

Case Report

Trabecular metal augmentation for idiopathic avascular necrosis of the patella following non-resurfaced total knee arthroplasty

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ABSTRACT

Avascular necrosis (AVN) of the patella is an uncommon complication following non-resurfaced total knee arthroplasty (TKA) and is typically attributed to compromised blood supply during surgery. We presented a case of idiopathic patellar AVN in a 71-year-old male one year after TKA with a non-resurfaced patella. Radiographs at that time revealed patellar erosion, prompting patelloplasty with a Zimmer NexGen Trabecular Metal Augmentation Patella (Zimmer Biomet, Warsaw, Indiana). Two weeks post-operatively, the patient resumed activities of daily living with minimal pain. At nine months, radiographs showed further patellar resorption and fragmentation, though the implant remained well-aligned. The patient exhibited no extensor lag but did present with mild weakness compared to the contralateral side. This case highlights trabecular metal patellar augmentation as a viable surgical option for managing symptomatic idiopathic patellar avascular necrosis following non-resurfaced total knee arthroplasty. The procedure preserved extensor mechanism function and provided meaningful clinical improvement, underscoring its potential role in select patients with limited patellar bone stock.

Keywords: Total knee arthroplasty, Patella, Avascular necrosis, Revision arthroplasty, Trabecular metal

INTRODUCTION

Complications involving the patella account for approximately 10% of possible issues following TKA, yet patellar AVN remains rare and relatively infrequently documented in the literature.^{1,2} Potential etiologies for this condition include idiopathic, iatrogenic, or traumatic causes. However, most commonly, the cause is compromised blood supply during surgery.^{1,3,5} Preservation of the lateral genicular arteries is critical during TKA. These vessels are often disrupted during lateral retinacular (LR) release or medial approaches, which may damage other vascular supplies.^{6,7} Alternative approaches, such as sub-vastus or lateral parapatellar, have been explored but show no significant advantage in preserving patellar vascularity over the medial approach.^{7,8}

Non-resurfacing of the patella during TKA, as studied by Choi et al., may initially reduce knee pain and complications, though its benefits diminish over time.⁹ AVN is defined as the loss of vascular perfusion leading to necrosis of osteocytes and bone marrow, resulting in irreversible bone loss.⁵ It can be localized, as in unilateral patellar AVN, or systemic, affecting epiphyseal or bone marrow regions.^{10,11} Causes of osteonecrosis include direct vascular injury, intraluminal obliteration, or extraluminal compression within the bone marrow.¹⁰ Diagnosis typically relies on magnetic resonance imaging (MRI) to assess disease severity. While no specific classification currently exists for patellar AVN, some studies have referenced the Ficat and Arlet classification for femoral head AVN, often recommending surgical intervention for the more advanced stages (III and IV).^{11,12}

Treatment for patellar AVN varies based on patient presentation, radiological stage, and surgeon preference. These patients often present with anterior knee pain, which is typically managed conservatively with physiotherapy before considering surgical options, and carries with it risks such as bleeding and infection. There is a paucity of literature outlining treatment of patella avascular necrosis.

This report presented a novel case of idiopathic patellar AVN following non-resurfaced TKA, successfully managed with trabecular metal patellar arthroplasty.

CASE REPORT

A 71-year-old male presented with one week of anterior left knee pain three months post-left TKA. The initial TKA, performed with lateral facetectomy but without patellar resurfacing or LR release, was uncomplicated with minimal blood loss. A non-sterile tourniquet was applied but not inflated, and the patient received two doses of tranexamic acid intraoperatively and appropriate postoperative anticoagulation. Six weeks post-TKA, the patient ambulated without assistance, completed physical therapy, and continued home exercises. Radiographs at that time showed stable prosthesis alignment, no loosening, and proper patellar alignment without tilt (Figure 1).



Figure 1: (A) AP, (B) lateral, and (C) sunrise radiographs six weeks post-operatively after total knee arthroplasty.

