CASE REPORT

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Case Report on Painful Patellar Crepitation Following a Knee Replacement with Preserved Patella

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Abstract

Patellar clunk crepitation is a well-known complication following knee replacement surgery and is associated with posterior stabilized knee replacement surgery and surgical technique. Currently, patellar clunk or crepitation management following knee replacement surgery with preserved patella remains unclear. The purpose of this case report is to discuss whether patellar clunk or crepitation management should include debridement with patellar resurfacing or debridement alone. This case describes a patellar crepitation after knee replacement surgery with the preserved patella. The surgery went uneventfully using the standard medial parapatellar approach. However, the patient was still unsatisfied with the chronic left knee pain (>3 months) and crepitation that developed following the surgery, and the patient was diagnosed with patellar clunk and crepitation (PCC). A patellar resurfacing procedure was performed with a satisfactory clinical outcome. Replicating the original joint line level and placing the tibial component posteriorly play a pivotal role in preventing PCC. Debridement and patellar resurfacing procedures are recommended in this type of case to overcome the valgus knee alignment and the placement of the tibial component.

Keywords: Clunk, crepitation, debridement, knee arthroplasty, knee replacement, patellar resurfacing

Introduction

Knee replacement surgery is one of the most common treatments for advanced knee osteoarthritis, with more than 80% satisfaction.[1] Patellar clunk crepitation (PCC) is a well-known complication following knee replacement surgery and is associated with posterior stabilized knee replacement surgery and surgical technique.

PCC is caused by peripatellar fibrous tissue formation described by crepitation or catching sensation on the knee when moving, especially from flexion to extension.[2] However, it has various manifestations ranging from painless catching of the knee to anterior knee pain, caused by the locked knee when it moves from full flexion to extension.[3] The incidence of PCC was about 1.8% in total knee arthroplasty with fixed-bearing tibial tray.[3] Nodule or scar tissue formation under the tendon of the quadriceps or at the top/superior pole of the patella has been considered the cause of PCC.[4,5]

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Crepitation may result from fibrous nodule entrapment at the intercondylar area of the femoral component. This fibro-synovial proliferation and entrapment are caused by increased contact forces between the superior aspect of the intercondylar box and the quadriceps tendon. Increased contact forces are associated with the small patellar component, thin patellar composite, short patellar tendon, and increased femoral condylar posterior offset.[6]

Fibrosynovial cell adapts to physical trauma (increased contact forces) by increasing cell proliferation, thus increasing its' number (hyperplasia) to avoid degeneration or death.[7] These fibrous tissues, when examined microscopically, show distinguishable polypoid hypertrophy and hyperplasia with some alternating focusses of fibrosis and synovial hyperplasia. In addition, there are diffuse neovascularization and mild lymphocytic infiltration without extensive collections and germinal center. There is also frequent hyalinization of the collagen and foreign-body giant cells.[8]

There are several knee prostheses designs. These designs can be grouped as unconstrained and constrained based on the stabilizing ability. The unconstrained designs, such as posterior-

cruciate retaining (CR) and posterior-cruciate substituting (PS), do not contribute to medial-lateral stability since there is no engagement to the cutting box. The PS design requires PCL resection. It is used in patients with a more severe deformity, PCL tear, or any inflammatory arthritis that leads to PCL rupture. PS design is also preferred for fixed flexion contracture of more than 20 degrees since it is easier to achieve symmetric flexion and extension gaps when the PCL is resected.[9]

Some features of the PS design cause irritate the quadriceps tendon. First, the notch portion of the femur is extended more proximally compared to the CR design. Second, the PS design requires a large cutting box. These features may irritate the quadriceps tendon during knee extension and flexion, and therefore PCC more often develops in the knee with a PS implant.[10] The first generation of PS implant designs has a high transition zone/intercondylar box ratio (intercondylar box height vs. the anterior-posterior height of the femoral component). A high intercondylar box ratio results in earlier contacts of the distal quadriceps tendon to the anterior edge of the intercondylar box during flexion (compared with the designs with a lower ratio), thus causing quadriceps tendon irritation. The 2nd and 3rd generations of PS femoral components have been improved by lowering the intercondylar box ratio. Designs with a ratio <0.7 are associated with a lower incidence of patellar clunk.[6]

Previous studies showed that PCC was primarily diagnosed by clinical findings and occasionally via ultrasound and magnetic resonance imaging (MRI) imaging.[1] Sonographic confirmation of PCC can be made by visualizing the fibrous nodule and redemonstrating the clunk during knee movement. MRI may be utilized to assess PCC with a particular technique that shows a soft tissue lesion in the sagittal and axial view proximal to the patella.[11,12]

