Incidence of Patellar Clunk With a Modern Posterior-Stabilized Knee Design

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Abstract

Patellar clunk is an uncommon complication of posterior-stabilized total knee arthroplasty (TKA), though the incidence has been reported to be as high as 7.5% with some posterior-stabilized implants, and the etiology is multifactorial. Femoral component design has been implicated as a major cause of this complication.

This series compares the incidence of patellar clunk with 2 different knee prostheses, the Insall-Burstein II (IB) and the NexGen Legacy PS (NG), both manufactured by Zimmer (Warsaw, Ind). One-hundred fifty consecutive posterior-stabilized TKAs were in each group, and the groups were similar in surgical approaches and techniques.

Insall-Salvati (IS) ratios and joint-line positions were measured on preoperative and postoperative x-rays. Knee Society Clinical and Functional scores were calculated.

Incidence of patellar clunk was reduced from 4% with the IB design to 0% with the NG design. IS ratios, joint-line positions, and clinical outcomes were no different between the groups. It appears that femoral component design may play a substantial role in development of patellar clunk after posterior-stabilized TKA.

Patellofemoral complications of total knee arthroplasty (TKA) are a common cause of dysfunction.[1] In 1982, Insall and colleagues[2] reported on a symptomatic peripatellar fibrous nodule that required resection. They subsequently reported on several patients who underwent peripatellar synovectomy for anterior catching and clicking.[3] Hozack and colleagues[4] in 1989 further characterized the "patellar clunk syndrome" as a painful anterior knee catching or clunk that results from engagement of a hyperplastic retropatellar fibrous nodule in the intercondylar notch of the femoral component in knee flexion that displaces (clunks) as the knee is extended from approximately 30° to 45° of flexion. The etiology is multifactorial and has been attributed to femoral component design, alteration in joint line, patellar height, patellar thickness, and patellar tracking.[5,6] Patellar clunk has largely been described in first-generation posterior-stabilized knee designs and has been attributed to a sharp anterior edge at the superior aspect of the intercondylar notch.[7,8] Synovial entrapment from hypertrophic tissue proximal to the patella and catching from the superior proximal aspect of an unresurfaced patella have also been reported.[9,10] Patients with patellar clunk have responded well to open débridement, patellar revision, and arthroscopic débridement.[2-4,8,9,11,12]

The purpose of the study described here was to compare the incidence of patellar clunk in a consecutive series of patients who received a second-generation posterior-stabilized knee design, Insall-Burstein II (IB), or a modern knee design, NexGen Legacy PS (NG), both manufactured by Zimmer (Warsaw, Ind).

Materials and Methods

A consecutive series of 150 primary TKAs performed with IB prostheses (99 patients) was compared with a consecutive series of 150 primary TKAs performed with NG prostheses (102 patients). The IB-TKAs were performed from January 2001 through March 2001 in a patient population of 32 men and 67 women (mean age, 66 years; range, 44-86 years). The NG-TKAs were performed from March 2001 through June 2001 in a patient population of 41 men and 61 women (mean age, 67 years; range, 30-93 years). All patients had osteoarthritis, with the exception of 3 patients in the IB group and 1 patient in the NG group, who had osteonecrosis.

All TKAs were performed by Drs. Lonner, Nazarian, and Booth. Each procedure was performed through a standard midline skin incision and medial parapatellar arthrotomy. After the trial tibial and femoral components were placed, the patella was everted, and the thickness was measured with a caliper. The articular resection was performed at the level of the subchondral bone with the "patellar nose" (intratendinous portion of the patella) as a guide. The 3-pegged patella trial was provisionally implanted on the medial and superior edges of the patella. The patellar-prosthesis composite was again measured with a caliper noted to be equal to or 1 to 2 mm less than the original patellar thickness. Careful synovial tissue débridement from the undersurface of the quadriceps tendon was performed for all knees. Patella tracking was evaluated with a "no thumbs" technique, and all patellae

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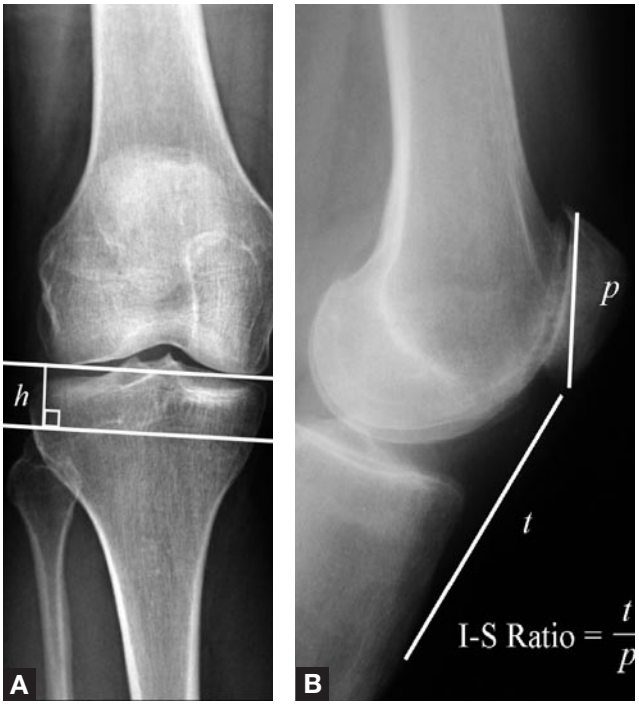

