information is maintained in a central database where the data is pooled anonymously.

The Surgical Data Management database was queried on all knee arthroscopies recorded between June 2, 1991 and October 2, 1995. Diskettes containing these data were sent to the Department of Public Health Sciences at the Bowman Gray School of Medicine of Wake Forest University and were uploaded to the VAX cluster located in that department. The SAS software package was used to describe the population in the database.

RESULTS

Information on 31,516 knee arthroscopies was sent in answer to our request. Chondral lesions were found in 63% or 19,827 of the arthroscopies. A total of 53,569 hyaline cartilage lesions were found during these 19,827 arthroscopies, for an average of 2.7 lesions per knee. The average age of the patients with lesions was 43 years (range, 1 to 92 years); more male than female patients had lesions (61.6% *v* 38.4%, respectively).

The prevalence of chondral injury in this series of arthroscopies was: 0.7% OCD lesions; 1.3% articular fractures; 9.7% grade I CM, 28.1%; grade II CM; 41.0% grade III CM; and 19.2% grade IV CM. Grade III lesions were the most common lesions in patients over 30 years of age. The most common locations for grade III lesions were the patella and the medial femoral condyle.

Because we believe that patients with grade IV CM lesions under the age of 40 years represent the ideal type of patient to receive hyaline cartilage implantation or transplantation, the dataset was further analyzed to characterize these patients. Overall, grade IV CM lesions were documented in 20% of all arthroscopies, but the majority (72%) were found in patients over 40 years of age. Patients under 40 years showing documented grade IV CM lesions accounted for 1,729 arthroscopies (5% of total). In 26% of these 1,729 arthroscopies, multiple grade IV CM lesions were documented; single grade IV CM lesions were documented in the remaining 1,277 arthroscopies (Fig 1). The medial femoral condyle was the most common location for single grade IV CM lesions; the patella and lateral femoral condyle were the next two most common sites (Fig 2).

Other knee joint lesions were seen in 13,538 of the 19,827 abnormal arthroscopies (68%). Medial meniscus injury was the most common associated lesion in all age groups beyond the third decade (Fig 3). In younger patients, anterior cruciate ligament injury was the predominant associated injury. For lateral meniscal injuries, there were significant gender differences (younger males had higher rates than females, but after age 50 years, females had higher rates than males (Fig 4A). Medial meniscus injuries were more common in male than in female patients (Fig 4B). Among the 1,277 patients under 40 years of age with only one grade IV lesion, 468 (36.6%) had no meniscal or ligament pathology (Fig 5).

DISCUSSION

Significantly injured articular cartilage is never spontaneously restored to a normal articular surface. Healing requires vascular ingrowth into the area of injury.[2-6] After healing has been set into action, the joint surface can often be restored to a functional level, but with fibrocartilage ingrowth. The current methods of treatment (drilling, abrasion, debridement) for these lesions are performed specifically to help encourage this vascular ingrowth and fibrocartilage healing.[7-11]

Both biomechanically and biochemically, fibrocar-

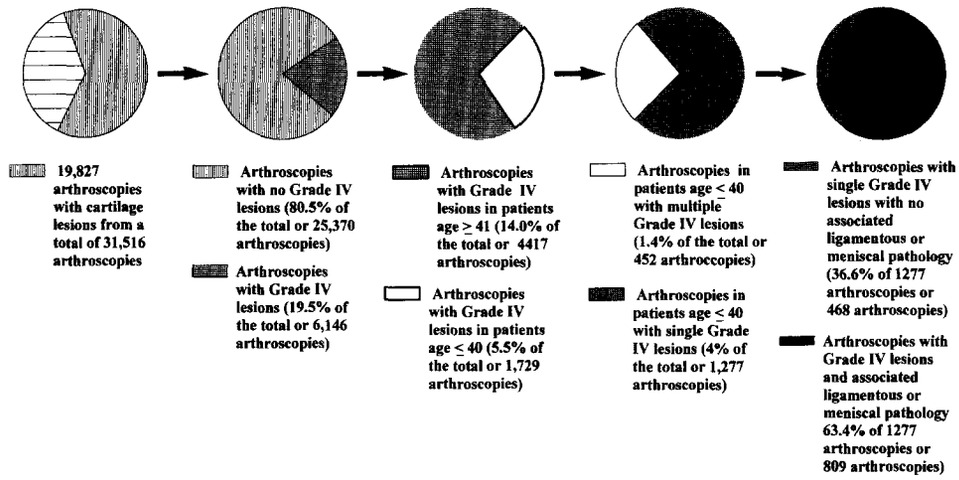

FIG 1. Summary of knee arthroscopy data. The first circle represents the total number of arthroscopies in the dataset. The second circle shows the number of patients with grade IV lesions; the third circle, the number of patients with grade IV lesions in two age groups who are either over or under 40 years of age; and the fourth circle, the number of single versus multiple grade IV lesions.