PCC can be treated with arthroscopic or open fibrous nodule excision. In addition, patellar maltracking/malposition should also be prevented to prevent further formation of the fibrous nodule and the development of anterior knee pain. Early in the knee replacement design, the patella is retained and results in high anterior knee pain incidences. After knee resurfacing is introduced, this complication is reduced, but other complications, such as patella fracture, avascular necrosis, and patella implant failure, appear. Later studies indicate that knee replacement with patella resurfacing improves long-term patient satisfaction and function, with reduced reoperation rate and crepitation after surgery and increased Knee Society Score and Function Score.[2] Nevertheless, patella resurfacing in knee replacement remains debatable, and many surgeons still preserve the patella, especially in the Asian population and female patients with a thin patella and lower Outerbridge score, as it may cause patellar fractures.[13–15]

There is no clear guideline for choosing debridement with patellar resurfacing or debridement alone (preserving the patella) to treat PCC. The purpose of this case report is to present a case of PCC that developed after a knee replacement and to discuss the options of only debridement with patellar resurfacing.

Case

A 63-year-old woman presented to an orthopedic clinic with a history of primary left knee replacement with preserved patella 12 months ago. Knee replacement surgery was performed due to painful, disabling left knee osteoarthritis. The surgery went uneventfully using the standard medial parapatellar approach. The prosthetic used was IRENE Diamond TKR PS (China), with a 10mm polyethylene tibial insert. No debridement and patellar denervation with electrocautery were done during the surgery. Physical exercises such as weight-bearing, knee muscle mobilization, and muscle-strengthening were started one day after the surgery.

Since five months after the surgery, she experienced chronic left knee pain, particularly on the anterior side of the knee. The patient characterized the pain as throbbing without any radiation to the lower extremity. The pain was worsened by walking and prolonged standing. She also reported crepitation in the left knee as the knee moves from flexion to extension. She denied any symptoms of fever, nausea, or vomiting. The patient routinely underwent physical therapy to alleviate the pain since she had had her knee replacement surgery. However, she was unsatisfied and was on crutches to aid walking. She consumes painkillers and rarely takes meloxicam, only when needed. The patient has type 2 diabetes mellitus with a well-controlled glucose level and hemoglobin A1c (HbA1c). She takes metformin daily for her type 2 diabetes.

The physical examination showed no deformity on the left knee and inflammation signs such as swelling, warmth, or redness. Mild

Figure 1 Knee Radiographs Examination Before Knee Replacement
(A) Erect Anteroposterior view; (B) Lateral view

left knee effusion and remarkable patellar grind pain were noted. The neurovascular examination was normal. The range of motion of the left knee was from 0° to 90° with pain. The laboratory test result was unremarkable. A knee radiograph was obtained (shown in Figure. 2A-C). CT-Scan was not performed due to financial problems.

Several radiographic measurements were carried out to assess implant malposition as the possible cause of PCC (Table). The joint line measurement using the lateral view method.

Since conservative management had been unable to rectify the patient's complaint, she underwent her second surgery 12 months after the first surgery. The surgeon performed a medial parapatellar approach to the left knee along with a subarachnoid block. Arthrotomy was performed, and the fibrous tissue was found on the superior pole of the patella. In addition, the patellar cartilage has shown Outterbridge 2 degeneration (Figure 3).

The fibrous tissue was excised completely.

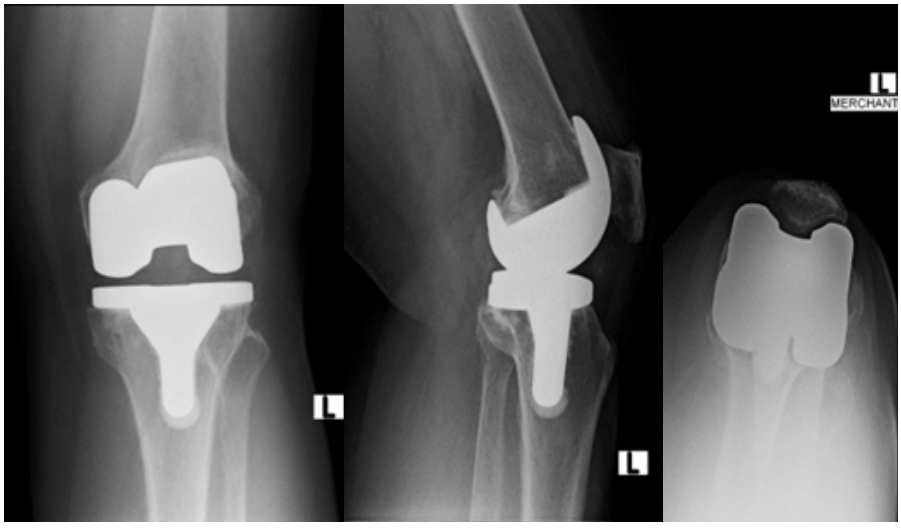

Figure 2 Knee Radiographs Examination Before the Patellar Resurfacing Procedure.
(A) Erect Anteroposterior view; (B) Lateral view; (C) Merchant view