Figure 1. **(A)** Standing anteroposterior x-ray shows joint-line height measured as perpendicular distance between a line connecting the distal points of the femoral condyles and the proximal tip of the fibular head. **(B)** Insall-Salvati ratios were determined from lateral x-rays with a knee flexion angle of 20°.

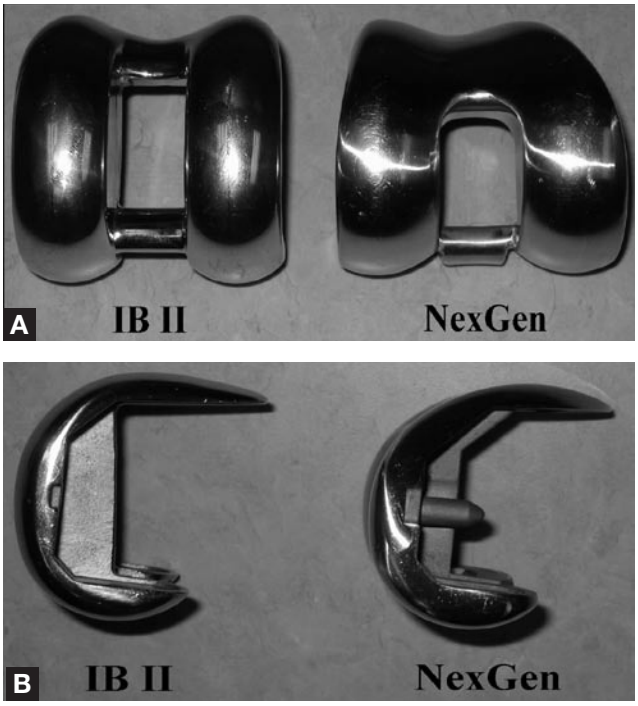

Figure 2. Comparison of Insall-Burstein II and NexGen Legacy PS femoral prostheses, both manufactured by Zimmer (Warsaw, Ind): **(A)** design and position of intercondylar box; **(B)** sagittal profile.

were cemented with an all-polyethylene component. The 2 patient groups had identical postoperative rehabilitation protocols, which included continuous passive motion while in the hospital. After discharge from the hospital, all patients underwent home and outpatient physical therapy for 6 to 12 weeks.

Routine follow-up was performed 6 weeks, 3 months, 6 months, 1 year, and 2 years after the index TKA. The diagnosis of patellar clunk was based on patient symptoms and clinical examination. Clinical findings included anterior knee pain, crepitus, and a painful clunk as the knee is extended from approximately 30° to 45° of flexion. Knee Society (KS) Clinical and Functional scores and knee range of motion (ROM) were recorded before and after surgery.

Preoperative and postoperative radiographic measurement included joint-line measurements (heights) and Insall-Salvati (IS) ratios[13] using a handheld ruler and corrected for magnification. On anteroposterior x-rays, joint-line height was the perpendicular distance between a line connecting the distal points of the femoral condyles and the proximal tip of the fibular head (Figure 1A).[7] The IS ratios were determined from the lateral x-rays with a knee flexion angle of 20° (Figure 1B).

Implant Design

Several design features, including a raised lateral flange, a deepened trochlear groove, and a more posterior intercondylar box, differentiate the NG femoral prosthesis from the IB femoral component (Figure 2).

Statistical Analysis

Within each implant group, preoperative KS scores, ROM, joint-line elevation, and IS ratios were compared with the postoperative values using the paired-samples *t* test. Examination of the effect of implant design involved subtracting preoperative radiographic measurements from postoperative radiographic measurements and analyzing the differences using the independent-samples *t* test. The Fisher exact test was used to compare the cohorts' incidence of patellar clunk. Differences were considered statistically significant at $P<.05$.

