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Early failure of all polyethylene tibial components in bilateral total knee arthroplasty: A case report

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Abstract
Introduction: Outcomes of Total Knee Arthroplasty (TKA) performed with modern all polyethylene (AP) tibial components have been reported to be comparable with or better than those TKAs performed using metal-backed modular (MBM) tibial components in several medium and long term studies. As AP components also provide substantial cost savings, there has been increase in their use in primary TKA. In spite of such good results, failure of AP tibial components has been reported.
Case Presentation: A sixty three year old lady operated for bilateral cruciate retaining PFC Sigma TKA utilizing AP tibial components without patellar resurfacing in 2011 presented to us in December 2014 with two-year history of severe pain in both knees and inability to walk or stand. She had marked varus deformity of both knees. Radiological examination revealed fracture of the medial tibial plateau with failure of AP tibial component and marked varus deformity. She was treated with bilateral staged revision TKA which resulted in a satisfactory outcome.
Conclusion: This case report describes previously unreported complication of AP tibial component following cruciate retaining bilateral AP tibia PFC Sigma TKA in a patient of varus osteoarthritis of knee joint. Early collapse of medial tibial plateau leading to failure of bilateral TKA, which could be attributed to under correction of varus deformity and instability, was managed with bilateral revision TKA using tibial metaphyseal sleeves which led to a very satisfactory outcome and excellent five year follow up.

Keywords: Varus osteoarthritis of knee, all polyethylene tibial component, Failure of All polyethylene tibial component, Revision Total Knee Replacement, Tibial Metaphyseal sleeve, Case Report

Introduction
Long term results of Total Knee Arthroplasty (TKA) performed with all polyethylene (AP) tibial components have been shown to be comparable with the results of metal-backed modular (MBM) tibial components in several studies. Over and above avoidance of backside wear and providing additional thickness of polyethylene with identical bone resection, AP components provide significant cost savings. Despite such excellent results, failure of AP tibial components has been reported due to various factors such as its design, severity of deformity and osteoporosis. We report five-year follow up study of bilateral revision TKA performed in a sixty three year old lady who suffered early failure of AP tibial component used in bilateral PFC Sigma TKA performed for varus osteoarthritis of knee joints. To our knowledge, such a case of bilateral failure of AP tibial component used in PFC Sigma TKA for varus osteoarthritis of knee joint has not been previously reported in the literature.

Case Presentation
A sixty three year old, otherwise fit and well, lady presented to us in December 2014 with history of undergoing bilateral staged posterior cruciate retaining TKA performed using AP tibial components without patellar resurfacing in 2011 (Left- January, Right- July). The postoperative x-rays (Figure 1) were unremarkable except fairly lateralised placement of AP tibial component on the left side. The postoperative course was uneventful after both TKA. She, however, developed increasing pain and deformity of both knees six months after the second i.e. right TKA. These symptoms progressivly deteriorated over the next few months and she was treated with braces. At the time of presentation to us(three and half years after the index surgery), she was barely able to stand because of severe pain and deformities of both knee joints. Clinical examination revealed gross medio-latereal instability in both knees with marked varus deformities. X-rays and scanogram revealed marked varus deformity and loosening of TKA components on both sides with breakage of AP tibial components and

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fracture of the medial tibial plateau along with extensive medial tibial bone loss. (Figure 2). There was no clinical evidence of generalised ligamentous laxity. A DEXA scan revealed mild osteopenia in lumbar spine with the rest of the bones showing normal bone density.

After ruling out infection (normal inflammatory markers and a sterile knee aspirate), she was operated for revision right TKA on 6 January 2015. Through the previous skin incision, an anteromedial arthrotomy was made. AP tibial component was found to be dislocated with fracture of the stem which was lying loose in the central hole. The femoral component was loose and was removed without any difficulty. After removal of the components, there was a huge defect of the medial tibial condyle measuring more than 20 mm.(Figure 3) with minimal bone loss on the femoral side A revision TKA (PFC Sigma- Depuy) was carried out using porous coated tibial metaphyseal sleeve assembled with intra medullary rod and rotating platform tibial base plate and a TC3 femoral component. Morselized femoral head allograft was packed underneath the tibial base plate medially to provide additional support and was secured in place by soft tissue sutures. (Figure 4) The postoperative course was uneventful and the patient made a satisfactory recovery.

