Original Article

A New Method For Assessing Coronal Alignment of The Tibial Component in Total Knee Arthroplasty With an Intramedullary Rod

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Abstract

Background and Aim: Total knee arthroplasty (TKA) is the primary operative treatment for advanced knee osteoarthritis. Proper positioning of the femoral and tibial components is very important because malpositioning can cause undesirable results, such as implant loosening and persistent pain, and can compromise implant survival. **Methods:** A total of 200 patients who underwent unilateral TKA were evaluated for their coronal tibial alignments. Group A included the last 100 patients operated on before use of the technique described here, and Group B included the first 100 patients operated on after its implementation. The checking technique involved using an intramedullary rod to help assess the coronal alignment of the tibial components. If the measured angle between the tibial plateau surface and the intramedullary rod was not within 90° ±3°, then adjustment cuts were indicated to create an ideal tibial plateau surface. **Results:** Group B had a significantly lower rate of tibial coronal malalignment than Group A (5% vs. 28%, respectively; $P < 0.05$). Tibial plateau cuts of 17 patients were adjusted with this method in Group B, and the final coronal position of tibial plateaus were in the ideal limits (90 ± 3). **Conclusion:** The intramedullary rod checking method is a simple and effective technique for arthroplasty surgeons to assess final tibial component coronal alignment during TKA.

Keywords: Coronal tibial alignment, intramedullary rot, knee prosthesis

Received: 19th November, 2017; ***Revised:*** 14th December, 2017; ***Accepted:*** 24th December, 2017

Introduction

Total knee arthroplasty (TKA) is the primary operative treatment for advanced knee osteoarthritis. Proper positioning of the femoral and tibial components is very important because malpositioning can cause undesirable results, such as implant loosening and persistent pain, and can compromise implant survival [Figures 1 and 2].[1] Proper coronal, sagittal, and rotational alignments of both the femoral and tibial components are vital, but the coronal alignment of the tibia is the most important.[2-5] In many clinics, expensive navigation systems are used to minimize errors in TKA operations.

In this study, we describe a simple, inexpensive method of identifying inaccurate coronal tibial alignment associated with undesirable outcomes. We report on the use of an intramedullary rod checking method of assessing the final tibial component coronal alignment after surgical cuts have been made. To our knowledge, this is the first article to describe a method of checking tibial coronal alignment.

Access this article online

Quick Response Code:

Website: www.ijcep.org

DOI: 10.4103/ijcep.ijcep_59_17

Materials and Methods

Subjects

The study included 200 patients who had unilateral TKAs for knee osteoarthritis between 2013 and 2015. All knees were followed up postoperatively and reviewed retrospectively. Postoperative radiographs were evaluated for tibial component coronal alignment by a radiologist not otherwise involved in the study. The senior author performed all the operations, and the same knee prosthesis was used for all patients (Sistem, Konya, Turkey). Group A consisted of the last 100 patients who were operated on before we began to use the intramedullary rod checking method for tibial coronal alignment. Group B included the first 100 patients who were operated on with the new method being utilized.

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How to cite this article: Sigirci A. A new method for assessing coronal alignment of the tibial component in total knee arthroplasty with an intramedullary rod. Int J Clin Exp Physiol 2017;4:195-7.

Surgical methods

For tibial cuts, extramedullary cutting guides were used in the operations. Approximately 10 mm of tibial plateau bone was resected. The tibia surface was cut to be perpendicular to the shaft of tibia in the coronal plane with a posterior slope of 7°. An extramedullary guide was used in alignment with the tibial crest and the second toe. Tibial mechanical and anatomical axes coincide with each other. Factors that can affect the position of the tibial cutting guide during procedure preparation include mistakes in placing the guide by the surgeon, anatomical variations in the tibia, or unintended alignment changes during the pinning of the guide. Before we began to use the intramedullary rod checking method, 28% of the operated knees had varus or valgus alignment of the tibial components. This was a problem because it was associated with postoperative knee pain (from mild to severe) and patient dissatisfaction.

To help prevent poor outcomes, a final check of the coronal position of the tibial components using an intramedullary rod (such as used to drill the femur bone) was performed [Figure 2]. The intramedullary rod was placed to correspond with the anatomical–mechanical axis of the tibia. A sterile goniometer was used to measure the angle between the rod and the prepared tibial plateau. If the angle was less or >90°, then recutting of the tibial plateau with a cutting guide was performed to correct the tibial alignment [Figure 3]. Out of the 100 patients in Group B, final adjustment cuts were required in 18 patients. In each of these cases, intraoperative checking revealed that the intramedullary rod was not perpendicular to the cut tibial plateau surface [Figure 1], indicating that coronal alignment was not in the acceptable range. Adjustment cuts were made using a tibial block, and all 18 patients subsequently had perfect coronal tibial component alignment [Figures 2-4]. There were no varus or valgus coronal malalignments.

