ORIGINAL ARTICLE

Patellar denervation in total knee arthroplasty without patellar resurfacing: A prospective, randomized controlled study

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Accepted: 6 March 2012

KEYWORDS
Patellar denervation; Electrocautery; Anterior knee pain; Total knee arthroplasty

Summary

Background: Anterior knee pain is still a major problem in total knee arthroplasty (TKA). Although the most widely accepted opinion is that anterior knee pain is often associated with a patellofemoral etiology, there is no clear consensus as to etiology or treatment. Disabling pain receptors by electrocautery could theoretically achieve denervation of the anterior knee region. The present prospective randomized controlled study aimed to evaluate results after patellar denervation with electrocautery in TKA at a minimum follow-up of 2 years.

Hypothesis: Patellar denervation provides some benefit in terms of pain and clinical outcomes after TKA without patellar resurfacing.

Patients and methods: Clinical and radiological results for 35 patients with single-stage bilateral TKA (70 knees; 26 women, nine men; mean age, 68 years [range, 58 to 77 years]) were reviewed. In addition to removal of all osteophytes, patellar denervation by electrocautery was performed on one patella; and debridement alone, removing all osteophytes, was performed on the contralateral patella, as a control. KSS score and a visual analog scale (VAS) were used to assess pre- and postoperative anterior knee pain.

Results: Mean follow-up was 36 months (24 to 60 months). No revisions or re-operations were performed. There were no patellar fractures. On all parameters (KSS score, range of motion and VAS), there was a statistically significant pre- to postoperative difference in favor of the denervation group.

Discussion: Patellar denervation with electrocautery can reduce anterior knee pain, with satisfactory clinical and radiological outcome, in TKA without patellar resurfacing.

Level of evidence: Level II: low-powered prospective randomized trial.

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doi:10.1016/j.otsr.2012.03.002

Introduction

Many studies compared outcome in resurfaced and non-resurfaced patella in total knee arthroplasty (TKA), reporting that patients had similar pain and function scores in both cases [1–3]. However, the results of recent meta-analyses show that patellar resurfacing reduces the risk of re-operation, while not reducing anterior knee pain after TKA [4,5]. Patella-related problems are responsible for patient dissatisfaction, morbidity and re-operation after TKA. Patellofemoral maltracking was reported as an important factor in the development of patellar chondopathy, and correlated with anterior knee pain according to several authors [6,7]. Normal joint cartilage is aneural, so that lesions in the surface are thought not to induce pain. Additionally, patients with recurrent patellar dislocation are free of pain between episodes of dislocation [8]. Although the most widely accepted opinion today is that anterior knee pain is often associated with a patellofemoral etiology, there is no clear consensus as to etiology and treatment [9,10]. Anterior knee pain was reported in 4 to 49% of patients after primary TKA [10–12]. In some studies, both the peripatellar soft tissue, such as retinaculum and synovium, and the infrapatellar fat pad were implicated as the source of anterior knee pain [13,14]. Several studies on innervation of the anterior knee found substance-P nociceptive afferent fibers in the peripatellar soft tissue [8,15]. Disabling these pain receptors by electrocautery could theoretically achieve desensitization or denervation of the anterior knee region [16–18]. In general, denervation of the patella by electrocautery and patelloplasty with removal of osteophytes have been used for treatment of anterior knee pain in TKA [3,19–22]. This attitude also has the advantage of easy implementation and fewer additional surgical procedures.

It was hypothesized that patellar denervation by electrocautery would present advantages in terms of pain and clinical results after TKA without patellar resurfacing. In addition to a control procedure consisting in removal of all osteophytes, electrocautery around one patella was used to achieve denervation, with no denervation of the contralateral patella. The present prospective randomized controlled double-blind study aims to evaluate early results after patellar denervation in TKA.

Patients and methods

All single-stage bilateral TKAs performed by a single surgeon (MAA) from January 2005 to April 2009 were included. Written informed consent was obtained from all patients, and approval to use their medical records and re-evaluate each patient was given by the Local Research Ethics Committee (Ref No:B.10.0.IEGO.0.11.00.01/010).

Inclusion criteria

Inclusion criteria were: all patients undergoing single-stage bilateral TKA, with electrocautery denervation of one patella and no denervation of the other, with a minimum follow-up of 24 months. Exclusion criteria were: previous patella realignment, fibrofemoral realignment such as high tibial osteotomy, hip arthroplasty, history of patellar fracture, inflammatory arthritis, severe co-morbidity or clinically severe arthritis in the hip or back.

