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Chapter 5

Long-term clinical effects of partial meniscectomy in patients with traumatic meniscal tears

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Submitted
Abstract

Purpose
To determine potential differences in 10 year clinical outcome of surgically and conservatively treated traumatic meniscal lesions in patients without locking.

Methods
We performed a 10-year follow-up study of 118 patients (mean age 32 years SD 7.8) with traumatic meniscal tears without locking complaints. Clinical outcome measures of surgically and conservatively treated patients were compared using the Noyes and KOOS knee questionnaires.

Results
There were no differences in short- and long-term Noyes scores and long-term cross-sectional KOOS Pain, Symptoms, ADL and Quality of life outcomes. KOOS Sports and Recreation outcomes were significantly better in surgically treated patients (19.2 points, 95% CI 1.5; 36.8, p=0.033). Higher activity levels before the start of the complaints improved this effect.

Conclusions
Partial meniscectomy of traumatic meniscal tears may result in better Sports and Recreation related long-term clinical outcomes. This effect is positively associated with higher activity levels before injury. Future randomized controlled trials may elucidate the effect of surgical treatment of traumatic meniscal tears.
Introduction

Meniscal tears are common injuries and are often treated by partial meniscectomy [1]. Figures from a database representing 9% of the U.S. population under 65 years of age showed that 387,833 arthroscopic partial meniscectomies were performed between 2005 and 2011 [2].

Recent studies have questioned the benefit of partial meniscectomy in patients with degenerative meniscal tears. [3]. A recently published trial showed that knee function outcomes in patients with degenerative meniscal tears after partial meniscectomy were not better compared to outcomes after sham surgery [4]. Whereas degenerative meniscal tears result from repetitive normal forces acting upon a worn down meniscus in the older population, traumatic meniscal tears are related to excessive force applied to a normal meniscus and are mainly present in the young to middle aged population [5].

Consensus based guidelines on the management of meniscal lesion exist [6] and long term follow-up clinical effects after meniscectomy have been studied [7;8]. However, no comparative studies between surgical and conservative management of traumatic meniscal tears have been performed [9]. Although it has been suggested that knee locking in patients with traumatic meniscal tears can be considered to be an indication for surgical treatment, controversy remains on the surgical management of traumatic meniscal lesions especially in those patients that present without locking symptoms [10].

The aim of this study was to evaluate the long term (10 year) clinical effect of partial meniscectomy in patients with knee complaints lasting for more than four weeks without symptoms of knee locking. Ten year follow-up differences in knee function and symptoms scores were compared between surgically and non-surgically treated patients with traumatic meniscal tears.

Patients and Methods

Patient selection.
The clinical effect of meniscectomy in 118 knee patients with traumatic meniscal tears 10 years after knee complaints was determined. All 118 patients were part of a prospective cohort of 855 patients with knee complaints who participated in a study on the cost-effectiveness of 0.5T magnetic resonance (MR) imaging (Gyroscan T5; Philips Medical Systems, Best, the Netherlands) relative to diagnostic arthroscopy 10 years ago [11]. All 855 participants of the initial study were invited by mail and/or by telephone call for clinical knee function evaluation, knee radiographs and 3.0T MR imaging (Achieva 3T, Philips Medical Systems, Best, the Netherlands) at 10 year follow-up.

Inclusion criteria for the original cohort study 10 years ago were knee complaints e.g. pain, swelling and instability lasting for more than four weeks. Exclusion criteria of the initial study were knee complaints lasting less than four weeks, clinical symptoms of a locked knee, known inflammatory diseases such as rheumatoid arthritis, moderate to severe radiographic knee OA and a history of knee surgery. At baseline MR images of the affected knee were made and all 855 patients received regular orthopedic care [12].

The study was approved by the Medical Ethics Review Boards of the three participating hospitals. Three hundred twenty-six patients were willing to participate in the current follow-up study (Fig. 1). Written informed consent of each participant was obtained. The mean age of the 326 patients willing to participate in the follow-up study was higher (32 years; SD 7.7) than of the 529 non-participants (31 years; SD 8.1). There were no differences in age, sex and traumatic meniscal tears without anterior cruciate ligament (ACL) injury between the follow-up group and the non-participants. Traumatic meniscal tears were more often surgically treated in the follow-up group [91 (77%)] than in the non-participants [118 (64%)], (p-value 0.016). Of the participants, patients without meniscal tears or those with an accompanying anterior cruciate ligament (ACL) ruptures were excluded from further analysis (Fig. 1).
Of the 118 patients with at least one traumatic meniscal tear and no ACL injury, 96 patients were treated by partial meniscectomy and 22 patients were treated conservatively. There was no difference in duration of the knee complaints before inclusion 10 years ago between surgically or conservatively treated patients (14 months (SD 28.2) vs. 13 months (SD 29.0), p-value 0.86) (Table 1).
Table 1

