The incidence of the patellar clunk syndrome in a recently designed mobile-bearing posteriorly stabilised total knee replacement

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The patellar clunk syndrome describes painful catching, grinding or jumping of the patella when the knee moves from a flexed to an extended position.1 It is caused by overgrowth of a fibrous nodule on the superior aspect of the patellar button,2 and is usually seen from three to nine months after the operation.3 Insall, Lachiewicz and Burstein4 first noted this peripatellar nodule after total knee replacement (TKR) in 1982, and Hozack et al2 coined the term ‘patellar clunk syndrome’ and examined the pathology in 1989. The posteriorly stabilised total knee prosthesis, which has an intercondylar box to accept the tibial post, has been reported to have a higher incidence of the syndrome than other types of prosthesis.1,5-10

The purpose of this study was to evaluate the association of the patellar clunk syndrome with the mobile-bearing posteriorly stabilised TKR (PFC Sigma RP, Depuy, Warsaw, Indiana) which was recently introduced to improve patellar tracking and reduce patellar-related problems with the use of a self-alignment mechanism.1

Patients and Methods

Between March 2003 and September 2004, 121 consecutive primary TKRs were performed in 100 patients using the mobile-bearing posteriorly stabilised TKR (PFC Sigma RP, Depuy, Warsaw, Indiana) which was recently introduced to improve patellar tracking and reduce patellar-related problems with the use of a self-alignment mechanism.1

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of the femur were carefully removed. Then, ligamentous balancing was performed. The patella was resurfaced with polyethylene components in all cases. The plica and all synovium around the patella were carefully removed. Patellar tracking was evaluated using the ‘no-thumb’ test. If maltracking was identified, a lateral retinacular release was performed from inside out. A total of 18 knees (16%) required this procedure. After pulsed lavage, all the components were inserted with cement. The day after operation, the drain was removed and patients were mobilised.

Clinical and radiological evaluation. This was performed at three and six months after operation, and every six months thereafter. The patellar clunk syndrome was defined as an audible clunk when the knee was brought from flexion to extension, according to the criteria described by Beight et al. Audible clunking, with or without pain, was recorded at each visit. True lateral radiographs with complete overlap of the medial and lateral femoral condyles were obtained using fluoroscopy with the knees flexed to 30°, and skyline views with the knees flexed to 45°. The Insall-Salvati ratio, the position of the proximal pole of the patella, and the relative anteroposterior position of the tibial tray were measured using the lateral radiographs (Fig. 1). The angle of patellar tilt was measured on the skyline view. For this study the radiographs taken at the last follow-up were used. All were digitally captured, and the radiological parameters were measured using computer software (Quick Grain Standard Ver 3.2.5, Inotech, Hiroshima, Japan).

We defined the ‘intercondylar box ratio’ as the ratio of the length of the intercondylar box to the anteroposterior size of the femoral component (Fig. 2).

Statistical analysis. Student’s t-test was performed to compare age, body mass index (BMI) and the radiological parameters between the patients with and without patellar clunk syndrome. The chi-squared test or Fisher’s exact test was used to compare gender, diagnosis, and lateral retinacular release between the two groups. Logistic regression analysis was undertaken to examine the roles of perioperative factors including age, gender, diagnosis, body mass index (BMI), lateral retinacular release, absolute value of pre-operative angle of the patellar tilt, the absolute value of post-operative angle of patellar tilt, the Insall-Salvati ratio, the position of the proximal pole of the patella, and the relative anteroposterior position of the tibial tray in determining the occurrence of the patellar clunk syndrome. Computer software (SAS software version 9.1, SAS Institute, Cary, North Carolina) was used for statistical analysis. Levels of significance of 95% or better were accepted.

Results

The patellar clunk syndrome was identified in 15 knees (13.3%). Of these, six (5.3%) had clunking with pain. The onset of symptoms was within 12 months of surgery (mean 7.8 (4 to 12)) in all 15 cases. Five of the six patients with pain underwent arthroscopic resection of fibrous tissue around the patella (Fig. 3). All were relieved of their symptoms without recurrence during the period of follow-up.

