Abstract

The aim of this study was to compare a patient cohort after total knee arthroplasty (TKA) in terms of the revision rate and the functional outcome, with and without patella resurfacing. Sixty-six patients (71 TKAs) were implanted with the mobile-bearing knee prosthesis system e.motion UC (Aesculap AG, Tutlingen, Germany). These patients were divided into 2 groups, 1 of which received primary patella resurfacing (PPR; 51 TKAs) and 1 of which did not (non-PPR; 20 TKAs), with an average follow-up of 65.6 months (±6.9). The cohort was recorded consecutively. The evaluation was performed using the Knee Society Score and selected questions relating to the Knee Injury and Osteoarthritis Outcome Score, as well as with radiographs. Results showed that PPR was no better than non-PPR in terms of functional outcome. Two knees (10%) were revised in the non-PPR group, and 1 knee (1.96%) in the PPR group (not significant). In this cohort, 100% of implants, including the 5 TKAs of patients who did not attend the follow-up examination, had neither explanted nor loosened at the time of follow-up examination. The authors concluded that the revision rate for PPR is slightly lower, and this avoids the need for secondary patella resurfacing. The risk for complications is low, and the functional outcome is comparable. [Orthopedics. 2016; 39(3):S31-S35.]

Advantages and disadvantages of primary patella resurfacing (PPR) or the procedure without patella resurfacing (non-PPR) in the implantation of knee prostheses has provoked controversial discussion in the literature. As a consequence, no standard procedure has been established, as demonstrated by the following meta-analysis: Fu et al1 published a meta-analysis on the effectiveness of PPR. This analysis reviewed 10 studies covering a total of 1003 total knee arthroplasty (TKA) procedures. The risk for needing another operation was lower in the PPR group than it was in the non-PPR group. No difference could be found with respect to anterior knee pain. He et al2 also concluded in a meta-analysis that incorporated 16 studies with more than 3000 TKAs that the incidence of revisions for patients with PPR was lower than it was for non-PPR patients. If the same meta-analysis had only considered high-quality studies, it would have found no difference with respect to the revision rate. Nor was any difference found by the authors with respect to anterior knee pain and functional outcome.

The revision rates in groups with PPR and non-PPR can vary, depending on the period of time investigated and the product brand employed. The 2014 Annual Report of the Swedish Knee Arthroplasty Register3 illustrated this point very clearly. During the observation period of 1991 to 2000, 35.8% of the...
recorded TKAs were implanted with PPR and the risk for revision was less than it was found to be for non-PPR (risk ratio [RR]×1.3 [confidence interval (CI) 1.1-1.4]). In contrast, during the observation period of 2002 to 2012, only 6.2% of the recorded TKAs were implanted with PPR and the risk for revision was now higher than it was found to be for non-PPR (RR×1.2 [CI 1.1-1.4]). This may be due to a more “patella-friendly” femur design in the course of further development of implants, rather than an improvement in the quality of implantation in TKA.

Chondrolysis was described as a complication for non-PPR patients. Anterior knee pain occurs with comparable frequency among patients with PPR and non-PPR and calls for a precise analysis before treatment measures can be adopted.

The complications noted with regard to PPR include patella fracture, aseptic loosening of the implant, overstuffing, and lateral facet syndrome arising when the patella implant is too small. After establishing the need among the current authors’ group of patients, following careful clinical and radiological analysis including scintigraphy, to implant secondary PPR in up to 10% of cases, the current authors made the decision in early 2007 to conduct PPR procedures more frequently. In terms of the geographic location of the current authors’ clinic in a mountain region, which imposes upon patients particular demands with respect to knee replacements, the current authors wanted to be certain that PPR did not further adversely affect function. After their operations, patients wanted to return to their mountain villages, and must be able to get around on rough terrain without walking aids.

In this study, the current authors asked whether PPR in TKA for patients under these special requirements has implications in terms of revision rate and functional outcome.

The hypothesis is that revision rate is reduced, and functional outcome is not inferior.

### MATERIALS AND METHODS

The study was assessed by the Ethics Committee responsible for the current authors’ region, part of the Working Community for Swiss Research Ethics Committees (Arbeitgemeinschaft der Schweizerischen Forschungs-Ethikkommissionen) for clinical trials, and it received a favorable opinion.

