Patellar Polyethylene Spinout After Low-contact Stress, High-congruity, Mobile-bearing Patellofemoral Arthroplasty

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abstract

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A low-contact stress, high-congruity, mobile-bearing patellofemoral joint arthroplasty decreases the contact force in the patellofemoral joint, theoretically reducing patellar polyethylene wear and increasing implant longevity. This article describes the case of a 47-year-old obese woman who presented with pain and loss of extension after a low-contact stress, high-congruity, mobile-bearing patellofemoral joint arthroplasty. Radiographs revealed dislocation (ie, spinout) of the patellar polyethylene. Patellar polyethylene spinout is a rare complication of metal-backed, mobile-bearing patellar resurfacing. Theoretically, patellar polyethylene spinout in low-contact stress, high-congruity, mobile-bearing patellofemoral arthroplasty is related to implant design and the placement of the metal base plate. Ultimately, the articulation of low-contact stress, high-congruity, mobile-bearing patellofemoral arthroplasty may be too congruent to resist the forces of the patellofemoral joint, particularly in patients who are obese, and the patellar rotation allowed by this articulation may not be sufficient for all patients. Should patellar spinout occur, replacement of the polyethylene is not sufficient to correct the problem; hence, revision of the patellar and trochlear components is required because it remains unclear whether failure is secondary to patellar or trochlear design deficiencies.

Figure: Lateral radiograph of the left knee showing a low-contact stress, high-congruity, mobile-bearing patellofemoral arthroplasty and dislocation of the patellar polyethylene (red arrows).

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The choice to resurface the patella is a controversial topic in total joint arthroplasty.[1-8] Complications associated with not resurfacing the patella include patellofemoral joint pain and patellar maltracking, whereas complications associated with resurfacing the patella include extensor mechanism compromise and implant wear. A metal-backed, mobile-bearing patellar resurfacing implant offers the theoretical advantage of less contact force (<5 MPa) in the patellofemoral joint, theoretically reducing polyethylene wear and increasing implant longevity.[9,10] Mid- to long-term retrospective studies with a mean follow-up of 5 to 15 years demonstrated a low complication rate (range, 1.0%-2.6%) with metal-backed, mobile-bearing patellar resurfacing implants in total knee arthroplasty (TKA).[11-17]

CASE REPORT

An obese 47-year-old woman (height, 70"; weight, 118 kg; body mass index, 37.3 kg/m^2) with a history of bilateral knee pain reported continued diffuse, aching, and sharp pain in her left knee. She underwent a previous arthroscopy with chondroplasy of the patella and trochlea, microfracture of a 2.5×2.5-cm trochlear lesion, and lateral release of the left knee 3 years previously. The remainder of her knee had no substantive degenerative changes in the medial or lateral compartments at arthroscopy. Her pain was progressive throughout the day and was exacerbated by prolonged standing, stair-climbing, entering and exiting cars, and donning and removing her shoes. Nonsteroidal anti-inflammatory drugs provided no durable pain relief.

On examination, her left knee had well-healed arthroscopy portal scars and a 2+ knee effusion. She was tender to palpation medially and had positive patellar blot, grind, and apprehension signs. Range of motion (ROM) was 0° to 130º, and she had no ligamentous instability. Radiographs were consistent with patellofemoral arthritis of the left knee with lateral patellofemoral joint space narrowing, bony sclerosis of the patella and trochlea, and diffuse osteophyte formation.

Based on clinical and radiographic assessment and the previous arthroscopic findings, the patient underwent patellofemoral joint arthroplasty. After appropriate milling and patellar preparation, a small left-inset trochlear low-contact stress (LCS) Complete Knee System (DePuy, Warsaw, Indiana) was cemented into the trochlear groove, and a standard metal 3-pegged LCS Complete Knee System mobile-bearing patellar component (DePuy) was fit to the cut and prepared underside of the patella (Figures 1A, B). After confirming that the patellar tracking was optimal, the left knee was closed without incident.