The differences in age, gender, diagnosis, BMI, lateral retinacular release, absolute value of the pre-operative angle of patellar tilt, Insall-Salvati ratio, position of the proximal pole of the patella, and relative anteroposterior position of
the tibial tray between the patients with and without patellar clunk syndrome were not statistically significant (Table I). The absolute value of the post-operative angle of patellar tilt was higher in patients with the syndrome than in those without (p = 0.020). The intercondylar box ratio of the PFC Sigma RP ranged between 0.85 and 0.87.

Logistic regression analysis showed that the absolute value of the post-operative angle of patellar tilt was significantly associated with the occurrence of patellar clunk syndrome (p = 0.025), with an odds ratio of 1.27 (95% confidence interval (CI) 1.03 to 1.56) (Table II). Analysis performed with control for peri-operative factors showed that a 1° increase in the absolute value of the post-operative angle of patellar tilt increased the incidence of patellar clunk 1.27-fold. No other main effects or interactions were significantly associated (p > 0.05).

**Discussion**

The risk factors for patellar clunk remain unclear. The design of the prosthesis, the extent of surgical trauma, a change in the joint line, patellar height and abnormal patellar tracking are suspected. In posteriorly stabilised TKRs of older

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**Table I. Peri-operative parameters and patellar clunk syndrome**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Patients with patellar clunk syndrome (n = 15)</th>
<th>Patients without patellar clunk syndrome (n = 98)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age at operation in years (SD)</td>
<td>72.3 (6.3)</td>
<td>61.8 (7.2)</td>
<td>0.402*</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M:F</td>
<td>1:14</td>
<td>5:93</td>
<td>0.583†</td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OA:RA‡</td>
<td>15:0</td>
<td>85:13</td>
<td>0.210‡</td>
</tr>
<tr>
<td>Mean body mass index in kg/m² (SD)</td>
<td>26.5 (4.8)</td>
<td>26.4 (3.9)</td>
<td>0.880*</td>
</tr>
<tr>
<td>Lateral release</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With/without</td>
<td>5:10</td>
<td>13:85</td>
<td>0.062†</td>
</tr>
<tr>
<td>Mean absolute value of pre-operative angle of patellar tilt° in (SD)</td>
<td>3.97 (2.7)</td>
<td>4.50 (3.3)</td>
<td>0.559*</td>
</tr>
<tr>
<td>Mean absolute value of post-operative angle of patellar tilt° in (SD)</td>
<td>6.00 (3.4)</td>
<td>4.08 (2.9)</td>
<td>0.020*</td>
</tr>
<tr>
<td>Mean Insall-Salvati ratio¹ (SD)</td>
<td>1.17 (0.2)</td>
<td>1.12 (0.2)</td>
<td>0.340*</td>
</tr>
<tr>
<td>Mean position of the proximal pole of the patella in mm¹⁴ (SD)</td>
<td>50.7 (3.8)</td>
<td>50.0 (7.1)</td>
<td>0.731*</td>
</tr>
<tr>
<td>Mean relative anteroposterior position of the tibial tray in mm¹⁵ (SD)</td>
<td>5.12 (1.6)</td>
<td>4.48 (1.47)</td>
<td>0.128*</td>
</tr>
</tbody>
</table>

*Student’s t-test
† Fisher’s exact test
‡ OA, osteoarthritis; RA, rheumatoid arthritis
design, such as the IB-II (Zimmer, Warsaw, Indiana) and the AMK PS (DePuy) the incidence of patellar clunk has been reported to be high (3.9% to 13.5%). Recently, improvements in the design of the femoral component with a raised lateral flange, a deepened trochlear groove and side-specific femoral components, which allow the patellar groove to be orientated obliquely, have been applied to posteriorly stabilised TKRs such as the NexGen LPS (Zimmer) and the Advance PS (Wright Medical, Arlington, Tennessee) in attempts to eliminate patellar clunk. However, Ranawat et al found that there was still a high incidence of the syndrome (12%) with a recently designed fixed-bearing posteriorly stabilised TKR (PFC Sigma PS; DePuy). We have observed a similar incidence (13.3%) in the equivalent mobile-bearing TKR. The intercondylar box ratios of the older posteriorly stabilised TKRs, with a high incidence of patellar clunk (IB-II and AMK) were > 0.7 (Table III). The intercondylar box ratios of the recently designed posteriorly stabilised TKRs that did not have patellar clunk (NexGen LPS and Advance PS), were < 0.7. The intercondylar box ratios of the PFC Sigma PS and the PFC Sigma RP were 0.85 to 0.87, and close to those of the IB-II and AMK PS. If the intercondylar box ratio is larger, the proximal pole of the patella and anterior edge of the intercondylar box come into contact earlier during flexion (Fig. 4). The larger intercondylar box ratio of the PFC Sigma RP might be one of the reasons for the higher incidence of patellar clunk.

