

Is it Safe to Use a Six-Degree Distal Femoral Valgus Cut in All Genu Varus Patients with Total Knee Arthroplasty?

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Abstract

Background: During a total knee arthroplasty, it is common to make a distal femoral cut based on the femoral mechanical-anatomical angle (FMA), which in most patients is six degrees. However, in patients with a higher FMA, there is not yet a consensus between surgeons regarding the degree of the cutting angle.

Objectives: The aim of this study is to assess the treatment outcomes of patients with a FMA of more than seven degrees who were treated by distal femoral cuts of six degrees during a total knee arthroplasty.

Methods: We retrospectively reviewed the clinical and radiological results of patients who were treated at our center by a conventional valgus cut of six degrees during a total knee arthroplasty and had a FMA of more than seven degrees. A knee society score (KSS) was completed for all patients during follow-up visits.

Results: A total of 31 cases with knee osteoarthritis and a FMA of more than seven degrees were enrolled in this study. The cases consisted of 8 men and 23 women with an average age of 65.41 (range 46 - 77 years) (SD \pm 7.61) years and a mean follow-up time of 11.51 months (range 3 - 24 months) (SD \pm 6.08). The mean KSS was 148.51 (SD \pm 7.43), (range 132 to 167), which is considered good. There was a statistically significant relationship between the lateral distal femoral angle (LDFA) and FMA. However, there was not a statistically significant correlation between LDFA and KSS.

Conclusions: Although the overall alignment of the lower extremity in our patients was in varus, this amount of varus does not prove to have an effect on the outcome.

Keywords: Valgus Cut, Femoral Mechanical-Anatomical Angle, Total Knee Arthroplasty

1. Background

The main goal of a total knee arthroplasty after relieving pain is restoration of the mechanical alignment of the lower extremity. This can be achieved by making bone cuts perpendicular to the mechanical axis of the tibia and the femur (1). In the tibia, the bone cut is perpendicular to both mechanical and anatomical axes. In the femur, the bone cut is in the valgus position in relation to the anatomical axis of the femoral shaft, and the amount of valgus is dependent to the difference between the anatomical and mechanical axes of the femur. This difference is estimated based on pre-operative radiographs of the entire lower extremity.

In normal situations, this difference, which is called "femoral mechanical-anatomical angle" (FMA), is between five to seven degrees, but when there is femoral deformity, the difference may be higher. Most surgeons do not use distal femoral cut angles higher than seven degrees for these patients, leading to the lack of perpendicular position of components related to the mechanical axis. These

surgeons believe that such a small amount of malposition does not lead to a poor outcome of total knee arthroplasty.

2. Objectives

The goal of this study is to assess the outcomes of the patients with FMA of more than seven degrees who were treated by distal femoral cuts of six degrees during total knee arthroplasty.

3. Methods

This retrospective study was performed on 31 patients who were treated with a total knee arthroplasty. Inclusion criteria were: knee degenerative joint disease (DJD) requiring total knee arthroplasty (TKA), femoral mechanical-anatomical angle (FMA) of more than seven degrees, and a minimum follow-up of three months. All patients were treated by two fellowship trained knee surgeons. Alignment view radiographs, which are a standing full-length

hip to ankle radiograph, were taken from all patients before and after surgery (2). The center of the femoral head was identified using Mose's circles. The lower end of the femur was designated as the center of the intercondylar notch before surgery. This value is represented as the midway point between the two prosthetic condyles after surgery. The femoral mechanical axis is determined as the line connecting the center of the femoral head to the lower end of the femur. The anatomical axis is considered as the line that best represents the mid medullary axis of the distal femoral shaft. The angle between the mechanical axis and the anatomical axis is considered as the FMA. The angle between the mechanical axis and the lower end of the femur on the lateral side is considered as the lateral distal femoral angle (LDFA). This angle demonstrates the coronal malalignment of the distal femur before surgery, and the varus position of the femoral components after surgery (2).

For the surgical approach, anteromedial knee arthroscopy was used with a valgus cut of six degrees in all patients and all implants were cemented. All arthroplasties were performed using Zimmer Nexgen LPS (Warsaw, Indiana 46580 USA) and LCCK prosthesis in 27 and 4 patients, respectively. During each follow-up visit, the alignment view, LDFA, and knee society score (KSS) (3) were recorded. One fellowship trained knee surgeon, who was blind to the study, visited the patients, completed the KSS questionnaire, and also measured all angles, before, and after surgery.

