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An Investigation on Conventional Preoperative Planning in TKA

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ABSTRACT

Introduction: Alignment view before the total knee arthroplasty is a conventional study aiming to regulate tibia and femur vertical cuts perpendicular to the tibia and femur mechanical axes. This research examines how successful this method is in fulfilling this objective.
Materials and methods: This is a prospective descriptive research study carried out over 50 samples. The difference of the mechanical angles of tibia and femur was measured before and after the operation. The difference of mechanical and anatomical axes of femur was also measured and recorded before the operation. The difference of the posterior condylarline and trans-epicondyle was recorded during the operation.
Findings: The difference of the mechanical angles of tibia and femur before and after the operation was (Mean ± SD) 12 ± 7.1 and (Mean ± SD) – 0.08 ± 2.8 respectively. The difference of the mechanical and anatomical axes of femur before the operation was recorded at (Mean ± SD) 5.8 ± 2.1. The difference of the posterior condylar (line) and trans-epicondyle (axis) in distal femur was (Mean ± SD) 3.7 ± 1.7.
Conclusion: About 82% percent of studied knees were in the standard area after the operation. The difference of mechanical and anatomical axes of femur in each knee was different. The same is true about the posterior condylar line and trans-epicondyle in each knee.
KEYWORDS: Total Knee Arthroplasty, Femur Mechanical Axis, Tibia Mechanical Axis.

INTRODUCTION

The knee joint is one of the most complicated joints in body. It may be destroyed by osteoarthritis, arthritis, or rheumatoid arthritis and need to be replaced by a physician. The damaged knee is removed by operation and replaced by an artificial joint called prosthesis. Total Knee Arthroplasty is a reliable treatment for patients suffering from osteoarthritis (1, 2). Finding appropriate methods for correctly doing this operation results in satisfying results and reduces the need to repeat the operation and spend additional time and money. Moreover, it has a positive impact on the society (3, 4). Mechanical axis of the lower body was first introduced by Pauwels in 1983. This line is depicted in two frontal and sagittal views. In the frontal view from the center of femur, it connects to the center of the ankle joint, and it naturally passes from the middle of the knee joint. In the sagittal view, the axis goes to the center of ankle from the anterior of S2 placing in the back of femur. It naturally passes from the knee anteriorly (5). According to studies and as a standard, the best clinical results are achieved when the mechanical axes of tibia and femur relative to each other is about 0 ± 3° (6, 7). A research study examined the results of 50 alignment views of TKA and reported that 26 percent did not have a standard criterion (8). Zigo et al. (2009) found out that the acceptable alignment views were obtained for 87 percent of patients through this method. According to this case-referrent prospective study, this method was less valuable comparing with the computer assisted method (9). Batis et al. also revealed that 78 percent of patients are in the limit of 0 ± 3° (10). Findings have revealed that surgeons inclined to create more accurate methods to find the best point for removing the tibia and femur bones. Computer assisted method is a new tool for verifying the correctness of the operation (9). Using precise measurements, researchers are now trying to determine that how much the mechanical axis is modified after TKA and what percent of cases are in the standard limit. Of other research purposes is to find the mechanical axis of the lower body in TKA by radiology. Measuring the rotation of femoral part during the operation and determining the mechanical axis of tibia and femur is in the standard limit.

MATERIALS AND METHODS

This is a prospective descriptive research study carried between 2009 and 2010 over patients visiting Imam Hussein Hospital to replace their knee joint. Only those were studied that had been nominated for TKA due to primary and advanced osteoarthritis. Patients that needed TKA because of the revision or recent trauma or systemic diseases such as RA or hemophilia were eliminated. All participants were operated by a surgeon by MIS subvastus approach. This method had not been employed before. NexGen-LPS and PCL-Sacrifice were used. Intera-medullary and extra-medullary guide were used for femur and tibia respectively. All radiographies were carried out in one center and with a

