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Original Article

Patellar clunk in total knee arthroplasty using modified Sigma posterior stabilized femoral component

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ABSTRACT

Aim: The purpose of this study was to evaluate the efficacy of the enhanced PS femoral component design released in 2008 by DePuy. The patellar clunk syndrome has been reported in a significant number of patients following total knee arthroplasty. Design modifications of the implant have been made to reduce the incidence of the patellar clunk, especially in the posterior substituted designs.

Methods: 130 total knee replacements performed using the enhanced PS femoral components were followed-up with clinical and radiographic evaluations.

Results: Patellar clunk was seen in 3 of the 130 knees (2%). This is much less than the incidence of patellar clunk reported until now.

Conclusions: Removal of the sharp ridge in the intercondylar groove in the newer implant seems to have been effective in reducing the incidence of the patellar clunk. It also indicates that the sharp ridge was the most probable cause of the clunk.

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1. Introduction

The 'patellar clunk syndrome' has been described as a painful catching, grinding or jumping of the patella when the knee is moving from flexed to extended position¹ and it is usually seen between 3 and 9 months following total knee arthroplasty.² It is said to be caused by the growth of a fibrous nodule on the posterior aspect of the quadriceps tendon near the superior

pole of the patella.³ Patellar clunk has been reported^{4–6} in both the cruciate retaining and cruciate substituting total knee arthroplasty implant designs but more commonly with the cruciate substituting prosthesis. It has been observed following knee arthroplasty with patello-femoral joint resurfacing as well as non-resurfacing of patella. In 2008, DePuy orthopaedics released the enhanced PS (posterior stabilized) femoral component design (Fig. 1) that includes the hyperextension relief and smoother transition in the trochlear groove

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CS Femoral Component

PS Femoral Component

Fig. 1 – Removal of material leading to additional clearance for soft tissue tracking (picture courtesy of DePuy Inc, Warsaw, IN, USA).

to eliminate the edges that may irritate the distal quadriceps tendon in deep flexion activities (DePuy Inc, Warsaw, IN, USA). The purpose of the study is to evaluate the incidence of patellar clunk in a new modified designed PFC femoral component when utilised with fixed bearing design.

The objective of the present study was to assess the effect of modification in the design of prosthesis on the incidence of patellar clunk.

2. Materials and methods

Between August 2012 and August 2013, 133 total knee replacements were done in 88 patients. Patella was resurfaced in all the patients. 3 patients were not able to attend the hospital for follow-up. The clinical and radiological evaluations were done in the remaining 85 patients (130 knees).

All the operations were done via the anterior midline skin incision and mid-vastus approach. Posterior cruciate ligament was excised. Tibial surface was resected with 3° posterior slope. Distal femur was resected perpendicular to the mechanical axis. Anterior reference instrument was used to perform antero-posterior femoral preparation. Gap balancing technique was used to balance the knee. Patella was prepared using the Ranawat technique.⁷ The medial facet was excised using an oscillating saw starting from inferior pole of the patella followed by excision of the articular surface of the lateral facet of the patella to the depth of the subchondral bone. The medial facet was excised parallel to the anterior surface. All the synovium and osteophytes were removed to minimise peri patellar scar formation and subsequent 'clunk'. Patellar implant with three peg oval was used. The patellar tracking was evaluated. If there was mal-tracking, lateral release was done using outside-in technique.⁸ Implants were inserted with cement. Wound was closed in layers. The drain was removed on the first post operative day.

The patients were evaluated at intervals of 1 month, 3 months, 6 months, 1 year and every 6 months thereafter. Range

of motion was recorded pre and post operatively. Radiographs with antero-posterior (with the patient standing), lateral view and skyline view (in 45° flexion) were obtained. The Insall-Salvati ratio,⁹ the position of proximal pole of patella, femoral component flexion, tibial slope, femoral/tibial offset, composite patellar thickness, position of the tibial tray and joint line elevation were measured on the radiographs. These parameters have been discussed in detail by Conrad and Dennis.¹⁰ The relation between the occurrence of patellar clunk and peri operative factors were analysed.

Statistical analysis was done using 'Epidemiological Information Package' (EPI 2010) (Centre for Disease Control, Atlanta, USA). Student's t-test and linear regression analysis were performed to compare age, body mass index (BMI) and the radiological parameters between the patients with and without patellar clunk syndrome and Fisher's chi square test for qualitative variables. A 'p' value less than 0.05 was considered significant.

3. Results

The average age of the patients was 61 years (range – 36–81 years) and the average body mass index (BMI) was 29.3 (range – 23–38). The mean duration of follow-up was 11.4 months (range – 8–20 months) and the minimum follow up was 8 months. The mean pre-operative and post operative flexion was 97.2° (range – 75–115°) and 117.5° (range – 100–130°) respectively. The mean femoral component flexion was 1.8° (range – 1–4°). The mean tibial slope was 2.6° (range – 1–5°). The mean posterior femoral condylar offset was 22.5 mm (14–26 mm). The mean pre operative and post operative composite patellar thickness was 22.4 mm (range – 20–26 mm) and 22.9 mm (range – 21–26 mm) respectively. The level of the joint line with reference to the tibial tuberosity was measured and the mean value was 23.5 mm (range – 22.7–25.2 mm). The mean value for relative position of the tibial tray with reference to the extensor mechanism was 8.6 mm (range – 7.3–11.1 mm). The mean patellar tendon length on the pre operative radiographs was 51.7 mm (48.3 mm–53.9 mm) and on the post operative radiographs, it was 52.5 mm (range – 49.3–54.7 mm). The mean Insall-Salvati ratio was 0.9 pre-operatively and 1.2 post-operatively.