Results

In the IB group, 6 knees in 6 patients (5 women, 1 man) developed patellar clunk, while none was observed in the NG group (4% vs 0%, $P = .03$). Of the 6 symptomatic patients, 4 underwent simultaneous bilateral primary TKAs, 1 underwent unilateral primary TKA, and 1 underwent simultaneous primary TKA on the left and revision TKA on the right (Insall-Burstein II Constrained Condylar Knee; Zimmer, Warsaw, Ind). The bilateral primary knee patients developed patellar clunk on only one side. The patient who underwent bilateral primary and revision TKAs also developed bilateral patellar clunk, though only the primary knee was included in the analysis. Mean age of patients with patellar clunk was 61 years (range, 45-68 years), and all patients had the preoperative diagnosis of osteoarthritis. Onset of symptomatic patellar clunk was 13 months (range, 3-21 months) after index TKA, and arthroscopic débridement was performed in all patients a mean of 14 months

Table I. Implant Groups' Preoperative and Postoperative Knee Society (KS) Clinical and Function Scores and Range of Motion (ROM)

Clinical Outcomes	Preoperative	Postoperative	*P*
Insall-Burstein II			
KS Clinical score	51 (26-96)	81 (44-100)	<.001
KS Function score	39 (6-66)	63 (21-100)	<.001
ROM	111° (75°-130°)	115° (95°-130°)	.024
NexGen Legacy PS			
KS Clinical score	47 (23-95)	82 (48-100)	<.001
KS Function score	34 (0-100)	54 (0-100)	<.001
ROM	107° (45°-130°)	110° (75°-130°)	.132

Table II. Implant Groups' Preoperative and Postoperative Joint-Line Heights and Insall-Salvati (IS) Ratios

Measurements*	Preoperative	Postoperative	Pre–Post Differences
Insall-Burstein II			
Joint-line height (mm)	20.6 (9-33)	23.8 (8-37)	3.25 (-7-17)
IS ratio	1.24 (0.78-1.65)	1.33 (0.82-1.88)	0.09 (-0.44-0.62)
NexGen Legacy PS			
Joint-line height (mm)	19.4 (0-29)	22.2 (7-41)	2.80 (-9-22)
IS ratio	1.17 (0.93-1.55)	1.30 (0.90-1.81)	0.13 (-0.13-0.46)

*For each measurement, the postoperative value was significantly larger than the preoperative value ($P<.001$). However, differences between preoperative and postoperative measures did not vary significantly with prosthetic design (joint-line height, $P = .556$; IS ratio, $P = .131$).

(range, 5-24 months) after TKA. At time of arthroscopy, a superior lateral portal was made to introduce instruments. A combination of arthroscopic forceps and a motorized shaver was used to resect the hyperplastic tissue.

The outcome measures were otherwise similar between the 2 groups (Table I). In the IB group, mean KS Clinical score improved from 51 (range, 26-96) before surgery to 81 (range, 44-100) after surgery ($P<.001$); mean KS Function score improved from 39 (range, 6-66) to 63 (range, 21-100) ($P<.0001$), and mean ROM improved from 111° (range, 75°-130°) to 115° (range, 95°-130°) ($P = .024$). In the NG group, mean KS Clinical score improved from 47 (range, 23-95) before surgery to 82 (range, 48-100) after surgery ($P<.001$), mean KS Function score improved from 34 (range, 0-100) to 54 (range 0-100) ($P<.001$), and mean ROM improved from 107° (range, 45°-130°) to 110° (range, 75°-130°) ($P = .132$). None of these scores differed significantly between the groups ($.209 \le P \le .807$).

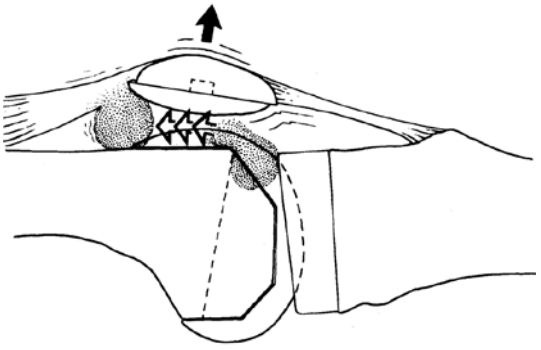

Figure 3. Pathogenesis of patellar clunk syndrome. Two impingement areas: between femoral component and quadriceps tendon and between patellar component and quadriceps tendon (open arrows). Reproduced with permission from Hozack WJ, Rothman RH, Booth RE, Balderston RA. The patellar clunk syndrome. A complication of posterior stabilized total knee arthroplasty. *Clin Orthop.* 1989;(241):203-208.