Surgical procedure

The same type of posterior cruciate-retaining primary prosthesis (Maxim, Biomet, Inc., Warsaw, IN, USA) was implanted with cement in each patient. According to our general clinical practice, all patients were treated without patellar resurfacing. The midvastus approach was systematically performed. In addition to removal of all osteophytes, in the patellar denervation group electrocautery was performed to a depth of 2 to 3 mm around the patella (Figs. 1 and 2), while debridement alone, with removal of all osteophytes, was performed on the contralateral patella for control. Lateral retinacular release was never carried out. Which procedure to implement on which knee was randomized using the sealed-envelope method. In this double-blind study, neither the patient nor the physical therapist doing the evaluation knew which patella had undergone which procedure. Any complications during the early postoperative period or subsequent follow-up were noted.

Clinical assessment

Preoperative data regarding age, sex, body mass index and operative time were recorded. Patients were followed up postoperatively at 6 weeks, 3 months, 6 months and annually thereafter. At all preoperative and postoperative visits, a clinical score was determined using the Knee Society Clinical Rating System [23] (knee and function scores), a specific patellofemoral pain questionnaire including the patella score [24], range of motion (ROM) and a visual analogue scale (VAS) to assess preoperative and postoperative anterior knee pain. Blood loss was calculated from the amount accumulated in a Hemovac drain.
Complications

No revisions or re-operations were performed. There were no deep infections or patellar fractures.

Clinical results

The denervation procedure did not affect operative time ($t = 1.139, P = 0.259$). Mean blood loss in the Hemovac drain was $458 \pm 79$ ml in the denervation group and $454 \pm 88$ ml in the control group, ($t = 1.156, P = 0.876$). In both groups, Knee Society scores (KSS) (knee and function score), patellar score and ROM increased and VAS scores decreased significantly between the preoperative and last follow-up exams ($P < 0.05$, for all). Furthermore, on all the parameters, there was a statistically significant difference postoperatively in favor of the denervation group (Table 1). All patients were able to perform a full straight-leg raise.

Discussion

It was hypothesized that patellar denervation with electrocautery would have some advantages in terms of pain and clinical results after TKA without patellar resurfacing. Our results show that postoperative knee and function scores, ROM, patellar score and VAS were significantly better in the denervation group. These findings indicate that patellar denervation by electrocautery can provide decreased anterior knee pain and clinical improvement after TKA without patellar resurfacing.

However, the short follow-up duration and limited number of patients are obvious limitations of this study.

In TKA, electrocautery was used for patellar denervation by several authors [3, 19–22]. For Rand and Gaffey [25], electrocautery has potentially harmful effects on the articular cartilage and, when utilized in an intra-articular location, must be handled carefully to avoid cartilage trauma. The consensus in the literature is that adult joint cartilage is capable of a limited response following injury. We therefore applied electrocautery only to the peripheral rim of the patella to prevent surface exposure.

Although the pathophysiology of anterior knee pain in osteoarthritis is often uncertain and frequently multifactorial, patellar cartilage erosion and surface incongruities (patellar maltracking) probably contribute to anterior knee pain in many patients [6, 7]. In cases with patellar-component-related complications such as component wear, loosening, fracture, ligament and tendon rupture, maltracking or anterior knee pain, patellar retention or selective resurfacing of the patella has been recommended [1, 26, 27]. According to Krompinger and Fulkerson [28], lateral retinacular release is best indicated in patients with intractable pain in the lateral retinaculum; Witoński and Wargowska-Danielewicz [8], however, showed that substance-P positive fibers appear to be more prevalent in the fat pad and medial retinaculum than in the other soft tissue around the knee in case of anterior knee pain. These results may explain why lateral retinacular release was not as effective as expected. The present study used a midvastus approach for all knees, and we did not need to perform lateral retinacular release.

Figure 2 Drawing of innervation of a patellar area: lateral femoral cutaneous nerve (A), anterior cutaneous branches of the femoral nerve (B) and medial femoral cutaneous nerve (C).

Radiological assessment

Standard weight-bearing anteroposterior, lateral and axial views were taken preoperatively, immediately postoperatively and at the follow-up visits. Radiographic evaluation followed the Knee Society Roentgenographic Evaluation and Scoring System [23]. Patellar tilt, patellofemoral joint space (normal, moderate loss and severe loss) and patellar sclerosis were assessed on the axial view.

Statistical analysis

Preoperative and final follow-up results were used for statistical analysis. Statistical analysis used SPSS 16 software (SPSS® for Windows 16.0, Chicago, IL). Continuous variables were expressed as mean ± SD. Distribution normality was assessed by one-sample Kolmogorov–Smirnov test. Group comparison used independent-samples t-test; pre- and postoperative values were compared by paired-samples t-test. A $P$-value < 0.05 was considered significant. The power of the study was calculated by post-hoc power analysis.

Results

Thirty-seven patients (74 knees) were included. Two patients died before the minimum 24 months follow-up and were excluded from analysis. The remaining 35 patients (70 knees; 26 women, nine men; mean age, 68 years [range, 58 to 77 years]) were reviewed clinically and radiologically. None were lost to follow-up. Mean follow-up was 36 months (24 to 60 months). There were no differences between groups in terms of side, preoperative clinical assessment, pre- or postoperative radiological assessment, or patellar cartilage status, (Table 1). The power of the study was calculated as 74%.

