Results of open meniscus repair
LONG-TERM FOLLOW-UP STUDY WITH A MATCHED UNINJURED CONTROL GROUP
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We have followed for 13 years a consecutive series of 31 patients who had open repair of a torn meniscus. They were between 13 and 43 years of age at the time of operation and all had intact stabilising ligaments. Comparison was made with a matched group of normal subjects of similar age and level of activity.

The total rate of failure after meniscal repair was 29%; three of the repaired menisci did not heal and six reruptured during the follow-up period. At follow-up 80% of the patients had normal knee function for daily activities. Radiological changes were found in seven. Two had reduction of the joint space (Ahlbäck grade 1), one with successful and one with failed repair. In the control group of uninjured subjects one knee showed Fairbank changes but none had changes according to Ahlbäck. The incidence of radiological changes did not differ between the group with meniscal repair and the control group but knee function was reduced after meniscal repair (p < 0.001).

We conclude that the long-term results of meniscal repair in stable knees are good with nearly normal function and a low incidence of low-grade radiological changes.

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The patients assessed their knee function using the Lysholm score. 

Follow-up examination. All patients were re-examined at between 11 and 19 years after the operation. Knee function was assessed using the Lysholm score. 

Results

The median operating time, including diagnostic arthroscopy was 67 ± 40 min (lateral meniscus 82 ± 51 min, medial meniscus 55 ± 23 min). The median period of sick leave was 20 ± 13 weeks with no difference between medial and lateral repairs. The median number of post-operative outpatient visits was four (0 to 9) and the median time between injury and operation was 13.5 ± 26 weeks; 13 patients were operated within eight weeks (ten lateral and three medial).

Rate of failure. Three repairs, one medial and two lateral, all in the peripheral third of the meniscus, did not heal and the meniscus was excised within two years of the initial treatment. Another five repairs (two medial and three lateral) displaced later and were excised at 4, 5, 7, 8 and 15 years, respectively, after the initial operation. One lateral

Table II. Type of tear, failure of repair and cartilage grading in the involved compartment at initial arthroscopy

<table>
<thead>
<tr>
<th>Meniscal tear</th>
<th>Failure</th>
<th>Medial</th>
<th>Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal to vertical</td>
<td></td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Inframenniscal</td>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Meniscocapsular</td>
<td></td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Bucket-handle</td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Cartilage changes*</td>
<td></td>
<td>Grade 0</td>
<td>13</td>
</tr>
<tr>
<td>Grade 1</td>
<td></td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Grade 2</td>
<td></td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

* graded according to the modified classification of Outerbridge: 0, normal cartilage; 1, discoloured or superficial cartilage fibrillation; 2, fragmentation of cartilage

support. The angle between the extended and the fully flexed position was measured.

Radiological examination. At the follow-up evaluation anteroposterior radiographs of both knees were taken of all patients in a slightly flexed, weight-bearing position as described by Ahlbäck. All radiographs were reviewed for signs of degenerative changes by a musculoskeletal radiologist who had no clinical knowledge of the patient. The radiological changes were graded according to the classifications of Fairbank and Ahlbäck.

Control group. Every patient who had had repair was matched with an individual with no previous knee injury according to age, gender and level of physical activity. The control group was selected consecutively from the list of members of a soccer club, and included both players and administrators. They were asked about their level of activity 13 years earlier. If the criteria for matching were fulfilled they were asked to participate; none refused. Previous and present levels of activity were graded according to Tegner et al and knee function according to Lysholm and Gillquist and Tegner et al. Radiographs were taken of both knees in the weight-bearing position, in all cases, with the approval of the local Ethics Committee. The radiographs of the study group were compared with the repair group to confirm accurate matching.

Statistical analysis. For non-parametric data (Lysholm score, Tegner scale, radiological score) we used the Wilcoxon signed-rank test for analysis of repeated measurements in the same patient and the Kolmogorov-Smirnov test for comparisons between groups. For parametric data (operating-time, sick leave, range of movement, angles at muscle strength measurements, stability) the paired t-test was used for analysis of repeated measurements on the same patient and the Kolmogorov-Smirnov test for differences between groups. Differences of proportion (radiological grading) between the knees and repeated measurements in the same patient were compared using the chi-squared test and evaluated by Statistica software (Statsoft Inc, Tulsa, Oklahoma).

