Case Report | Journal of Orthopaedic Case Reports 2023 October:13(10):Page 127-131

Erosion and Failure of the Tibial Post after Posterior-stabilized Total Knee Replacement: A Case Report

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Learning Point of the Article:

Failure of the tibial insert post in a posterior stabilized TKA design can be a chronic and non-traumatic occurrence. Patients can present with progressive instability without acute trauma. Surgeons should be aware of common and uncommon failure mechanisms, to help plan revision surgery accordingly.

Abstract

Introduction: Posterior-stabilized (PS) total knee arthroplasty (TKA) prostheses are characterized by an articulation between the polyethylene tibial post and the cam of the femoral component. Tibial post-fractures, traumatic and non-traumatic, are uncommon but catastrophic complications. We report a rare and unusual case of complete atraumatic erosion of the tibial post after PS-TKA.

Case Report: We present a case of atraumatic tibial post-failure (complete erosion) in a 73-year-old female after primary TKA. The patient presented with chronic pain, effusion, and instability both in the coronal and sagittal plane over a period of 1 year. There were no signs of component loosening on plain radiography, no fractures, and revealed medial extension laxity on valgus stress views. During revision surgery, polyethylene insert retrieval revealed a completely eroded tibial post, without any obvious fracture. There was no fractured tibial post lying freely in the joint cavity. The patient was subsequently revised with a hinged component due to gross bi-planar instability.

Conclusion: In a post-TKR (PS knee) patient with chronic pain and instability, one should consider tibial post-complications after ruling out infection. Chronic instability can cause progressive erosion of the tibial post, which can fail without an obvious fracture. Revision surgery with constrained implants may be needed to manage such cases.

Keywords: Instability, failure, polyethylene, total knee arthroplasty, revision.

Introduction

Total knee arthroplasty (TKA) is a reliable surgical option in the management of end-stage osteoarthritis of the knee. Posterior-stabilized (PS) designs are one of the most widely used prosthetic designs in TKA. The first PS prosthesis was designed by Insall and Burstein [1]. The PS-TKA design compensates for the absent PCL with a cam post-mechanism. The tibial post of the PS polyethylene insert engages the cam of the femoral component to prevent posterior subluxation of the tibia under the femur.

The intricacies that are distinctly linked to the design of PS-TKA implants encompass a range of potential complications, primarily manifested in the patellofemoral joint. These complications may manifest as the patella clunk syndrome or crepitus, both of which can impede the optimal functionality of the implant system [2]. In addition, complexities can arise in connection to the post and cam mechanism, giving rise to issues such as tibial post-wear, impingement, or even fracture, as

Access this article online

Website: www.jocr.co.in

DOI: https://doi.org/10.13107/jocr.2023.v13.i10.3962

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Submitted: 14/07/2023; Review: 29/08/2023; Accepted: Sep 2023; Published: October 2023

