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# Intra-articular knee injuries in racquet sports

## A review of 128 arthroscopies

J. M. Powell, T. G. Kavanagh, D. K. Kennedy, H. J. Marans, and T. A. Wright

Toronto Western Hospital Sports Medicine Institute, 25 Leonard Avenue, Toronto, Ontario M5T 2R2, Canada

**Summary.** Within the last decade, there has been a significant increase in racquet sport participation. The authors report that in a 5-year period, 17% of the injuries seen in a busy sports injuries clinic were associated with raquet sports, and over half of these were injuries to the knee. The findings are reported of those patients requiring knee arthroscopy, and the patterns of injury sustained are identified. Injuries to the knee in racquet sports are largely unavoidable and are inherent to the nature of the game.

**Key words:** Knee injuries – Arthroscopy – Racquet sport injuries – Meniscal lesions – Chondromalacia patellae.

Within the last 10 years there has been a rapid escalation in the participation in racquet sports. In the latest Canadian national census of leisure time activities [3], it was found that, out of a target population of 20.7 million individuals of age 10 and over, tennis was the most popular competetive sport, with 3.05 million people (15%) having played this sport within the preceding year. Racquetball was played by 1.23 million (6%) and badminton by 430,000 (2%). Squash has overtaken racquetball as the fastest growing raquet sport in Canada with a growth rate of 8% per annum. There are now 325,000 registered members of the Canadian Squash Racquets Association [2], and it has been projected that over 1.5 million people now play this sport. We have been impressed by the number of patients presenting at our Sports Injuries Clinic with knee injuries associated with racquet sports, a good proportion of whom require arthroscopic assessment and surgery.

*Offprint requests to:* T. A. Wright

### Materials and methods

An analysis was undertaken of all injuries seen at the Department of Sports Medicine at Toronto Western Hospital over a 5-year period. Of the 2,300 patients seen, a total of 404 patients (17%) presented with an injury associated with racquet sports. Of this number, 222 patients (55%) had knee injuries, and 121 of these required arthroscopic investigation (including 7 patients who underwent bilateral arthroscopy), resulting in 128 arthroscopies.

Each of the 121 patients who attended for a clinical assessment completed a questionnaire giving details of pre- and postinjury status and postarthroscopic progress. The details included the sport played when injured, surface conditions, extent and nature of warm-up period, performance level, mechanism of injury, and previous related knee injuries. The return-to- sport interval, new performance level, other treatment modalities, and any residual symptoms were recorded. The follow-up period in this study ranged from 6 months to 78 months with a mean of 27.2 months.

### Results

The age at presentation ranged from 14 to 68 years with a mean of 32.8 years. There were 55% males and 45% females in the study population. Analysis of the sport being played when injured revealed that 36% were injured while playing squash, 31% while playing tennis, 21% while playing badminton, and 12% while playing racquetball. The competition level of the injured participants ranged from recreational beginner to professional. Over 90% of the players injured in this study were of an intermediate or advanced level of participation. The surface played on varied from processed concrete to artifical novocourt and resilient indoor surfaces. Over 50% of the

participants played on a sprung wooden floor surface.

More than 60% of the participants reported an inadequate warm-up period prior to participation, which was represented by either no warm-up at all or an inadequate length of stretching or rallying prior to participation in the racquet sport. Only a small number of participants engaged in an adequate warm-up procedure of 10 min or more of slow, prolonged stretching followed by at least 5 min of rallying prior to competition.

Analysis of the mechanism of injury revealed that 89% of the patients injured their knees through a twisting mechanism. This places rotatory forces on the knee joint and commonly leads to intra-articular knee injuries. In 5% of patients, the injury resulted from direct contact with either the wall, the racquet, or, on one occasion, the player's opponent. Other causes of injury were described by 6% of patients.

The patients were asked about related, pre-existing knee injuries. Twenty-two percent of the patients described prior knee injuries, including 1 anterior cruciate ligament injury, 7 sprains of the medial collateral ligament, and 14 known meniscal lesions. Other related, pre-existing injuries included 5 lateral collateral ankle ligament sprains, 4 patients with patellar tendonitis, and 2 previously fractured patellae.

