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PRIMARY CARTILAGE LESIONS OF THE KNEE JOINT IN YOUNG MALE ADULTS. OVERWEIGHT AS A PREDISPOSING FACTOR. AN ARTHROSCOPIC STUDY

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ABSTRACT

Background and Aims: **This study was undertaken to evaluate the relationship between overweight and severity of arthroscopically confirmed primary cartilage lesions of the knee.**

Material and Methods: **The hospital records of 88 young male adults (98 knees), who underwent arthroscopy of the knee and were diagnosed of primary cartilage lesion during 1997–98, were reviewed. The depth of the lesions was graded according to Beguin and Locker classification.**

Results: **73.5 % of the lesions were patellar and 12.0 % in the medial condyle of the femur. 74.5 % of the patients had superficial (grade I–II) and 25.5 % deep (grade III–IV) lesions. Patients with deep lesions had a significantly higher body mass index (BMI 25.3 vs. 22.9, $p < 0.001$) and they were older (20.8 vs. 19.7 years, $p = 0.023$) than other patients. Similarly, patients with overweight (BMI ≥ 25.0) had significantly more often deep lesions than other patients (50 % vs. 10.4 %, $p < 0.001$).**

Conclusions: **These results suggest, that overweight may predispose young patients to more severe cartilage lesions independent of other etiologic factors, and support the hypothesis of the cumulative effect of overweight on cartilage injuries during early adult life.**

Key words: Arthroscopy; knee joint; knee osteoarthritis; articular cartilage; risk factors; body mass index; overweight

INTRODUCTION

The Central Military Hospital of the Finnish Defence Forces (CMH) provides good facilities for research on both young male and female adults. Data on knee arthroscopies performed at the CMH in 1997–8 were subjected to retrospective analysis.

Arthroscopy of the knee is more sensitive and specific than either plain radiographs or MRI in the evaluation and detection of surface cartilage abnormalities (1, 2).

It has been demonstrated by several epidemiological studies, that overweight (obesity) is a risk factor in the development of osteoarthritis of the weight-bearing joints, particularly the knee (3–13). McAlindon et. al found, that obesity is an important risk factor for both patellofemoral, tibiofemoral and combined patterns of knee osteoarthritis (11). In two re-

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TABLE 1

The mechanism of injury in 32 patients with a history of knee trauma.

Injury mechanism	Number of knees	% of injuries	% of total
Direct hit	13	40.6	13.3
Valgus stress	7	21.9	7.1
Varus stress	2	6.3	2.0
Hyperextension	2	6.3	2.0
Inner rotation	1	3.1	1.0
Unknown	7	21.9	7.1
TOTAL	32	100.0	32.7

cent studies, it was also shown that a high body mass index in early adulthood is associated with an increased risk of osteoarthritis of the knee (14, 15).

The aim of the present retrospective study was to test the hypothesis that overweight is associated with the severity of arthroscopically confirmed primary cartilage lesions of the knee in male conscripts. Moreover, the possible association between a knee injury and primary cartilage lesion was investigated. The etiology of these injuries, their distribution in the knee joint and the association with preoperative clinical findings and severity of the lesions were also analyzed.

MATERIAL AND METHODS

This study was retrospective. Arthroscopies had been performed by four senior orthopedic surgeons. Surgical data on each individual arthroscopy during 1997–1998 had been prospectively recorded on single data collection sheets. Type and number of portals, instruments used, method of anesthesia, knee stability in anesthesia, size and depth of chondral lesions, meniscal lesions, ligament injuries, synovial lesions, intra-articular loose bodies and procedures performed had all been recorded on this sheet.

The depth of the cartilage injuries were classed into four grades based on the classification of chondropathy proposed by Beguin and Locker (16): Grade I, chondromalacia, with or without swelling; Grade II, superficial fissures and erosions, that do not reach subchondral bone; Grade III, deep fissures, down to subchondral bone; Grade IV, exposure of subchondral bone. The classification of Beguin and Locker is a modification of the classification originally described by Outerbridge (17). The size and localization of the chondral lesions had been drawn and/or described in text.