Median follow-up time in years 13.5

Table I. Details of the 31 patients who had meniscal repair

<table>
<thead>
<tr>
<th>Median age in years (range)</th>
<th>25 (14 to 43)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male:female</td>
<td>26:5</td>
</tr>
<tr>
<td>Medial:lateral</td>
<td>17:14</td>
</tr>
<tr>
<td>Median preop activity (Tegner) (range)</td>
<td>7 (3 to 9)</td>
</tr>
<tr>
<td>Level 4 to 10 (%)</td>
<td>97</td>
</tr>
<tr>
<td>Number with history of injury</td>
<td>26</td>
</tr>
<tr>
<td>Median time from injury to surgery in weeks (range)</td>
<td>13.5 (0 to 102)</td>
</tr>
<tr>
<td>Median follow-up time in years</td>
<td>13.5</td>
</tr>
</tbody>
</table>

partial tear of the posterior oblique ligament, and another a partial tear of the lateral collateral ligament. These ligament injuries had been repaired at the same operation.

All the meniscal repairs had been performed by an open technique as described by Hamberg et al. After the procedure the knee was immobilised in a plaster cast at 20° of flexion for five weeks. The mean hospital stay was 5 ± 2 days. Movement and weight-bearing were subsequently restored under the supervision of a physiotherapist over a period of between three and six months. Eight surgeons were involved in the surgery of whom four performed 24 of the operations.

Follow-up examination. All patients were re-examined at between 11 and 19 years after the operation. Knee function was assessed using the Lysholm score. Levels of activity before the operation, one year after and at each follow-up occasion, were graded according to the scale of Tegner et al. The patients assessed their knee function using a visual analogue scale ranging from 0 to 100 (0, no disability; 100, severe disability).

The physical examination included determination of the range of movement, stability, signs of meniscal pathology, patellofemoral disorder and atrophy of the thigh muscle. The stability of the knee was evaluated by instrumented measurement of sagittal tibial displacement at 20° of knee flexion using the OSI laxity tester (Orthopedic Systems Inc, Hayward, California) with a 90 N load. A difference between the knees on sagittal tibial displacement of up to 3 mm was considered to be normal.

The muscle strength of the thigh was estimated according to the technique of Appel. The patient was asked to squat as low as he was able and to rise again without
meniscus redisplaced after five years and was successfully resutured (Table II). Five of 12 menisci repaired within eight weeks failed compared with four of 17 repaired more than eight weeks after injury. The total rate of failure after meniscal repair in a 13-year period was 29% of the total of 31.

Three patients had a traumatic rupture of the anterior cruciate ligament (ACL) 7, 11 and 12 years, respectively, after meniscal repair. Two had reconstruction one year after the injury to the ACL and were considered to be stable at the 13-year follow-up; the third was treated conservatively. In all the repaired meniscus failed, two before and one at the same time as the subsequent injury to the ACL. Another four patients had an arthroscopic meniscectomy on the contralateral knee during the follow-up period.

**Knee function and activity.** After 13 years the mean Lysholm score (Fig. 1) in the repair group was 95 (95% confidence interval (CI) 89 to 95) out of a possible 100 points and 100 (95% CI 97 to 100) in the control group (p < 0.001). After meniscal repair 25 patients (81%) had no problems during daily activities (Lysholm score >84 points) and 16 (52%) had normal subjective knee function (Lysholm score >94 points). The median Lysholm score was 95 (95% CI 88 to 96) after repair of the medial meniscus compared with 94 (95% CI 86 to 96) for the lateral meniscus. The 22 patients who had a successful repair, excluding late injury to the ACL, had a Lysholm score of 95 (95% CI 92 to 97) and the nine with failure of repair a median score of 86 (95% CI 78 to 95; p = 0.11). The control subjects had better knee function than patients with successful repair (p < 0.001).

The initial level of activity was high; 87% in the repair group and 90% in the control group had participated in recreational or competitive sports. An equal decline of two levels of activity according to Tegner et al. was seen in both groups during the follow-up period of 13 years (Fig. 2).

The patients’ assessment of knee function was high after repair, eight had no problems and 15 patients had minor problems (2 to 20 on the visual analogue scale). Two patients had major complaints (>60), each having had the meniscus removed because of a repeat tear.

**Physical examination.** No patient had a deficit of range of movement greater than 6° in extension or 15° in flexion compared with the other knee. The range of movement, girth of the thigh muscle, muscle power and sagittal displacement of the knee did not differ between the two knees in the same patient. All knees were shown to be stable except for one with deficiency of the ACL. Five patients complained of tenderness of the joint line and one had a
positive sign (McMurray’s) of meniscal pathology. Two complained of patellofemoral tenderness.