Three months later, she was operated for a revision left TKA. Loose metallic femoral component and AP tibial component were removed without any difficulty. The tibial stem had deformed. Like on the right side, there was fracture of the medial tibial plateau with a huge defect of the medial tibial condyle measuring more than 30 mm. (Figure 5). In view of a large uncontained defect of the medial tibial plateau, a porous coated metaphyseal tibial sleeve and intra-medullary rod for tibia were used along with TC3 femoral component and necessary augments and a stem. Morselized femoral head allograft was packed underneath the tibial base plate medially.(Figure 6) She made a good post-operative recovery and regained her activities of daily living(ADL).

At five years following bilateral revision TKA, the patient is pain free and is able to walk unaided. She has 0-110 degrees of flexion in both knee joints. She is independent for her ADL. X-rays of her knee joints (Figure 7) reveal no evidence of loosening and good incorporation of metaphyseal sleeves as well as bone formation under the tibial base plate medially. In spite of bilateral patella baja, she has good range of motion without anterior knee pain. (Figure 8)

Discussion

Use of All-polyethylene (AP) tibial components in TKA has been well substantiated in the literature. Several medium and long term studies, randomized controlled trials and radiostereometric analyses have shown equivalent or better results of AP tibial components compared with metal backed modular (MBM) tibial components. Advantages of an AP component over MBM tibial component are avoidance of locking mechanism issues leading to backside wear and osteolysis, increased polyethylene thickness after identical bone resection and lower cost, whilst its disadvantages are lack of modularity thereby limiting intra-operative flexibility, no option of removal of liner in the setting of irrigation and debridement for acute infection and late liner exchange. Since its benefits outweigh its drawbacks, use of a modern AP tibial component in primary TKA can be carried out in a large number of patients with substantial cost savings across the healthcare system [1]

In a prospective, randomized, controlled trial comparing the results of AP and MBM tibial components, Gioe *et al*. [2, 3] found no difference in clinical or radiographic outcomes between the two groups at a mean of forty-nine months postoperatively and at 8-12 years(mean- 115 months) postoperatively. The ten-year survival rate of the AP component was 91.6% while that of MBM tibial component was 88.9%. In a retrospective review of eighty-one AP tibial components in fifty-nine patients followed for a mean of 8.1 years, Pagnano *et al*. [4] noted the survival rate at fourteen years to be 100% with symptomatic loosening as the end point. Ranawat *et al*. [5] in a review of the results of fifty four total knee arthroplasties performed in a relatively younger age group(less than sixty years of age) of thirty-eight patients, reported excellent clinical performance and survivorship at a mean of five years postoperatively without any radiographic evidence of component loosening, progressive radiolucent lines, or osteolysis.

Muller *et al*. [6] in prospective randomized controlled trial using radio-stereophotogrammetric analysis to compare the performance of AP with a MBM cruciate-retaining PFC-Sigma TKA for up to 24 months concluded that in an uncomplicated primary TKA, an AP PFC-Sigma tibial prosthesis showed no statistical difference in migration from that of its MBM counterpart. There was no difference in the clinical results as assessed by the SF-12, Oxford knee score, alignment or range of movement at 24 months. V. Mohan *et al*. [7], on the basis of their retrospective evaluation of 27,657 TKAs (8.3% receiving AP tibial components and 91.7% receiving MBM tibial components) of a prospectively followed cohort of primary TKA patients who underwent a primary TKA from a single implant manufacturer (Depuy) concluded that the risk of revision was approximately 49% lower in AP tibial component group than in patients with MBM tibial components at a median follow-up of 2.9 years. In these implants, the surface geometry of the tibial liner has concave portions, which are neither flat nor completely conforming, to accept the femoral bearing surface.