Table Radiographic Measurements Between Preoperative Knee Replacement and Postoperative Knee Replacement Without Patellar Resurfacing Procedure

Radiographic Measurements	Preoperative Knee Replacement without Patellar Resurfacing	Postoperative Knee Replacement without Patellar Resurfacing
Blackburne-Peel Ratio	1.13	0.94
Patellar Tendon Length (mm)	53.54	52.86
Femoral Component Flex (°)	N/A**	1.74
Posterior Tibial Slope (°)	N/A**	1.45
Joint line (mm)	34.14	36.32
Tibiofemoral Angle (°)	0.80	6.70 (Valgus)
Patellar Tilt (°)	None	4.32

N/A** = not available

Thereafter, patellar resurfacing was performed with a 38 mm diameter implant. The patellar tracking was assessed using the 'no touch' technique and did not show patellar mal-tracking. The range of motion was full intraoperatively. Post-operative radiograph examination was obtained following the patellar resurfacing procedure (shown in Figure 4A-B). Early full weight-bearing and muscle-strengthening exercises were started after the surgery.

Before the resurfacing procedure, the Knee score was 21, and the functional score was 48. One month after the resurfacing procedure, while the patient was still in progress on the physiotherapy program, the patient still felt the pain from the incision; however, the patient already noticed no more crepitation. A six-month follow-up showed that the patient reported significant improvement in pain relief with a Knee Score of 75 and a Functional score of 65 (Knee Society Score). The patient still uses an assistive cane to walk, with minimal limping. On physical examination, neither patellar grind nor crepitation was noted, and the left knee range of motion showed improvement (0-120°). The participant consented to submit this case report, including all data and images. Despite having two procedures, the resurfacing procedure significantly relieves the pain, and the patient is satisfied with the outcome.

Discussion

Anterior knee pain after a total knee replacement may be caused by patellofemoral maltracking,

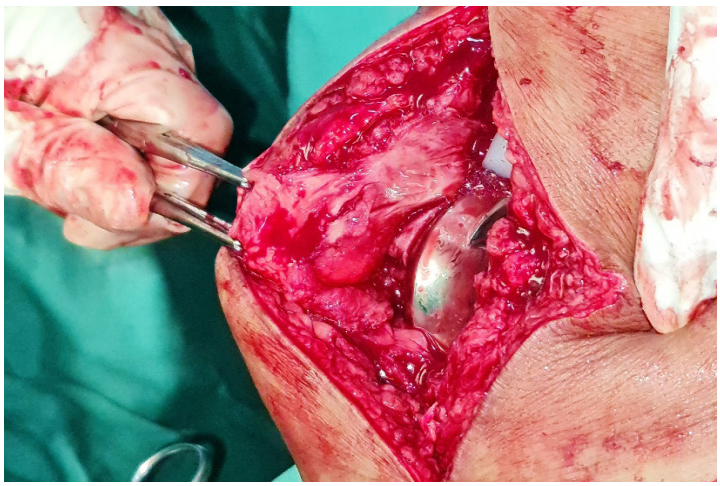

Figure 3 Fibrous Tissue on the Superior Pole of the Patella

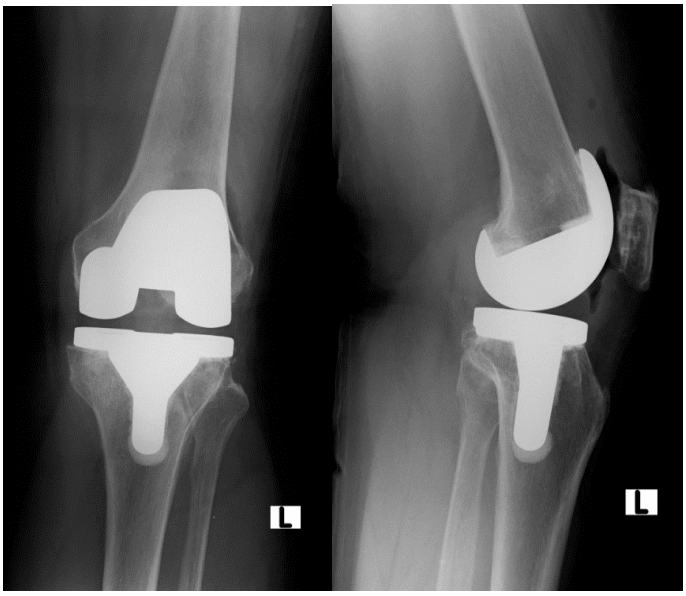

Figure 4 Knee Radiographs Examination Following Patellar Resurfacing Procedure
(A) Erect Anteroposterior view; (B) Lateral view

