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# Tibial Stress Fracture After Computer-Navigated Total Knee Arthroplasty

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In this case report, the patient experienced a stress fracture at one of the pinhole sites used for placement of the computer navigation system's tibial trackers.

## Introduction

The use of computer navigation systems in total knee arthroplasty (TKA) has become increasingly popular in recent years. Many authors have already documented satisfactory short- to mid-term results after using various types of software [1-3].

Bathis et al [4], as well as Decking et al [5] and Rosenberger et al [6], showed how the use of navigation systems can improve the accuracy of the femoral and tibial component placement when compared with the "traditional" techniques. Because a correct alignment of the components is one of the most important factors determining favorable long-term results of a TKA, this could lead to a higher longevity of the prosthesis.

Despite these positive aspects, some authors have reported no advantages, as well as a longer operative time with the use of computer-assisted systems [7,8]. Moreover, recently three cases of stress femoral or tibial fractures have been reported as a complication of navigated TKA [9,10].

We present a case of a stress fracture of the tibial diaphysis that occurred after a TKA performed with the use of a computer navigation system. The stress fracture occurred at one of the pinhole sites used for the placement of the tibial trackers.

We have been using computer navigation systems since 2005 as a standard procedure for TKA. This complication occurred after a series of 155 (0.64%) uncomplicated procedures (ie, well after the learning curve was complete).

## Case Presentation

A 79-year-old woman (height 155 cm, weight 68 kg) with painful bilateral knee osteoarthritis was surgically treated at our orthopaedic institute with a total knee replacement on the left side. No previous operations had been done on her left knee.

The pain had begun 7 years earlier; however, in the 10 months preceding surgery, the patient experienced a sudden worsening of the pain with subsequent restrictions of important daily activities. Conservative treatment was performed and judged as useless by the patient. Consequently, she was given a surgical option.

Before the operation, the range of motion (ROM) of the patient's left knee was 5–100°, with pain at the last degrees of flexion and extension. Patellofemoral crepitus, widespread tenderness, and mild effusion were also detected at the physical examination. Walking and ability to climb stairs were severely compromised and possible only with the use of crutches.

A bilateral knee valgus deformity was registered with a left knee valgus of 12°. Preoperative radiographs showed a severe osteoarthrosis with significant reduction of the external compartment joint space.

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## Management

With the patient in a supine position and with the use of a tourniquet, an antero-medial approach of the left knee was performed under spinal anaesthesia. Prophylactic antibiotics were administered in a single dose before surgery. A low-contact-stress rotating-platform prosthesis (Complete LCS, DePuy International Ltd, Leeds, UK) was used; neither the femoral nor the tibial component was cemented.

The operation was performed by the same expert surgeon who had already performed more than 100 computer-assisted procedures before this operation with the same software and hardware. A computed tomography (CT)-free navigation system (Ci™ navigation system, DePuy I-Orthopaedics, Munich, Germany) was used. To perform the electronic measurements, one bicortical navigation tracker (5 × 200 mm) was set at the distal part of the femur and two bicortical navigation trackers (4 × 130 mm) were set on the tibial diaphysis (Figure 1).

*Figure 1. Trackers set on the tibial diaphysis.*

Postoperative Course

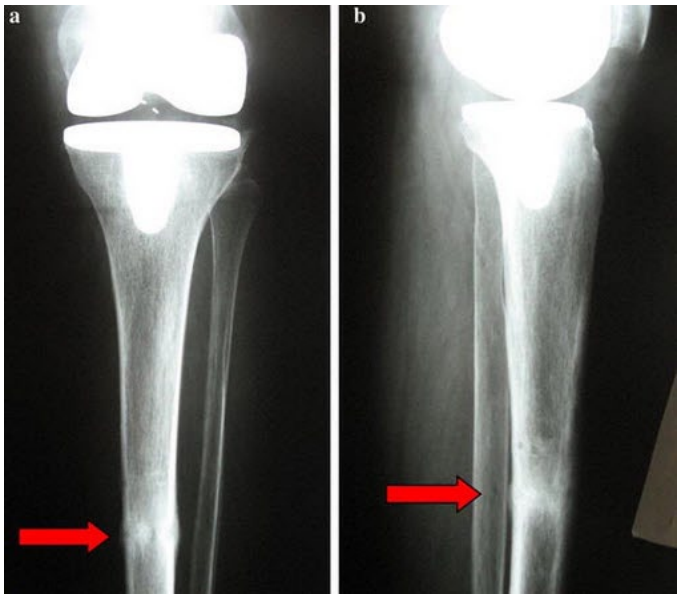
The outcome was excellent in the first 3 weeks after the operation: The skin incision completely healed and the patient was able to walk with crutches without pain or restrictions.