Though high success rates of AP tibial components have been reported as above, Faris *et al*. [8] described a failure rate of 68% at ten years in a study of 536 flat-on-flat nonconforming coronal design all polyethylene AGC tibial components in 405 patients. Fifty-eight (73%) of seventy-nine failures occurred with loosening or collapse of the bone beneath the medial tibial plateau. They concluded that the high rate of clinical failure was due to the flat coronal plane geometry and low conformity of this tibial component, which contributed to peripheral-edge loading. According to them, the results of AP tibial components are design-sensitive and the ideal design for AP tibial components would have round-on-round conforming or moderately conforming articulation surfaces.

In our case, it is rather difficult to explain the exact cause of early failure of AP tibial components on both sides of PFC TKA. Though not validated clinically or radiologically, this complication could have occurred due to under-correction of varus deformity and instability in the coronal plane leading to excessive load on the medial side of the AP tibial component resulting in accelerated wear and failure. Also, the post-operative x-rays of the left knee after the index

arthroplasty shows a fairly lateralized tibial component which could be responsible for the early medial collapse due to lack of cortical support. Pai *et al*. [9] in their review of twenty patients who were followed up at ten years after a cemented Depuy PFC TKA using AP tibial component and a cruciate retaining femoral component concluded that the AP tibial component demonstrated satisfactory clinical and radiographic performance at long-term follow up. The two patients in their series, who required revision for tibial component failure, had valgus deformities preoperatively and in each case the tibial tray had been lateralised leaving a gap on the medial side where the AP tibial component had no rigid support. They concluded that appropriate cortical support of the AP tibial component is important and the AP component should be used with a degree of caution in patients with severe deformities and osteoporosis. Contrary to this observation, our patient had preoperative varus deformities on both sides and did not have severe osteoporosis or deformities.

Various authors have shown the usefulness of tibial metaphyseal sleeves to manage large tibial defects in revision TKA. They provide very good component stability and fixation [10] as well as excellent medium to long term results [11]. In our patient, use of tibial metaphyseal sleeve along with use of morsellized allograft resulted in a very satisfactory clinical and radiological outcome with the prosthesis showing no signs of failure at five year follow up.

