Total Knee Arthroplasty for Neuropathic Joint Disease After Severe Bone Destruction Eroded the Tibial Tuberosity

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abstract

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This article describes a patient in whom total knee arthroplasty was performed for neuropathic joint disease secondary to diabetes mellitus after severe bone destruction eroded the tibial tuberosity. At initial examination, radiographs of the knee showed bone destruction in the medial and anterior regions of the tibia, and fine bone fragments were seen in the joint. Conservative therapy was performed using a brace. However, bone destruction gradually advanced, and 10 months after the initial examination, radiographs of the knee showed bone destruction in the lateral condyle of the femur and advanced bone destruction of the anterior tibia; the tibial tuberosity was missing.

It is rare for the tibial tuberosity in the anterior tibia to disappear. If this happens, reconstruction is difficult and total knee arthroplasty becomes complicated. For the bone defect in the tibia, cement was used to recreate the shape of the anterior surface of the tibia. It was possible to minimize the volume of bone resection and morphologically reconstruct the tibial tuberosity. The patient recovered quickly. At postoperative week 5, the patient was able to walk using a cane. Thirty-six months after total knee arthroplasty, knee extension was 0°, flexion was 120°, extension lag was 5°, knee score improved from 40 points to 94 points, and functional score improved from 20 points to 75 points. However, long-term implant stability needs to be carefully monitored.

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Figure: Intraoperative photograph of the anterior bone defect, including the tibial tuberosity, with cement used to recreate the shape of the anterior surface of the tibia.
Neuropathic joint disease was reported by Charcot as an arthropathy related to tabes dorsalis. In this disease, central or peripheral neuropathy hinders deep and proprioceptive sensations to advance joint destruction, and severe bone defects and joint deformity make treatment difficult. Bone defects in the proximal tibial plateau can be divided into central and peripheral; central defects occur in genu valgus, and peripheral defects occur on the posteromedial side in genu varus. However, it is rare for the tibial tuberosity in the anterior tibia to disappear. If this happens, reconstruction is difficult, and total knee arthroplasty (TKA) becomes complicated.

This article describes a patient in whom TKA was performed for neuropathic joint disease after severe bone destruction eroded the tibial tuberosity. For the bone defect in the tibia, cement was used to recreate the shape of the anterior surface of the tibia. The patient consented to data concerning the case being submitted for publication.

**CASE REPORT**

In December 2004, a 70-year-old woman with diabetes mellitus consulted her family physician because her left knee swelled up for no apparent cause and was treated conservatively. Because bone destruction advanced rapidly, the patient presented to the authors’ department in May 2006. Left knee extension and flexion were 5° and 125°, respectively. The left knee exhibited significant swelling and a 5° extension lag. Motor and sensory function were intact. Knee Society knee score was 56 points and functional score was 75 points. No significant laboratory findings were observed, and the levels of rheumatoid factor and anti-agalactosyl IgG antibodies were within normal ranges. Radiographs of the knee showed bone destruction in the medial and anterior regions of the tibia and fine bone fragments in the joint (Figure 1A). Arthrocentesis showed no bacteria or crystals, and the fluid was bloody and transparent.

Despite severe bone destruction, the patient reported no pain; hence, the clinical diagnosis was neuropathic joint disease secondary to diabetes mellitus. Conservative therapy was undertaken using a brace. However, bone destruction gradually advanced, and 10 months after initial examination, extension lag had deteriorated to 30°, and knee and functional scores had decreased to 40 points and 20 points, respectively. Radiographs of the knee showed bone destruction in the lateral condyle of the femur and advanced bone destruction of the anterior tibia; the tibial tuberosity was missing. The fine bone fragments were absorbed, and most of the larger fragments fused together, adhered to, and coalesced with the adjacent bones. Furthermore, sclerosis was seen on the joint surface (Figure 1B). Computed tomography scan also showed marked bone destruction in the anterior tibia and
a missing tibial tuberosity (Figure 2). The anterior bone defect that included cortical bone was a peripheral defect. Ultrasonography showed that the patellar tendon had soft tissue adhesions to the tibia and was not ruptured.

In April 2007, TKA was performed using the NexGen Legacy Constrained Condylar Knee prosthesis (Zimmer, Inc, Warsaw, Indiana) by a medial parapatellar approach. In the femur, a bone defect was seen in the lateral condyle, and synovial tissue covered the surface of the medial condyle. The anteromedial surface of the tibia contained a large, oblique, irregular bone defect that obliterated the tibial tuberosity (Figure 3A). The patellar tendon was continuous, not ruptured, and attached to the distal aspect of the missing tibial tuberosity. For the bone defect in the distal femur, a 10-mm distal metal augment was placed on the lateral side. In the tibia, an implant was placed in relation to the posterolateral wall, and for the anterior bone defect, including the tibial tuberosity, cement was used to recreate the shape of the anterior surface of the tibia (Figure 3B).

