Progress towards understanding anterior knee pain after total knee arthroplasty

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Chapter 7

No difference in anterior knee pain between a fixed and a mobile posterior stabilized total knee arthroplasty after 7.9 years

S.J.M. Breugem, B van Ooij, D Haverkamp
I.N. Sierevelt, C.N. van Dijk

Abstract

Purpose
The presence of anterior knee pain remains one of the major complaints following Total Knee Arthroplasty (TKA). Since the introduction of the mobile TKA many studies have been performed and only a few show a slight advantage for the mobile. In our short-term follow-up study, we found less anterior knee pain in the posterior stabilized mobile knees compared to the posterior stabilized knees. The concept of self alignment and the results from our short term study led us to form the hypothesis that the posterior stabilized mobile knee leads to a lower incidence of anterior knee pain compared to the posterior stabilized fixed knee. This study was designed to see if this difference remains after 7.9 years in the follow-up. A secondary line of enquiry was to see whether one was superior to the other regarding pain, function, quality of life and survival.

Methods
This current report is a 6 to 10 year (median 7.9 years) follow-up study of the remaining 69 patients with a cemented three component TKA for osteoarthritis in a prospective, randomized, double-blinded clinical trial.

Results
In the posterior stabilized group five of the 40 knees (13%) versus five of the 29 posterior stabilized mobile group (17%) experienced anterior knee pain. No differences were observed with regard to ROM, VAS, Oxford 12-item knee questionnaire, SF-36, HSS patella, Kujala or the AKSS score. Patients with anterior knee pain reported more pain, lower levels of the AKSS, HSS patella and the Kujala scores than the patients without anterior knee pain.

Conclusion
In the current clinical practice the appearance of anterior knee pain persists as a problem; simply changing to a mobile bearing does not seem to be the solution. The posterior stabilized mobile total knee did not sustain the advantage of less anterior knee pain, compared with the posterior stabilized fixed total knee arthroplasty.
Level of Evidence: Level II Therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Keywords
Total Knee Arthroplasty, Anterior Knee Pain, Mobile knee, Fixed knee
Chapter 7

Introduction

Although Total Knee Arthroplasty (TKA) has become the generally accepted treatment for osteoarthritis of the knee, not all problems have been solved yet [2-6,8,13-15,22,26,37,39,43,45,48]. The presence of Anterior Knee Pain (AKP) remains one of the major complaints after TKA and is reported by between 4 and 49% of TKA patients [2-6,8,13-15,26,37,39,45,48]. Many theories have been proposed to explain the etiology of AKP after TKA; Prosthesis design [8,13,22,28,29,39], resurfacing the patella [3,6,15,25,36], joint line changes, instability, malpositioning/malrotation [5,37], wear [45], referred pain [26], soft tissues [26,39] and patient characteristics [12,44,48]. This type of pain restricts patients in climbing stairs, getting up from a chair, cycling, or even normal walking [2,5,6,8,26,37,38,47]. Apart from being bothersome and impairing quality of life, AKP is one of the main reasons for early revision [2,5,6,39,40]. Few prospective randomized studies have demonstrated any benefits of mobile bearing TKA compared to fixed bearing TKA [13,22,40,41,45,49]. The theoretical advantage of the mobile bearing TKA is the ability to self align, and therefore to accommodate small mismatches. If this were the case, a better patellar tracking could be expected with a decrease in the incidence of anterior knee pain and possibly due to the accommodation of small mismatches, would lead to a longer survival. In the current clinical practice the appearance of anterior knee pain persists as a problem; can we solve this problem by choosing a mobile bearing TKA?