Of the 121 patients in the study, 114 underwent a unilateral arthroscopy, and 7 had bilateral arthroscopies, resulting in a total of 128 arthroscopic examinations. Eleven arthroscopic examinations revealed no intra-articular pathology. The remaining 117 knees had a total of 213 arthroscopic lesions, indicating that in most cases more than one lesion was present.

The five major lesions found at arthroscopy were meniscal lesions, chondromalacia patellae, anterior cruciate ligament injuries, chondral lesions, and pathological plicae. Other intra-articular lesions found included loose bodies, fat-pad contusions, traumatic synovitis, and subluxing patellae (Table 1).

**Table 1.** Arthroscopic findings

| Findings | Frequency | Percentage |
|---|---|---|
| Meniscal lesions | 76 | 36 |
| Chondromalacia patellae | 32 | 15 |
| Anterior cruciate tears | 28 | 13 |
| Chondral lesions (femoral condyle) | 26 | 12 |
| Pathological plicae | 15 | 7 |
| No pathological findings | 11 | 5 |
| Osteoarthritis | 7 | 3 |
| Miscellaneous (including loose bodies, fat pad contusions, subluxing patellae) | 18 | 9 |
| Total | 213 | 100 |

**Table 2.** Meniscal lesions

| Lesion | Frequency | | | Percentage |
|---|---|---|---|---|
| | Medial | Lateral | Total | |
| Oblique (flap or parrot beak) | 28 | 8 | 36 | 47 |
| Vertical longitudinal (bucket handle) | 16 | 0 | 16 | 21 |
| Vertical transverse (radial) | 6 | 4 | 10 | 13 |
| Multiple plane (degenerative/complex) | 6 | 2 | 8 | 11 |
| Horizontal | 2 | 0 | 2 | 3 |
| Miscellaneous (discoid meniscus, hypermobile meniscus, meniscal cyst) | 3 | 1 | 4 | 5 |
| Total | 61 | 15 | 76 | 100 |

Of the 76 meniscal lesions found, there were 45 posterior horn tears, 38 on the medial side, and 7 on the lateral side. There were 16 bucket-handle tears – all on the medial side. Other meniscal lesions included 6 peripheral tears, 5 anterior horn tears, 2 hypermobile menisci, 1 lateral discoid meniscus, and 1 meniscal cyst. The classification of the type of meniscal lesion is shown in Table 2 and reveals that almost 50% of the meniscal lesions were of the oblique (flap or "parrot-beak") type. The type of meniscal lesions found in this study correlates with the findings of Metcalf [6]. There was, however, in this study a lower percentage of vertical longitudinal (bucket handle) tears and a higher percentage of vertical transverse (radial) tears than recorded in Metcalf's study.

In the 32 knees with chondromalacia patellae, on further subclassification [7 it was found that 14 had grade 1, 16 had grade 2, and 3 had grade 3 lesions [5]. The distribution of the chondromalacia was widespread but, in those patients with more severe pathology, the lesions were more commonly on the medial facet.

There were 28 anterior cruciate ligament injuries, of which 17 were total tears of the ligament, 8 were partial tears involving the posterolateral band, and 3 were partial tears of the anteromedial

band. Only six patients with tears to the anterior cruciate ligament went on to have major ligamentous reconstruction, which consisted of a lateral substitution over-the-top repair [3].

There were 26 knees with femoral chondral lesions. Of these, 22 had damage to the medial femoral condyle, which included 12 chondral fractures and 10 instances of condyle chondromalacia. Only 4 had damage to the lateral condyle, including 2 chondral fractures and 2 cases of condylar chondromalacia. A system of arthroscopic classification of chondral lesions has been described by Bauer et al. [1]. On utilizing this classification, it was found that, of the 14 chondral fractures seen, 8 were type I (linear) and 6 were type III (flap) chondral lesions. It has been described that both these types of chondral lesion occur as a result of shearing and rotational forces [1], and this correlates well with the mechanism of injury described for the chondral lesions seen in this study.

Thirty-seven knees were found to have synovial plicae, of which 15 were felt to be pathological, 10 in the medial gutter and 5 in the suprapatellar pouch. The pathological plicae seen differed from the other plicae in that localized changes were found either on the patella or on the femoral condyle that corresponded with the area of discomfort described by the patient.