The patient's course was complicated by a delay in wound healing, which necessitated revision of her scar 2 months postoperatively. Her infectious workup and intraoperative cultures remain negative to date.

After recovery, the patient had complete resolution of her symptoms and returned to her normal activities of daily living. She returned to the clinic with sharp pain in her left knee while rising from a chair 10 days prior to 3-year follow-up. She was unable to flex her left knee more than a few degrees and had instability about the knee when ambulating with a cane.

Examination of her left knee revealed a well-healed midline surgical incision and no knee effusion. No palpable defect was present in the patellar or quadriceps tendons, but she reported pain at the distal extent of the patella and down the patellar tendon. Knee ROM was 0° to 110°, with no obvious crepitance. Active knee extension was 4−/5. Prior to obtaining radiographs, the differential diagnosis included patella fracture, patellar tendon rupture, quadriceps tendon rupture, loosening of the trochlear component, loosening of the patellar component, and patellar polyethylene spinout.

Lateral radiographs revealed no patella alta, as indicated by an Insall ratio of 1.0. In addition, no appreciable knee effusion existed. Lateral and merchant radiographs showed no fracture, loosening, or metal component dislocation.[18] Significant narrowing of the patellofemoral joint space was present compared with previous postoperative images, consistent with possible

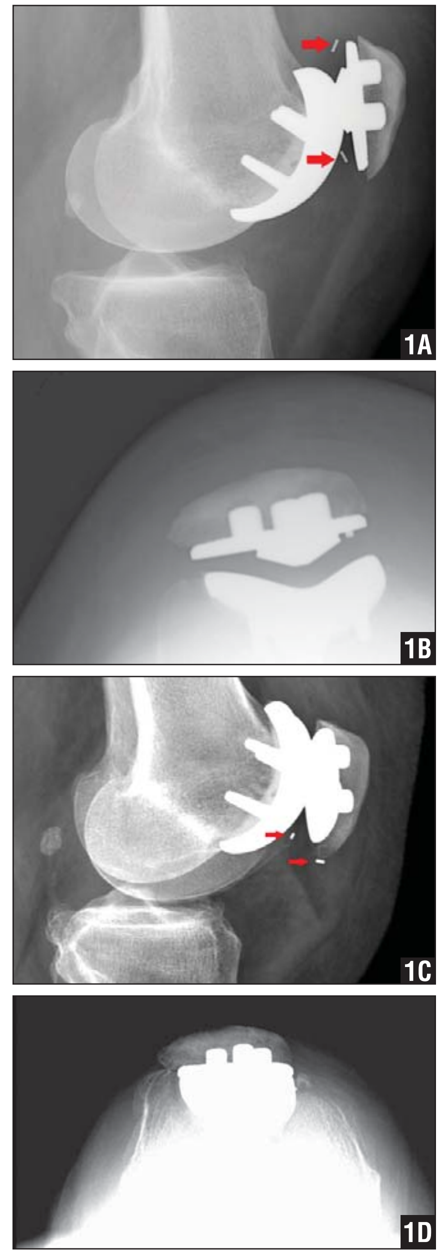

Figure 1: Lateral (A) and merchant (B) radiographs of the left knee showing the polyethylene in the trochlea and on the metal post (red arrows). Lateral (C) and merchant (D) radiographs of the left knee showing the polyethylene dislocated (red arrows). Anterior tenting of the patellar tendon by the dislocated polyethylene is demonstrated.

metal-on-metal articulation. The inferior translation of the radiopaque markers of the polyethylene component, when compared with previous radiographs (Figures 1A, B), indicated probable spinout of the polyethylene from the metal backing (Figures 1C, D). In addition, the dislocated polyethylene was tenting the patellar tendon anteriorly.

Based on physical examination and radiographs, patellar tendon rupture, quadriceps tendon rupture, and patella fracture were unlikely. Polyethylene spinout was diagnosed.[17] We recommended revision patellofemoral joint arthoplasty with an initial knee arthroscopy to rule out adjacent chondromalacia or meniscal pathology and possible conversion to TKA if severe tibiofemoral arthritis was identified.