Patient characteristics of the conservatively and surgically treated patients

<table>
<thead>
<tr>
<th></th>
<th>Conservative treatment</th>
<th>Meniscectomy</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=22 (44 menisci)</td>
<td>N=96 (192 menisci)</td>
<td></td>
</tr>
<tr>
<td>Mean age at baseline (SD)</td>
<td>32.1 (6.4)</td>
<td>35.3 (7.0)</td>
<td>0.049*</td>
</tr>
<tr>
<td>Number of women (%)</td>
<td>8 (36.4)</td>
<td>20 (20.8)</td>
<td>0.163</td>
</tr>
<tr>
<td>Duration of the knee complaints before inclusion in months (SD)</td>
<td>12.9 (28.2)</td>
<td>14.1 (28.9)</td>
<td>0.860</td>
</tr>
<tr>
<td>Tegner activity level before complaints (SD)</td>
<td>5.7 (2.1)</td>
<td>5.6 (2.3)</td>
<td>0.739</td>
</tr>
<tr>
<td>Number of traumatic tears &lt; 5mm (%)</td>
<td>6 (13.6)</td>
<td>3 (1.6)</td>
<td>0.002*</td>
</tr>
<tr>
<td>Number of traumatic tears ≥ 5mm (%)</td>
<td>19 (43.2)</td>
<td>100 (52.4)</td>
<td>0.319</td>
</tr>
<tr>
<td>Traumatic tear in both menisci (%)</td>
<td>3 (13.6)</td>
<td>8 (8.3)</td>
<td>0.428</td>
</tr>
<tr>
<td>Traumatic tear in medial meniscus (%)</td>
<td>16 (72.7)</td>
<td>74 (77.1)</td>
<td>0.426</td>
</tr>
<tr>
<td>Traumatic tear in lateral meniscus (%)</td>
<td>9 (40.9)</td>
<td>29 (30.2)</td>
<td>0.234</td>
</tr>
</tbody>
</table>

*Statistically significant difference.

The independent sample T-test, the Fisher’s Exact test and the Chi-square tests were used to compare means and proportions.
A traumatic meniscal tear was defined as an intrameniscal signal intensity unequivocally extending to an articular surface visible on MR images after traumatic distortion of the knee, leading to complaints.

**Outcome Measures**

The clinical effect of management of the traumatic meniscal tears was determined by comparing Noyes knee Function and Symptoms scores and KOOS knee function scores of the 96 patients treated with partial meniscectomy and the 22 patients treated conservatively treatment. Noyes Symptoms scores range from 0 (serious symptoms) to 400 (no symptoms), Noyes Function scores range from 200 (poor function) to 550 (good function)[13]. Noyes knee scores were obtained at inclusion, 3 months, 6 months and 10 years follow-up. At 10 year follow-up knee function was also cross-sectionally scored using the KOOS questionnaire [14].

A modified Lotysch classification system: a five-point grading scale for meniscal lesions (degenerative tears and traumatic tears, including buckethandle tears), was used to score the meniscal tears [15;16]. To determine radiographic knee OA development the Kellgren & Lawrence scoring system was used [17]. Knee OA was considered to be present in patients with a K&L score > 1. Knee OA in the patellofemoral compartment was scored on joint space narrowing (JSN) and osteophyte formation similar to the skyline view radiographs described in the OARSI atlas [18]

More detailed knee radiograph and MRI results of the 10 year follow-up cohort have been published earlier [19].

The Tegner activity score before the start of symptoms at baseline 10 years ago was obtained retrospectively at the time of inclusion to determine the level of activity before the knee complaints. The Tegner activity scale ranges from 10: high level competitive sports, through 0: not working due to knee problems [20]. Factors associated with functional outcomes after meniscectomy described in literature being gender, age and activity level [21] were also compared.

**Data Analysis**
Longitudinal Linear Mixed Model analysis was used to compare the Noyes Function and Symptoms outcomes. Mancova analysis was used to compare the KOOS scores. All models included the variables sex, age, radiographic OA in the tibiofemoral end patellafemoral compartment, newly developed ACL lesions and Tegner activity level before the complaints. Effect estimates and 95% confidence intervals were determined. P-values < 0.05 were considered statistical significant.

**Results**

*Management of Meniscal Tears*

In the first six months after inclusion, 91 of the 118 patients (77%) with traumatic meniscal tears were surgically treated, which is significantly higher than in the non-participant group with traumatic meniscal tears and no ACL lesions (64%, p = 0.014). None of the patients were treated with meniscal repair. There were no differences in number of patients treated with meniscectomy between the three participating centers (27 (79%), 33 (89%) and 36 (77%), p = 0.319).