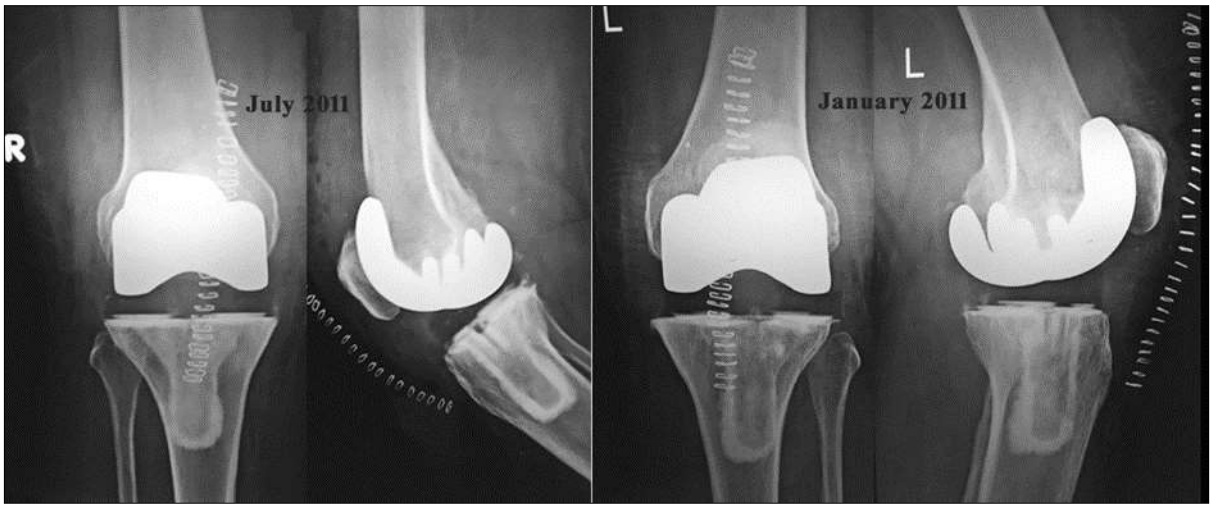

Fig 1: Postoperative X-rays after Index Arthroplasties - 2011

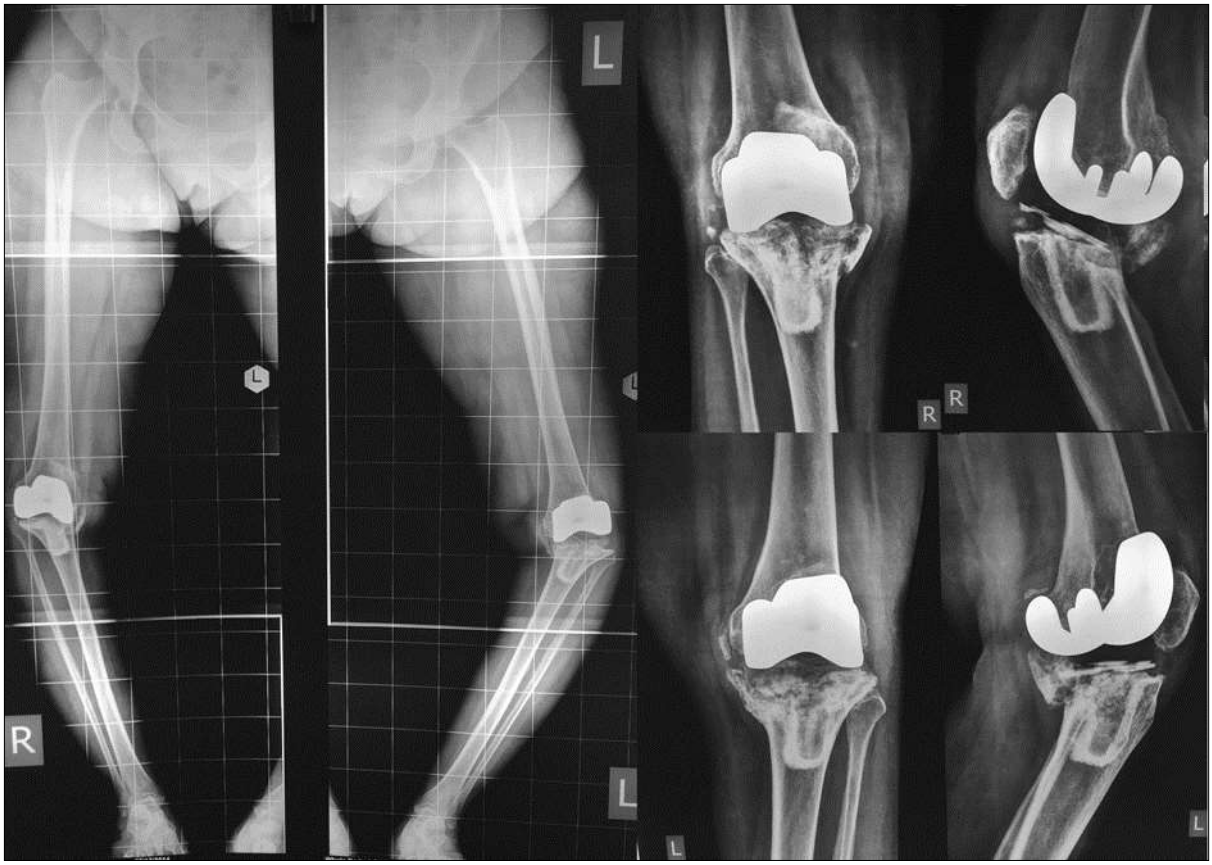