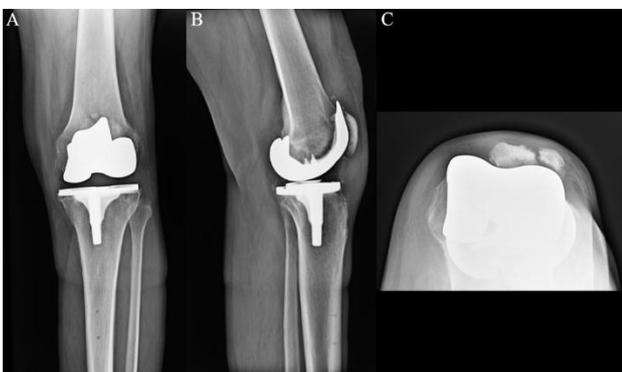


Figure 2: (A) AP, (B) lateral, and (C) sunrise radiographs one year post-operatively after total knee arthroplasty.

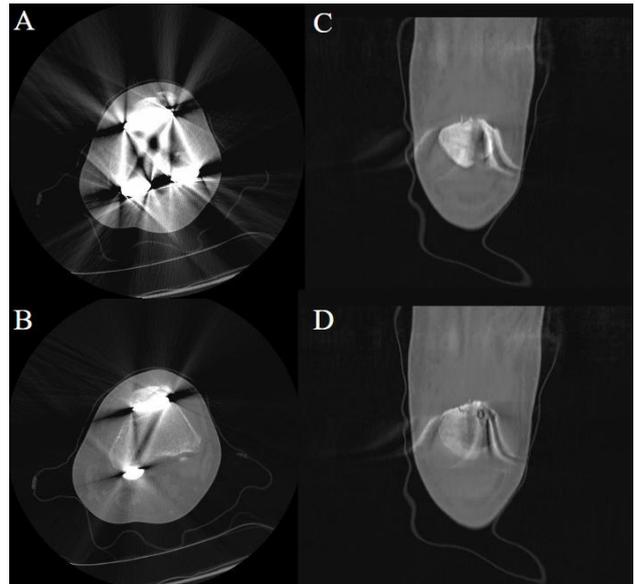


Figure 3: (A, B) Axial and (C, D) coronal computed tomography obtained at seven months post-operatively after total knee arthroplasty.

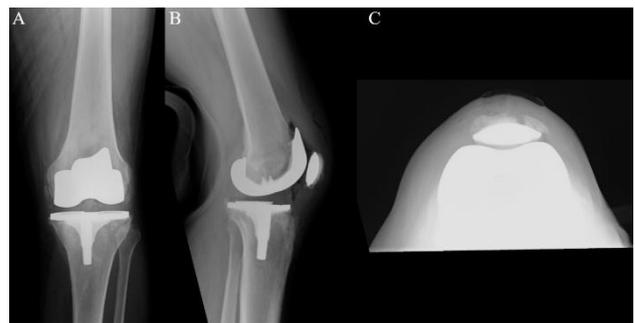


Figure 4: (A) AP, (B) lateral, and (C) sunrise radiographs obtained immediately after patelloplasty.

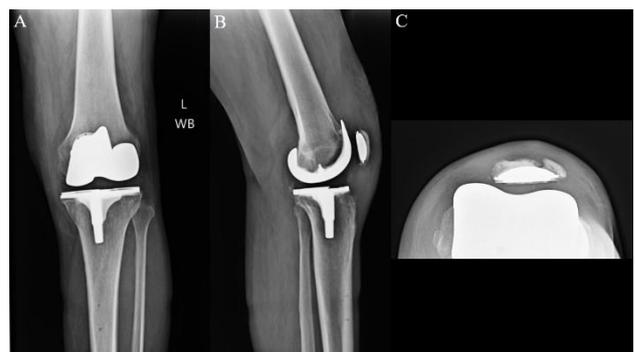


Figure 5: (A) AP, (B) lateral, and (C) sunrise radiographs six weeks post-operatively after patelloplasty.

At three months post-TKA, the patient reported anterior knee pain with increased activity and prolonged ambulation. By seven months, he described worsening pain and a sense of discomfort compared to his prior contralateral TKA. A CT scan confirmed appropriate

femoral and tibial implant positioning with no appreciated acute abnormalities. The patient continued with conservative management. At one year, persistent pain prompted repeat radiographs, which revealed patellar erosion and a vertical fracture of the lateral facet (Figure 2). Retrospective review of the seven-month CT showed early signs of these changes; however, this is limited by metal artifact (Figure 3). An infectious workup, including labs and knee aspirate, was negative. Due to ongoing pain unresponsive to conservative management and progressive radiographic osteonecrosis of the patella, surgical intervention was planned.