The inclusion criteria in the present study were arthroscopically confirmed cartilage lesion of the knee joint without associated meniscal or ligamentous pathology on male conscripts. The small group of female conscripts (n = 7) were excluded in order to eliminate gender as a confounding factor. Knees with mediopatellar plica and chondral lesions were also included into the study material.

Between January 1, 1997 and December 31, 1998, arthroscopy was performed to total of 88 male conscripts (98 knees, 46 right and 52 left knees) at the Central Military Hospital, Helsinki, among whom diagnosis of primary cartilage lesion was confirmed. During years 1997–1998 a total of 761 arthroscopies were performed to conscripts. Thus, a primary cartilage lesion was found in 13.8 % of knees (98 male knees and 7 female knees) in patients, who underwent arthroscopy during this period. The mean age of the patients at the time of operation was 20.02 ± 1.54 years. Their mean height was 180.48 ± 5.85 cm and mean body mass 76.47 ± 11.0 kg. The mean body mass index (BMI) was 23.46 ± 3.06.

According to the case histories, the cartilage lesions were associated with varying degrees of trauma in 32 knees or 32.7 % of the patients (Table 1). Most frequently injury had occurred during sports activities (n = 12; 37.5 % of the traumas). Injury had occurred in 6 patients (18.7 %) during military training and in 5 patients (15.6 %) in association with a motor vehicle accident. In 8 patients (25 %) the injuries were due to miscellaneous causes.

Arthroscopies had been performed through a standard anterolateral or a central portal. The area of the chondral lesions was divided into two groups, < 2.0 cm^2 and ≥ 2.0 cm^2, for statistical analysis. In case of multiple cartilage lesions in the same knee, only the one with the deepest lesion and only the lesion with the largest area were included.

The relationship between body mass and height or the body mass index (BMI; Quetelet index) of the patients was calculated according to the formula mass (kg)/height^2 (m) (18). Overweight was defined as a BMI ≥ 25.0 (13).

STATISTICS

Normality of distributions was established with the Kolmogoroff-Smirnoff goodness of fit test with the Lilliefors method of significance correction. The Independent Samples T-test was applied for comparisons between two normally distributed groups. When the distributions were skewed, the Mann-Whitney U-test was applied. Differences between two groups with respect to categorical measures were tested with the Chi-square analysis or Fisher's exact test when the expected number of subjects in any cell was less than five. P-values of 0.05 or less were considered statistically significant. Each arthroscopic procedure was counted as one case, and an individual patient may have undergone more than one arthroscopic procedure (e.g. both knees). Each case was considered to have its own variables. The data were analyzed using the SPSS 9.0 computer program (SPSS Inc., Chicago, IL, USA).

RESULTS

Preoperative clinical findings included: intra-articular fluid collection in 8 patients (8/86; 9.3 %), positive patellar tracking test in 52 patients (52/84; 61.9 %), positive McMurray's meniscal provocation test in 21 patients (21/85; 24.7 %), and anterior cruciate ligament insufficiency in 4 patients (4/89; 4.5 %).

Standard anteroposterior, lateral and patellar view plain radiographs revealed abnormalities in 20 patients (20/85; 23.5 %). In 6 of these early signs of patellofemoral osteoarthritis were evident, in 4 the patellar groove in the facies patellaris was shallow, in 3 there were intra-articular loose bodies, in 2 there was patellar subluxation, in 2 patella bipartita, in 1 patella alta, in 1 apophysis of tibia was irregular and in 1 there was a zone of sclerosis in the middle of patella.

Arthroscopy was performed through a standard anterolateral portal of entry in 72 and a central portal through the patellar ligament in 26 cases. Synovitis was revealed in 41 knees (41.8 %). A total of 117 cartilage lesions were recorded in the 98 operated

TABLE 2

Surgical procedures performed during arthroscopic examination of the knee joints.

Surgical procedure	Procedures (n)	% of patients
Shaving of articular cartilage	85	85.7
Resection of mediopatellar synovial plica	41	41.8
Intra-articular drilling of subchondral bone	2	1.0
Diagnostic arthroscopy alone	10	10.2
TOTAL	138	138.7*

* The total percentage exceeds 100 % as more than one procedure was performed in several patients.

knees. In 16 knees there were more than one cartilage injury. 86 lesions were located in the patella, 14 in the medial femoral condyle, 10 in the femoral groove, 4 in the lateral femoral and 3 in the lateral tibial condyle (Fig. 1).

