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CASE REPORT

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Early aseptic loosening of primary total knee arthroplasty in patients with osteonecrosis of the knee: A case series

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Abstract

The cause of early aseptic loosening in total knee arthroplasty (TKA) is uncertain, although several possibilities could be offered. We report that osteonecrosis of the knee should be considered as a possible cause or contributing etiologic factor for early aseptic loosening following primary TKA.

KEYWORDS

early aseptic loosening, osteonecrosis, total knee arthroplasty

1 | INTRODUCTION

Total knee arthroplasty (TKA) is an effective surgical procedure for treating end-stage osteoarthritis of the knee by decreasing pain and improving function. With a rapid increase in the demand for primary TKA in the elderly population, concomitant increase of revision TKA is expected.[1,2] The most frequent cause of failure following TKA has been reported to be aseptic loosening of the implant.[3,4] Understanding failure mechanisms of aseptic

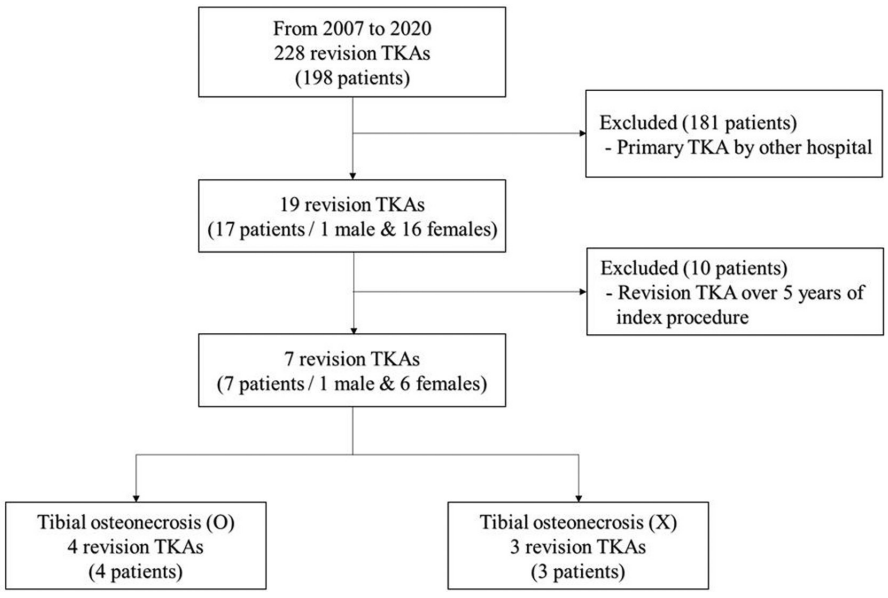

FIGURE 1 Schematic diagram of the selection of subjects for this study.

Case	Age (time of revision)	Sex	BMI	Laterality	Initial diagnosis	Time from TKA (months)
1	58	F	30.0	Left	Osteonecrosis	33
2	65	F	27.7	Left	OA	19
3	68	F	28.3	Right	Osteonecrosis	50
4	73	F	26.2	Left	OA	57
5	74	F	21.5	Right	Osteonecrosis	45
6	75	F	25.8	Right	Osteonecrosis	56
7	80	M	24.8	Right	OA	26

Abbreviations: BMI, body mass index, F, female, M, male, OA, osteoarthritis, TKA, total knee arthroplasty.

TABLE 1 Demographic characteristics of patients.