Fig 2: X-rays and Scanogram of bilateral failed TKA December 2014

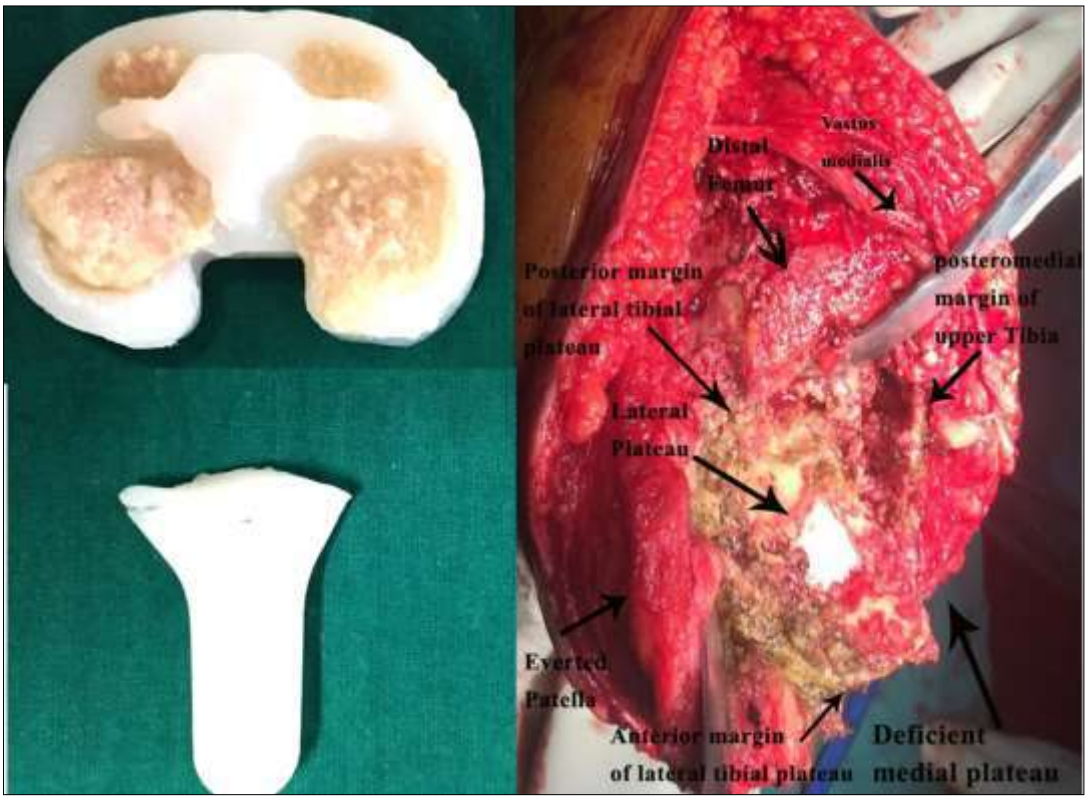

Fig 3: A. Broken AP tibial component B. Intra-operative pictures of Revision Right TKA