Materials and methods

Between 2000 and 2004, we invited all consecutive patients with unilateral osteoarthritis of the knee undergoing a primary TKA to participate in a prospective, double-blinded, randomized clinical trial performed at the orthopedic department of the Academic Medical Centre, Amsterdam, the Netherlands [13]. All patients older than 21 and in stable health, suitable for surgery, and able to participate in the follow-up program were invited to participate. Exclusion criteria were revision or unilateral knee arthroplasty, patellectomy, a fixed varus or valgus deformity of more than 20°, skeletal immaturity, Charcot joints, inability or unwillingness to cooperate in the follow-up program, life expectancy of less than 5 years, or no signed informed consent.
Based on design features and our results in our short term study \cite{13} we were led to the hypothesis that the Posterior Stabilized Mobile (PSM) knee leads to a (1) lower incidence of anterior knee pain than the Posterior Stabilized fixed (PS) knee. This study was designed to see if this difference remains after 6 to 10 year (median 7.9 years) follow-up of a prospective, double blinded, randomized trial. The secondary questions are whether one design is superior to the other regarding (2) overall pain, (3) function, (4) quality of life and (5) survival.

We randomly allocated the 103 patients who agreed to participate to either a PS or PSM prosthesis. Block randomization was accomplished with the use of a specially designed computer program developed by our institute’s statistic department. The two patient groups were balanced on the basis of age and previous operation, therefore ensuring approximately equally sized treatment groups. A power analysis was performed based on an estimated incidence of 25% of anterior knee pain \cite{13}. To achieve a successful reduction, we presumed a reduction to at least 10% should be obtained, in which 10% was the lower limit of the reported incidence, creating an effect size of 15% stating a power of 0.8 with a 0.05 significance level resulted in a sample size of 100 patients per group \cite{13}. While performing a one-year analysis our study demonstrated a difference in the incidence of anterior knee pain between the PS and Mobile. Seeing that our research question was answered our study stopped including patients \cite{13}. The Internal Review Board approved the study. We obtained informed consent from each patient. The demographic data showed no differences between the groups \cite{13}. Both treatment groups were comparable preoperatively for anterior knee pain \cite{13}. Follow-up controls took place at 6 weeks, 3 months, 6 months, and 12 months postoperatively including standard radiographs and physical examination. Preoperative, 1-year and again between 6-10 years (median 7.9 years) postoperative, standardized subjective questionnaires were completed. After 6 to 10 years, 69 patients were available for follow-up (figure 1, flow chart). Three patients were lost to follow-up and were excluded. One was living in France and was not able to come to the Netherlands; the other withdrew due to family circumstances, the third was living in an Alzheimer department. As far as we know these patients do not have any knee complaints.
The Nexgen Complete Knee Solution Legacy Posterior Stabilized Fixed and the Nexgen Complete Knee Solution Legacy Posterior Stabilized Mobile were manufactured by Zimmer Inc. (Warsaw, IN). The PS and the PSM TKA share the same femoral component. The mobile bearing polyethylene component is more congruent than that of the fixed bearing TKA. The pivot axis of the articular surface is located anteriorly and allows rotation. The tibial plate includes a rotational stop that helps prevent spinout of the articular surface.

The operations were performed by three experienced orthopedic surgeons with a special interest in TKA. The same intraoperative protocol was used as that described in our short-term follow-up study [13].

At 6 to 10 years follow-up, the patients were carefully questioned (by SB, BvO) with regard to the location of any pain in the knee. The presence of AKP was registered and additional HSS patella score and the Kujala anterior knee pain score were used to assess the severity of reported AKP [4,29]. These scores were also added because the Oxford 12 and the SF36 were not intended to measure AKP. Furthermore, we asked the following questions; “Do you have anterior knee pain?” or “Does the pain in your knee get worse when you are standing up from a chair, climbing stairs or riding a bicycle against the wind?”. The severity of AKP was classified by using a scale within specific questions, comparing AKP at rest, walking and with climbing stairs as (1) none, (2) mild, (3) moderate and (4) severe.