patella baja, offset errors of the femoral component, rotational error of the femoral or tibial component, tibiofemoral instability, patellar fracture, patellar clunk, and synovial hyperplasia.[12] Clunk or crepitation is determined by the shape of the fibrous tissue or nodule. In patellofemoral crepitation (without clunk), fibro-synovial hyperplasia still occurred. Still, a discrete fibrous nodule does not develop, and the clinical manifestation is only anterior knee pain with a grinding sensation when the knee is loaded at 30-60 degrees.[16,17] The patient was diagnosed clinically with PCC due to anterior knee pain, crepitation as the knee extends, positive patellar grind test, and exclusion of prosthetic joint infection.

Before the resurfacing procedure, an X-ray radiograph was taken. The radiographic implant measurements showed no malposition and tolerable joint elevation. A patellate tilt of 4.32 degrees was present but patella lateralization, tilting of the patella, or a lateral osteophyte was not found from merchant view, no patellar fracture was found, the Blackburne peel ratio was 0.94 (no patella baja), Radiographic implant measurements showed tibial component laid precisely at the anterior border of the tibia, valgus alignment was noted and considered as a factor that worsens patella tracking that might be a contributor to the recurrence of PCC. The rotational error of the femoral/tibial component (which may contribute to the development of PCC by altering patellar tracking) cannot be excluded pre-operatively because we cannot attain a CT scan due to financial problems. Nevertheless, there are no intraoperative findings of any malrotation of the femoral/tibial component.

There are several risk factors and preventive measures to avoid the development of PCC. There are several design features intended to avoid PCC. Extending the trochlear groove more posteriorly and distally, and lowering the intercondylar box ratio can minimize contact between the superior part of the patella and the intercondylar box.[6] Tibial tray placement at the neutral or posterior position also minimalizes the risk of various patellar complications. During knee flexion, the patella will contact the trochlear groove. The stresses caused by the contact between the patella and trochlear groove will also intensify and shift superiorly as the flexion progresses. It is recommended to avoid contact between un-resurfaced bone with the femoral component by placing the patellar component at the patella's most superior part but not surpassing the patella's prominent border, as it may cause quadriceps tendon irritation and PCC. Exciting excess bone tissue uncovered by the patellar component at the superior pole also prevents the development of crepitus and

clunk. Choosing thicker patellar components, performing debridement of the fibro synovial tissue, and avoiding over-resection of the patella may also help to prevent PCC development.[7] The author suggests that maintaining joint line level, TFA neutral alignment, patellar tracking & positioning, and proper placement of the femoral & tibial component (not placing the tibial component overly anterior) may prevent the development of PCC.

Treatment of PCC depends on the patient's tolerance to the symptoms. If the only symptom is mild crepitus and unrecognizable by the patient, then no surgical treatment is needed. Physiotherapy with exercises to stretch the quadriceps and hamstrings also have good outcomes.[18] If PCC causes disabilities or disturbances in daily activities, open or arthroscopic removal of suprapatellar tissue is the main procedure to treat PCC.[19] Several studies[4,5] have shown the satisfactory result of arthroscopic debridement procedure to manage PCC. Most of the time arthroscopic fibrous nodule debridement is sufficient in typical PCC. However, if there are other peripatellar soft tissue impingements, the result is less predictable. Open debridement allows a more extensive intra-articular synovial debridement and adequate excision, including any excessive synovial tissue that may proliferate and cause PCC on the posterior aspect of the quadriceps tendon that should also be excised. Open debridement also allows patellar button revision and additional procedures when needed. Nevertheless, it has a higher risk of co-infection and extensor apparatus disruption.[20]

Open debridement was performed to explore, address, and excise the nodule that caused PCC. In this case, open debridement was preferred because the procedure was performed along with the patellar resurfacing procedure.[21] In a primary total knee replacement, patella resurfacing is not always done unlike the distal end of the femur and the proximal end of the tibia which are routinely replaced. The thickness of the patella, which is usually thinner in the Asian population, especially in females, is one of the considerations that influence the decision to resurface or not.[22] In this case, the consideration of the patellar resurfacing procedure was to improve tracking (to compensate for postoperative valgus alignment).