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similar method. In the alignment view before the operation, the mechanical axis of femur was depicted from the center of Notch of distal femur to the center of femur head. The anatomical axis of femur was depicted from to median points of cortex of the two sides in metaphysis and central point in notch . The angle between them was also measured. The mechanical axis of tibia was depicted from the center point of plateau to the center of Plafond. Its difference with the mechanical axis of femur was measured and recorded. It was considered as the negative valgus and positive varus. The mechanical angle of the lateral distal femur (m LDFA) was drawn from a line touching the joint surface of distal femur. Its difference with the mechanical axis of femur was obtained. The medial proximal tibia angle (MPTA) was achieved from a line touching the joint surface of the proximal tibia. Its difference or the mechanical axis of medial tibia was measured. During the operation, the surgeon's observations about the difference angle of the line touching the surface of posterior distal femur and the line between two medial epicondyle and lateral distal femur was measured and recorded with a specialized measure. The soft tissue was balanced after distal femur cut and the proximal tibia in the extension. One week after the surgery, the difference of the mechanical axes of femur and tibia was measured in an alignment view. Each patient's observations were gathered and recorded in a specific form. As the digital radiography was not available for all patients for measuring angles, the conventional method with goniometer was used. Data were analyzed by SPSS v. 16.

RESULTS

In this research, 50 of the related angles were achieved. The difference of mechanical axes of femur and tibia before the operation was (Mean ± SD) 12 ± 7.1. The range varied from 5 ° valgus to 26° varus. The difference of mechanical axes of femur and tibia before the operation was 5.8 ± 2.1 (Mean ± SD). The range varied from 3 ° to 10° (see Fig. 1).

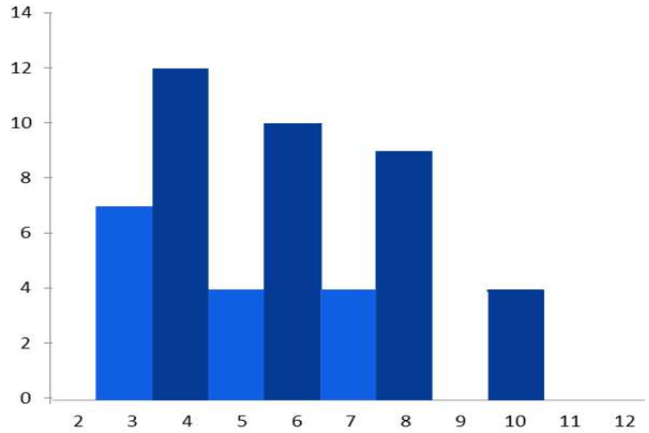

Fig. 1 the frequency of the difference of mechanical and anatomical axes of femur before the operation

The difference of mechanical axes of femur and tibia after the operation was (Mean ± SD) -5.8 ± 2.8. The range varied from 6 ° to 7° (see dig. 2).

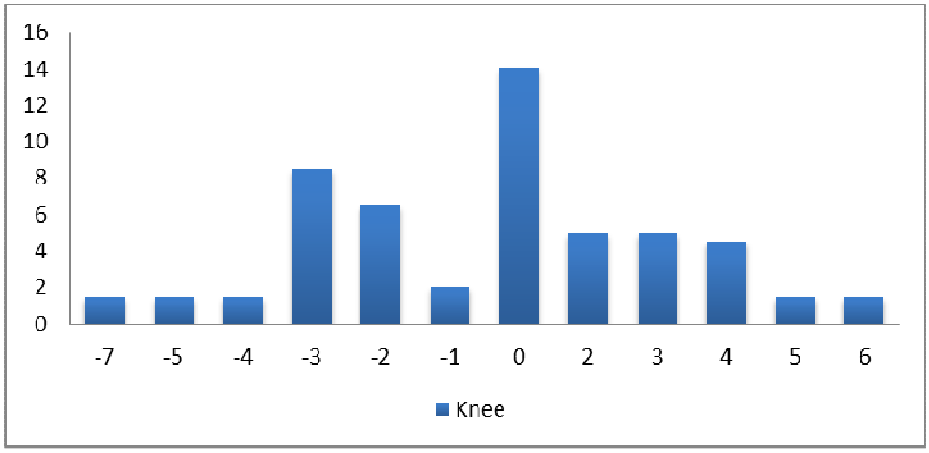

Fig. 2 the frequency of normal alignment deviation postoperatively

Postoperatively the lateral distal femur angle (m LDFA) was (Mean ± SD) 90.5 ± 2.08. The medial proximal tibia angle (mMTPA) was (Mean ± SD) 88.7 ± 2.6. The difference of the line touching the surface of posterior condylar

distal femur and the of epicondylar line was (Mean ± SD) 3.7 ± 1.7 ranging from 0 to 10°. In all cases, the epicondylar line was in parallel with tibia cut (see dig. 3).