Starting on postoperative day 1, range of motion training with maximum flexion of 90° was initiated, and from postoperative week 3, gait training was started using a brace with 90° of maximum flexion. At postoperative week 5, the patient was able to walk using a cane. Thirty-six months postoperatively, left knee extension was 0°, flexion was 120°, extension lag was 5°, and knee and functional scores were 94 and 75 points, respectively. Radiographs of the knee revealed a gap between the cement in the medial side of the tibia and the bone and a clear zone around the tibial stem. Progressive radiolucent lines were not seen, and no loosening was seen in the anterior cement, implant, or stem (Figure 4).

**DISCUSSION**

Neuropathic joint disease is defined as a relatively painless progressive arthropathy of single or multiple joints caused by an underlying neurological deficit. The prevalence of neuropathic joint disease in patients with diabetes mellitus is low; Kleinerman reported that it occurred in 0.4% of patients. Moreover, involvement of the knee is rare because the foot and ankle are commonly affected in patients with diabetes mellitus. In the current patient, radiographs of the knee showed the typical findings of neuropathic joint disease. None of the classical disorders associated with neuropathic joint disease, except diabetes mellitus, were demonstrated, such as tabes dorsalis, leprosy, meningomyelocele, or congenital absence of pain. The patient was given a clinical diagnosis of neuropathic joint disease secondary to diabetes mellitus.

Arthrodesis used to be the first choice of operative treatment for neuropathic joint disease, but TKA has been performed more often in recent years due to improved long-term results. Parvizi et al performed TKA on 40 neuropathic joints, and 8-year prosthesis survival was 85%. Soudry et al performed TKA on 9 knees, and at an average 3-year follow-up (range, 2-4.25 years), results were excellent in 8 knees and good in 1 knee. Bae et al performed TKA with the Endo-Model rotating hinge prosthesis (Waldemar Link GmbH & Co. KG, Hamburg, Germany) on 11 neuropathic joints secondary to neurosyphilis, with an average of 12.3 years of follow-up (range, 10-22 years). Mean knee score increased from 44.9 points (range, 30-54 points) preoperatively to 95.0 points.
(range, 85-98 points) at final follow-up. Mean functional score increased from 45.0 points (range, 25-60 points) preoperatively to 93.6 points (range, 80-98 points) at final follow-up. Postoperative complications occurred in 3 knees: 2 dislocations and 1 deep infection.

Regarding arthrodesis, loss of joint mobility and marked difference in leg length are important issues, so TKA that conserves knee joint function is useful. Therefore, TKA was performed on the current patient.

Eichenholtz divided neuropathic joint disease into the following 3 stages: development (debris, fragmentation, joint capsule loosening, subluxation, and luxation), coalescence (absorption of debris, fragment fusion, and joint surface sclerosis), and reconstruction (smooth fragment mass, diminution in the degree of sclerosis, and joint surface reformation). Yoshino et al recommended performing surgery after the stage of coalescence. Tountas reported that postoperative outcome was poor when surgery was performed during the stage of development. At the current patient’s initial examination, the presence of fragmentation and progressive bone destruction indicated advanced neuropathic joint disease. If TKA had been performed during the stage of development, postoperative bone destruction could have caused early loosening. Hence, the patient was treated conservatively until reaching the stage of coalescence. Total knee arthroplasty was performed 10 months after the initial examination, when absorption of debris, fragment fusion, and joint surface sclerosis were confirmed.

When treating bone defects, bone grafts, metal augment, and cement can be used. With bone grafts, long-term stability can be expected if bone fusion is achieved. However, if a bone defect is marked and includes the cortical bone, as in the current case, it is difficult to harvest enough autologous bone. Allografts can be used, but these involve the risk of disease transmission, graft fracture, nonunion, collapse, and resorption. With any bone graft, weight bearing is restricted for a considerable period. Furthermore, structural allograft is reportedly contraindicated for neuropathic joint disease. No available metal augments fit the shape of the anterior tibia. Hence, when using a metal augment, an osteotomy must be performed at the lowest point of the tibial bone defect, and, as a result, excessive bone is resected, reducing bone strength at the site of tibial component placement. Moreover, a smaller tibial component can lead to incompatibility with the femoral component. Cement is associated with long-term component fixation issues but was used in the current patient because it was difficult to treat the bone defect with the other techniques. Consequently, it was possible to minimize the volume of bone resection and morphologically reconstruct the tibial tuberosity. Furthermore, because it was not necessary to restrict loading, gait training was initiated early and the patient recovered quickly.

Postoperatively, radiographs of the knee revealed a gap between the cement in the medial side of the tibia and the bone and a clear zone around the tibial stem. Radiolucent lines are often seen in TKA, but, if not progressive, radiolucent lines do not affect fixation. In the current case, progressive radiolucent lines were not seen, so no loosening was detected in the anterior cement, implant, or stem. However, long-term implant stability will need to be carefully monitored. If loosening is detected, revision TKA with a megaprostheses will be considered.

**REFERENCES**