In both groups, postoperative joint-line height was significantly greater than preoperative height (Table II). Mean joint-line height increased from 20.6 mm (range, 9-33 mm) to 23.8 mm (range, 8-37 mm) in the IB group ($P<.001$) and from 19.4 mm (range, 0-29 mm) to 22.2 mm (range 7-41 mm) in the NG group ($P<.001$). Amount of joint elevation did not differ significantly ($P = .556$) between the IB group (3.25 mm; range, -7-17 mm) and the NG group (2.80 mm; range, -9-22 mm). Mean IS ratio increased significantly after surgery in both groups—from 1.24 (range, 0.78-1.65) to 1.33 (range, 0.82-1.88) in the IB group ($P<.001$) and from 1.17 (range, 0.93-1.55) to 1.30 (range, 0.90-1.18) in the NG group ($P<.001$). Change in IS ratio was not statistically different ($P = .131$) between the IB group (0.09; range, -0.44-0.62) and the NG group (0.13; range, -0.13-0.46).

Discussion

Patellar clunk is only one of a spectrum of patellar impingement complications of posterior-stabilized TKA.[4,6,7,9] This spectrum includes painful crepitation, synovial entrapment, peripatellar fibrous hyperplasia, and patellar clunk.[4,6-9,12] The incidence of patellar clunk has been previously reported to be 3.5% in IB prostheses at our institution,[12] 3.9% in a series reported by Maloney and colleagues,[8] and 7.5% in a series reported by Ip and colleagues.[14] The 4% incidence reported in this series is therefore consistent with earlier reports. Pollock and colleagues[9] reported a 13.5% incidence

of synovial entrapment in the Anatomic Modular Knee-Congruency implant (Biomet, Warsaw, Ind.) and a 3.8% incidence in the Anatomic Modular Knee-Posterior-Stabilized implant (Biomet, Warsaw, Ind). In the original description of patellar clunk, by Hozack and colleagues,[4] patients experienced a painful catch or clunk while extending the flexed knee. Both symptoms were attributed to a hypertrophic suprapatellar nodule that engaged the intercondylar box of the femoral component in flexion and then was suddenly released as the knee extended from approximately 30° to 45° of flexion[4] (Figure 3). The nodule appears to develop from irritation at the level of the quadriceps insertion and fibrous hyperplasia but can also arise from retained synovial tissue.[7] Patellar clunk seldom occurs in patients with poor ROM, as reasonably good flexion (90°) is required before the superior pole of the patella comes into contact with the intercondylar box and allows soft-tissue impingement.[7]

Although the etiology of patellar clunk may be multifactorial, our study results implicate the femoral component design as the leading cause. At the superior aspect of the intercondylar box, first-generation posterior-stabilized femoral components had a sharp anterior edge that caused suprapatellar irritation in the extremes of flexion.[7] The second-generation IB prosthesis has a smooth transition from the notch to the anterior flange but differs substantially from the NG prosthesis. Modifications to the NG design include a raised lateral flange, a deepened trochlear groove, and a more posterior intercondylar box, which allow the patella to be engaged in the component for a larger arc of motion and are therefore responsible for reduced patellar clunk.[7,8,14]

Joint-line alteration, patellar height, patellar thickness, patellar tracking, and anterior placement of the tibial tray have also been reported as etiologic factors in the development of patellar clunk.[6,7,12] Neither joint-line position nor patellar height was noted to influence development of patellar clunk in this series. Although the true height of the patellar button and the position of the proximal pole of the patellar button may influence the incidence of patellar clunk, these were not measured in this series, yet all 3 surgeons attempted to place the patellar button as superior as possible. Anterior placement of tibial trays was not measured in our series; however, there were no trays with anterior overhang. Adequate débridement of synovium from the undersurface of the quadriceps tendon at the patellar junction is important in reducing the risk for patellar clunk and likely does not differ between these groups, as all 3 surgeons meticulously cleared this synovial tissue in all cases.[6]

Our study results corroborate those of Clarke and colleagues,[15] who followed 238 knees with a cemented NG posterior-stabilized prosthesis for a minimum of 2 years after surgery and found no cases of patellar clunk. They used the epicondylar axis to gauge femoral component rotation. There was a 36% incidence of lateral retinacular release. There were no patellar complications. Clarke and colleagues attributed the reduced incidence of patellar clunk to design features of the NG implant versus the IB implant.

Conclusions

In our series, we compared 2 knee designs with regard to incidence of patellar clunk. Results suggested that femoral component design plays a large role in development of this syndrome. Although other factors may be involved, femoral component design is probably the leading reason for development of patellar clunk syndrome.

Authors' Disclosure Statement

Mr. Jasko and Dr. Bezwada report no actual or potential conflict of interest in relation to this article. Drs. Lonner, Nazarian, and Booth wish to note that they have consultation relationships with and receive royalties from Zimmer (Warsaw, Ind).

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