DOI: https://doi.org/10.13107/jocr.2023.v13.i10.3962

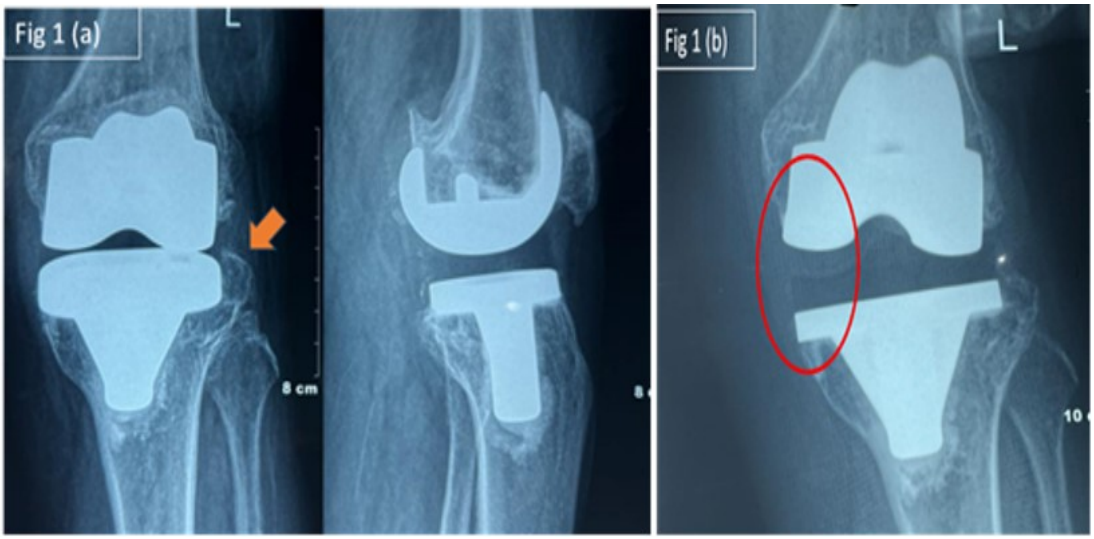

Figure 1: (a) Primary implant following total knee arthroplasty showing no component loosening/fracture, with slight valgus positioning of the tibial base plate, (b) Valgus stress test view radiograph: Demonstrates medial opening.

substantiated by reference [3]. Notably, an assortment of case reports has reported both traumatic and non-traumatic fractures of the tibial post, without any documented rate of tibial post-attrition in literature.

We present an unusual case of prosthetic failure with a completely eroded tibial post and provide a review of the literature regarding the commonly elicited causes of erosion and treatment options for such complications.

Case Report

A 73-year-old female presented to our outpatient department with a complaint of left knee pain and instability while walking, over a duration of 1 year. This patient had undergone primary TKA 5 years before presentation at a different center for primary OA of the knee. She was operated with a PS knee design (Maxx Destiknee, Meril, Vapi, India). This cemented PS prosthesis has an ODEP rating of 5B. The patient had a well-functioning joint for 4 years after the primary surgery and was ambulating without aid or pain and was able to perform all ADLs independently. 12 months before presentation, she started experiencing pain which was insidious in onset and gradually progressive and noticed instability while walking 2–3 months after the onset of pain.

Clinical examination revealed a well-healed midline scar without local signs of infection or inflammation. Clinical examination showed a knee effusion, with diffuse and mild tenderness over the anterior knee. Her knee range of motion was from −20° hyper-extension to 100° of flexion. The valgus stress test was positive (grade 2) and the anterior draw was >5 mm, suggesting instability in both the coronal and sagittal planes. She did not have any neurovascular deficit.

Plain radiographs did not reveal obvious osteolysis or component loosening. The tibial base plate showed mild valgus alignment. The tibial component appeared undersized with bone beyond the lateral edge of the baseplate (Fig. 1a). Valgus stress radiograph revealed medial extension laxity (Fig. 1b).

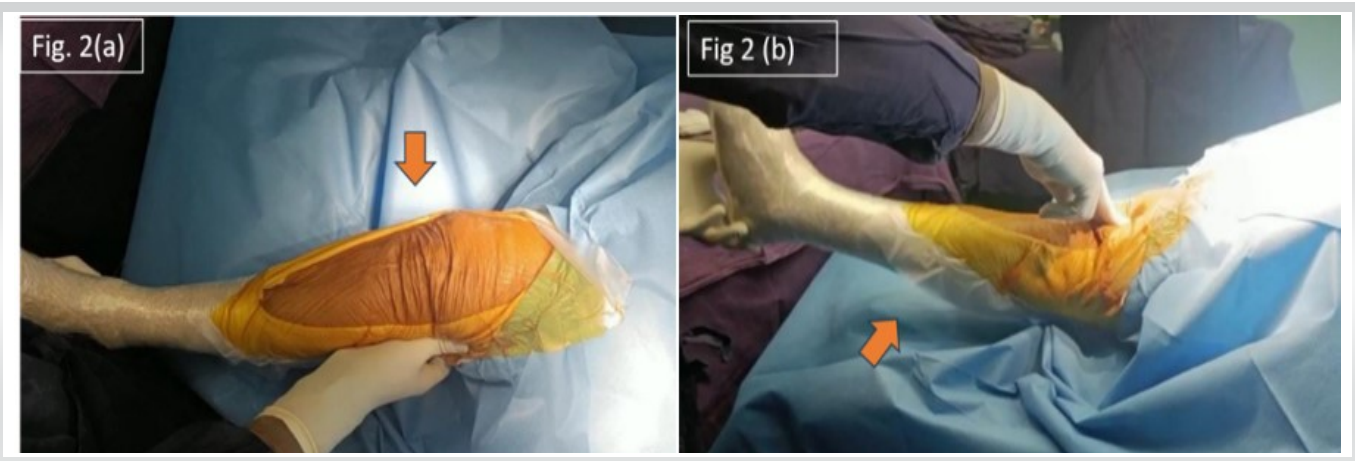

Figure 2: (a and b) Sagittal and coronal plane instability.