Retrospectively and consecutively, all patients included were treated in the current authors’ clinic in 2007 and 2008 with a TKA and were willing to participate in the study. Of the 71 consecutively recorded patients, 5 were excluded because they did not appear for follow-up. None of these 5 patients had undergone a revision at the time of follow-up. No patient had died. The remaining 66 patients with a total of 71 TKAs appeared for clinical and radiographic examination after 5 to 6 years and were divided into 2 groups: PPR (51 TKAs) and non-PPR (20 TKAs). Five patients were treated bilaterally, 2 of whom each received a TKA with PPR and 1 non-PPR, meaning that no complete number of patients can be depicted in either group. All implants were performed by the senior author (A.O.). The demographic patient data are listed in Table 1.

### Prosthesis and Surgical Method

The e.motion UC prosthesis with rotating inlay (Aesculap AG, Tuttlingen, Germany) was used in all implantations. All operations were performed under computer-assisted navigation (OrthoPilot, Aesculap AG, Tuttlingen, Germany). This navigation recorded the ligament tension as well as the leg axes. The rotation of the femoral components was set at a lateral rotation of at least 3° to maximum 12° in relation to the dorsal femoral condyles, to produce flexion gaps that were as symmetrical as possible and to avoid internal rotation positions of the femoral components that would be unfavorable to patellar motion. With asymmetric patellas, lateral patellar facetectomies (Figure) were performed, regardless of whether PPR was employed. For PPR, the patella was resected very sparsely to ensure that sufficient bone would still be available in case of future revisions of the PPR.

### Table 1

Demographic Data of the Sample by the Time of Entry in the Study (N=66)

<table>
<thead>
<tr>
<th>Variables</th>
<th>All (N=66)</th>
<th>PPR (N=51)</th>
<th>Non-PPR (N=20)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of knees</td>
<td>71</td>
<td>51 (71.8%)</td>
<td>20 (28.2%)</td>
<td></td>
</tr>
<tr>
<td>Age, mean±SD, y</td>
<td>66.3±7.4</td>
<td>67.0±7.3</td>
<td>64.6±7.5</td>
<td>.2104</td>
</tr>
<tr>
<td>Female gender</td>
<td>43 (60.6%)</td>
<td>35 (68.6%)</td>
<td>8 (40%)</td>
<td></td>
</tr>
<tr>
<td>Right knees</td>
<td>39 (54.9%)</td>
<td>29 (56.9%)</td>
<td>10 (50%)</td>
<td></td>
</tr>
<tr>
<td>Follow-up, mean±SD, mo</td>
<td>65.6±6.9</td>
<td>62.9±5.7</td>
<td>72.9±3.8</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Body weight, mean±SD, kg</td>
<td>84.1±16.9</td>
<td>80.5±15.4</td>
<td>93.3±17.3</td>
<td>.0035</td>
</tr>
<tr>
<td>Body height, mean±SD, cm</td>
<td>167±9</td>
<td>167±8</td>
<td>169±11</td>
<td>.3044</td>
</tr>
<tr>
<td>BMI, mean±SD, kg/m²</td>
<td>29.9±5.0</td>
<td>28.9±4.5</td>
<td>32.6±5.4</td>
<td>.0040</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index; PPR, primary patella resurfacing.
Without exception, the implants were fixated using cement prepared under vacuum after first performing pulsed lavage.

Clinical and Radiological Examination

For functional evaluation purposes, the Knee Society Score (KSS) was used. The KSS is subdivided into knee score (kKSS, maximum 100 points) and function score (fKSS, maximum 100 points). In addition, individual questions arising from the Knee Injury and Osteoarthritis Outcome Score (KOOS) were recorded. The individual questions focused on pain in general and pain experienced while going up stairs and/or walking on level ground, and also on other difficulties encountered when going up and down stairs, while walking on level ground or when kneeling down. From the KSS, the question of the use of walking aids and the range of motion (ROM) were analyzed in particular.

Radiologically, the mechanical tibiofemoral angle (mTFA) was evaluated from long-leg standing images and signs of loosening were checked.

Statistical Method

Sample parameters were summarized using means and standard deviations for continuous variables, and also using absolute and relative frequencies (percent) for rates.

Two sample t tests were used for comparisons of continuous variables.

Multivariate linear regression models were used for outcome comparisons, which were always adjusted for gender, age, and body mass index. The significance level was set to 5%, 2-sided, for confirmatory tests, and no significance level adjustment was made.

RESULTS

Functional Outcome

No significant differences for the groups can be established in the KSS, neither in the subscales nor in the overall score. Even the individual analysis of some of the questions from the KOOS did not yield any significant differences (Table 2).