tilage is significantly different from hyaline cartilage.[4,12,13] Additionally, in the absence of treatment, the long-term prognosis after significant articular injury is unpredictable. In an effort to prevent the need for arthroplasty, multiple techniques to restore hyaline cartilage have been studied, including the use of transforming growth factors,[14,15] fresh allografts,[16] periosteal grafts,[17] perichondral autografts,[18,19] chondral autografts,[20] fibrin clot,[21,22] autologous marrow,[23] as well as resorbable and unresorbable scaffolded allografts.[24,25] These procedures have shown significant potential in the restoration of hyaline cartilage,[23] especially of isolated femoral condylar lesions. Lesions elsewhere have shown some, albeit less, promise,[20] with significant variability being seen among the methods used.[16,20] The response of multiple lesions to such procedures is not yet known, although there has been some reported success.[26]

This study of a 5-year-period has documented nearly 50,000 articular injuries of which almost 20% had exposed bone. Significant numbers of articular injuries were found in patients whose age is a relative contraindiction to total joint arthroplasty. Studies on knee replacements generally show good outcome but over a finite time period.[27] Clearly, the availability of simpler technologies to restore the knee to a more normal state, especially for the younger patient, would reduce the morbidity, the mortality, and possibly the cost of caring for these patients. Our data further suggest that the current criteria for grafting (i.e., isolated lesions involving the femoral condyles only) must be expanded.

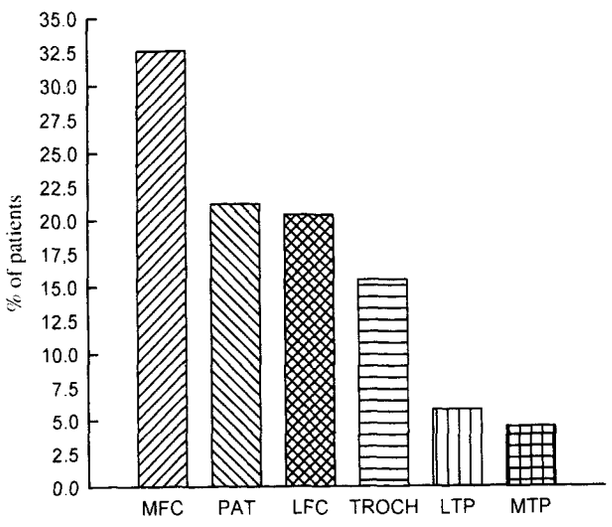

FIG 2. The locations of single grade IV lesions in patients 40 years of age or younger. MFC, medial femoral condyle; PAT, patella; LFC, lateral femoral condyle; TROCH, trochlea; LTP, lateral tisial plateau; MTP, medial tisial plateau.

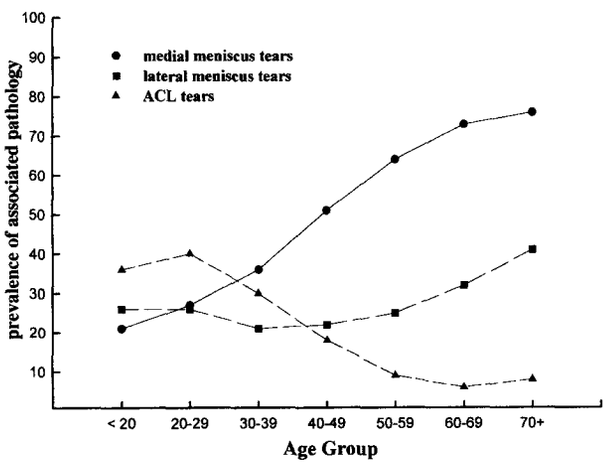

FIG 3. The percentage in each age group with meniscal or ligament pathology. Ligament tears are reported for the anterior cruciate ligaments only.