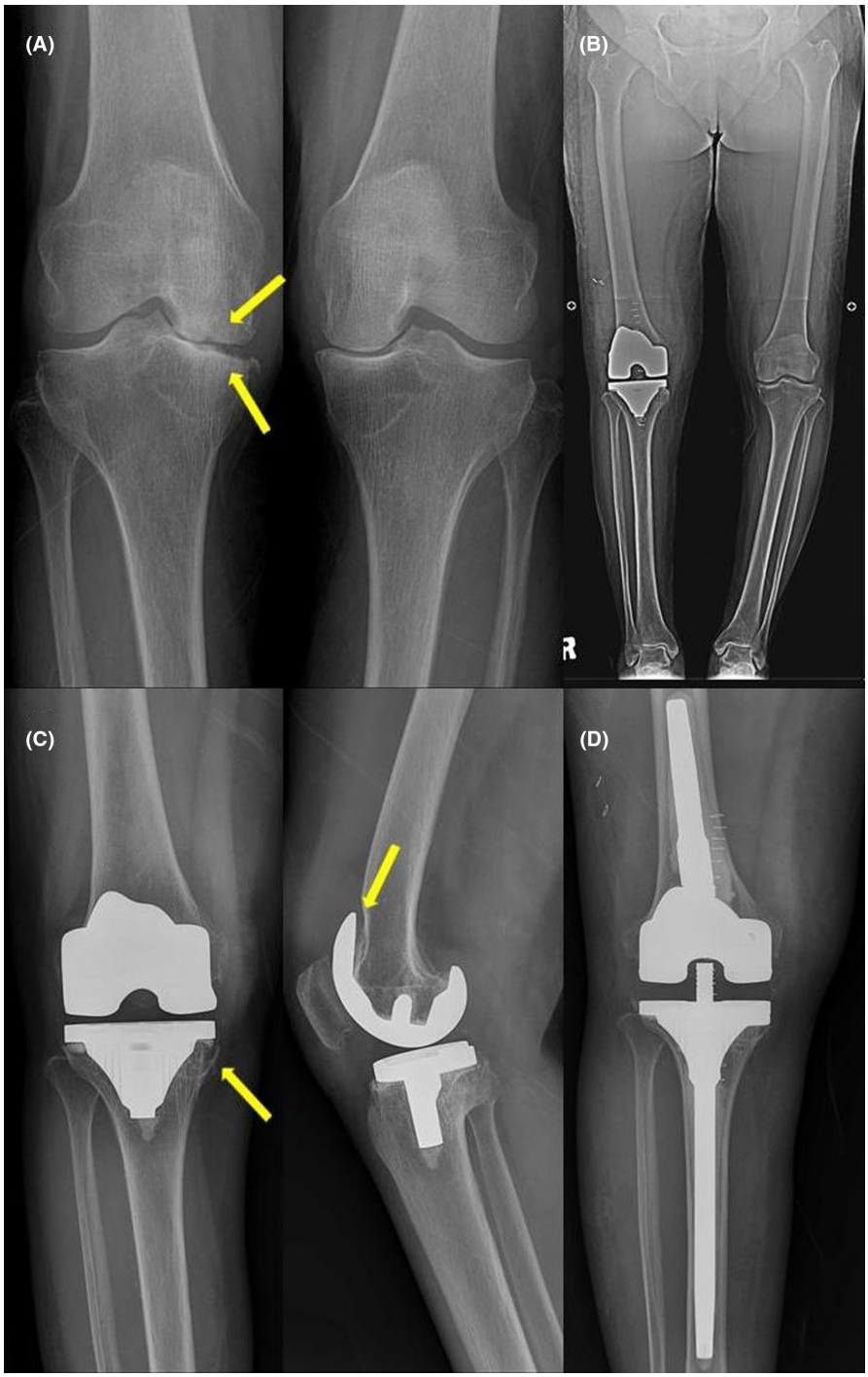

FIGURE 2 (A) Anteroposterior (AP) radiographs of a 70-year-old female patient who developed right progressive medial femoral and tibial condyle osteonecrosis with joint collapse that failed conservative management. (B) Standing AP radiograph of bilateral lower extremities of the same patient taken 2 weeks postoperatively, showing appropriate AP alignment. (C) Image taken prior to revision demonstrates osteopenia and radiolucency of the medial tibial plateau and moderate bone resorption of the femoral component. (D) She underwent posterior-stabilized (PS) TKA with cemented femoral and tibial stems.

loosening is important for reducing the revision rate and associated burdens of health affiliations.

Early TKA failure has been defined as the need for revision within two to 5 years of the index procedure.[5] Early aseptic failure of the implant might be caused by imbalanced implant loading, malalignment of component, poor cementing technique, implant design failure, and fixation failure of the precoated polymethylmethacrylate (PMMA) tibial implant surface.[6–9] Mont et al.[10] have reported a near 40% revision rate for aseptic loosening in TKAs performed for steroid-induced osteonecrosis. However, the exact causes of early aseptic loosening remain uncertain.

We observed a concerning trend involving early loosening from TKA in patients with osteonecrosis of the knee. The objective of this case series was to present four cases of early aseptic loosening of TKA in older patients who had osteonecrosis of tibial condyle preoperatively.

