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Early determinants of long-term clinical outcome after cartilage repair surgery in the knee

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ABSTRACT

Purpose: To identify early determinants of clinical outcome after knee cartilage repair.
Methods: 205 patients were evaluated before surgery and at median 14-years follow-up.
Results: Baseline factors predicting a good outcome were: single lesion; normal appearing cartilage surrounding the lesion; high baseline Lysholm score; short duration of symptoms; non-involvement of the patella-femoral joint; young age; and small defect. Factors predicting a poor outcome were: multiple lesions; low baseline Lysholm score; degenerative cartilage surrounding the lesion; long symptom duration; meniscal lesion; and large defect.
Conclusions: The choice of surgical method seem to be less important than other patients-specific predictors.
Level of evidence: Case series, Level IV.

1. Introduction

Focal chondral lesions of the knee are commonly occurring, as displayed by the incidence of 19% in a group of 1000 knee arthroscopies in a prospective study by Hjelle et al.[1] Such chondral lesions can have a major impact on patients' quality of life – in some cases patients have been described to have a reduction in quality of life that is similar to patients that are scheduled for knee replacement.[2]

Chronic articular cartilage lesions have little or no potential for spontaneously healing and their treatment continues to pose a challenge for orthopaedic surgeons.[3,4] During the last few decades a range of new treatment options have been introduced, including microfracture[5,6] and osteochondral autograft transplantation (OAT) such as mosaicplasty.[7] Whereas the short-term results after cartilage repair procedures are acceptable in most patients, few regain normal pain-free function[8, 9] and the results seem to deteriorate with time.[10–12] Thus, there is a need to identify (baseline) predictors for the long-term outcome.

Our group has previously presented results for microfracture and mosaicplasty (separately) at short-term, mid-term as well as long-term (10–14 years) after surgery. In the current study, a pooling of all cartilage repair patients was performed with a follow-up of up to 18 years. The main purpose of the study was to relate baseline findings to clinical results at median 14 years after two commonly used cartilage repair techniques to possibly identify determinants of the outcome; good or poor, by calculating risk ratios.

2. Materials and methods

2.1. Patient selection

All patients undergoing a cartilage repair procedure at our institution from 1998 to 2003 were registered prospectively. The data were acquired from standardized forms completed by both the patient and the surgeon. The form contained details about preoperative symptoms and function, perioperative findings and details about the surgery performed – including localisation and size of the articular cartilage defect – similar to the system recommended by the International Cartilage Repair Society.[13] The data were stored in a local database (Access, Microsoft Corporation, Redmond, USA).

Patients of age 60 years or younger, at the time of surgery, with symptomatic focal full-thickness chondral lesions verified by arthroscopic examination treated with microfracture or mosaicplasty were included in the study. Exclusion criteria (at the time of surgery) were: joint space narrowing (< 4 mm) on standard antero–posterior radiographs, more than 5° varus or valgus malalignment, previous or concurrent realignment surgery, ligament instabilities or inability to follow the rehabilitation protocol.

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2.2. Surgical techniques

After an arthroscopic evaluation a microfracture or mosaicplasty procedure was performed. The choice of procedure was done based on the surgeon's preference (and patient's wishes) in each individual case. Mosaicplasty was not used in defects larger than 5 cm^2 and not in tibial cartilage lesions.

The lesion was debrided down with curettes to subchondral bone and around the edges until only healthy surrounding cartilage would remain. The area of the lesion was calculated as centimetres squared after measuring the length and width using a meniscal probe.[1] The cartilage surrounding the (main) focal full-thickness chondral defect was classified as (A) normal when no sign of degenerative changes were macroscopically visible – or palpable with a probe – during the arthroscopic examination; or (B) slightly abnormal when minor degenerative changes could be detected, i.e., superficial fissures, irregularities, or softening.[14,15]

The microfracture procedure was performed as formerly described by Steadman et al.[6] Angled awls were used for piercing the subchondral bone plate with holes 3–4 mm apart. The flow of marrow elements from the openings was verified by stopping the inflow of fluid to the joint. The mosaicplasty procedure (Smith and Nephew Inc., Andover, MA, USA) was performed as described by Hangody et al. [7,16] Grafts were harvested from the periphery of the femoral condyles at the level of the patello-femoral joint and transplanted to correspondingly sized burr holes in the defect. Usually, the procedure was performed using a mini-arthrotomy. In small defects of the femoral condyle an arthroscopic approach was used. In lesions of the patello-femoral joint a large arthrotomy with luxation of the patella was used.

2.3. Rehabilitation

For both procedures, continuous passive motion was started within a few hours after the operation and was continued for 4–7 days (the duration of the stay in hospital). The patients were instructed in the use of crutches by a physiotherapist and maintained foot-touch weight bearing for 6 weeks, thereafter full weight-bearing was gradually introduced. Physiotherapy was commenced at the hospital and continued after the discharge. Initial exercises included stretching, straight-leg rises and passive motion – progressing gradually through active closed-chain exercises including stationary bicycling to dynamic weight training.[17] The Ethical Committee at our institution reviewed and approved of the study (HDS ID 1998-0201). All patients gave their informed consent prior to inclusion in the study.