However, at the beginning of the fourth postoperative week, an acute pain appeared in the operated leg with local tibial pain and swelling. The patient immediately had an X-ray check-up which revealed a stress fracture of the diaphysis of the tibia, at the level of the more distal tibial tracker (Figures 2a-b).

As a result, the patient wore a brace and was instructed to avoid weight-bearing for the following 4 weeks. After 4 weeks, she was allowed to gradually weight-bear with use of a leg cast for another 4 weeks. Subsequent X-rays at the 14th week showed good healing of the fracture (Figures 3a-b).

The patient was followed up at 7 months. Clinically, a satisfactory outcome was reported by the patient, with a good recovery of her daily activities; crutches were no longer needed to walk. Physical examination showed a lack of tenderness at the level of the stress fracture; final ROM of the affected knee was 0–120°. The Knee Society score [11] was 94.


*Figures 2a-b. a - Antero-posterior (AP) X-ray: stress fracture at the level of the distal tibial tracker. b - Latero-lateral (LL) X-ray: stress fracture at the level of the distal tibial tracker.*




*Figures 3a-b. a - AP X-ray: good healing of the tibial stress fracture. b - LL X-ray: good healing of the tibial stress fracture.*

Radiologically, the stress fracture was completely healed and the left lower limb showed a good alignment (Figures 4a-b).

The patient provided her consent to the publication of the case report.


*Figures 4a-b. a - 7-month follow-up AP X-ray: complete healing of the fracture. b - 7-month follow-up LL X-ray: complete healing of the fracture.*

## Discussion

Stress fractures after TKA are not common and they are usually related to preoperative osteoporosis, femorotibial malalignment, or other concomitant diseases.

Our report presents a case of a patient who underwent a knee replacement without any postoperative complications or factors that would lead the surgeon to expect any particular complication. The onset of a stress fracture on the tibial diaphysis 3 weeks after the operation represented an interesting event. X-rays clearly showed how the tibial fracture occurred right where the tibial pins for the navigation trackers were set; more specifically, where the distal tibial pin was set.

The type of navigator used required the insertion of two pins on the tibia, and the diameter of such pins is rather large (5 mm for the femoral tracker and 4 mm for each of the tibial trackers). In accordance with Ossendorf et al [10], we believe that the insertion of such pins (especially if in a pair) can significantly decrease the breaking stress of the bone locally and in the surrounding area.

Brooks et al [12] and Burstein et al [13] have already shown the positive correlation among screw holes in bone and the residual weakness of the bone to afford bending loads and torsional stresses. As a consequence, the occurrence of a fracture at the pin insertion site should always be considered.

This is especially true in cases in which bicortical pins are used because their penetration in the tubular bone occurs in a "transcortical" way, or in cases in which they are inserted in the cortical bone as a result of several attempts to obtain a perfect stability of the pin.

That is exactly what happened in our case, as the distal tibial pin was inserted twice due to a lack of stability of the tracker obtained after the first attempt. Indeed, a critical review of the postoperative X-ray shows a slightly larger diameter of the distal tibial hole.

The use of a bicortical pin, especially if inserted more than once, could increase weakness of the local bone; however, this hypothesis contrasts with the results provided by Kuo et al [14], which showed how bone stress concentration after single-cortex defect was similar to double-cortex defect. However, the use of bicortical pins provides a better stability of the navigation trackers, which is a priority in performing a correct computer-assisted knee surgery.

For all our patients treated with the computer-navigated system, weight-bearing is allowed progressively and always with the use of crutches. Patients are instructed that the amount of weight-bearing depended on their pain. Because we did not see stress fractures in our other similarly treated patients, we do not believe that an excessive weight-bear contributed to the occurrence of the stress fracture by itself.

In summary, we recommend paying particular attention to inserting the pins in an orthogonal way, reaching the distal cortical bone without completely penetrating it. This should provide adequate stability of the trackers, reducing the risk of loss of strength of local tibial bone.

Moreover, patients with concomitant diseases (such as rheumatoid arthritis or osteoporosis) or who are receiving concomitant drug treatment (such as corticosteroids) should be kept under particular control and, if necessary, undergo a slower postoperative rehabilitation protocol.

*Source*

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