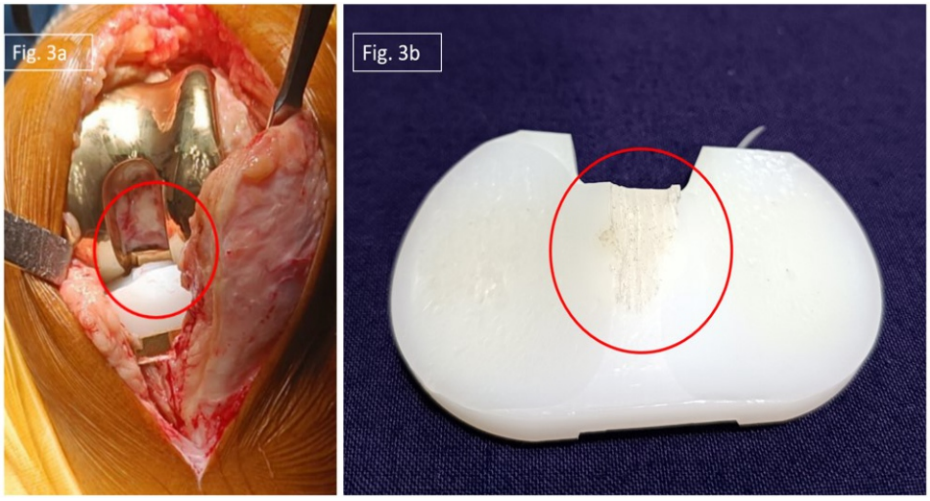

Figure 3: (a) Following arthrotomy completion, the femoral cam was visible, however, the polyethylene tibial post was missing, and was not located within the knee joint cavity. (b) Explanted tibial polyethylene showing complete delamination of the tibial post.

Figure 4: Immediate post-operative radiograph following revision surgery.

Notable laboratories on admission included a white blood count of 10 K/μL, erythrocyte sedimentation rate of 60 mm/h, and C-reactive protein of 8.3 mg/L. Considering the marginally elevated inflammatory markers and a clinically relevant knee effusion, her knee was aspirated. Synovial fluid analysis showed clear fluid with normal cell counts. The gram and acid–fast staining and routine cultures were all negative. Based on these findings and her clinical picture, the patient was advised aseptic revision surgery.

Revision surgery was carried out using a standard medial parapatellar approach. Before beginning the revision procedure, the knee recurvatum and valgus opening were assessed and demonstrated intraoperatively (Fig. 2a and b). After the completion of the arthrotomy, the polyethylene tibial post was missing and was not located within the knee joint cavity (Fig. 3a). There were no signs of infection. The polyethylene insert was removed and noted to have evidence of polyethylene wear, with clear evidence of delamination and striping in the location of the tibial post. (Fig. 3b) both the femoral and tibial components were well fixed, and the surgeon tried to address the instability with a thicker insert (17 mm maximum PS insert available). However, the knee was still lax, with an incompetent MCL. Subsequently, the decision was taken to proceed with a complete revision arthroplasty with a rotating hinge prosthesis. The surgeon implanted the DePuy (DePuy Synthes, J and J, Warsaw, USA) Noiles rotating hinge knee. The trial hinge components gave the surgeon good biplanar stability and knee ROM. The components were cemented and tourniquet deflated. The immediate post-operative X-ray is shown in (Fig. 4).

The patient was allowed to fully bear weight on the 1st post-operative day, without knee range of motion restrictions. At the most recent follow-up of 12 months, the patient is walking without pain or instability, has no wound-healing complications, and active ROM of 0–100°.

Discussion

PS prosthetic designs represent a prevailing choice for TKA. These designs incorporate a cam post-mechanism to replace the function of the posterior cruciate ligament, effectively preventing posterior subluxation of the tibia under the femur during knee flexion and promoting improved femoral rollback and knee flexion [4, 5].