There were four commonly associated combinations of lesions seen at arthroscopy. The first group included 18 meniscal lesions associated with anterior cruciate ligament injuries, of which 16 were tears to the posterior horn, usually on the medial side. In the second group, there were 14 meniscal lesions associated with chondral lesions to the femoral condyles. Except for 1 patient, the lesion to the meniscus was in the same compartment as the lesion to the articular cartilage of the femoral condyle. In the third group, there were 12 meniscal lesions associated with chondromalacia patellae, of which 6 were to the posterior horn, 5 to the anterior horn, and 1 was a peripheral meniscal lesion. The fourth combination group was that of eight knees with chondromalacia patellae associated with pathological plicae. The chondromalacia patellae in this group tended to be more severe, that is, grade 1 or 3, and was associated with a medial plica in five knees and a suprapatellal plica in three knees.

A wide variety of surgical procedures were performed to treat the intra-articular lesions (Table 3). A total of 165 procedures were performed, including 61 soft tissue resections mainly to meniscal lesions, 40 shavings of the articular cartilage of the patella or the femoral condyle, and 33 lavage procedures. Other procedures performed included debridement of osteoarthritic compartments and three closed lateral releases for subluxing patellae. The miscellaneous group of surgical procedures comprised 1 arthroscopic chondroplasty for articular cartilage damage to the medial femoral condyle, 6 reconstructive procedures for anterior cruciate ligament deficiency, and 3 open meniscectomies for difficult posterior horn tears to the lateral meniscus.

Other therapeutic modalities were used in the postarthroscopic management period and included the use of oral anti-inflammatory agents and physical therapy. The use of oral anti-inflammatory medication has been shown to reduce postarthroscopic swelling and pain, thus enabling the patient to rehabilitate earlier and more effectively [8].

The time taken to return to sport varied from less than 1 week to more than 6 months; however, 71% of the patients returned within 3 months of the arthroscopy. There were 11 patients who never returned to their chosen racquet sport. Of those patients who did return to racquet sports, over 90% played at a performance level similar to that prior to their injury. A small number of patients report-

**Table 3.** Surgical procedures

| Procedure | Frequency | Percentage |
|---|---|---|
| Resection | | |
| Meniscal | 51 | |
| Plica | 10 | |
| Total | 61 | 37 |
| Articular cartilage shaving | | |
| Patella | 19 | |
| Medial femoral condyle | 18 | |
| Lateral femoral condyle | 3 | |
| Total | 40 | 24 |
| Lavage | 33 | 20 |
| Trimming | | |
| Meniscal | 8 | |
| Fat pad | 2 | |
| Total | 10 | 6 |
| Debridement | 8 | 5 |
| Closed lateral release | 3 | 2 |
| Miscellaneous | | |
| Lateral substitution over-the-top repair | 6 | |
| Open meniscectomy | 3 | |
| Chondroplasty | 1 | |
| Total | 10 | 6 |
| Total | 165 | 100 |

ed persistent symptoms at the time of follow-up, which included some residual pain, instability, or swelling around the knee joint, mostly after vigorous physical activities. The majority of these patients, however, still participated in their chosen racquet sport and reported that the symptoms were not prohibitive to their physical activities.

## Discussion

This study indicates that a significant number of racquet-sports-related injuries occur to the knee joint (55%). Of those participants presenting with knee injuries, over 50% had an injury that required arthroscopic investigation to determine the nature and extent of the intra-articular lesion or to perform a necessary arthroscopic procedure for treatment.

From our arthroscopic findings, there were five major groups of pathological lesions seen in this study. The first major group was meniscal lesions and, on analyzing the factors contributing to injuries in this group, a vast majority of these patients had inadequate warm-up prior to their participation, and over 95% injured their menisci as a result of twisting mechanisms to the knee. The majority of meniscal lesions were to the posterior horn in the medial compartment, requiring either resection or trimming of the torn part of the meniscus. On only three occasions was it necessary to perform an arthrotomy to remove a torn meniscus and, on each occasion, this was a posterior horn tear to the lateral meniscus. On questioning those patients who presented with meniscal lesions, very few had pre-existing, related injuries at the time of their presenting injury. The majority of patients with meniscal lesions responded quickly to arthroscopic surgery and returned to their chosen racquet sport within 2 months of the arthroscopy. The majority of those who returned to their chosen sport achieved a performance level comparable to that prior to their injuries.