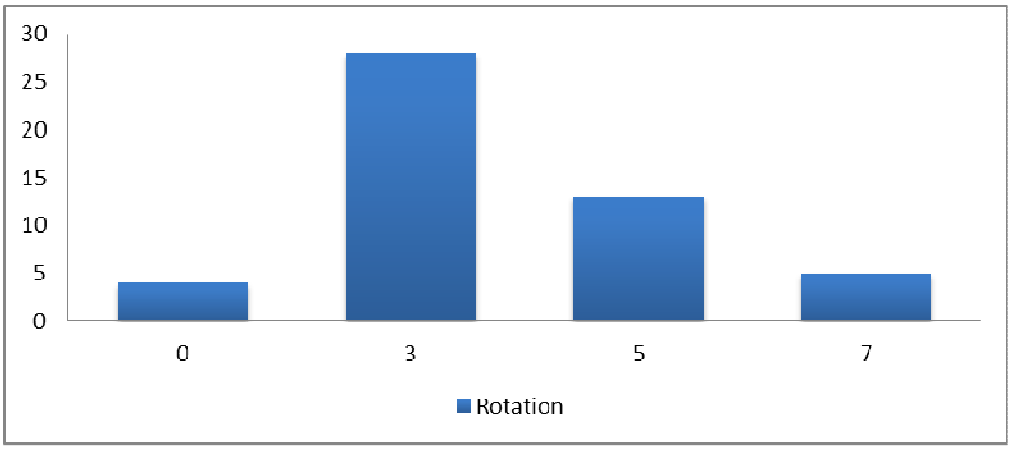

Fig. 3 the frequency of the difference of the posterior condylar distal femur and the line of epicondylar

The balance of soft tissue in the extension was over the third degree in most patients. 18 percent of knees after the operation were out of the standard range of Varus and Valgus (0 ± 3).

DISCUSSION

By 1998, the conventional method was an acceptable and standard method before the computer assisted method became a common technique to do distal femur and proximal tibia cuts in knee joint replacement. These two methods have been widely studied. Results show that using the computer assisted method presents better results (in the standard range of 0 ± 3) (10-12). The computer assisted method aims to raise the survival of prosthesis and clinical improvement. This results is not good responsiveness when the operation time and the length of cut increase (4, 8, and 13). Our study showed that improving the measurement precision of the conventional method developed the proficiency in surgery, as the results of conventional method and the computer assisted method are comparable. As the computer assisted method has not been promoted in Iran, the conventional method is done in high precision. In this research, the main problem is in putting the tibia part. The reason is that inter-medullary and extra-medullar leading systems are not as much precise. This affects the alignment and raises the error coefficient. In all cases, the difference of the mechanical and anatomical axes of femur was not constant. The standard 6° difference is not followed and any case should be separately determined during the alignment view before the surgery so that the distal femur cut is done perpendicular on the mechanical axis of femur which is targeted for replacement. Many research studies have been conducted in this regard some which are referred to here. In 2009, David Fange studied 6070 knees of 3992 patients with TKA. He intended to consider the mechanical axis as a predictor for additional surgeries. According to results, the best rate of prosthesis survival in alignment is between 7.2 and 7.4 Valgus. Results also indicated that the Valgus knee was not successful because of ligament instability. The reason of failure was primary Varus medial tibia knee (14). Zigo et al. (2009) compared the computer assisted surgery and the conventional method. According to their findings, 94 percent of patients from the group under the computer assisted surgery (1.51 ± 1.34) were in the range of 0 ± 5° Valgus. In the group under the conventional surgery method, however, 87 percent of patients (2.12 ± 1.350) were in the range of 0 ± 5° Valgus (9). Parratte et al. (2010) conducted a retrospective research study over 398 patients had had a surgery from 2006 to 2011. They reported that the mechanical axis before the surgery had been between 6 ± 8.8 (from 30 ° Varus to 22° Valgus). But after the surgery, the average mechanical axis changed into 0 ± 2.8° (from 8° Varus to 9° Vulgus). They finally stated that after the surgery, 292 knees were in the standard range (0 ± 3°) and 106 knees were not in this range (4).

Conclusion:

About 82% percent of studied knees were in the standard area after the operation. The difference of mechanical and anatomical axes of femur in each knee was different. The same is true about the posterior condylar line and trans-epicondyle in each knee. Results from this study revealed that in case of using posterior condylar line, it cannot be regulated in all cases on 3° external. Using several methods simultaneously increases the precision of the rotation of femur part.

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