Pre and postoperative outcome measures were registered, containing a Visual Analog Scale (VAS) for pain [11], the Oxford 12-item knee questionnaire (Oxford 12) [17,23], Kujala anterior knee pain score [29], HSS patella score [4], the American Knee Society Score (AKSS) [25] and the SF-36 [1]. The VAS is a continuous score.
from 0 to 100 that is used to determine the level of pain \(^{[11]}\). We obtained VAS scores for current knee pain and for summarizing the overall average pain over a period of 4 weeks. The Oxford 12 is a knee-specific questionnaire; every item has a score from 1 to 5 (from less to most difficult or serious) and a total score with a range from 12 to 60 \(^{[17,23]}\). This score also contributes to determining patient satisfaction \(^{[17,23]}\). The Kujala score, also known as the anterior knee pain score, is a 13-item questionnaire including different items on pain related to function and activities \(^{[29]}\). The score has a range from 0 to 100 and higher scores indicate less disability. The Hospital for Special Surgeries patella (HSS patella) score is a knee specific questionnaire, which contains questions relating to anterior knee pain \(^{[4]}\). The score has a range from 0 to 100 and higher scores indicate best-case scenario \(^{[4]}\). Furthermore, we performed a thorough clinical evaluation. The SF-36 is a general health-related quality of life instrument \(^{[1]}\). Thirty-six questions reflect eight dimensions of functioning: physical functioning, role limitation resulting from physical problems, role limitation resulting from emotional problems, social functioning, mental health, energy vitality, pain, and general health perception. The score has a range from 0 to 100 per dimension. Higher scores indicate a better quality of life. This score also contributes to determining patient satisfaction.

The clinical evaluation of the knee using the AKSS was performed to determine the function, pain, range of motion, and stability of the knee \(^{[25]}\). This score has a range from 0 to 200 and can be divided into a knee score and a function score. A higher score implies a better outcome.

Pre and postoperative roentgenograms of the knee were obtained making a standing anterior-to-posterior, lateral (in some degrees of flexion) and Merchant view (skyline of the patellofemoral joint). SB reviewed all radiographs of the knee as did a radiologist specialized in skeletal radiology who was blinded to outcome, but could not be blinded to the type of prosthesis. The Knee Society Total Knee Arthroplasty Roentgenographic Evaluation and Scoring System was used directly postoperative, at 1-year and at 6 to 10 years follow-up to determine the varus-valgus angle, signs of loosening, or wear of the prosthesis. The median preoperative femorotibial angle was 3.9° varus with a range of 14° varus to 19° valgus. In the PS group, this was 3.8° varus and in the PSM, this was 4.0°. Postoperatively, the median femorotibial angle was 6.4° valgus with a range of 3.0° varus to 11° valgus. There were no differences between PS and PSM knees.
All complications were divided into intraoperative, general and local complications and into early (first 3 months) and late complications.

Statistical analysis
Data were entered into a personal computer (MS Access 2003; Microsoft Corp, Redmond, WA) by an independent research assistant (IS) and were subsequently checked for inconsistencies and errors in data entry. For the statistical analyses we used PASW Statistics 18 software (SPSS Inc., Chicago, IL). Because of skewed distributions, the data were analyzed non-parametrically. Mann-Whitney U tests were used for continuous variables and Fischer’s exact tests for categorical variables comparing the PSM and PS knees. Pre- and postoperative comparisons were performed using the Wilcoxon Signed Ranks test and McNemar tests. Associations between continuous variables were determined using the Spearman product moment correlation coefficient. Significance was set at a level of <0.05.

Results
Six to 10 years (median 7.9 years) postoperatively, there was no statistical difference comparing anterior knee pain between the PS and PSM knees (table 2). Five of the 40 patients with a PS knee (13%) and five of the 29 patients with a PSM knee (17%) experienced persistent anterior knee pain. There was no difference with regard to obesity, gender, age and follow up duration between the two treatment groups (table 1).