Written consent was obtained from all patients in order to publish the results of their surgery. This study was approved by the ethical committee of our institute and conforms to the ethical guidelines of the 1975 Declaration of Helsinki.

4. Results

A total of 31 patients were included in this study consisting of 8 men and 23 women with an average age of 65.41 years ($SD \pm 7.61$) (range 46 - 77 years). The mean follow-up time was 11.51 months (range 3 to 24 months). The average body mass index (BMI) of the patients was 28.71 ($SD \pm 3.35$), (range 22.4 - 35.9). The average FMA was 8.64 ($SD \pm 1.05$) (range 8 to 12 degrees). The average LDFA in the postoperative period was 92.67 ($SD \pm 1.51$), (range 91 to 97) which represents the varus component.

Results of the patients are demonstrated using the KSS. The average KSS was 148.51 ($SD \pm 7.43$), (range 132 to 167), which is considered good. There was a statistically significant relationship between LDFA and FMA, which shows that overall alignment was in varus. However, there was not a statistically significant correlation between LDFA and KSS (Figure 1).

5. Discussion

The main goal of TKA surgery is relieving pain as well as making the joint line perpendicular to the mechanical axis of the lower extremity. This means that the joint line becomes parallel to the horizontal line, or that the central load-bearing axis passes through the center of the joint (4). This is important because when components are not placed perpendicular to the mechanical axis of the limb, malalignment is inevitable, which may lead to knee pain, instability, and in severe malalignment early failure of the prosthesis (5, 6).

The femoral mechanical-anatomical angle (FMA) is important in total knee arthroplasty. However, the average FMA differs between different races. In Chinese population the average FMA is 5.5 (4.7 to 6.2) (7). This ratio is equal to 8.5 degrees in healthy western adult population (8). In patients with knee osteoarthritis, the angles might be different. In varus knees the average FMA is 3.6 degrees, and in valgus knees 7.4 degrees (9). In a study performed by Mulla et al. the FMA was greater than seven degrees in 44.9% of cases (2).

In surgeries without navigation systems, the FMA is estimated to be five to seven degrees from the anatomical axis of the femur (10). Most surgeons routinely use a six-degree distal femoral angle cut during total knee arthroplasty. Although Kharwadkar et al. reported acceptable results with this method, Bardakos et al. showed that using a fixed amount of valgus cut is not able to achieve a normal mechanical axis for the lower extremity (11, 12). In our patients, the prostheses were not perpendicular to the mechanical axis, as the study by Bardakos et al., however the average KSS of our patients was good and similar to the results of the study by Kharwadkar, et al. Relying on a fixed amount of FMA has been shown to be unreliable in western populations (13). In another study it is shown that a five to six degrees valgus cut of the distal femur for an uncomplicated total knee arthroplasty is safe (11). The reasons for these different recommendations may rely on pre-operative deformities and racial differences. In our study we operated on patients with FMA of more than seven degrees, while in the mentioned studies FMA angles of less than seven degrees were also included.

In femurs with severe anatomical variations, FMA would be higher than usual. In these cases, if the distal femoral cut is made perpendicular to the mechanical axis of the femur, there would be a great amount of bone resection on the lateral side. For the ligament balancing in these cases, extra release of the medial soft tissue structures is needed, which leads to flexion instability (14). In another study valgus cuts based on FMA of each patient led to better limb alignment after surgery (15). In our patients due to