Fig 4: Post-operative X-ray Revision Right TKA

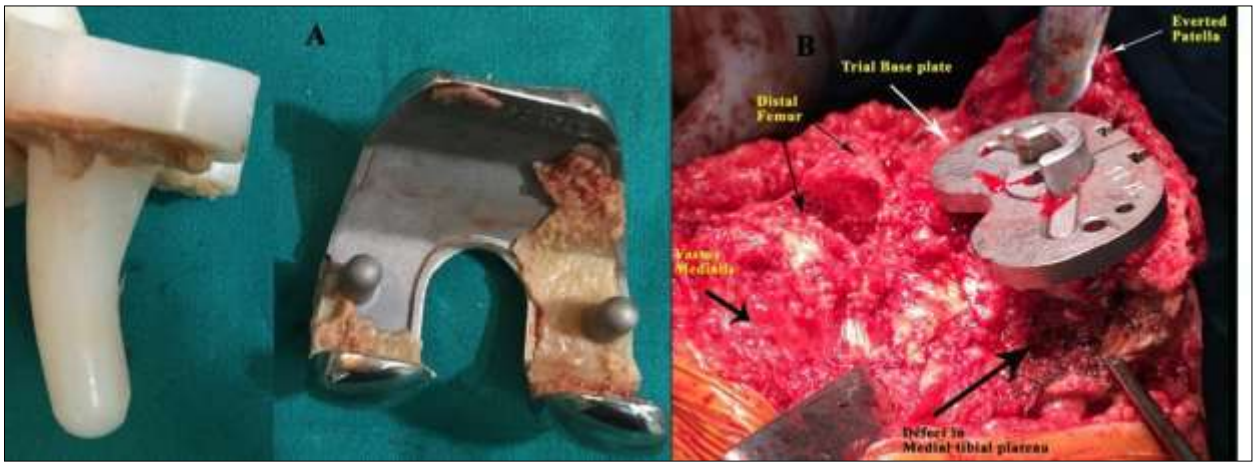

Fig 5: A. Removed components from Left Knee with deformed AP tibial component B. Intra-operative pictures of Revision Left TKA