Patellar clunk was identified in 3 patients (2%). The clunk was noticed at 4 and 6 months following the operation. One patient with relief of pain with anti-inflammatory medications and the severity of the clunk reduced spontaneously. The second patient was advised surgery. In 3 patients (2%) there was crepitus without any clunk. Patients with patellar clunk post-operatively had significantly lower pain ($p = 0.035$) and function ($p = 0.033$) scores compared with patients without patellar clunk as evaluated on the Knee Society Score. There was no significant difference in the range of flexion in patients with patellar clunk compared to those without the clunk. There was no significant association between patellar clunk and factors such as body mass index, range of flexion, Insall-Salvati ratio, composite thickness of the patella, femoral component flexion, position of the tibial tray and joint line elevation in our series.

Table 1 – Intercondylar box ratio and the incidence of patellar clunk syndrome reported in various Studies.

Prosthesis	Intercondylar box ratio (range)	Incidence of patellar clunk syndrome (%)	Study
IB-II	0.71 to 0.72	7.5	Ip et al. ¹
		10.2	Yau et al. ¹⁵
AMK PS	0.84 to 0.85	3.3	Ip et al. ¹⁶
		18.3	Yau et al. ¹⁵
Nex Gen LPS	0.56 to 0.59	0	Ip et al. ¹⁶
		0	Clarke et al. ¹⁷
Advance PS	0.62	0	Maloney et al. ¹⁸
PFC Sigma PS	0.85 to 0.87	12	Ranawat et al.
RP	0.85 to 0.87	13.3	Fukunaga et al.
PFC Sigma prosthesis	0.85 to 0.87	2	Present Study

4. Discussion

Factors such as the design of the prosthesis, surgical techniques, patellar height, patellar tracking, and Insall-Salvati ratio have been implicated in the causation of the patellar clunk, but the single most contributory factor responsible for the clunk has remained elusive.

The older designs of posterior substituted prostheses such as IB II and AMK had highest incidence of clunk (3.9–13.5%).^{11,12} Improvement of the design of the femoral prosthesis with raised lateral flange, deepened patellar groove with anatomical oblique orientation and the use of side specific femoral implant have reduced the incidence of patellar clunk in ‘Nex Gen’ and Advanced PS system.¹³ Ranawat et al. found a high incidence of patellar clunk syndrome in fixed bearing PFC Sigma total knee implant (12%).¹⁴ This was the same with mobile bearing prosthesis (13.3%) as reported by Fakunga et al. who studied the PFC Sigma RP implant.¹⁵ In our series, the incidence was reduced to 2%. The reduction in the clunk may be due to further modification in the design, i.e. sharp ridge in the inter-condylar groove has been smoothed, while retaining the same inter-condylar box ratio (Tables 1 and 2). It seems to indicate that the sharp ridge is probably an important contributor to the patellar clunk. Further studies are essential in this regard.

Other factors such as patellar thickness, height of the patella and patellar tracking have been mentioned as the reason for the clunk, but in our study there was no significant correlation between these factors and incidence of patellar clunk.

The diagnosis of patellar clunk is usually made when the knee is actively extended from 30 to 40 of flexion. But this is not always true. It depends upon the design of the box-height of the femoral component.¹⁵ When the height of the box is low, the patellar clunk may become obvious at 60–70 of flexion. Routine use of 30 of flexion to elicit the patellar clunk in all patients would mean that the ‘clunk’ goes undetected in knees with lower condylar box-height.

Dynamic skyline view in 45 of flexion is more reliable than the Merchant view to assess the patellar tracking.¹⁶ The dynamic pull of the vastus-medialis acting helps to maintain the patella central. It may appear as if there is a patellar tilt in merchant view, but the patella will be seen central on dynamic view.

5. Conclusion

Incidence of patellar clunk seems to be reduced after modification of the sharp ridge of the inter condylar groove of the femoral component. The thickness of the patella, patellar tilt and Insall-Salvati ratio did not seem to affect the incidence of patellar clunk in our series of patients. Further studies are essential to confirm the impact of this design modification on patellar clunk.

Conflicts of interest

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.

Table 2 – Comparative incidence of Patellar Clunk in different studies.

Study	Total knees studied	Incidence of patellar clunk
Current study (PFC Sigma prosthesis)	130	3 (2%)
Fukunaga et al (2009)	113	15 (13.3%)
Ip et al (2002) – IB prosthesis	80	6 (7.5)
Ip et al (2002) – Nex Gen prosthesis	50	0
Yau et al (2003) – AMK prosthesis	93	17 (18.3%)
Yau et al (2003) – IB II prosthesis	98	10 (10.2%)

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