At arthroscopy, grade II changes to the medial and lateral femoral condyles and intact medial and lateral menisci were evident. We proceeded with revision patellofemoral joint arthroplasty. A median parapatellar arthrotomy was performed, and the patella was everted, revealing the dislocated patellar polyethylene with an exposed central peg of the well-fixed metal-backed patellar component. The dislocated polyethylene component was encased in fibrous scar tissue (Figure 2). After removing the scar tissue and extracting the dislocated patellar polyethylene, the 3-pegged metal-backed patellar component was removed using a reciprocating saw and stacked osteotomes to preserve patellar bone stock. After removing the metal-backed patellar component, 14 mm of intact patella remained. We revised the entire patellofemoral system to avoid potential kinematic conflict created by mixing implant systems.

We resurfaced the patella with a standard size 32, 8.5-mm-thick All-Poly Patellar Component (Zimmer, Warsaw, Indiana). After the trochlear component was removed, the anterior cut was refreshed. The milling guide was then placed on the anterior surface of the femur and referenced off the distal aspect of the trochlear notch or the predicted position of the distal aspect of the trochlea in case of bone loss from the previous implant removal. The milling was performed to allow a stable platform for the NexGen Complete Knee Solution trochlear implant (Zimmer). Both implants were then cemented in place with a standard cementation technique.

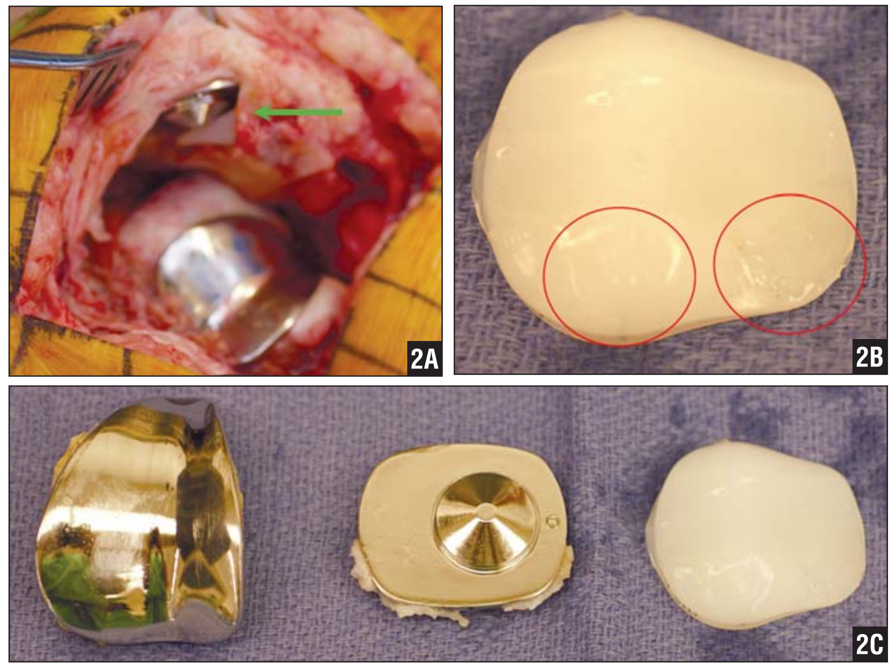

Figure 2: Photographs of the dislocated patellar polyethylene covered in fibrotic tissue (green arrow) (A). Dislocated polyethylene showing wear (red circles) (B). Removed trochlear and metal-backed and polyethylene patellar components (C).