Table 1: Demographics (n=69)

<table>
<thead>
<tr>
<th></th>
<th>PS (n=40)</th>
<th>PSM (n=29)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>80 (56-88)</td>
<td>78 (62-95)</td>
</tr>
<tr>
<td>Male</td>
<td>14 (35%)</td>
<td>10 (35%)</td>
</tr>
<tr>
<td>Female</td>
<td>26 (65%)</td>
<td>19 (65%)</td>
</tr>
<tr>
<td>Follow up (years)</td>
<td>7.7 (6-10)</td>
<td>7.9 (6-10)</td>
</tr>
<tr>
<td>Unilateral</td>
<td>18 (45%)</td>
<td>16 (55%)</td>
</tr>
<tr>
<td>Bilateral</td>
<td>22 (55%)</td>
<td>13 (45%)</td>
</tr>
</tbody>
</table>
In both groups, the VAS related to the current pain and pain experienced in the last 4 weeks in the affected knee improved (p < 0.01) postoperatively (table 2). However, significant differences in pain or function between the PS and PSM knees were not observed. The Range of Motion (ROM) in both groups improved postoperatively but was not different between the two groups (table 2). The preoperative and postoperative clinical scores correlated moderately (r = 0.47; p < 0.001), reflecting the independence of the responses before and after the operation. In other words, the patients did not necessarily respond similarly preoperatively and postoperatively. Severely affected patients did not necessarily report worse results postoperatively.

Table 2: Comparing the PS (n = 40) and the PSM (n = 29) knees pre and post operative regarding Anterior Knee Pain (AKP), Range of Motion (ROM), American Knee Society Score (AKSS), VAS, Oxford 12 item-knee questionnaire (Oxford 12-item Q), the HSS patella score and the Kujala patellofemoral score.

<table>
<thead>
<tr>
<th></th>
<th>PS (n=40)</th>
<th>PSM (n=29)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anterior knee pain</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>18 (45%)</td>
<td>17 (59%)</td>
<td></td>
</tr>
<tr>
<td>1 yr</td>
<td>4 (10%)</td>
<td>2 (7%)</td>
<td>n.s.</td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>5 (13%)</td>
<td>5 (17%)</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>ROM median (range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>110 (80-140)</td>
<td>110 (22-140)</td>
<td></td>
</tr>
<tr>
<td>1 yr</td>
<td>120 (40-140)</td>
<td>120 (70-135)</td>
<td></td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>120 (80-135)</td>
<td>120 (70-130)</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>AKSS Knee score median (range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>59 (0-78)</td>
<td>59 (6-77)</td>
<td></td>
</tr>
<tr>
<td>1 yr</td>
<td>92 (43-100)</td>
<td>88 (41-100)</td>
<td>n.s.</td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>95 (50-100)</td>
<td>97 (51-100)</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>AKSS Function score median (range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>45 (0-70)</td>
<td>35 (0-100)</td>
<td></td>
</tr>
<tr>
<td>1 yr</td>
<td>75 (15-100)</td>
<td>75 (10-100)</td>
<td>n.s.</td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>63 (0-100)</td>
<td>65 (0-100)</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>VAS Current median (range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>62 (0-97)</td>
<td>52 (3-97)</td>
<td></td>
</tr>
<tr>
<td>1 yr</td>
<td>9 (0-97)</td>
<td>6 (0-89)</td>
<td>n.s.</td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>9 (0-92)</td>
<td>10 (0-79)</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>VAS Last month median (range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>70 (0-97)</td>
<td>65 (27-97)</td>
<td></td>
</tr>
<tr>
<td>1 yr</td>
<td>18 (0-100)</td>
<td>6 (0-89)</td>
<td>n.s.</td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>13 (0-90)</td>
<td>10 (0-88)</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Oxford 12-item Q median (range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>37 (19-51)</td>
<td>39 (27-54)</td>
<td></td>
</tr>
<tr>
<td>1 yr</td>
<td>21 (12-42)</td>
<td>21 (12-49)</td>
<td>n.s.</td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>22 (12-53)</td>
<td>23 (12-54)</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>HSS patella score median (range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1 yr</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>95 (28-100)</td>
<td>100 (45-100)</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Kujala score median (range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1 yr</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>64 (15-98)</td>
<td>64 (30-100)</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

*p<0.01, pre- post operative comparison with a significant difference*
Chapter 7

Table 3: Comparing the SF 36 score regarding quality of life score(Q1_ ‘Physical Functioning’, Q2_ ‘Role limitation due to Physical problems’, Q3_ ‘Role limitation due to Emotional problems’, Q4_ ‘Social Functioning’, Q5_ ‘Mental Health’, Q6_ ‘Energy Vitality’, Q7_ ‘Pain’, Q8_ ‘General Health Perception’).

