Navigated Lateral Unicompartmental Knee Arthroplasty - Technique and Case Report

Case Report

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Abstract: Lateral unicompartmental knee arthroplasty (UKA) outcomes have been inferior to those described after medial UKA. Inaccurate implant positioning and mechanical axis malalignment appear to be the most common technical errors. Rare studies or failure identification on lateral UKA are currently presented in the literature. We describe the utilization of computer-assisted lateral UKA placement for lateral knee osteoarthritis with a valgus malalignment of 10°. Navigation allows for a dynamic intraoperative visualization of the mechanical axis, as well as for accurate component positioning and overall postoperative limb alignment. The systems allow the knee position to be captured with appropriate tension in extension and flexion prior to making definite cuts. Postoperatively, no instabilities occurred with a precise component placement. Navigation can be used in rare cases for lateral UKA.

Keywords: Navigation • Lateral unicompartmental knee arthroplasty • Computer assisted surgery • Knee kinematics

1. Introduction

The incidence of isolated lateral compartmental osteoarthritis of the knee is substantially lower than isolated varus gonarthritis. The relative infrequency of this diagnosis has resulted in a paucity of well-described techniques or outcome studies of lateral unicompartmental knee arthroplasty (UKA). It is estimated that only 5% to 10% of all unicompartmental knee replacements are performed for isolated lateral-compartment disease [1,2].

Although UKA for the medial or lateral compartment was introduced in the late 1960’s, the overall results have shown inferior longevity and reproducibility compared to conventional total knee arthroplasty (TKA). Furthermore, the outcomes of isolated lateral UKA have been inferior to those described after medial UKA [3,4]. Whereas short-term outcomes for cases of lateral UKA with a 5-year follow-up have reported to have an 89% survival rate, 10-year follow-up analysis has shown an overall survivorship of only 67% [3,5].

Although the precise cause of the relatively high failure rate of unicompartmental arthroplasty is not entirely known, it is believed to be multifactorial in nature. Improper patient selection and biomechanically unfavourable implant design have both been implicated. However, inaccurate implant positioning and secondary mechanical-axis malalignment appear to be the most common technical errors compromising the longevity of the implant [6,7]. Proper alignment of both implant
components has been shown to be the major limiting factor during medial UKA, accounting for early failure of the implant [8-10]. Proper restoration of the coronal axis has been shown to have the highest correlation with the survival of the prosthesis.

Whereas techniques for total knee arthroplasty typically use reliable tools for intramedullary or extramedullary mechanical alignment, most techniques for performing UKA require significant “freehand” surgical judgement due to limited or potentially inaccurate instrumentation. Furthermore, recent interest in minimally invasive procedures with limited visualization of the joint have created additional challenges for the surgeon in achieving accurate component position and limb alignment.

Recent technological innovations in medial UKA have included the use of computer-assisted navigation technology. Computer-assisted navigation has been shown to improve postoperative leg alignment compared to conventional techniques [11]. Navigation generally has been shown to increase the congruency of the planned-versus-achieved leg alignment in corrective lower-limb osteotomies and component positioning in TKA [12-15].

In this case report, we describe the novel application of computer-assisted navigation in the placement of a lateral UKA for valgus osteoarthritis. Dynamic intraoperative visualisation of the mechanical axis allowed for accurate component positioning and overall limb alignment postoperatively.

2. Patient and Technique

An 86-year-old woman presented to our clinic with refractory knee pain. Despite multiple attempts at nonoperative management, her walking distance was reduced to half a block, and she was unable to climb any stairs. Clinical examination revealed a moderate valgus malalignment of the limb. She was neurovascularly intact, with range of motion in the knee from full extension to 110° of flexion. The knee was focally tender to palpation along the lateral joint line. The lateral and medial collateral ligaments were intact to stress examination, and the valgus deformity was passively correctable to slight valgus limb malalignment.

Bilateral anteroposterior radiographs of the lower limbs were obtained preoperatively. The right knee demonstrated a 10° valgus deformity. Severe lateral compartment osteoarthritis including joint narrowing and subchondral sclerosis was appreciated (Figure 1). The medial knee compartment, however, appeared well-preserved. The patient was not in favor of total knee arthroplasty, and she desired the least potentially invasive procedure that would allow a rapid return to activity and function. The risks and benefits of unicompartmental knee arthroplasty were reviewed, and the patient elected to proceed with a lateral UKA.

2.1. Operative technique

After a combination of epidural and femoral-block anesthesia was administered, the patient was positioned supine, and the right lower extremity was prepared and draped in the usual sterile fashion. A commercial navigation system (BrainLAB, Heimstetten, Germany) including an image-free module for navigated unicompartmental lateral knee arthroplasty was used. Initially, two minimally invasive reference arrays were attached to the distal femur and the tibial shaft with two 3.0-mm Schanz screws. Registration of the mechanical leg axis is based on a pivoting mechanism of the hip to define the hip center. Percutaneous registration of the ankle joint was obtained with a navigated pointer tool. A 6-cm parapatellar lateral approach was performed, and the tibial plateau, tibial slope, distal lateral femoral condyles and proximal lateral ventral tibial shaft defined with the pointer-based palpation of predefined landmarks. On the basis of this data, the navigation system created an adapted bone model of the patient’s anatomy and determined the mechanical axis of the lower extremity. It subsequently recommended the appropriate distal femoral and tibial resections necessary to achieve accurate placement of the components (Preservation Figure 1. Preoperative radiographs of the 86-year-old patient.