Discussion

Three studies currently report patellar polyethylene spinout as a complication of metal-backed, mobile-bearing patellar resurfacing in TKA or patellofemoral joint arthroplasty. A retrospective evaluation published in 2001 evaluated 235 metal-backed, mobile-bearing patellar-resurfacing implants in TKA followed-up for a mean of 4 years and showed high patient satisfaction, with 93% of patients reporting good to excellent results. However, 7 (3%) required revision of the metal-backed, mobile-bearing patella. Of these 7 revisions, 2 (0.85%) were attributed to polyethylene spinout.[19]

A multicenter outcomes study evaluating 2838 metal-backed, mobile-bearing patellar-resurfacing implants in TKA demonstrated 30 (1.1%) patella-related complications and a 98.5% survival rate at 15 years. Of 30 patella-related complications, 5 (0.18%) were due to polyethylene spinout.[2]

Witjes et al[20] reported spinout in 2 low-contact stress, high-congruity, mobile-bearing patellofemoral arthroplasties. The first patellofemoral joint arthroplasty was performed on a 33-year-old woman with an initial patellofemoral joint arthroplasty and tibial tubercle transposition for patella alta and grade II changes to the patellar cartilage by arthroscopy with worsening anterior knee pain after a motor vehicle accident. Three years after the index procedure, she had sudden-onset knee pain, grinding of the patellofemoral joint on physical examination, and radiographs consistent with patellar polyethylene dislocation. The second patellofemoral joint arthroplasty was performed on a 43-year-old woman with a 25-year history of anterior knee pain, isolated patellofemoral joint arthritis on radiographs, and a mobile patella alta that underwent initial patellofemoral joint arthroplasty and tibial tubercle transposition. Two years after the index procedure, she had the sensation of persistent subluxation, and radiographs revealed dislocation of the patellar polyethylene.[20] These studies exclusively used the LCS metal-backed mobile-bearing patellar resurfacing implant (DePuy).[1,19,20]

The success of patellofemoral joint arthroplasty depends on the sagittal radius of curvature, proximal extent, and patellar constraint of the trochlear component.[21] Inset trochlear components that attempt to match the area of resected trochlea, like the LCS, have an obtuse sagittal curvature, making alignment of the component with the anterior femoral cortex and articular margin difficult, resulting in trochlear component flexion or anterior translation.[22-29] In addition, inset trochlear components do not extend proximally to the articular margin of the trochlea, resulting in articulation of the patellar implant with the native cartilage prior to transitioning to the trochlear component, especially in highly constrained articulations like the LCS.[21] These design flaws result in the patella snapping or catching on the trochlear component during the first 30° of flexion.[27]

In our case, significant polyethylene wear occurred on the proximal edge, suggesting mechanical wear during flexion that could have resulted in the eventual levering of the polyethylene off the metal back.

In addition, rotating the polyethylene >30° to 35° with respect to the metal backing causes the polyethylene to jump the metal peg on the fixed metal base plate. Malrotation of the base plate typically occurs during patellar preparation if the transverse axis of the patella is not reproduced after it is everted. The patellar template should be angled approximately 20° distal to the joint line to ensure that the patellar template and the reduced patellar implant reproduce the original transverse axis of the patella.[14] Any mechanical disturbance as a result of known design flaws may exacerbate the rotation of the patella and increase its chances of spinout.

However, our experience with mobile-bearing TKA suggests that patient-related factors, such as body habitus, extensor dysfunction, hamstring spasm, posterolateral release, soft tissue laxity, and work status, may also contribute to implant dislocation.[19,30] Should patellar spinout occur, polyethylene replacement is not sufficient to correct the problem. Revision of the patellar and trochlear components are required because it remains unclear whether failure is secondary to patellar or trochlear design deficiencies.[14,21] If insufficient patellar thickness for revision exists, the patella can be left unresurfaced, or patellectomy may be used as a salvage procedure.[14] We have reservations about using this type of implant in the future, particularly with the excellent results available with all-polyethylene patellar components used with less constrained trochlear designs. Ultimately, this articulation may be too congruent to resist the various forces in the patellofemoral joint, particularly in patients who are obese. The patellar rotation allowed by this articulation may not be sufficient for all patients.

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