Postoperative radiograph review

Postoperative radiographs for patients from both Groups A and B were retrospectively investigated. The coronal alignment of the tibial component for all patients was examined by an independent radiologist who did not otherwise participate in the study.

Figure 1: Total knee arthroplasty in varus alignment

Figure 2: Collapse of the tibial plateau in the same knee

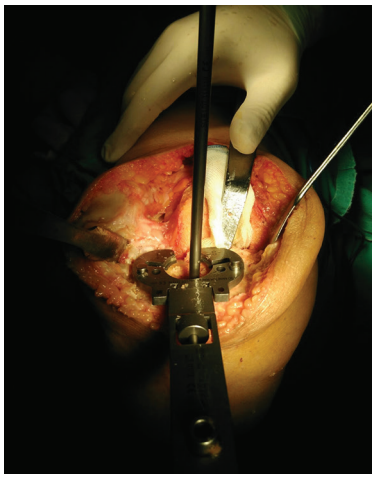

Figure 3: The intramedullary rod is not perpendicular to the tibial plateau; the tibial plateau cut is in valgus

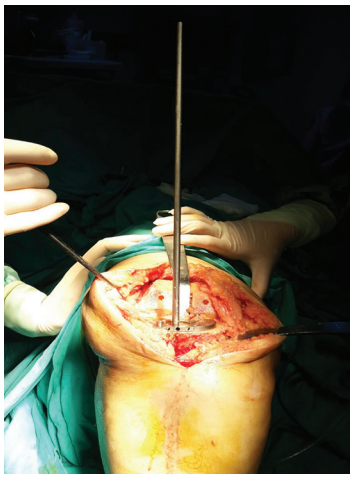

Figure 4: Following correction cuts, the cut tibial surface is perpendicular to the intramedullary rod, showing the ideal coronal alignment

Table 1: Coronal malalignment rate before and with use of the intramedullary rod checking method

	Varus	Valgus	Rate (%)	*P*
Before use of the checking method (*n*=100)	21	7	28	<0.01
Using the intramed-ullary rod checking method (*n*=100)	4	1	5	<0.05

Statistical analysis of data

Statistical analysis was used to compare the coronal malalignment rates for Groups A and B. The Mann–Whitney U and Kruskal–Wallis tests were used to compare group results. Data were considered statistically significant if $P < 0.05$.

Results

Postoperative radiographs were reviewed to determine tibial coronal alignment. From Group A, 28 patients had abnormal coronal alignments: 21 patients had tibial components in varus (mean varus angle, 11°), and 7 patients had tibial components in valgus (mean valgus angle, 7°). From group B, there were four cases of varus and one of valgus alignment; however, the mean deviation from 90° was only 3°, which was within the acceptable range.

Therefore, there were 28 malalignments in Group A, with an overall mean angle of 15°; whereas Group B had only five malalignments, with a mean angle of 3° [$P < 0.05$; Table 1]. These results show the effectiveness of the intramedullary rod checking method.

Discussion

Although neutral coronal, sagittal, and rotational alignments of the femoral and tibial components are vital, coronal alignment of the tibial component is most important for implant longevity.[1,2]

The consequences of TKA are determined by patient, implant, and surgeon factors. Proper positioning of the components is crucial for implant survival. Expensive navigation systems are used in many clinics to help eliminate errors during TKA operations. In this paper, we propose a simple, inexpensive method to detect mistakes in tibial coronal alignment. An intramedullary rod issued to help assess the final tibial coronal alignment. The goal is to have a 90° angle between the rod and the tibial plateau surface. In the literature, there are many articles showing the importance of tibial coronal alignment, but none offer a specific checking or correction method to achieve accurate alignment.

Kim *et al*. examined 3048 TKA knees. Of these, 2168 were neutrally aligned (90°) and did not need revision; however, out of 880 found to be in varus, 30 (3.4%) required revision. The high revision rate shows the importance of coronal alignment.[6] Berend *et al*. reported a statistically increased revision rate for cases with tibial components positioned at >3.9° of varus.[2] Ritter *et al*. also found an increased implant failure rate in knees with a varus tibia.[8] Howell *et al*. emphasized that it is most important for surgeons to cut the tibia perpendicular to the mechanical–anatomical axis of the tibia,[4] and Pagnano *et al*. also highlighted the importance of coronal alignment in TKA.[7] In addition, Fang *et al*. found that varus knees required three times more revisions than neutrally aligned knees.[3] All of these studies show the importance of neutral tibial coronal alignment. Our study found that the intramedullary rod checking method was very useful for achieving proper positioning: all patients that were operated on with its use had tibial coronal alignments within the acceptable neutral range of 90° ± 3°.

Conclusion

The intramedullary rod checking method is a simple and effective technique for arthroplasty surgeons to assess final tibial component coronal alignment during TKA.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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