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Evaluation of outcomes based on femoral component rotation in patients undergoing knee replacement surgery at Baqiyatallah University of medical science

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ABSTRACT

Introduction and Purpose: Knee arthroplasty is a common surgical procedure and knee joint replacement is a widely used intervention in the management of osteoarthritis. In elderly patients, the walking pattern may change due to arthritis and underlying diseases, which causes functional limitations. Various studies show that the correct rotation of the components in Total Knee Arthroplasty (TKA) by affecting the tibiofemoral and patellofemoral kinematics may affect the patient's performance after surgery and various studies have shown that the malrotation of the femoral component clinically by affecting the tibiofemoral and patellafemoral kinematics affects the patient's satisfaction after surgery, surgery is effective. This study aims to a study of the results of total knee joint replacement surgery based on rotation of the femur fragment was carried out at Baqiyatullah University of Medical Sciences.

Materials and Methods: This study was conducted as a retrospective cohort. With the census sampling method, all patients who underwent knee surgery in 1400 at Baqiyat Elah Azam Hospital were included in the study. The inclusion criteria included: patients with severe osteoarthritis with involvement of at least two compartments, who underwent UC TKA by Aescolap company. were placed and the exclusion criteria included: people with vascular disorders and underlying diseases (diabetes, neurological diseases, psychological diseases, collagen diseases, radiculopathy disability).

In the next stage, after obtaining permission and receiving the code of ethics from the university, the researcher was introduced to the medical records unit, then the information of the patients who underwent knee joint replacement surgery was extracted, and the patients were divided into two groups based on fixed femoral component rotation and also variable femoral component rotation and then the WOMAC questionnaire was completed by contacting the patients. Finally, all information was entered into SPSS version 22 and analyzed.

Results: In this study, 22 (26.2%) male patients and 62 (73.8%) female patients were studied. The average age of patients in the fixed group was 63.61 years ± 6.06 years and in the variable group was 65.54 years ± 4.26 years. In general, no statistically significant difference was found between the average age of patients (p=0.096) and the gender distribution of patients (p=0.620) between the two fixed and variable groups. The results of the WOMAC test in the initial follow-up of the patients showed that the pain score, the physical function score, and the WOMAC questionnaire score in general were significantly higher in patients with a fixed component than in the group with a variable component (p<0.005), also ,there was no significant difference in Joint stiffness.

Conclusion: Our study showed that malrotation of the femoral component has a clinical effect on the patient's satisfaction after surgery by affecting the tibiofemoral and patellofemoral kinematics, the increase in the prevalence of TKA highlights the increasing need for proper evaluation of the postoperative result. It increases the satisfaction and function of the patients from surgery. The correct selection of rotation of the femoral prosthesis in a variable manner (according to each person) based on the surgical transepicondylar line improves physical function and reduces pain after surgery compared to the selection of rotation of the femoral prosthesis in a fixed manner based on the posterior condylar line.

Keywords: knee joint, WOMAC, femur

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INTRODUCTION

Osteoarthritis of the joints accounts for more than half of the problems of people over 65 years old. It is estimated that worldwide 40% of people over 70 years of age suffer from knee arthritis, there are different treatment methods for this problem, including drug treatment, lifestyle changes, weight loss, crutches, muscle strengthening, It is from the heel and surgical methods such as arthroscopic debridement and osteotomies [1]. All these methods have a palliative effect and only delay the course of the disease, but knee joint replacement is one of the final solutions for knee diseases with joint destruction and clinical symptoms of pain, deformity and movement limitation [2]. Modern knee Arthroplasty began in the early 1970s with the development of the condylar knee prosthesis. The lifespan of this type of prosthesis for 53 years to 56 years is about 37% and it is considered one of the most successful orthopedic surgeries. The main indication for knee joint replacement is to relieve severe knee pain with or without deformity [3]. The comparison of knee joint replacement with other treatment methods for knee osteoarthritis shows that the quality of life is increased and the pain is relieved for many years after joint replacement, considering its treatment costs, it is significantly superior to other methods [4]. Since knee joint replacement is a vast surgical procedure, it requires multifaceted evaluations and detailed investigations before and after surgery to obtain the best results [5]. A longer lifespan leads to the development of osteoarthritis in the elderly, and the elderly are significantly affected by osteoarthritis. Knee arthroplasty is a common surgical procedure when an prosthesis is transferred to the knee due to altered biomechanics for walking, sometimes causing failure in the function of the prosthesis. In elderly patients, the walking pattern may change due to arthritis and underlying diseases, which causes functional limitations. Different studies show that the correct rotation of components in TKA by affecting tibiofemoral and patellofemoral kinematics may affect the patient's performance after surgery, and different studies have shown that femoral component malrotation clinically affects tibiofemoral and patellafemoral kinematics. It is effective on the satisfaction of the patient after surgery and the performance of the patient. Malrotation causes an unacceptable number of defects in knee joint replacement, and the geometry of the proximal tibia and distal femur is related to the biomechanics of the tibiofemoral and patellofemoral joints. The position and size of the components are widely It affects the results after the operation and any malrotation affects the tension and ligaments, which causes unfavorable kinematic behavior such as stiffness and instability and premature loosening of the prosthesis, and the correct rotation of the femoral component affects the stability of flexion and kinematics of the patellofemoral joint. and tibiofemoral effect and the relationship between femoral component rotation and patellofemoral joint stability is determined in the early days of knee joint replacement, the correct rotation of components in knee joint replacement greatly affects the postoperative results [6, 7]. The correct rotation of the femoral component in knee joint replacement has a significant effect on patellofemoral balance and kinematics [8]. Excessive internal and external rotation of the femoral component is associated with poor results and defective knee replacement surgery [9]. Wrong rotation of the femoral component is associated with pain and patellar maltracking and poor treatment results and in clinical malrotation of the femoral component in knee joint replacement is associated with dissatisfaction and dysfunction of the patient [9-11]. There are several criteria for assessing physical performance in arthritis, The WOMAC criteria can be an objective method for performance evaluation. Knee joint replacement is a widely used intervention in the management of osteoarthritis. Also, the increase in the prevalence of TKA requires a proper evaluation of the postoperative result. It highlights the WOMAC criterion, a tool used by specialists to evaluate knee function after TKA. This study aims to a study of the results of total knee joint replacement surgery based on rotation of the femur component was carried out at Baqiyatullah University of Medical Sciences.