Wear and failure of the tibial post have been documented in previous studies [6, 7, 8, 9, 10] (Table 1). Several causative factors have been proposed for tibial post-wear and erosion:

1. An increased posterior slope of the tibial baseplate may lead to premature and suboptimal femoral contact with the post.
2. Femoral rotation can induce edge loading on non-rounded posts and cams, thereby contributing to tibial post-failure.
3. Excessive flexion of the femoral component may result in cam post-impingement.
4. Post-cam engagement velocity and flexion engagement angle under dynamic physiological conditions also play a role in wear [11]. Severe cases have shown complete erosion of the tibial post, while another rare yet significant complication is tibial post-fracture due to wear and deformation, occurring in <1% of cases [12, 13, 14, 15].

Addressing tibial post-related complications typically necessitates case-specific treatment, often involving

Study	Year	Mode of failure	Diagnosis	Comments
Ip et al. [2]	2004	Atraumatic	Patella clunk syndrome	The IB II prosthesis (PS design) is especially prone to cause patella clunk syndrome
Jung et al. [3]	2009	Atraumatic	Tibial post-fracture	Hard mass palpable in the suprapatellar pouch
Kumar et al. [13]	2015	Atraumatic	Tibial post-fracture and polywear	Complaint of pain and swelling, locking and clicking sensation
Lim et al. [14]	2009	Traumatic	Tibial post-fracture and polywear	Pain, effusion, genu recurvatum, patella fracture, and soft endpoints on varus-valgus stress test
Bal et al. [16]	2008	Traumatic/Atraumatic	Tibial post-delamination	Excessive femoral component flexion, anterior positioning of the tibial tray, excessive posterior tibial slope, and joint line alterations of 8 mm or greater can predispose to anterior tibial post-impingement and failure
Clarke et al. [17]	2004	Traumatic	Tibial post-fracture	Calf pain, swelling, locking sensation
PS: Posterior stabilized				

Table 1: Tibial post-complications reported in literature in posterior-stabilized-total knee arthroplasty.

polyethylene liner exchange to a thicker insert [12]. Bal et al. have demonstrated promising short-term results in 18 knees following polyethylene exchange to address this issue [16]. Moreover, some researchers have noted that revising components with increased constraint to manage persistent coronal instability can yield improved short-term outcomes [13, 15, 17, 18].

As illustrated in this case report, tibial post-failure post-TKA can manifest without an overt history of trauma or falls. Such failure may arise from either traumatic or non-traumatic causes. In cases where progressive instability presents without a history of trauma, surgeons should consider the possibility of polyethylene wear-related failure. Revision surgery, involving a complete component revision as necessary, should be diligently planned, as the chronic and progressive nature of failure results in significant joint laxity that cannot be adequately addressed by polyethylene exchange alone.

Conclusion

Surgeons must be cognizant of the various prosthetic failure mechanisms that can occur after TKA. PS-TKA designs are susceptible to unique failure mechanisms, such as the disruption of the cam post-mechanism. The tibial post may fracture in acutely (traumatically) or chronically (atraumatically). The patient's clinical history can assist surgeons in diagnosing these issues. Pre-revision imaging with advanced modalities such as computed tomography (CT) or magnetic resonance imaging (MRI) can facilitate surgical planning.

Clinical Message

Surgeons should be aware of all possible prosthetic failure mechanisms after TKA. PS-TKA designs have unique failure mechanisms, including failure of the cam post-mechanism. Tibial post-failure can be acute (traumatic) or chronic (atraumatic) and obtaining a good clinical history will help guide surgeons in diagnosing these issues. Pre-revision imaging with advanced imaging modalities such as CT or MRI may be helpful in planning revision surgery.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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Conflict of Interest: Nil
Source of Support: Nil

Consent: The authors confirm that informed consent was obtained from the patient for publication of this case report

How to Cite this Article

Shah S, Mulpur P, Vecham R, Jayakumar T, Hippalgaonkar K. Erosion and Failure of the Tibial Post after Posterior-stabilized Total Knee Replacement: A Case Report. Journal of Orthopaedic Case Reports 2023 October;13(10): 127-131.