<table>
<thead>
<tr>
<th>SF 36 q1 median (range)</th>
<th>Baseline</th>
<th>1 yr</th>
<th>6-10 yrs</th>
<th>PS (n=40)</th>
<th>PSM (n=29)</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF 36 q2 median (range)</td>
<td>Baseline</td>
<td>1 yr</td>
<td>6-10 yrs</td>
<td>PS (n=40)</td>
<td>PSM (n=29)</td>
<td>p-value*</td>
</tr>
<tr>
<td>SF 36 q3 median (range)</td>
<td>Baseline</td>
<td>1 yr</td>
<td>6-10 yrs</td>
<td>PS (n=40)</td>
<td>PSM (n=29)</td>
<td>p-value*</td>
</tr>
<tr>
<td>SF 36 q4 median (range)</td>
<td>Baseline</td>
<td>1 yr</td>
<td>6-10 yrs</td>
<td>PS (n=40)</td>
<td>PSM (n=29)</td>
<td>p-value*</td>
</tr>
<tr>
<td>SF 36 q5 median (range)</td>
<td>Baseline</td>
<td>1 yr</td>
<td>6-10 yrs</td>
<td>PS (n=40)</td>
<td>PSM (n=29)</td>
<td>p-value*</td>
</tr>
<tr>
<td>SF 36 q6 median (range)</td>
<td>Baseline</td>
<td>1 yr</td>
<td>6-10 yrs</td>
<td>PS (n=40)</td>
<td>PSM (n=29)</td>
<td>p-value*</td>
</tr>
<tr>
<td>SF 36 q7 median (range)</td>
<td>Baseline</td>
<td>1 yr</td>
<td>6-10 yrs</td>
<td>PS (n=40)</td>
<td>PSM (n=29)</td>
<td>p-value*</td>
</tr>
<tr>
<td>SF 36 q8 median (range)</td>
<td>Baseline</td>
<td>1 yr</td>
<td>6-10 yrs</td>
<td>PS (n=40)</td>
<td>PSM (n=29)</td>
<td>p-value*</td>
</tr>
</tbody>
</table>

* p<0.01, pre- post operative comparison with a significant difference

There was no significant difference in Quality of Life (QoL) comparing PS and PSM knees (table 3). The influence of anterior knee pain, however, did affect the QoL. The presence of anterior knee pain significantly limits (p <0.01) the daily activities patients can perform, and patients reported more pain; resulting in lower levels on the AKSS knee score and lower scores for the HSS patella and Kujala score compared to the patients without anterior knee pain (table 4).
Table 4: Comparing patients with and without anterior knee pain (AKP) regarding VAS, Oxford 12 item-knee questionnaire (Oxford 12-item Q), the American Knee Society Score (AKSS), the HSS patella score and the Kujala score (Mann Whitney U test).

<table>
<thead>
<tr>
<th></th>
<th>AKP (n=10)</th>
<th>No AKP (n=59)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS Current, median (range)</td>
<td>41 (10-92)</td>
<td>3 (0-79)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>VAS Last month, median (range)</td>
<td>47 (5-90)</td>
<td>10 (0-88)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Oxford 12-item Questionnaire, median (range)</td>
<td>36 (15-50)</td>
<td>21 (12-54)</td>
<td>0.02</td>
</tr>
<tr>
<td>AKSS function, median (range)</td>
<td>48 (0-100)</td>
<td>65 (0-100)</td>
<td>n.s.</td>
</tr>
<tr>
<td>AKSS knee score, median (range)</td>
<td>75.5 (50-95)</td>
<td>97 (59-100)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>HSS patella score, median (range)</td>
<td>48 (28-80)</td>
<td>100 (55-100)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Kujala score, median (range)</td>
<td>48 (33-73)</td>
<td>65 (15-100)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