2 | CASE PRESENTATION

A total of 228 revision TKAs were performed for patients with aseptic loosening at one hospital from August 2007 and December 2020. After excluding 181 patients who had primary TKA in other hospitals due to unclear preoperative diagnosis or the absence of preoperative radiographs, 17 patients (19 TKAs) who underwent primary TKA procedures at our hospital were analyzed. Seven of these TKAs were revised for early aseptic loosening of the tibial component or/and the femoral component (36.8%, 7/19) (Figure 1). One was male, and six were females. Body mass index (BMI) ranged from 21.5 to 30.0 for these patients. The mean age of these seven patients at the time of revision was 70.4 years (range, 58–80 years). Demographic and clinical data of these patients are summarized in Table 1.

Postoperative radiographs of seven failed TKAs were evaluated to determine initial alignment of femoral and

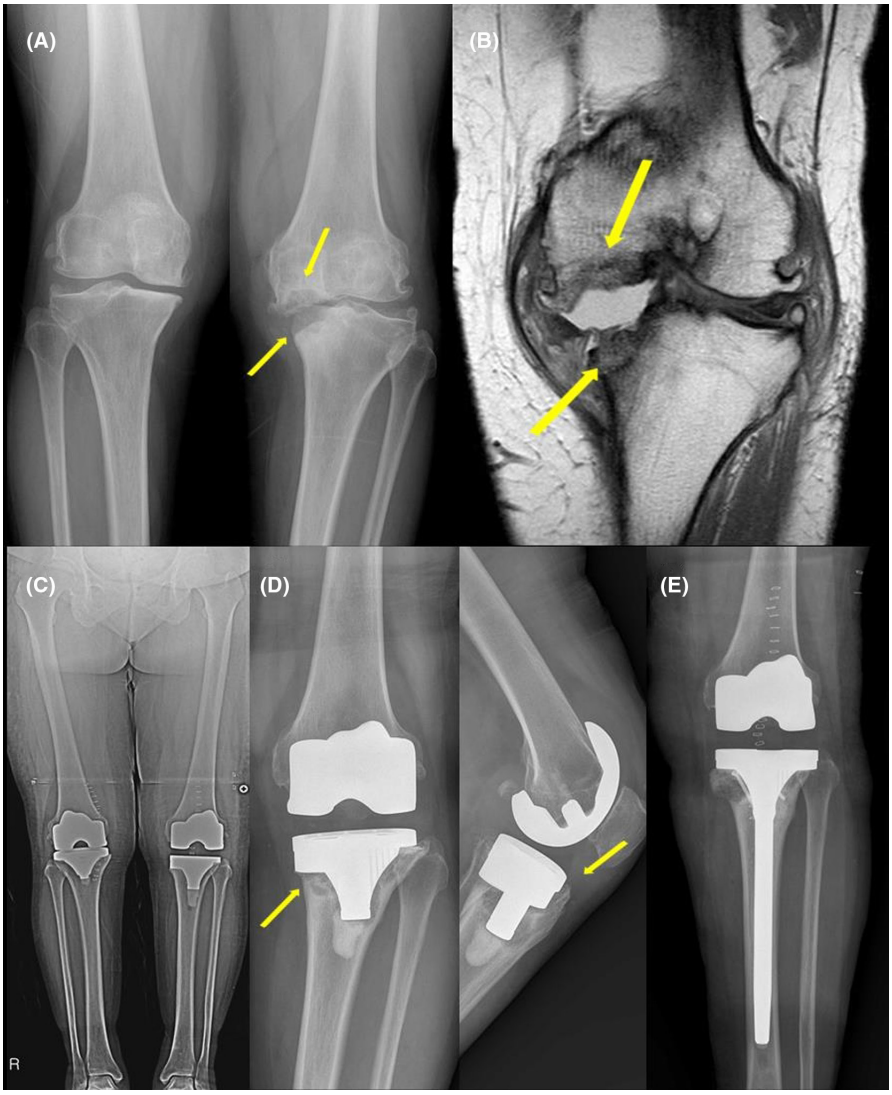

FIGURE 3 (A) AP radiographs of a 56-year-old female patient who developed left severe medial femoral and tibial condyle osteonecrosis with joint collapse. (B) Magnetic resonance imaging (MRI) of the left knee joint reveals severe medial femoral and tibial condyle osteonecrosis with joint collapse. (C) Standing AP radiograph of bilateral lower extremities of the same patient taken 2 weeks postoperatively, showing appropriate AP alignment. (D) Image taken prior to revision demonstrates subsidence and a continuous radiolucency around the entire tibial component. (E) She underwent PS TKA with cemented tibial stems.

tibial components. The femoral component was determined to have an average of 4.3° of valgus (range, 3.6°–5.2°) and 2.7° flexion (range, 2.1° of flexion to 3.5° of flexion). Tibial components were found to have an average of 0.16° of varus (range, 1.4° of vs. to 0.8° of valgus) with an average of 4.1° of posterior slope (range, 1.3°–6.2°). No outliers (>2° of varus/valgus) in knee alignment were identified among failed TKAs, including standing full leg radiographs.