Figure 6: (A) AP, (B) lateral, and (C) sunrise radiographs five months post-operatively after patelloplasty.

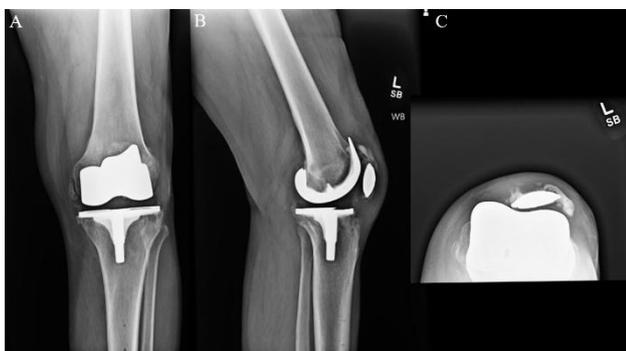


Figure 7: (A) AP, (B) lateral, and (C) sunrise radiographs nine months post-operatively after patelloplasty.

Fifteen months after the initial TKA, the patient underwent patellar arthroplasty. The prior incision was utilized, with scar excision, followed by a medial parapatellar arthrotomy. The patella was mobilized, everted, and cleared of synovitis and marginal osteophytes. Fragmentation of the patella was noted. A Zimmer NexGen trabecular metal augmentation patella was sized, and the bony surface was reamed to optimize implant contact. The trial implant was sutured in place, and dynamic patellar tracking confirmed appropriate positioning. Over 50% of the native patellar bone contacted the implant, negating the need for bone grafting. Antibiotic cement secured the trabecular metal implant, which was further stabilized with non-absorbable braided

sutures through peripheral drill holes. After cement polymerization, range of motion (ROM) testing verified patellar stability and tracking. The surgical site was irrigated with Irrisept (Irrimax, Lawrenceville, Georgia), and the arthrotomy was closed with Vicryl and barbed sutures, followed by layered skin closure. Postoperative AP, lateral, and sunrise radiographs confirmed appropriate implant positioning within the trochlear groove without tilt (Figure 4). The patient was allowed to weight-bear as tolerated without ROM restrictions and was discharged home the same day.

Two weeks post-patelloplasty, the patient reported reduced pain, independent ambulation, and return to activities of daily living. At six weeks, ROM improved to 0-100 degrees, with radiographs showing stable implant alignment (Figure 5). By five months, intermittent anterior knee pain persisted, though overall improvement was noted. The patient admitted to inconsistent home exercises. Radiographs revealed some bony resorption (Figure 6). At nine months, intermittent pain continued, with unchanged ROM (0-100 degrees). Physical examination showed no extensor lag but mild weakness compared to the contralateral side. Radiographs demonstrated the implant remained within the trochlea; however, continued progressive osteonecrosis with increased patellar fragmentation, resorption, tilt, and lateral translation was noted (Figure 7). Femoral and tibial components showed no changes. Given the patient's improved functional status and minimal pain, the radiographic findings were deemed clinically insignificant. Follow-up was scheduled for one year.

DISCUSSION

This case described a 71-year-old male with idiopathic patellar AVN following non-resurfaced TKA, presenting with significant anterior knee pain that failed conservative management. Patellar arthroplasty with trabecular metal augmentation successfully restored function with minimal discomfort. The intact extensor mechanism post-index TKA was preserved, but progressive AVN necessitated surgical intervention.