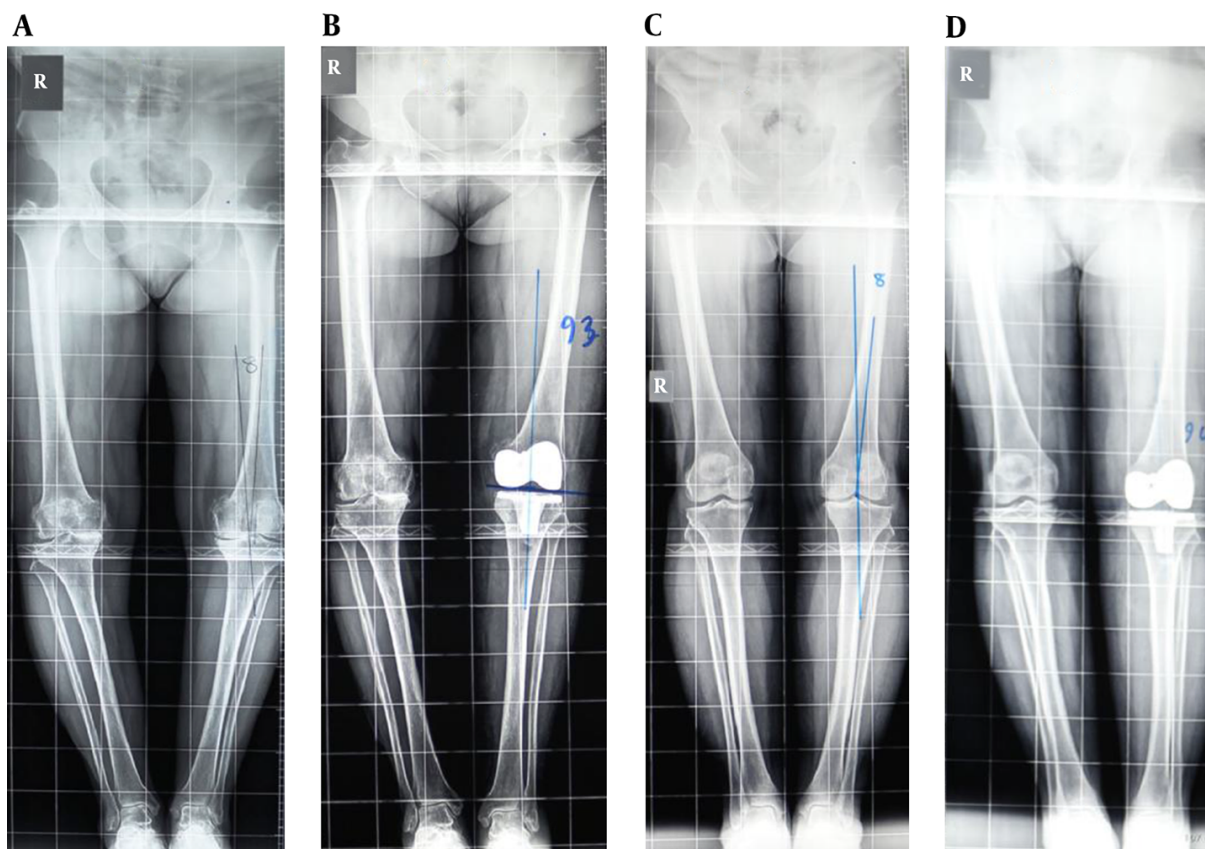


Figure 1. A, Femoral mechanical-anatomical angle (FMA) is 8 degrees before surgery; B, Lateral distal femoral angle (LDFA) is 93 degrees after surgery; C, FMA is 8 degrees before surgery; D, LDFA becomes 94 degrees after surgery.

high amount of FMA, and our concern about flexion instability, we used a six degrees valgus cut. Ligament balance was achieved in 27 patients, while it was not possible in 4 patients, in whom we used a constrained prosthesis. We assume that the reason for this ligament imbalance is the severity of pre-operative varus deformity, and not due to the amount of valgus cut.

Computer navigation has made the position of components more accurate in total knee arthroplasty (16). This equipment allows us to make distal femoral cut angle in the exact correct angle to the mechanical axis of the femur (17). New data show that the functional results of patients after surgery with or without navigation systems are equal (18). The short-term follow-up is the main limitation of this study, and we propose that longer-term follow-up studies be undertaken.

In conclusion, the results of our study show that although the routine use of a six-degree valgus cut in higher FMA leads to varus malalignment, the short-term functional results are positive and there is no instability during

this period. A valgus cut angle of six degrees of the distal femur in patients with higher amounts of FMA does not influence the short-term outcome of total knee arthroplasty.

Footnote

Authors' Contribution: Study design: Mehdi Moghtadaei, Hosein Farahini and Ali Yeganeh; data acquisition and analyses: Ali Shahsavari Poor, Alireza Askari, Sina Aminizadeh and Mehrdad Bahrabadi; draft and critical revision: Mehdi Moghtadaei, Hosein Farahini, Ali Yeganeh, Ali Shahsavari Poor, Alireza Askari, Sina Aminizadeh and Mehrdad Bahrabadi; study supervision: Mehdi Moghtadaei and Hosein Farahini

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