In those patients with chondromalacia patellae, a trend similar to that with meniscal lesions was found with respect to the factors that had precipitated their injuries. However, a high percentage of these patients played on what was considered a hard playing surface, and the injury mechanism, although still predominantly twisting, included a higher incidence of direct contact and overuse mechanisms. In this group, there was a delay in return to sport in comparison to those with a meniscal injury, to the extent that over 50% did not return until after 3 months had elapsed from the time of arthroscopy.

There were 29 patients who presented with an injury of the knee ligament, of which 28 had an injury to the anterior cruciate ligament, and 1 patient had a grade I sprain of the medial collateral ligament. There is little doubt that the injury mechanism contributed to this ratio of injuries. All of those patients presenting with anterior cruciate ligament injuries described a twisting mechanism with their leg fixed and their upper body and pelvis twisting, either from an improper landing or a fast turn. On no occasion was there an associated body contact or valgus stress applied to the knee joint, which would predispose to collateral ligament injuries. Only 6 of the 28 patients with known anterior cruciate ligament injuries went on to have major reconstructive surgery. The remaining 22 patients underwent an extensive rehabilitation program. Six of the 28 patients did not return to their chosen racquet sport; 2 of these had undergone reconstructive surgery. Of those who did return to their racquet sport, over 80% required more than 3 months' rehabilitation prior to returning.

A significant group of patients with chondral lesions involving the femoral condyles reported hard playing conditions and an inadequate warm-up period prior to their activity. Almost all of our patients with chondral lesions indicated a twisting mechanism as the cause of their injury. There were many combined lesions in this group, particularly of the meniscus and requiring meniscal resection as well as articular cartilage shaving of the affected femoral condylar surface. The return to racquet sports was delayed, with the majority returning 3 months or more after their arthroscopy.

The fifth major group seen at arthroscopy was that of pathological plicae. Of these 15 patients, over a third were unsure as to the mechanism of their injury. There was an association with other lesions seen in the knee, the majority of which were grade 2 or 3 chondromalacia patellae, particularly of the medial facet. The majority of the patients in this group required resection of their plicae and shaving of the patellar surface when associated chondromalacia was found. Most patients returned to sporting activities within 2 months of their arthroscopy.

The combination of lesions has already been outlined, and it is important to note that, in this study, there was a high incidence of more than one lesion found at the time of arthroscopy. The most common combination of lesions found involved primarily the meniscus in association with either anterior cruciate ligament injuries, chondral lesions to the femoral condyle, or chondrom-

alacia patellae. There was also an association of severe chondromalacia patellae with pathological plicae.

The rapid rise in participation in racquet sports necessitates investigative studies into the etiologies and incidence of injuries related to racquet sports. In the past, emphasis has been placed on facial and upper extremity injuries in racquet sports, but it is evident from this study that a significant number of injuries related to racquet sports occur to the knee joint. Squash and racquetball, in particular, are fast-moving games played in a confined space demanding rapid changes in direction on a firmly planted foot and a flexed knee. It is not surprising that the knee is particularly prone to injury. It is difficult to know how to reduce the incidence of knee injuries occurring during racquet sports other than by suggesting that all participants allow an adequate time for passive stretching and warming-up.

## References


1. Bauer M, Jackson RW, Ogilvie-Harris DJ, Morbidi M (1987) Classificazione artroscopica delle lesioni condrali del ginocchio. Med Sport 40: 41–44
2. Canadian Squash Racquets Association (1987) Canadian squash profile for 1986
3. Crenshaw AH (1987) Campbell's operative orthopaedics, 7th edn. Mosby, St Louis, Mo, pp 2400–2448
4. Fitness Canada (1983) Fitness and lifestyle in Canada. Fitness Canada, Ottawa
5. Goodfellow J, Hungerford DS, Woods CJ (1976) Patello-femoral joint mechanics and pathology. J Bone Joint Surg [Br] 58: 291–295
6. Metcalf RW (1984) Advances in surgery, vol 17. Salem Year Book Medical Publishers, pp 197–240
7. Ogilvie-Harris DJ, Jackson RW (1984) The arthroscopic treatment of chondromalacia patellae. J Bone Joint Surg [Br] 66: 660–665
8. Ogilvie-Harris DJ, Bauer M, Corey P (1985) Prostaglandin inhibition and the rate of recovery after arthroscopic meniscectomy. J Bone Joint Surg [Br] 67: 567–571