The assessment of preoperative radiographs and magnetic resonance images (MRIs) was performed for the 19 TKAs, and a postoperative radiological assessment was performed for each failed TKA. Six of seven patients that had revision arthroplasty for early aseptic loosening were due to loosening of the tibial component. One was due to loosening of femoral and tibial components. We observed that all failures occurred between the cement mantle and the bone interface. In all failures, there were loosening and varus subsidence of the tibial implant. Radiographic signs of loosening were not observed for femoral components of six patients. None of these cases showed significant polyethylene wear or debris.

Among seven patients with early aseptic loosening, four patients had tibial osteonecrosis of the knee on X-ray and/or MRI (Figures 2–5). The cause of knee osteonecrosis in one patient (Figure 3) is assumed to be due to long-term steroid use for asthma; however, the cause of osteonecrosis could not be determined for the other three patients. Figure 2A is a standing anteroposterior (AP) image of bilateral knees of a patient taken 3 months after the onset of knee pain. It demonstrated osteonecrosis of the medial tibial plateau and medial femoral condyle. Figure 2B is a standing AP image of bilateral lower extremities of the same patient following primary TKA, demonstrating appropriate AP alignment. Figure 2C is a standing AP and lateral image of the right knee of a patient taken 4 years postoperatively. It demonstrated osteopenia and radiolucency of the medial tibial plateau with moderate bone resorption of the femoral component. This radiograph is typical of early failures. At the