<table>
<thead>
<tr>
<th>Variables</th>
<th>All (Mean±SD)</th>
<th>PPR (Mean±SD)</th>
<th>Non-PPR (Mean±SD)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSS knee</td>
<td>87.2±12.0</td>
<td>86.4±13.3</td>
<td>89.4±7.5</td>
<td>.3450</td>
</tr>
<tr>
<td>KSS functional</td>
<td>87.4±16.7</td>
<td>87.5±15.8</td>
<td>87.3±19.3</td>
<td>.9640</td>
</tr>
<tr>
<td>Total KSS</td>
<td>174.6±20.3</td>
<td>173.8±20.7</td>
<td>176.7±19.5</td>
<td>.6029</td>
</tr>
<tr>
<td>KSS walking aids</td>
<td>-1.34±3.58</td>
<td>-1.18±3.55</td>
<td>-1.75±3.73</td>
<td>.2675a</td>
</tr>
<tr>
<td>P1 Pain frequency</td>
<td>1.01±1.3</td>
<td>1.12±1.39</td>
<td>0.75±1.02</td>
<td>.2884a</td>
</tr>
<tr>
<td>P5 Pain walking</td>
<td>0.14±0.46</td>
<td>0.16±0.50</td>
<td>0.10±0.31</td>
<td>.6402a</td>
</tr>
<tr>
<td>P6 Pain stairs up or down</td>
<td>0.42±0.84</td>
<td>0.51±0.92</td>
<td>0.20±0.52</td>
<td>.1634a</td>
</tr>
<tr>
<td>A1 Difficulty descending stairs</td>
<td>0.42±0.79</td>
<td>0.47±0.83</td>
<td>0.30±0.66</td>
<td>.4065a</td>
</tr>
<tr>
<td>A2 Difficulty ascending stairs</td>
<td>0.32±0.65</td>
<td>0.37±0.72</td>
<td>0.20±0.41</td>
<td>.3951a</td>
</tr>
<tr>
<td>A6 Difficulty walking</td>
<td>0.08±0.37</td>
<td>0.08±0.39</td>
<td>0.10±0.31</td>
<td>.7491a</td>
</tr>
<tr>
<td>SP5 Difficulty kneeling</td>
<td>2.02±1.61</td>
<td>2.22±1.60</td>
<td>1.45±1.54</td>
<td>.0716a</td>
</tr>
</tbody>
</table>

Abbreviations: KSS, Knee Society Score; PPR, primary patella resurfacing; TKA, total knee arthroplasty.

Revisions and Complications

All of the implants from the patient group investigated were still in situ at the time of the follow-up.

In the PPR group, there was one restriction in flexion. It was possible to treat this by means of arthroscopic arthrolysis and prior mobilization while anesthetized. This equates to a revision rate of 1.96% after an average follow-up of 62.9±5.7 months.

In the non-PPR group, a total of 2 secondary procedures were required. This equates to a revision rate of 10% after an average follow-up of 72.9±3.8 months, P=1298. One patient from this group required PPR as a secondary procedure due to symptoms that were evidently caused by the patella. Additionally in this group, an infected wound was successfully treated in an operation involving debridement, flushing, and displacement plastic repair.

DISCUSSION

As demonstrated in 2 larger meta-analyses there are no measurable

Figure. Tangential osteotomy just below the cortical bone from caudal to proximal to ensure the medial and lateral symmetry of the patellar thickness under visual control.
differences in TKA with or without patellar replacement if only high-level studies are taken into consideration. An interesting question is whether that fact is still valid if patients with enhanced loads on the back surfaces of the patella are investigated. For this reason the authors of this study have chosen a patient population from a mountain region, which will exhibit the same characteristics in clinical and radiological outcome, with a special focus on the revision rate and the functional outcome.

The hypothesis was that the revision rate is reduced with PPR and that the functional outcome is not inferior.

The decisive information to emerge from this study is that no implant replacement was required in either of the 2 groups. In all consecutively recorded patients from 2007 and 2008, information was available relating to this and there was no selection bias.