In this follow-up period we revised 9 TKA’s, all because of aseptic loosening. The average time to the revision operation was 61 months. There were 7 PS and 2 PSM knee failures. This means 7 of the original 53 PS knees (13%) and 2 of the original 47 PSM knees (4%) failed (n.s.). Of these 9 patients, 4 had AKP at one-year follow-up. One patient with AKP had an internal rotation of the femur component and a loose femur component at the revision operation (figure 2). Two patients were treated with a one-stage revision and seven needed two operations. All cultures taken during the revision operations were negative for bacteria. Two patients had a peri-prosthetic fracture in the distal femur and were treated with a locking plate. One patient fell directly on her patella, and had a comminutive patella fracture. This was first treated with an osteosynthesis, but after a non-union a patellectomy was performed.

Discussion

The most important outcome of our study is that a Posterior Stabilized Mobile (PSM) knee does not sustain the lower incidence of anterior knee pain compared to the Posterior Stabilized Fixed (PS) TKA. In our short-term follow-up study, less AKP was found in the PSM knees compared to the PS knees [13]. The concept of self alignment and the results from our short term study led us to form the hypothesis that the PSM knee leads to a lower incidence of anterior knee pain compared to the PS knee. A secondary line of enquiry was to see whether one
was superior to the other regarding pain, function, quality of life and survival. We specifically evaluated whether the PSM (mobile) knee could make the intended difference in AKP, compared to the PS (fixed) knee. In our short-term follow-up study, there was less anterior knee pain in the PSM knees compared to the PS knees [13]. It seemed therefore, that the PSM (mobile) knee did have an influence on anterior knee pain. Kim et al reported less pain in the mobile bearing group compared to a fixed bearing group at a mean follow-up of 2.6 years [27]. Wohlrab et al found a difference in pain scores at three months favoring the mobile bearing, but found no difference after three and five years [47]. In this 6 to 10 year (median 7.9 years) follow-up study the PSM knees did not sustain the difference in AKP, found in the short-term trial [13]. This result is comparable to the findings of other similar studies [2,38]. Therefore we agree with the study by Aglietti et al who suggested that the performance of a mobile bearing knee might decline over time [2]. Matsuda et al noted that the Nex Gen LPS knee is not fully conformed in the tibio-femoral articular surface, allowing up to 12 degrees of rotational freedom in full extension [33]. This could be part of the reason why different studies did not find a clinically relevant difference between a mobile and a fixed bearing knee [2,7,28,38].

Our trial was designed to determine anterior knee pain and we therefore performed a patella component in all patients in an endeavor to minimize the risk of bias. Literature is still not conclusive as to whether the patella component should be resurfaced or not [3,6,15,35,48]. Some studies suggest malrotation/malpositioning of the components as the main reason for anterior knee pain [5,26]. Excessive internal rotation of the femur and/or tibial component seems to play an important role in the development of AKP [5]. In our series at least two patients had internal rotation of either the femur and/or the tibia.

Other authors suggest that the presence of substance P nociceptive afferent fibers in the peripatellar soft tissues or the infrapatellar fat pad may be the major reason for pain [26]. After looking at certain aspects of anterior knee pain, one could wonder if AKP is not the tip of the iceberg. The root of the problem could be an imbalance in the homeostasis between the soft tissues and the TKA, as this could lead to a range of factors, which might combine to create AKP. This theory was proposed in 1996, by Dye, who referred to the ‘envelope of function’ or ‘zone of homeostasis’ in patients without a total knee prosthesis and AKP [26]. Hopefully, future research will be able to provide further insight in to this hypothesis.
Looking at overall pain, Price et al found a small but clinically significant short-term advantage for the mobile bearing design [40]. In their later follow-up study (three year study), Beard et al did not find that this difference had been sustained [7]. In line with such studies, we also found these subjective outcome scores to improve from baseline for both the PS and the PSM groups; however, we observed no difference between the two types of TKAs (table 2) [2,45].