MATERIAL AND METHOD

This study was conducted as a retrospective cohort. With the census sampling method, all patients who underwent knee surgery in 1400 at Baqiyat Elah Azam Hospital were included in the study. The inclusion criteria included: patients with severe osteoarthritis with involvement of at least two compartments, who underwent UC TKA by Aesculap Company. Were placed and the exclusion criteria included: people with vascular disorders and underlying diseases (diabetes, neurological diseases, psychological diseases, collagen diseases, and radiculopathy disabilities). In the next stage, after obtaining permission and receiving the code of ethics from the university, the researcher was introduced to the medical records unit, then the information of the patients who underwent knee joint replacement surgery was extracted, and the patients were divided into two groups based on fixed femoral component rotation and also variable femoral component rotation was divided and then the WOMAC questionnaire was completed by contacting the patients.

All patients were followed up for two years and the interval between two follow-ups was one year. Finally, all information was entered into SPSS version 22 and analyzed. The tool for collecting information in this study was the WOMAC questionnaire. This questionnaire consists of 3 parts. In each of the sections, the person is asked separately about the amount of pain, joint stiffness and disability during the last 48 hours while performing daily activities. WOMAC functional questionnaire includes: 5 questions for pain level, 2 questions for joint stiffness and 17 questions for the patient's physical function. Scoring in this questionnaire is as follows: not at all: 0, little: 1, moderate: 2, high: 3, too much: 4, for each question there are five options, the answers are scored from 0 to 4 and the total score is from 0 to 96. The number zero indicates no problem and the number 96 indicates the maximum problem. A decrease in the WOMAC score is a sign of improvement. The result obtained in each subgroup is expressed as a quantitative value in five WOMAC subgroups. This questionnaire has been translated and localized in Persian language in Iran, and its Persian version has been confirmed in terms of repeatability in various studies. Finally, all the information was entered into SPSS software version 22 and reporting for quantitative descriptive statistics was expressed in the form of mean ± standard deviation. And qualitative descriptive statistics were expressed as frequency and percentage. The comparison between quantitative variables was done using t-test if normal distribution was established and Mann-Whitney test if non-normal distribution was established. Comparison between qualitative variables was also done using Chi-square test or Exact Fisher test. All analyzes were performed considering α equal to 0.05 as a significant level. Statistical analysis

was done using SPSS 22 software.

RESULTS

In this study, 22 (26.2%) male patients and 62 (73.8%) female patients were studied. The average age of patients in the fixed group was 63.61 years ± 6.06 years and in the variable group was 65.54 years ± 4.26 years. In general, no statistically significant difference was found between the average age of patients (p=0.096) and the gender distribution of patients (p=0.620) between the two fixed and variable groups. The results of the WOMAC test in the initial follow-up of the patients showed that the pain score, the physical functions score, and the WOMAC questionnaire score in general were significantly higher in patients with a fixed component than in the group with a variable component (p<0.005) (Table 1).