Of the 11 patients with traumatic tears in both the medial and the lateral meniscus a partial meniscectomy was performed in both menisci in one patient, in four patients meniscectomy was performed in only one meniscus and three patients were conservatively treated. The surgical reports of the remaining three patients were not available for analysis.

Between 6 months and 10 years follow-up, four of the initially conservatively treated patients with a traumatic tear underwent a partial meniscectomy. Ten year follow-up 3T MR images showed that three patients had developed new traumatic meniscal tears. Two of these three patients had been additionally treated with partial meniscectomy.

The mean age in the meniscectomy group was higher (3.2 years) and there were no differences in number of women or activity levels.

*Knee function outcome scores*
At inclusion the Noyes Function (360, SD 71 vs. 357 SD, 72) and Noyes Symptoms (268, SD 84 vs. 276, SD 86) scores were not significantly different between the surgically and conservatively treated patient groups (p>>0.05). None of the Noyes Function outcomes scores were different in surgically or conservatively treated patients with traumatic meniscal tears (Table 2) (Fig 2). Uncorrected outcomes showed a significant positive effect of meniscectomy on long term Noyes Symptoms scores. However, after correction for sex, age, radiographic knee OA, newly developed ACL lesions and Tegner activity level before the complaints no differences were present (Table 2)(Fig 2). Long term Noyes Symptoms were mainly related to sex differences (women had lower scores) and activity level before the start of the knee complaints (higher Tegner activity scores were related to higher Symptoms scores).

**Figure 2**

Diagram showing the differences in Noyes knee Function and Symptoms scores between conservatively and surgically treated patients with traumatic meniscal tears.
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Baseline (n)</th>
<th>3 months (n)</th>
<th>6 months (n)</th>
<th>Effect Estimate (95% CI)</th>
<th>P-Value</th>
<th>10 years (n)</th>
<th>Effect Estimate (95% CI)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noyes Function</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservative</td>
<td>360 (22)</td>
<td>391 (25)</td>
<td>421 (23)</td>
<td>22.2 (-11.7; 56.1)</td>
<td>0.20</td>
<td>460 (20)</td>
<td>1.3 (-16.1; 18.8)</td>
<td>0.88</td>
</tr>
<tr>
<td>Meniscectomy</td>
<td>357 (96)</td>
<td>389 (86)</td>
<td>446 (85)</td>
<td></td>
<td></td>
<td>471 (88)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noyes Symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservative</td>
<td>268 (22)</td>
<td>322 (25)</td>
<td>339 (23)</td>
<td>2.9 (-36.8; 42.7)</td>
<td>0.88</td>
<td>309 (20)</td>
<td>14.7 (-6.0; 35.3)</td>
<td>0.16</td>
</tr>
<tr>
<td>Meniscectomy</td>
<td>276 (95)</td>
<td>324 (86)</td>
<td>355 (85)</td>
<td></td>
<td></td>
<td>360 (88)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Longitudinal Linear Mixed Model analysis was used to compare the Noyes Function and Symptoms outcomes
In four of the five KOOS subscales there were no differences in outcome scores between surgically or conservatively treated patients with traumatic meniscal tears (Table 3) (Fig 3). In the KOOS subscale Sport & Recreations score there was a non-significant different higher mean score of 14.3 points in patients with traumatic meniscal tears treated with partial meniscectomy. This effect increased to a statistically significant 19.2 points when corrected for gender, age, knee OA, newly developed ACL lesions and Tegner activity level before the complaints (95% CI 1.5; 36.8, p 0.033). Higher Tegner activity scores had an additional positive effect on Sport & Recreations outcome scores after meniscectomy, whereas ACL lesions developed during follow-up and the presence of knee OA diminished this effect.

**Figure 3**

Knee injury and Osteoarthritis Outcome Score (KOOS) after 10 years in patients with traumatic meniscal tears.
### Table 3 KOOS outcomes