Residual patellofemoral pain is one of the main problems in TKA without patellar resurfacing. To reduce the prevalence of anterior knee pain, circumpatellar denervation has been used by several authors [3,19–22]. Following demonstration of a positive effect of patellar denervation in intractable patellofemoral pain [16,18], researchers tried to establish the relationship between patellar denervation and treatment of patellofemoral pain. In a postal questionnaire study, van Jonbergen et al. [12] found that 56% of Dutch orthopedic surgeons performing TKA used circumpatellar electrocautery to prevent anterior knee pain when not resurfacing the patella, compared to 32% in case of patellar resurfacing.

Although patellar denervation is not a new technique in TKA, there are few articles about patellar innervation and/or denervation. Horner and Dellon [29] showed that innervation to the lateral skin of the knee is variable and may come either from the lateral femoral cutaneous nerve or from branches of the femoral nerve, but the pain mechanism and innervations of the patella have not been completely elucidated. According to Maralcan et al. [17], the patella has two nerve supplies, to the superomedial and superolateral quadrants, coursing within the substance of the vastus medialis and lateralis; additionally, they are accompanied by small vessels that can be traced through the course of the nerves. The authors conclude that better understanding of the patella’s nerve supply enables effective and selective denervation in severe patellofemoral joint problems. Denervation should include both the medial and lateral nerves. We therefore performed circumpatellar denervation; the increase in clinical scores and decrease in VAS scores in the patellar denervation group can be attributed to adequate complete denervation.

### References


### Table 1

<table>
<thead>
<tr>
<th></th>
<th>Denervation group (n = 35)</th>
<th>Controls (n = 35)</th>
<th>t value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time (min)</td>
<td>74.71 ± 6.69</td>
<td>72.85 ± 6.67</td>
<td>1.139</td>
<td>0.259</td>
</tr>
<tr>
<td>Preop KSS knee</td>
<td>46.88 ± 5.04</td>
<td>46.80 ± 5.40</td>
<td>0.069</td>
<td>0.946</td>
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<tr>
<td>Postop KSS knee</td>
<td>92.74 ± 6.62</td>
<td>89.85 ± 4.75</td>
<td>2.113</td>
<td>0.038</td>
</tr>
<tr>
<td>Preop KSS function</td>
<td>47.14 ± 5.32</td>
<td>47.57 ± 4.90</td>
<td>−0.350</td>
<td>0.727</td>
</tr>
<tr>
<td>Postop KSS function</td>
<td>92.88 ± 7.70</td>
<td>87.71 ± 7.70</td>
<td>2.483</td>
<td>0.016</td>
</tr>
<tr>
<td>Preop ROM</td>
<td>82.57 ± 7.72</td>
<td>84.11 ± 8.75</td>
<td>−0.782</td>
<td>0.437</td>
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<tr>
<td>Postop ROM</td>
<td>121.57 ± 7.15</td>
<td>117.42 ± 6.68</td>
<td>2.504</td>
<td>0.015</td>
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<tr>
<td>Preop PS</td>
<td>17.85 ± 3.32</td>
<td>18.14 ± 3.26</td>
<td>−0.363</td>
<td>0.718</td>
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<tr>
<td>Postop PS</td>
<td>27.82 ± 1.63</td>
<td>26.37 ± 1.39</td>
<td>4.010</td>
<td>&lt;0.001</td>
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<tr>
<td>Preop VAS score</td>
<td>8.14 ± 1.39</td>
<td>7.94 ± 1.28</td>
<td>0.624</td>
<td>0.535</td>
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<tr>
<td>Postop VAS score</td>
<td>2.20 ± 1.10</td>
<td>2.82 ± 1.20</td>
<td>−2.278</td>
<td>0.026</td>
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<td>Preop alignment</td>
<td>0.08 ± 4.91</td>
<td>1.08 ± 5.88</td>
<td>−0.772</td>
<td>0.437</td>
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<tr>
<td>Postop alignment</td>
<td>5.97 ± 4.01</td>
<td>6.45 ± 3.98</td>
<td>−0.509</td>
<td>0.776</td>
</tr>
</tbody>
</table>

KSS: Knee Society score; preop: preoperative; postop: postoperative; ROM: range of motion; PS: patellar score; VAS: visual analog scale.

### Conclusion

Based on the clinical and radiological results of what is, to our knowledge, the first controlled study of the subject, patellar denervation by electrocautery in TKA seems to decrease anterior knee pain and to improve clinical and radiological outcome. Further larger long-term prospective comparative series are needed to support these results.

### Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Funding: The authors did not receive any outside funding or grants in support of their research or in preparation of this study.
Patellar denervation in total knee arthroplasty