2.4. Outcome measures

Outcome evaluation was performed by the Lysholm score.[18,19] Data were prospectively collected before the operation and at several time-points after, for the first few years at routine check-ups at the out-patient department, thereafter by completing and returning standardized questionnaires sent by mail every 2–3 years, most recently in 2016. In deceased patients, the most recent Lysholm score was used for the calculations (and the corresponding follow-up time recorded). Patients having undergone a knee replacement (after the cartilage repair surgery), were defined as failures and the time of replacement surgery was used for calculating the follow-up time.[20]

2.5. Statistical analyses

As measures of central location and spread of data, mean and standard deviation (SD) or median and range were calculated based on the type of data. For examining determinants of either a poor result (Lysholm score < 64) or a good or excellent result (Lysholm score 80 or greater) two sets of calculations were performed, one for each outcome.[18,19] All predictors were converted into dichotomous data. The odds ratio (OR) and 95% confidence interval (CI) for each predictor were calculated. The statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, USA) on a personal computer. A predictor with a value of $P < 0.05$ was considered to be statistical significant as tested by chi-square statistics.

3. Results

Two hundred and five patients were eligible for inclusion in the study. We were able to record at least one follow-up (at one year or longer) in all patients (100%), 42% women and 58% men, aged median 37 (range, 15–60) years. We used the most recent follow-up data for the calculations. The follow-up time (of the total population) was median 14 (range, 1–18) years. Five patients were deceased during the study period, from 2 to10 years (median 7) after having been included. Twenty-three patients had undergone a knee replacement procedure and were defined as failures. The time of the replacement was recorded as the last follow-up, median 10 (range, 2–18) years. One hundred and twenty-one knees were treated by the microfracture technique, whilst 84 cases had a mosaicplasty performed.

At the time of surgery, median symptom duration was 60 months (range 1–360). The right knee (62%) was more often treated than the left knee (38%). The treated lesion, or the largest of multiple treated lesions, was located on the medial femoral condyle (57%), trochlea (15%), patella (15%), lateral femoral condyle (7%) or lateral tibia (6%). We treated one (75%), two (21%) or three (4%) lesions with a median defect size of 3.5 cm^2 (range 1–17). In 46 cases (22%) previous or concurrent partial medial meniscectomy (in the ipsilateral knee) had been performed. At the time of the index surgery 100 cases (49%) had signs of mild degenerative changes in the cartilage surrounding the treated defect.

The statistical significant factors for predicting a good or excellent result, defined as Lysholm score 80 or higher were: A single cartilage lesion, OR = 4.04; normal appearing cartilage surrounding the lesion, OR = 2.77; high baseline Lysholm score (50 or higher), OR = 2.71; duration of symptoms < 36 months, OR = 2.45; non-involvement of the patella-femoral joint, OR = 2.27; young age at surgery (25 years or less), OR = 2.23; and defect size 3 cm^2 or smaller, OR = 2.20 (Table 1). The following analysed factors did not significantly predict a good or excellent result: Surgical technique (microfracture versus mosaicplasty) (P = 0.2); gender (P = 0.2); right versus left knee (P = 0.4); history of knee trauma (or not) (P = 0.4); or meniscal lesion or not (P = 0.5).

The statistical significant factors for predicting a poor result (Lysholm score < 64 points or having had an ipsilateral knee replacement) were: multiple (2 or 3) lesions, OR = 2.84; low baseline Lysholm score (< 50), OR = 2.48; mild degenerative cartilage surrounding the lesion, OR = 2.31; symptom duration of 36 months or more, OR = 2.02; partial meniscectomy, OR = 1.90; and defect size 4 cm^2 or larger, OR = 1.77 (Table 2). The following analysed factors did not significantly predict a poor result: Surgical technique (microfracture versus mosaicplasty) (P = 0.2); age at surgery (P = 0.8); gender (P = 0.08); right versus left knee (P = 0.5); involvement of the patello-femoral joint (P = 0.2); or history of knee trauma (or not) (P = 0.9).

Table 1
Predictors of a good or excellent outcome (Lysholm score 80 or higher) by odds ratio.

Predictors	P-value	Odds ratio	95% CI
Single lesion (N = 152)	0.002*	4.041	1.618 – 10.093
Normal surround. cartilage (N = 104)	0.001*	2.774	1.469 – 5.240
High baseline Lysholm (N = 91)	0.001*	2.711	1.459 – 5.039
Duration (months) < 36 (N = 66)	0.005*	2.452	1.300 – 4.628
Not patello-femoral joint (N = 145)	0.027*	2.274	1.086 – 4.760
Age at surgery 25 or less (N = 29)	0.047*	2.230	0.998 – 4.985
Small size 3 cm^2 or less (N = 88)	0.011*	2.204	1.195 – 4.062

* Statistical significant difference.