<table>
<thead>
<tr>
<th>Treatment</th>
<th>N</th>
<th>KOOS Subscale</th>
<th>KOOS Score</th>
<th>Mean Difference (95% CI)</th>
<th>Uncorrected P-Value</th>
<th>Effect Estimate (95% CI)</th>
<th>Corrected P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative</td>
<td>21</td>
<td>Pain</td>
<td>80.9</td>
<td>1.2 (-9.1; 11.5)</td>
<td>0.814</td>
<td>5.1 (-6.6; 16.8)</td>
<td>0.387</td>
</tr>
<tr>
<td>Meniscectomy</td>
<td>89</td>
<td></td>
<td>82.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservative</td>
<td>21</td>
<td>Symptoms</td>
<td>78.1</td>
<td>3.1 (-6.5; 12.7)</td>
<td>0.519</td>
<td>5.7 (-5.0; 16.4)</td>
<td>0.289</td>
</tr>
<tr>
<td>Meniscectomy</td>
<td>90</td>
<td></td>
<td>81.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservative</td>
<td>21</td>
<td>ADL</td>
<td>85.9</td>
<td>0.7 (-10.5; 9.1)</td>
<td>0.880</td>
<td>1.8 (-9.0; 12.7)</td>
<td>0.738</td>
</tr>
<tr>
<td>Meniscectomy</td>
<td>89</td>
<td></td>
<td>85.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservative</td>
<td>21</td>
<td>Sports &amp; Recreation</td>
<td>51.0</td>
<td>14.3 (-1.5; 30.0)</td>
<td>0.075</td>
<td>19.2 (1.5; 36.8)</td>
<td>0.033*</td>
</tr>
<tr>
<td>Meniscectomy</td>
<td>90</td>
<td></td>
<td>65.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservative</td>
<td>21</td>
<td>Quality of Life</td>
<td>57.7</td>
<td>6.3 (-6.6; 19.2)</td>
<td>0.311</td>
<td>9.6 (-3.2; 22.4)</td>
<td>0.141</td>
</tr>
<tr>
<td>Meniscectomy</td>
<td>89</td>
<td></td>
<td>64.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Statistically significant difference.

The independent T-test was used to compare the mean differences. MANCOVA was used to compare 10 year follow-up outcomes.
The mean activity levels before the start of the knee complaints were in the conservatively treated group 5.7 (SD 2.1) and in the meniscectomy group 5.6 (SD 2.3). The mean activity levels after 10 years were in the conservatively treated group 5.2 (SD 2.3) and in the meniscectomy group 4.9 (SD 2.4). These were not statistically significant differences.

Discussion

The results of this 10 year follow-up cohort study show that surgical treatment of traumatic meniscal tears in knee patients without locking complaints appears to have a positive effect on long term knee function outcomes compared to conservative treatment. Treatment with meniscectomy is related to better cross-sectional measured long term Sports and Recreation KOOS scores after 10 years, and this effect increases in patients with higher Tegner activity level scores before the complaints started. Although patients treated with meniscectomy also appear to be scoring better on long term follow-up Noyes Symptoms outcome scores, multivariate analysis shows that this effect is mainly related to gender differences (women scored worse than men).

The effect of meniscectomy in patients with degenerative tears has been investigated in several randomized controlled trials [4;22;23], but there is a void in the literature for the treatment of traumatic tears with no mechanical symptoms. The indication for surgical treatment is mainly based on clinical symptoms and supportive MR images findings [10]. The current study results show that the clinical effect of meniscectomy in relative young patients with traumatic meniscal tears and without significant knee OA is limited to better KOOS sports and recreation outcome scores. This effect is mainly present in patients who: (1) showed higher activity levels before the start of the knee complaints 10 years ago, (2) developed no ACL lesions during follow-up and (3) had no radiographic OA changes. The effect of a mean 19.2 points higher score in the KOOS Sport & Recreation scale seems to be of clinical relevance since 8-10 points is considered to be the minimal clinically important change [24].

In the conservatively treated patient group, smaller traumatic meniscal tears were more often present compared to the patient group treated with meniscectomy (6 (13.6%) vs. 3 (1.6%)). This may be due to confounding by indication in the conservative group, since the general opinion is that meniscal tears smaller than 5mm are not clinically relevant and should be treated.
conservatively [25]. However, the number of larger meniscal tears was not significant different between the conservatively treated group and the meniscectomy group (19 (43.2%) vs. 100 (52.4%)) (Table 2).

Several limitations of the current study should be mentioned. The large number of patients lost to follow-up, which may be partially due to the 10 year follow-up (529; 62%). Another limitation of the study was that only patients with persistent knee complaints might have been interested in participating in the follow up study, possibly biasing the results. To investigate this, all 87 subjects who refused participation were asked if they still had knee complaints. The majority of these subjects, 49 patients (56%), had knee complaints, but had other reasons not to participate in the study. Traumatic tears were more often surgically treated in the follow-up group (77% vs. 64%, p-value 0.014). Another limitation is that the KOOS questionnaire was used at 10 years follow-up only, because it did not exist at baseline 10 years ago. There is a chance that baseline KOOS scores would have been different between the surgically and conservatively treated patient groups, however the baseline Tegner and Noyes scores were not different between these groups. Finally, at the start of the original cohort study, meniscal repair was not yet incorporated in common clinical practice, therefore we were not able to determine the clinical effects of meniscal repair in patients with traumatic meniscal tears.

In conclusion, partial meniscectomy of traumatic meniscal tears in knee patients without locking complaints seem to result in better Sports and Recreation related long-term clinical outcomes. This effect is positively associated with higher activity levels before injury. Future randomized controlled trials may elucidate the effect of surgical treatment of traumatic meniscal tears.

Reference List