Patellar AVN is a rare and challenging complication following TKA, often linked to vascular compromise during surgery, particularly with LR release, which increases ischemia risk as demonstrated by Subramanyam et al. using bone scintigraphy.¹⁹ In this case, lateral facetectomy during the index TKA, despite careful soft tissue protection, may have contributed to AVN.^{6,7}

Our patient had persistent pain warranting the need for surgical intervention. They lacked identifiable risk factors including corticosteroid use, excessive alcohol consumption, or systemic diseases, which suppoa likely idiopathic etiology.¹⁻⁴ AVN developed despite preservation of the lateral genicular arteries during the index TKA. Their preservation minimized vascular

compromise pointing to the complexity of the disease pathogenesis.^{6,7}

Treatment options for patellar AVN range from conservative to surgical, depending on symptom severity, radiological findings, and surgeon preference. Conservative management, including physiotherapy and activity modification, is often the first line of treatment for anterior knee pain, as it avoids surgical risks such as bleeding and infection.^{1,2} However, persistent pain or radiographic evidence displaying progressive osteonecrosis merits surgical intervention. Common options include patelloplasty, patellectomy, bone grafting, and trabecular metal augmentation; each of which has its own distinct advantages and limitations.^{13-17,22}

A Patelloplasty involves reshaping the patella to improve its congruence with the femoral component and tends to be a less invasive option. However, it often yields suboptimal outcomes due to persistent pain or inadequate restoration of the extensor mechanism.^{2,14} Patellectomy, the complete removal of the patella, is reserved for severe cases in which there is extensive bone loss or irreparable damage. However, it is associated with significant functional deficits, including both quadriceps weakness and extensor lag, thus making it less favorable.^{1,15} Bone grafting, as described by Ries et al., can be used to address patellar bone deficiency, particularly in cases where residual bone stock is found to be inadequate (<50%) for implant fixation.¹³ While it may prove effective in some cases, bone grafting carries with it the risks of graft resorption and non-union, which may potentially lead to implant failure.¹⁴

In contrast, trabecular metal augmentation offers a robust solution for managing cases of patellar AVN with significant bone loss. Even in the presence of deficient bone stock, the Zimmer NexGen Trabecular Metal Augmentation Patella leverages the porous tantalum structure to promote bone ingrowth and stable fixation.^{13,15,16} Nelson et al and Tigani et al have reported successful outcomes with trabecular metal implants in revision TKA, highlighting their ability to restore the extensor mechanism and minimize patellofemoral joint overstuffing.^{15,16} In our case, the implant was secured with antibiotic cement and non-absorbable sutures, achieving over 50% native bone contact, which Ries et al. note is critical to prevent loosening.¹³ Despite these advantages, our patient exhibited progressive resorption and fragmentation at nine months. This suggests that bone grafting or alternative suture techniques could further enhance long-term stability in similar cases.¹⁴

Emerging techniques such as patellar subchondroplasty, in which calcium phosphate is injected into the subchondral bone defects to stabilize the bone and reduce pain, have also been explored for managing pathology involving the patella and have been found to have favorable outcomes. While the technique may be promising for early stages of the disease, subchondroplasty may be less effective in

advanced AVN with significant bone loss and fragmentation. As seen in our patient, trabecular metal augmentation can be more appropriate in scenarios with more extensive patellar erosion and fragmentation.²²

Compared to other surgical options, trabecular metal augmentation balances the need for stable fixation with preservation of functional anatomy. Unlike patellectomy, it maintains the extensor mechanism, and unlike patelloplasty, it addresses significant bone loss more effectively.^{1,2,15} Bone grafting, while viable, may not provide the same immediate stability as trabecular metal, particularly in cases with ongoing osteonecrosis.^{13,14} Subchondroplasty, though less invasive, is better suited for less severe cases.²² The choice of trabecular metal augmentation in this case was driven by the need for durable fixation and the patient's persistent symptoms, which were not adequately addressed by conservative measures.

Despite the success of trabecular metal augmentation in restoring function, the progressive resorption observed at nine months underscores the need for vigilant follow-up. Kloiber et al. emphasize the importance of monitoring for implant loosening in cases of patellar bone deficiency, as inadequate bone stock can lead to failure rates approaching 100%.¹⁷ Future strategies may involve combining trabecular metal implants with bone grafting or advanced suture techniques to mitigate resorption risks, particularly in cases where ongoing osteonecrosis may persist.^{13,14}

CONCLUSION

Patellar AVN following non-resurfaced TKA is a rare but significant complication. Surgeons should be vigilant for its occurrence, as maintaining an intact extensor mechanism is critical for patient function. Trabecular metal patellar arthroplasty offers a reliable treatment option with favorable outcomes, as demonstrated in this case. Awareness of this complication and its management may guide future treatment strategies.

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