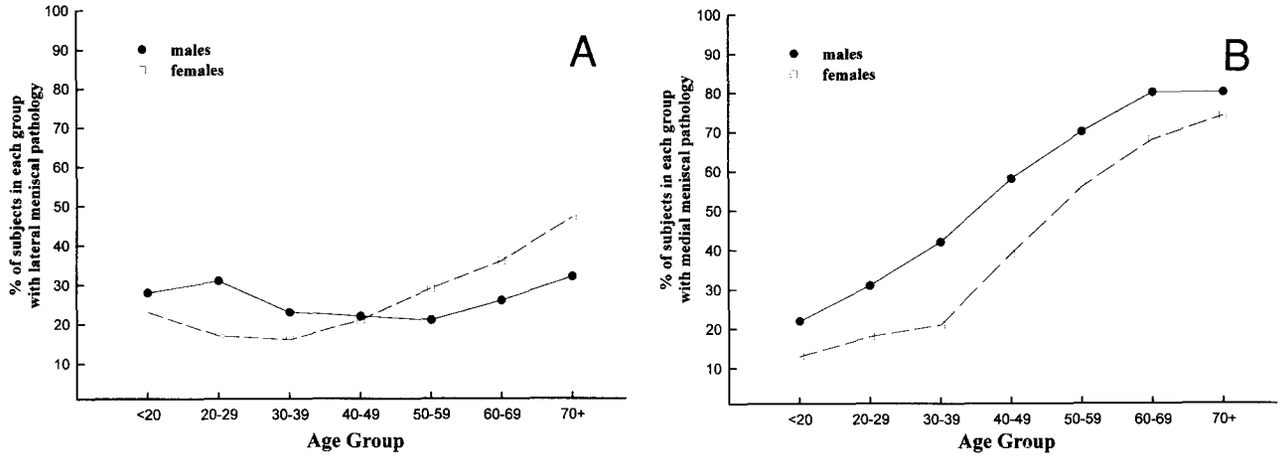

FIG 4. Gender differences in meniscal injury. (A) Lateral meniscal pathology was documented more often in males until age 50 years when females had the higher incidence. (B) Medial meniscus injuries predominated in males in all age groups.

Several authors studying chondral injuries associated with specific intra-articular lesions have commented on the specific mechanism, location, and severity of these lesions and their relationship to knee instability in their patients.[28-31] Previous information on location of chondral lesions is quite variable, and is dependent on the method assessed as well as the presence of knee instability.[16,28,32,33] Such information can and will be very important in treatment algorithms for cartilage injury, especially, when cartilage grafting becomes available. Only with this information will we be able to answer such questions as: Will grafts only work if used in one area within a knee? Will it be possible to graft multiple lesions in the same knee? Will grafts hold up in the presence of other pathological entities within the knee?

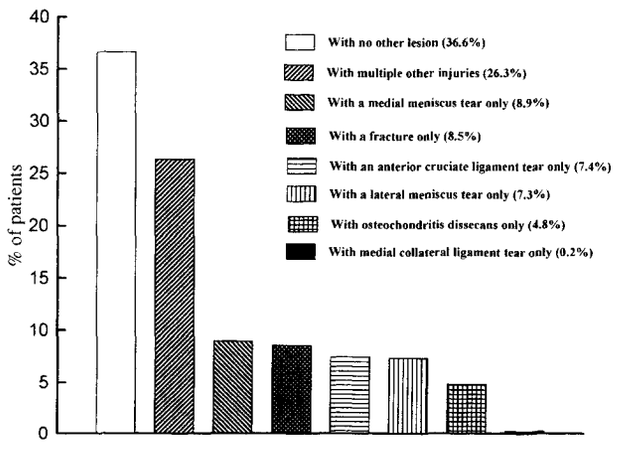

FIG 5. A description of the knee lesions and injuries documented in patients under 40 years of age who had a single grade IV lesion.

The etiology of the cartilage lesion is another factor not clearly defined in this patient base, and it too can come into play with regard to treatment algorithms. A single lesion in an active 50-year-old patient is not the same as a single lesion in a sedentary 50-year-old rheumatoid patient. Although arthroplasty may be an available alternative in one group, grafting may be more appropriate in other groups.

A third factor is the variability in current systems for grading articular cartilage injury. Numerous methods for grading the degeneration of articular injuries have been reported, based on depth, size, or shape.[34-36] An additional group has sought to combine multiple variables into a single grading scale.[37,38] For the sake of simplicity, our institution relies on a depth grading scale used in each location within the knee. The interobserver and intraobserver reproducibility of our system has not been evaluated, although others have reported potentially significant differences in estimating the surface of the lesion.[39] The grading system can obviously play a significant role in the evaluation of our data and may lead to significant variability when compared with the findings of others.

Despite these shortcomings, we believe these data are significant in demonstrating the need for aggressive investigation into treating cartilage injury. Additionally, they indicate the need to expand these technologies to the treatment of knees with multiple articular injuries as well as in those with associated pathological processes.

In conclusion, articular injury is a commonly found entity at arthroscopy, occurring in more than half of the arthroscopies performed in this time period. In our study, there was a tendency toward more than one lesion being found at arthroscopy, and a significant proportion of chon-

dral lesions were associated with other intraarticular disorders. The more severe lesions were found most often in the medial femoral condyle and patella, and more often in the patients under 40 years of age. The patients we previously believed would be the "ideal" candidates for grafting accounted for 1,277 of 31,516 (4%) of the knee arthroscopies in this data set; no other ligamentous or meniscal injury was documented in only 36.6% of these arthroscopies.

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