Theoretically, the design of the PSM knees could lead to better Range Of Motion (ROM) during knee flexion activities [21]. We observed no difference for ROM between the PS and the PSM groups. The patients in both groups reached a mean ROM of more than 110°, which is comparable to other reported studies and sufficient for normal daily functioning [45].

Anterior knee pain is known to cause most problems in daily activities like climbing stairs, rising from a chair, getting in and out of a car, or cycling, and therefore compromises daily living? [3,13,26,29] As previously reported in other studies we also found no difference in functional outcome between fixed and mobile bearing TKA designs [44,45]. This study was not primarily designed to detect this functional difference. The statistical power may have been too low to achieve such detection.

Quality of life can be influenced by many factors and not only those tested in the present study [12]. Subjective questionnaires are becoming a valuable and essential instrument in evaluating our operative results [1,4,17,23,25,29]. We could not detect a difference in QoL comparing the PSM to the PS knee, but we could definitely detect the influence of anterior knee pain not only in the general...
subjective health questionnaires, but also in the knee specific questionnaires. Patients with anterior knee pain reported lower levels of QoL than the patients without anterior knee pain. The use of the HSS patella score and the Kujala score serves to further highlight this important difference and we advise the use of these questionnaires for studies evaluating AKP.

An important finding of this study was our high number of revision operations. In all the revision operations at least one of the components was loose. Overall, 7 PS knees and 2 PSM knees were revised. Seven knees were treated in two-stages: this was typically done because no clear explanation for the loosening at the time of the operation could be found. Since this difference was not statistically significant, we cannot conclude that it is relevant. Matsuda et al showed in an in vitro study that the rotational stability of the mobile TKA is similar to that of the normal knee. The fixed TKA showed a decrease in rotational deflection, which is evidence of stress being transmitted to the prosthesis and cement interface \[32\]. This finding could mean that the mobile bearing knee (PSM) can minimize bone-implant stress and help prevent mechanical failure and thus the need for revision surgery. With our data we cannot support this finding. However, our study was not primarily designed to detect this difference. We looked into the possible reasons for our higher number of exclusions and revisions, when compared to other studies. The main reason could be that we are a tertiary referral center and mostly treat patients with a high ASA score based on comorbidity requiring specialized academic treatment. We recognize limitations to our study. Firstly, we had a high number of exclusions; 12 re-operations, 3 lost to follow-up and 19 patients who died (for reasons not related to the knee prosthesis). These exclusions influenced the number of patients reporting AKP, and this could therefore influence our data. Secondly, by specifically enquiring about AKP, the number of patients with AKP could be higher than in other studies, where researchers did not specifically ask about AKP. Thirdly, a limitation of this study might be the limited sample size, which could lead to a lack of power to detect clinically important difference. However, while carrying out our one-year analysis, our study was able to demonstrate a statistically significant difference in the incidence of anterior knee pain between the PS and PSM \[13\].

The particular strength of this trial is the equal randomization with a double-blind trial, both groups receiving the same three-part prosthesis, with the only exception being the tibial insert. Observer- and patient-related bias was thus
minimized. Patients with anterior knee pain reported lower levels of QoL than the patients without anterior knee pain. Our data could not support the notion that the PSM knees can be more forgiving with small mismatches, leading to a lower incidence of anterior knee pain than the PS TKA. Anterior knee pain does not only seem to be influenced by a mobile and/or fixed total knee arthroplasty.

**Conclusion**

In the current clinical practice the appearance of anterior knee pain persists as a problem, simply changing to a mobile bearing does not seem to be the solution. The posterior stabilized mobile total knee did not sustain the advantage of less anterior knee pain, compared with the posterior stabilized fixed total knee arthroplasty.

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Chapter 7

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