In addition to component design, alteration of the joint line, patellar height, patellar thickness, patellar tracking and anterior placement of the tibial tray have been reported as aetiological factors in the development of patellar clunk. However, Ranawat et al found that there was still a high incidence of the syndrome (12%) with a recently designed fixed-bearing posteriorly stabilised TKR (PFC Sigma PS; DePuy). We have observed a similar incidence (13.3%) in the equivalent mobile-bearing TKR. The intercondylar box ratios of the older posteriorly stabilised TKRs, with a high incidence of patellar clunk (IB-II and AMK) were > 0.7 (Table III). The intercondylar box ratios of the recently designed posteriorly stabilised TKRs that did not have patellar clunk (NexGen LPS and Advance PS), were < 0.7. The intercondylar box ratios of the PFC Sigma PS and the PFC Sigma RP were 0.85 to 0.87, and close to those of the IB-II and AMK PS. If the intercondylar box ratio is larger, the proximal pole of the patella and anterior edge of the intercondylar box come into contact earlier during flexion (Fig. 4). The larger intercondylar box ratio of the PFC Sigma RP might be one of the reasons for the higher incidence of patellar clunk.

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femoral component at 3° from the posterior condyles. This might be one of the causes of patellar maltracking and the high incidence of patellar clunk in our patients. Sawaguchi et al.\textsuperscript{11} reported that the recently designed mobile-bearing posteriorly stabilised TKRs reduced the prevalence of patellar tilt by virtue of a self-alignment mechanism of the mobile design. This advantage might be offset by the larger intercondylar box ratio and our surgical technique. Knees with patellar clunk showed a higher tendency to have had a lateral release (5 of 15 cases, 33.3%) than knees without the syndrome (13 of 98 cases, 13.3%), but the difference was not statistically significant (p = 0.062). A larger study might reveal the relationship between the syndrome and the requirement for lateral release.

Arthroscopic resection of the nodule at the proximal aspect of the patellar component has yielded satisfactory results.\textsuperscript{19-22} The rates of successful relief of symptoms of patellar clunking without recurrence were 100\%\textsuperscript{19} and 82\%\textsuperscript{22}.

There are some limitations to this study. The duration of follow-up was short (2.0 to 3.2 years), but the time from operation to occurrence of patellar clunk has for the most part been three to nine months, and sometimes 12 months.\textsuperscript{3} The mean time in our series was 7.8 months (4 to 12) which is similar to other series.\textsuperscript{1,8,15-18} Lateral radiographs were taken under non-weight-bearing conditions on a fluoroscopic table. Weight-bearing may change the measurement of patellar height,\textsuperscript{23} and the Insall-Salvati ratio and patellar button height might be underestimated in this study. However, we believe that the influence of weight-bearing was minimised because our lateral radiographs were strictly standardised and controlled under fluoroscopy.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References


\begin{figure}
\centering
\includegraphics[width=\textwidth]{fig4a}
\caption{Diagram showing the relationship between the intercondylar box ratio and the patella. a) If the intercondylar box ratio is smaller, the proximal pole of the patella and anterior edge of the intercondylar box come into contact later in flexion, b) if the intercondylar box ratio is larger, the proximal pole of the patella and anterior edge of the intercondylar box come into contact earlier in flexion.}
\end{figure}