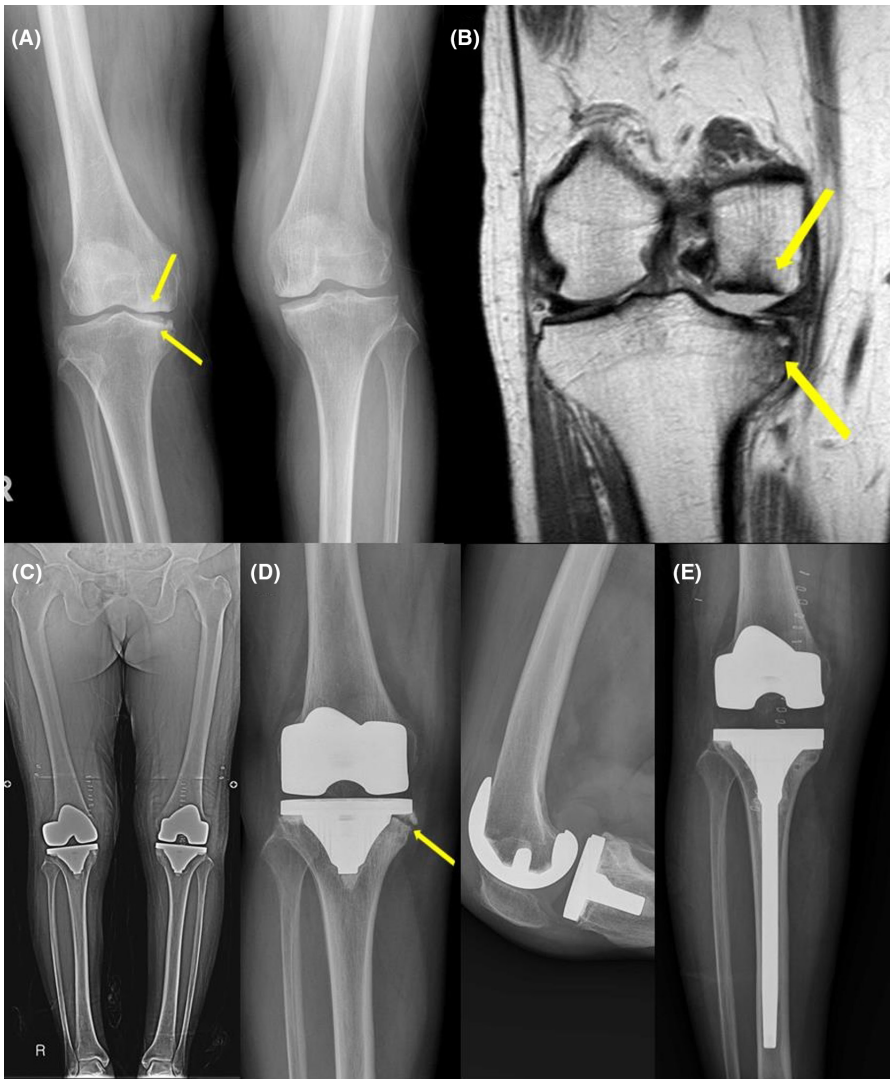

FIGURE 4 (A) AP radiographs of a 64-year-old female patient who developed right progressive medial femoral osteonecrosis with joint collapse that failed conservative management. (B) MRI of the right knee joint reveals medial femoral and tibial condyle osteonecrosis. (C) Standing AP radiograph of bilateral lower extremities of the same patient taken 2 weeks postoperatively, showing appropriate AP alignment. (D) Image taken prior to revision demonstrates minimal bone resorption and radiolucency of the tibial component. (E) She underwent PS TKA with cemented tibial stems.