In 73/98 knees (74.5 %) the depth of the deepest lesion was graded I–II, and in 25/98 knees (25.5 %) it was graded as III–IV. In 27/98 knees (27.6 %) the area of the largest lesion was less than 2.0 cm^2 and in 71/98 knees (72.4 %) larger than 2.0 cm^2. The operative procedures performed during arthroscopy are presented in Table 2.

In patients with deep articular cartilage lesions (grade III–IV) both the mean BMI and mean body mass were significantly higher than in patients with superficial lesions (grade I–II): BMI 25.3 vs. 22.9 kg/m^2 ($p < 0.001$) and mean body mass 82.5 vs. 74.6 kg ($p < 0{,}001$), respectively (Table 3, Fig. 2). Similarly, overweight patients (BMI ≥ 25) had significantly more often deep lesions than other patients (50.0 % vs. 10.4 %, $p < 0.001$) (Table 3, Fig. 2).

In addition, patients with large lesion areas (> 2.0 cm^2) had a significantly higher mean BMI (23.8 vs. 22.6 kg/m^2, $p = 0.032$), and a higher body mass (77.9 vs. 72.8 kg, $p = 0.011$), than patients with small lesion areas. However, there was no statistically significant difference in proportion of large cartilage lesions between groups of overweight (BMI ≥ 25) and other patients (85.0 % vs. 68.7 %, $p = 0.253$) (Table 3, Fig. 2).

The association of the preoperative factors with the depth and/or area of the cartilage lesions is summarized in Table 4. The patients with deep (grade III–IV) lesions were statistically significantly older than the patients with superficial (grade I–II) lesions (20.84 vs. 19.74 years, $p = 0.023$). A knee injury in the patients' histories was not found to be associated with the depth or the size of the articular lesions, and there were no preoperative clinical findings which could have predicted the presence of deeper or larger articular lesions.

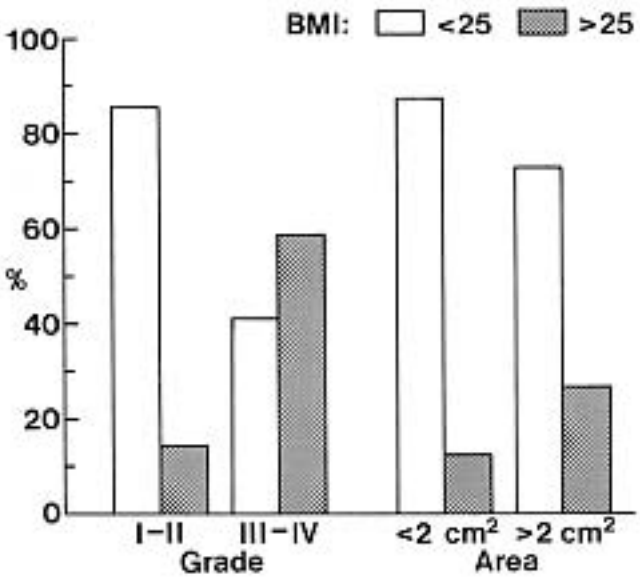

Fig. 1. Distribution (%) of primary cartilage lesions in the knee joint according to location.

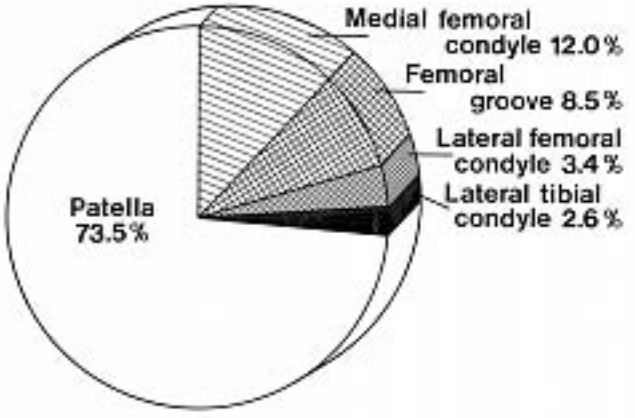

Fig. 2. Percentual shares of body mass indexes (BMI) below and above 25.0 in relation to depth (Grade I–IV) and area (< 2.0 and > 2.0 cm^2) of primary cartilage lesions.