**Radiological examination.** At the 13-year follow-up, seven patients had radiological changes in the involved compartment, five had Fairbank¹ changes, and two had grade-1 arthritis according to Ahlbäck²⁵ (Table III). One patient with Ahlbäck grade-1 arthritis and two patients with Fairbank changes had had the meniscus removed within two years of its repair because of failure to heal. No patient had obliteration of the joint space (Ahlbäck grade 2). In the unjured control group one subject had Fairbank changes in the corresponding knee compartment. The incidence of radiological changes did not differ between meniscal repair and the corresponding compartment in the control group (chi-squared test, p = 0.06).

Radiological changes occurred in four out of the 22 knees with successful repairs, excluding those with injury to the ACL; one of these was graded Ahlbäck grade 1.

In 27 patients the contralateral uninjured knee was available as a control. None had radiological changes in the corresponding compartment.

**Discussion**

The options for treatment of a peripheral longitudinal tear are meniscectomy and meniscal repair. In many long-term follow-up studies total meniscectomy has been shown to lead to a high incidence and severity of radiological changes.¹⁻⁵ Few studies analyse the long-term results after repair of the meniscus and the number of patients with stable knees in these studies is low. In 1995 DeHaven et al.¹⁸ described 33 open meniscal repairs performed over a period of three years, but only 12 were in stable knees. After 11 years he found early radiological changes in eight of the 33.

Between 1978 and 1986 we have treated more than 1500 meniscal injuries, but in only about 10% was repair indicated. The pattern of damage and the quality of meniscal tissue were crucial for the choice of a specific treatment. Moreover, 75% of repairable menisci were associated with tears in the ACL or major ligament injuries leaving only 34 patients with meniscal repair in stable knees in this period. This group is a complete cohort from a population of about 150 000.

The inconvenience of the long rehabilitation and absence from work after repair, compared with meniscectomy, is a problem despite the recent introduction of accelerated rehabilitation programmes.²⁶,²⁷ The possibility of failure after repair leading to a second operation also has to be taken into account. These uncertainties have led to a low acceptance of the procedure by patients as shown by Sommerlath¹⁷ and discussed by DeHaven et al.¹⁸ In experimental studies Baratz et al.⁵,⁶ suggested that repair restores the function of the knee to normal and protects from arthritis in the long term because normal stresses are preserved, but Fu and Baratz²⁰ state that meniscal repair should be offered only to ‘appropriate’ patients with the ability and willingness to comply with the postoperative regimen.

In our study radiological changes were similar after repair, despite the rather high rate of failure to heal and of retear compared with the control group. In a previous study we found arthritis of Ahlbäck grades 1 and 2 in two-thirds of patients 13 years after arthroscopic total meniscectomy in stable knees.¹⁴ The difference in the rate of arthritis after total meniscectomy and meniscal repair is highly significant which underlines the long-term advantages of meniscal repair. Most patients in our study had good or excellent knee function and were able to participate in sporting activities. In previous studies we have found similar satisfactory function after both arthroscopic partial and total meniscectomy with comparable follow-up, even in patients who had some initial cartilage fibrillation.¹⁴,²⁹ Compared with the normal control group, however, patients with meniscal repair had a lower knee function score in spite of a similar level of activity. A natural deterioration with age explains the decrease in participation in strenuous sports which was similar both in the repair and control groups.

We conclude that 13 years after repair knee function is good but not better than after meniscectomy and not as good as in an uninjured knee. The incidence and grade of radiological change after repair, however, are lower than are seen after meniscectomy. It remains to be shown whether patients with a successful repair will maintain a better knee function than those with meniscectomy in the long term. The most appropriate treatment for a repairable meniscal tear varies between individuals and depends on age, future demands and the patient’s own opinion. Therefore it is important that the patient is informed about the alternative procedures and their outcome so that he can participate in the decision-making process.

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**References**


**Table III.** Radiological changes after meniscal repair and in uninjured control knees, by number and percentage. No patient had more severe changes than Ahlbäck grade 1

<table>
<thead>
<tr>
<th>Grade of arthritis</th>
<th>Total repair group (n = 31)</th>
<th>Successful repair group (n = 22)</th>
<th>Control group (n = 31)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No changes</td>
<td>24.774</td>
<td>19.864</td>
<td>30.968</td>
</tr>
<tr>
<td>Fairbank¹ changes*</td>
<td>5.161</td>
<td>2.91</td>
<td>1.32</td>
</tr>
<tr>
<td>Ahlbäck² grade 1†</td>
<td>2.65</td>
<td>1.45</td>
<td>0.00</td>
</tr>
</tbody>
</table>

* formation of a ridge, flattening of the femoral condyle, sclerosis or minor reduction of the joint space
† reduction of the joint space of more than 50% but not total obliteration or if 1 to 3 mm of the joint space remains with or without Fairbank changes