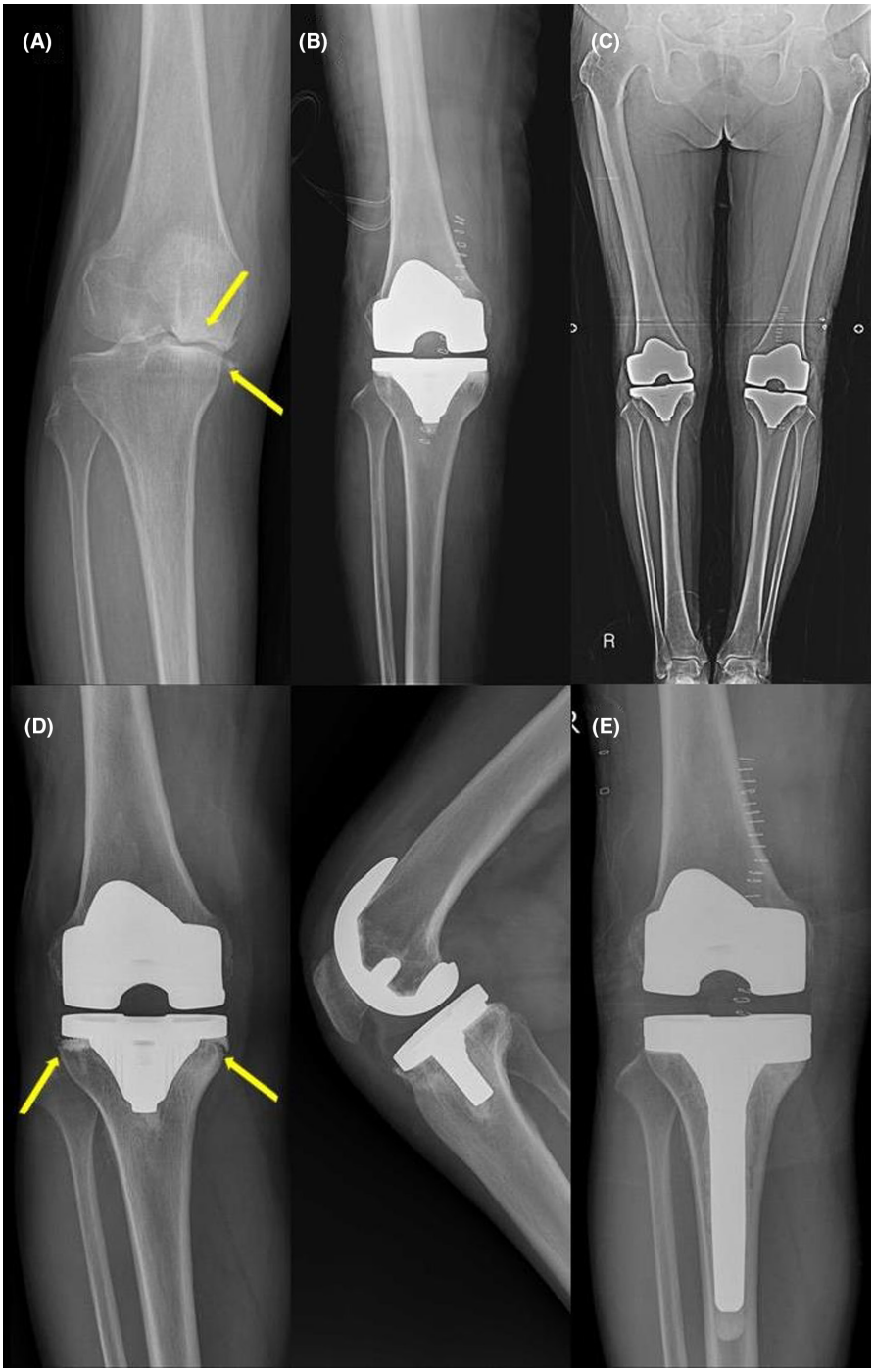

FIGURE 5 (A) AP radiographs of a 70-year-old female patient who developed right progressive medial femoral and tibial condyle osteonecrosis with joint collapse. (B) She underwent cemented non-constrained TKA. (C) Standing AP radiograph of bilateral lower extremities of the same patient taken 2 weeks postoperatively, showing appropriate AP alignment. (D) Image taken prior to revision demonstrates medial minimal bone resorption and lateral loosening at the tibial component. (E) She underwent PS TKA with cemented tibial stems.

time of the index primary TKR, no patient reported minor or major postoperative complications.

3 | DISCUSSION

The cause of early aseptic loosening is uncertain, although several possibilities may be offered. Cheng et al.[11] have demonstrated that tibial component debonding should be considered a possible a cause of early aseptic loosening following TKA. The authors concluded that metal and PMMA debris in a TKA was produced from debonding and micromotion between the tibial cement and the implant interface. Foran et al.[6] have proposed several possible causes for early aseptic loosening, including minimally invasive surgical technique, poor cement technique, inherent factors of Palacos cement, unfavorable design features of the tibial implant, and precoated PMMA surface. Arsoy et al.[9] have reported specific implants have a high early rate of aseptic loosening with failure mechanism unidentified. In addition, surgical technique and bone quality are among

the important factors in early aseptic loosening of the implant in TKA. In this case series, osteonecrosis of the knee should be considered a possible cause or contributing etiologic factor for early aseptic loosening following primary TKA.

Early TKA failure has been defined as the need for revision surgery within 5 years of the index arthroplasty. Fehring et al.[5] have reported that 63% patients have a revision surgery within 5 years after the index arthroplasty in a series of 440 knees. Schroer et al.[4] have reported that 35.3% and 60.2% of TKA failures occur within 2 years and 5 years of the index arthroplasty, respectively, and that aseptic loosening is the predominant failure mechanism. In our study, the rate of revision for early aseptic failure among aseptic loosening cases was 36.8% (7/19 cases).

Osteonecrosis of the knee may lead to progressive cartilage deficiency and joint arthritic change and deformity.[12] In patients with this pathologic disorder, implant fixation is a problem owing to bone collapse and bone loss secondary to the underlying osteonecrosis process. Previous studies have reported a high possibility of aseptic loosening of the implant.[10,13,14] Mont et al.[10] have reported a high failure rate from aseptic loosening in TKAs performed for steroid-induced osteonecrosis. In contrast, Chalmers et al.[15] have reported a revision rate of 2% for aseptic loosening. They concluded that TKAs with selective stem utilization for osteonecrosis could result in a durable implant survivorship at a mid-term follow-up. The use of a stem is an effective option for obtaining stable implant in the tibial condyle with low bone quality but is also the cause of cost increase in revision TKA. It is assumed that medial tibial condyle deficiency was prevalent in a majority of preoperative cases, but nothing was done for the build-up, which was the cause for early failure. Therefore, we believe that the prophylactic use of a stem could be a good surgical option during TKA in patients with osteonecrosis of the knee.

Our study reports that osteonecrosis of the knee should be considered as a possible cause or contributing etiologic factor for early aseptic loosening following primary TKA. In addition, prophylactic use of a stem could be a good surgical option during TKA for patients with osteonecrosis of the knee.

AUTHOR CONTRIBUTIONS

Ji-Hoon Baek and Chang Hyun Nam involved in writing and revision of article. Su Chan Lee, Suengryol Ryu, and Hye Sun Ahn involved in data collection and statistical analysis.

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None.

CONFLICT OF INTEREST

Each author certifies that he or she has no commercial association (e.g., consultancies, stock ownership, equity interest, patent, and licensing arrangements) that might pose a conflict of interest in connection with the submitted article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICAL APPROVAL

This study was approved by the Institutional Review Board of Himchan hospital.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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