TABLE 3

Height (cm), weight (kg) and BMI of the patients. (Mean ± SD).

Articular lesion (n; %)	Height	Weight	BMI
Grade I–II (73; 76 %)	180.47 ± 5.78	74.58 ± 11.03	22.87 ± 2.95
Grade III–IV (23; 24 %)	180.52 ± 6.21	82.48 ± 8.60	25.33 ± 2.64
Area < 2.0 cm^2 (27; 28 %)	179.19 ± 6.48	72.78 ± 12.29	22.64 ± 3.46
Area > 2.0 cm^2 (69; 72 %)	180.99 ± 5.56	77.91 ± 10.18	23.78 ± 2.84

TABLE 4

Statistical significance (p-values) of association between preoperative variables and established area and/or depth of cartilage lesions. (= significant).*

Preoperative variable	Area of lesion	Depth of lesion
Age	0.118	0.023*
Weight	0.011*	0.001*
BMI	0.032*	< 0.001*
Hydrops	0.099	0.095
Anamnestic trauma	0.881	1.000
Radiologic changes	0.164	0.771

DISCUSSION

Knee injuries are common during military training. In a Norwegian series of 321 cadets knee injuries accounted one quarter of all musculosceletal injuries (19).

Primary cartilage lesions of the knee are rather uncommon. In their series of 31 516 knee arthroscopies, Curl et al. found that in 36.6 % of their patients with articular cartilage lesions there was no associated ligamentous or meniscal pathology (20). In a recent study of 1000 consecutive arthroscopies 15 % of the patients with chondral lesions had no other joint abnormalities (21).

In a Finnish study primary cartilaginous lesions were observed in 9 % of 408 consecutively arthroscopied knees among Finnish conscripts. These primary lesions counted 27 % of all cartilaginous lesions observed (22).

In a large epidemiological study by Gelber et al. a greater BMI in young males aged 20 to 29 years was found to be associated with an increased risk of osteoarthritis of the knee but not of the hip, suggesting that cumulative exposure to overweight during early adult life is an important predisposing factor (15).

Evidence provided by clinical studies supporting significant epidemiological evidence has, however, not been available. The present clinical study is retrospective and the number of patients is rather small. The results of this study, however, suggest that overweight may predispose to more severe cartilage lesions independent of other etiologic factors. In addition, age was found to be associated with the depth of the lesions, which supports the hypothesis of the cumulative effect of overweight on cartilage injuries during early adult life.

None of the prearthroscopic clinical findings were able to predict the depth or the area of the cartilage lesions. Actually, this is not surprising. In a recent study, Niskanen and co-workers came to the conclusion, that the current clinical tests seem to have little value as indicators of patellar chondral pathology (23).

Among male conscripts trauma appears to be a significant etiologic factor of primary cartilage lesions of the knee. Thus, the result, that knee trauma was not found to be associated with the depth or size of the lesions, is somewhat confusing. Trauma in the present material was minor, because more severe cases were excluded for the definition of primary cartilage lesions. It seems that traumatic cartilage lesions act the same way as lesions having another etiology. This could be explained by the fact, that in patients with primary cartilage lesions there is no other intra-articular pathology (e.g. meniscal or ligamentous injury), which prevents the cartilage injury from proceeding.

To conclude, it seems, that whatever the etiology of the primary cartilage lesion, the same risk factor, overweight, may predispose young patients to more severe cartilage injuries. As this study has it's obvious limitations with retrospective nature and small number of patients, prospective clinical studies with larger number of patients and long-term follow-up are needed to confirm these results. With long-term follow-up and for example MRI controlling of primary cartilage lesions, the progression of the lesions and the possible accelerating effect of overweight on severity of these lesions could be examined. Then the important question, whether overweight causes primary cartilage lesions to develop into osteoarthritis in the future, could also be answered.

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