In overall terms, the revision rate was low, and with 1 revision in the PPR group and 2 revisions in the non-PPR group, it was within the range stated in the literature. Although no significant outcomes emerged, the revision rate tended to be reduced with PPR compared with non-PPR. He et al came to the conclusion that, in higher-caliber randomized studies, no difference could be established with respect to the revision rate. The results of the Swedish Knee Arthroplasty Register–2014 Annual Report indicate that, for the period of 2003 to 2012, during which the current authors’ implant procedures were also conducted, the revision rate for the non-PPR group is now lower than for the PPR group. The current authors could not do more than speculate about the possible causes of this adjusted revision rate. The reduced number of PPR procedures in the Swedish Knee Arthroplasty Register–2014 Annual Report indicated a selective indication process that might concentrate at-risk patients in the PPR group. Complications such as anterior knee pain may be due to a very wide range of causes in the view of Petersen et al and this applies both to PPR and to non-PPR procedures. In the current authors’ view, primary treatment with a patella implant slightly increases the average 80-minute operation time by 3 to 4 minutes. Virtually no implications in terms of the risk for infection are therefore to be anticipated. However, additional malpositioning such as overstuffing could arise, as could additional loosening of the implant. In the current authors’ cohort of PPR patients, there was not a single instance of clinical symptoms associated with overstuffing. The current authors describe this to the design of the femoropatellar bearing, located at great depth due to the generously proportioned ventral cranial osteotomy for the type of knee prosthesis used here and that can help to compensate for the thicker patella. Instances of loosening and infection were equally rare occurrences. Accordingly, none of the typical complications described for PPR procedures were found.

The results of the KSS show no differences between the 2 groups, both in terms of overall result and in the subscales kKSS and fKSS. The result is comparable to that found by Peng et al. In their meta-analysis, Pilling et al found a significantly higher kKSS for the PPR group, but did not ascribe any decisive importance to this advantage because the mean difference between the 2 groups was not clinically relevant. In the points total for the overall KSS score and for the subscores, the current authors’ results were comparable to those of Jenny et al with a comparable knee system.

For the functional outcome, the current authors decided in this study to consider the specific questions of pain and difficulties when climbing stairs and when walking on level ground. The current authors chose to do this to concentrate on the requirement posited in the current authors’ hypothesis. The current authors were unable to find any difference between the groups with respect to pain or function. Patients with PPR kneel with much more difficulty than those without replacement.

The current perception in the literature relating to the differing risk associated with sensitivity to pain in the 2 groups differs. Whereas a few studies report an increased level of pain in the non-PPR group, other studies and meta-analyses find no advantage in terms of pain in the PPR group. In terms of pain, the current authors’ result is in line with those of other authors.

During the analysis, the current authors noticed that 15 patients achieved a passive flexion of less than 110°. Twelve of these were in the PPR group, and only 3 were in the non-PPR group. However, the ROM result did not indicate any significant difference. With 115.6° and 117.9° for the PPR group and the non-PPR group respectively, the current authors achieved comparable values to those in the literature.

Breugem et al report on advantages with respect to anterior knee pain in patients implanted with a mobile-bearing knee prosthesis compared with patients implanted with a fixed-bearing knee prosthesis. Lygre et al describe differing trends with knee prostheses from different manufacturers in terms of pain, symptoms, and patient satisfaction levels. However, this work did not find any differences in outcome between the PPR and the non-PPR groups. These studies indicate that the PPR and non-PPR treatment models should not be considered alone, but that instead the design of the knee system may be what determines any difference in functional outcome.

The principal limitations of this current investigation arise primarily from the nonrandomized, retrospective design. In addition, the aim of incorporating a consecutive patient group led to a different size of patient groups being created. There were also differences in terms of the demographic values for the 2 groups (Table 1).
Up until the end of 2006, the TKAs performed in the current authors’ clinic almost all involved the non-PPR procedure. Following an unacceptable rate of 10% secondary PPR procedures, effective from March 2007, a trend emerged in favor of the PPR procedure. From December, 2007 TKAs were only implanted with PPR. At the same time, from early 2007 the version of knee prosthesis known as floating platform was switched over to the ultracongruent rotating platform. To eliminate the influence of different implant systems, the follow-up period for this study was therefore limited to the years 2007 and 2008.

Future studies should show the short-term outcome, the time required for convalescence, and patient satisfaction. The question of whether different complications in the PPR and non-PPR groups lead to the need for revisions, and whether these can be avoided primarily by a differentiated approach to indication, is one that has yet to be answered in a satisfactory manner.

**Conclusion**

The clinical results of TKA with c.motion UC prosthesis with rotating inlay and its anatomical femoropatellar bearing indicate, at the end of a 5-year follow-up period, an excellent survival rate and good functional results. The complication rate is low. Advantages relating to primary PPR in relation to the revision rate could only be shown in terms of broad trends. The functional outcome is, as was expected, comparable in both groups. The secondary patellar resurfacing procedure is avoided through the use of PPR, without the risk for increasing other complications.

**References**