Patella malposition and maltracking are potential causes of PCC. Patella malposition such as post-operative Patella Baja can be caused by excessive distal femoral cut and inferior placement of the patellar component. Patella baja can be prevented by placing the patellar component as superior as possible and by avoiding excessive distal femoral resection that raises the joint line. In this case, the Blackburne peel ratio was 0.94 (no patella baja). Patella mal tracking can be attributed to inadequate soft-tissue balance or tibial/femoral component malrotation.[23] The patellofemoral contact force and lateral retinacular tension can be reduced by medialization of the patellar component.[23] Internally rotated femoral component (relative to the trans epicondylar line) or internally rotated tibial component (relative to the tibial tubercle) will cause the patella to track laterally with a higher risk for dislocation. In addition, medial translation of both the femoral and tibial components should also be prevented because it will result in lateralization of the tibial tubercle and a lateral force vector force on the patella.

Patellar tilt is one of the morphological features that is associated with patella maltracking. A study showed that the incidence of PCS increases by 1.27 for every degree increase in patellar tilt.[24] During surgery, to make sure that the patella tracks centrally without lateral tilt or subluxation, the knee's full range of motion should be tested during implant trialing and before capsular closure. The "no thumb" technique is used to assess tracking (without the surgeon having to manually reduce the patella, the medial border of the patella should make contact with the medial femoral condyle through the knee range of motion). The etiology should be identified for any patellar tilt or instability. The most likely etiologies are the imbalance of extensor mechanism soft tissues, component malposition, or anatomic abnormalities. For extensor mechanism imbalance, a lateral retinacular release can improve tracking. It significantly reduces the contact force of the patella femoral. Many patients with lateral mal-tracking have tight lateral retinacular structures, causing increased pressure at the patella-femoral joint and stress at the metallic implant-articular cartilage junction, thus causing the fibrous nodule to form at the bone-implant interface.[25]–Other methods are also available such as advancement of the vastus medialis muscle or medial retinacular via imbrication. A medial tibial tubercle transfer can be performed for severe valgus deformities. If maltracking does not resolved, revision and repositioning of the components can be done to improve rotation and tracking.

Patella resurfacing is a method that removes

the under surface of the patella and inserts a plastic surface in its place. Resurfacing the patella will aid the optimization of patella tracking by allowing the positioning of the patellar button (proximal dan medial positioning) and optimizing the thickness of the construct, to achieve better fit over the femoral flange, creating less contact with the proximal edge of the femoral box. Indications that support patellar resurfacing are valgus knee deformity, rheumatic disease, patellofemoral arthritis, and maltracking.[23]

When resurfacing was not performed, an alternative method called phalloplasty can be done to reduce the rate of PCC by reshaping and improving the congruence of the patella with the different prosthetic trochleae geometries to optimize tracking. The patellar articular cartilage is removed to reduce the patellar thickness to get the best match possible with the femoral trochlea, the facets are reshaped (mimicking a normal anatomical shape with a 130° angle between the facets). Osteophyte removal and smoothening of the fibrillated cartilage are also done. Peripheral denervation is usually also performed by electrocautery. In contrast, the traditional treatment only removes marginal osteophytes on the patellar surface.[25] A systematic review studied the role of patelloplasty in total knee arthroplasty and conclude that in terms of preoperative functional outcomes and the rate of anterior knee pain, patelloplasty is superior to traditional treatment but inferior to patella resurfacing. However, patelloplasty has fewer complications than patella resurfacing such as component failure, instability, fracture, and tendon rupture.[25,26] A study conducted by Liu et al.[27] compared patella resurfacing with a procedure similar to patelloplasty called patella reshaping (whereas only the lateral patellar facet is resected to match the trochlea) the Knee Society Pain Score, Knee Society Function Score improved in both groups with no statistically significant differences between the two. The authors prefer patellar because it preserves bone stock and is still convertible to patellar resurfacing if the anterior knee pain continues.

PCC is a rare complication following knee replacement surgery and is associated with using posterior stabilized TKR prosthesis. The author suggests that PCC treatment should include patella resurfacing to improve the patellar tracking when there is an alteration in joint line level, joint malalignment, or prosthesis malposition after the primary knee replacement. A further comparative study is needed to assess the clinical outcome between the debridement only and debridement with patellar resurfacing combined for PCC treatment following a knee replacement surgery with the preserved patella.

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