Fig 6: Postoperative X-ray Revision Left TKA

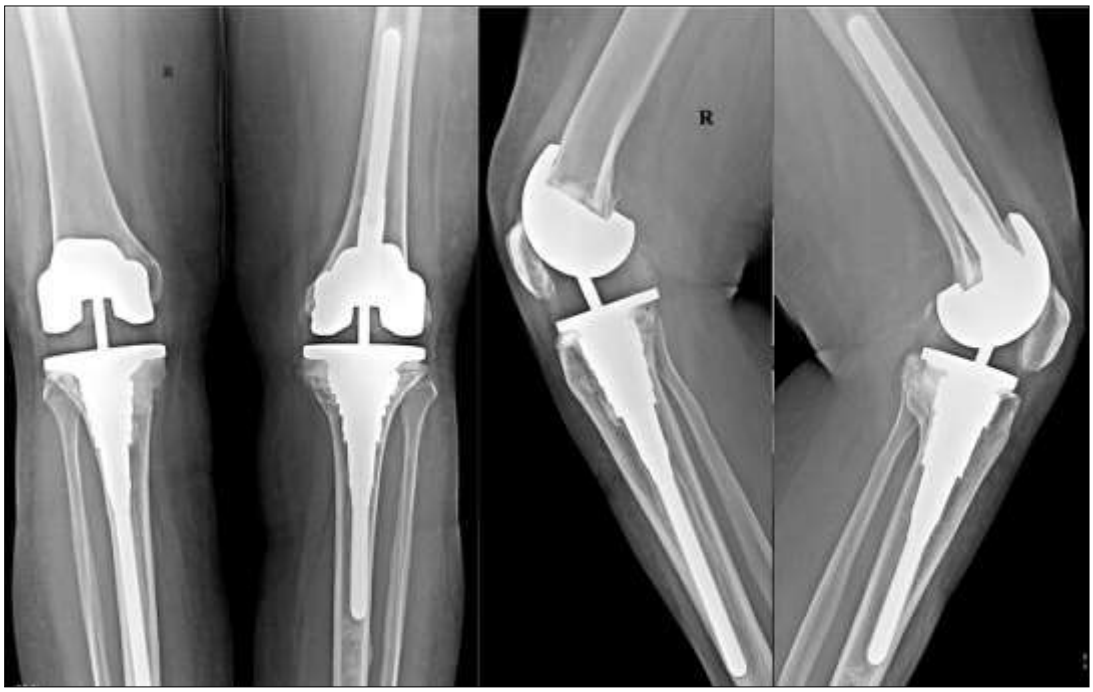

Fig 7: Five years postoperative X-rays – AP and Lateral views

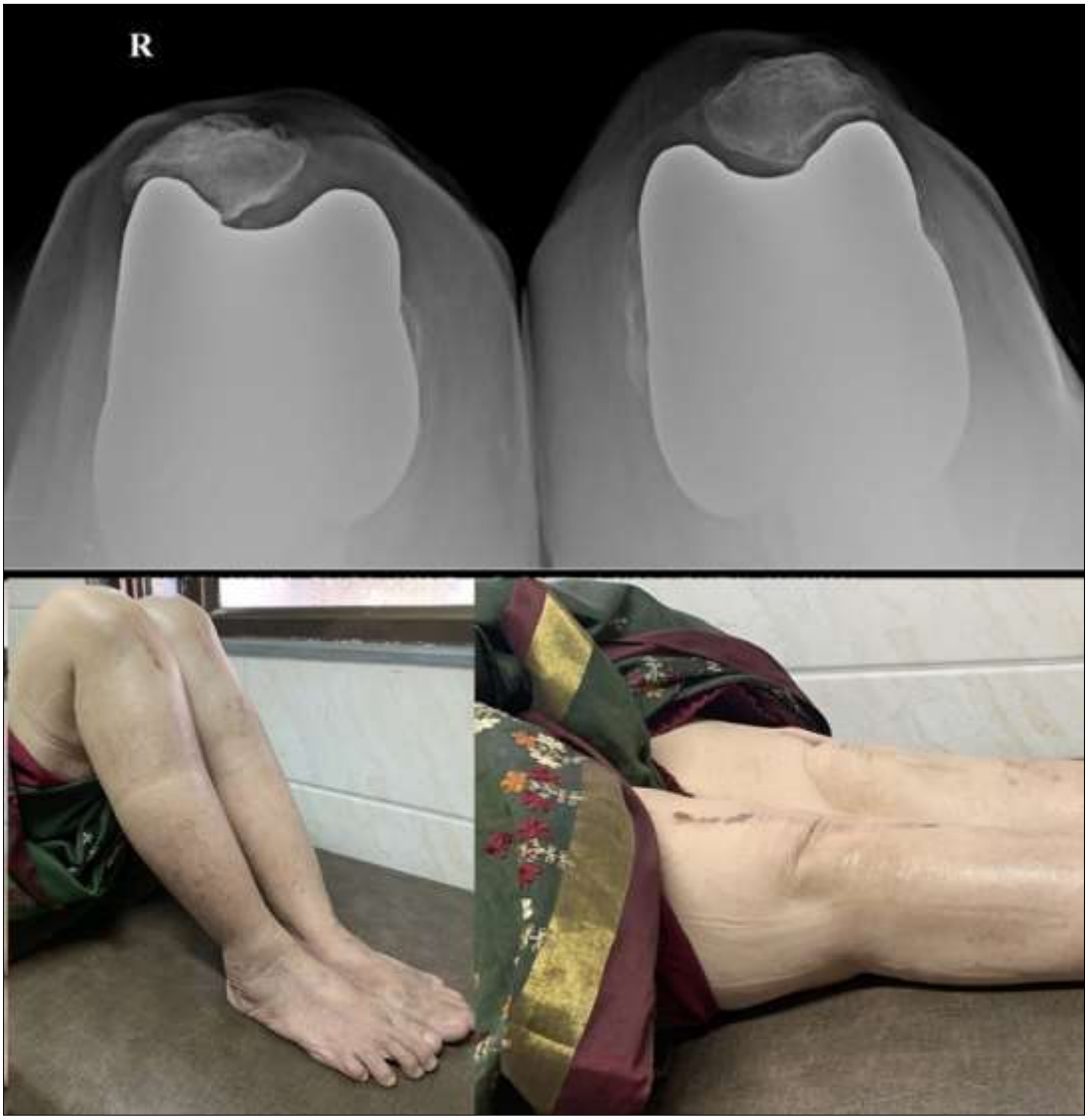

Fig 8: A. Five years postoperative X-rays – skyline views of both patellae B. Clinical picture showing range of motion of knees

Conclusion

This case report narrates a previously unreported case of early failure of AP tibial component leading to failure of bilateral PFC TKA carried out for the treatment of varus osteoarthritis of knee joint. Though the exact cause of the failure remains uncertain, certain factors related to operative technique appear to have led to this catastrophic complication which was treated successfully with bilateral revision TKA using tibial metaphyseal sleeves leading to a satisfactory outcome at five years.

Declarations

- Funding: No funding was received for this project
- Conflict of Interest: The authors declare that there is no conflict of interest
- Ethics Approval: Appropriate approval was obtained from the Ethics Committee of Sterling Hospital, Ahmedabad.
- Consent to Participate: Necessary consent was obtained from the patient for submission of this case report.
- Consent for Publication: Necessary consent was obtained from the patient for publication of this case report.

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