Tab. 1. Review and comparison of WOMAC questionnaire scores and its subscales between two groups with fixed and variable components in primary and secondary follow-ups

Variable	WOMAC	Group		p-value
		Fixed	Variable	
Primary follow-up of patients	Pain score	1.26 ± 1.2	0.79 ± 0.64	0.007
	Joint stiffness score	0	0.3 ± 0.071	0.179
	Physical function score	4.59 ± 1.9	2.5 ± 1.5	0.001
	The overall score of the WOMAC questionnaire	5.85 ± 2.72	3.2 ± 1.9	0.001
Secondary follow-up of patients	Pain score	2.26 ± 1.23	1.64 ± 0.75	0.001
	Joint stiffness score	1.07 ± 0.26	1.14 ± 0.47	0.393
	Physical function score	5.59 ± 1.93	3.54 ± 1.59	0.001
	The overall score of the WOMAC questionnaire	8.92 ± 2.73	6.33 ± 1.95	0.001

DISCUSSION

For a Total Knee Arthroplasty (TKA) a correct limb alignment, with good joint kinematics, without pain and long-term survival is required. One of the important steps in a good TKA is the correct measurement and alignment of the femoral components in three dimensions, mainly in the sagittal plane, with rotational alignment in mind. Rotational alignment creates the symmetry of the flexion gap, which is key to obtaining a knee is stable in the entire range of motion and has a correct joint kinematics [12, 13]. Any incorrect association with inappropriate flexion gap leads to varus or valgus instability during knee flexion and especially in mid-flexion [14, 15]. It leads to pain. The knee with medial laxity is painful in flexion (valgus stress), while lateral laxity is slightly more tolerated (in varus stress) [16]. Symptomatic laxity can lead to early failure of the prosthetic implant. Several articles emphasize the harmful effect of internal rotation of femoral components, which leads to valgus alignment during bending, with mechanical overload on the inner side of the joint and as a result implant failure [17]. The rotational alignment of the femur components also affects the correct patella traction. Incorrect positioning of the femur components in internal rotation leads to patellofemoral complications along with anterior knee pain syndrome and misbehavior that causes patella subluxation and even patella dislocation) [18, 19]. There are several indications and references to obtain a correct alignment [20-22]. In this study, we described the alignment of the femoral component. Despite everyone being convinced of the clinical importance of correct rotational alignment, there is still no single accepted surgical procedure that leads to superior results. The results showed that pain, physical function and WOMAC score in general in the group of patients with variable femoral component rotation (0°-9°) were higher than in the group with fixed (3°) femoral component rotation. But the results of other studies in this field were that Zhao and his colleagues conducted a study with the aim of analyzing the effect of femur rotation on the dynamic alignment of the lower limb in TKA, seventy-six consecutive patients with knee osteoarthritis in the final stage were included in the study. . External rotation osteotomy of the distal femur during TKA was completed according to preoperative External Rotation Angle (ERA), intraoperative Transepicondylar Axis (TEA), and Anteroposterior (AP) line. Passive dynamic alignment of the lower limb during knee flexion was recorded. The trend of Hip-Knee-Ankle (HKA) alignment changes and the effects of femoral external rotation osteotomy were analyzed. The result of the study showed that the external rotation osteotomy of the distal femur played an important role in determining the dynamic level of HKA in TKA [23]. Palit and colleagues performed a prospective observational study to compare functional outcomes after total knee arthroplasty among subjects with and without rotational malalignment. They studied 396 patients (with 709 knees with Kellgren-Lawrence grade 4 osteoarthritis) who underwent total knee arthroplasty at a tertiary care hospital, with 2 years-3 years of follow-up. A postoperative axial CT scan was obtained to estimate the rotational alignment of the femoral and tibial components. Internal and external rotation of the components were measured with software to estimate combined external rotation, combined internal rotation, or component misalignment, according to which knees were grouped into two groups: with rotational misalignment or with normal alignment. The functional outcome was evaluated using knee community score, Oxford knee score, knee community pain score, lower limb functional scale and general health questionnaire [9]. The results of the study showed that rotational misalignment of the components is almost always associated with a poorer outcome of total knee arthroplasty. It appears with anterior knee pain or incomplete functional recovery compared to knees with a normal state [24]. Mirza Taloui and his colleagues conducted a study with the aim of investigating the degree of outward rotation of the femur in knee joint replacement in patients with severe varus, 42 patients with severe varus were randomly divided into two groups: TEA (group 1) and PCL (group 2). and the amount of rotation of the femoral part was determined in group 1 by TEA method and in group 2 by PCL method. Corrosion rate of medial femoral condyle was recorded during operation. After 12 months, a CT scan was performed for the patients and the angle between the posterior limit of the metal condyle, the metal condyle of the femoral

prosthesis and the axis between the condyle was measured in two groups. The degree of knee flexion in the two spheres was compared and after one year the WOMAC questionnaire was completed for the two groups and the results were compared. The conclusion of this study showed that despite the absence of twisting of the medial femoral condyle, the use of TEA produces more external rotation than PCL in severe varus patients [16]. Rotational balance for a good functional result and long-term success of Total Knee Arthroplasty (TKA) is important. Misalignment can cause patellofemoral complications such as subluxation, dislocation and wear. In addition, abnormal internal or external rotational alignment has been reported to cause instability, implant loosening, and unexplained painful total knee arthroplasty. To determine accurate rotational alignment for femoral and tibial components, several studies have already been performed, discussing the advantages and disadvantages of different methods. Combining knowledge from these multiple sources and the different methods used can reduce component rotation in TKA. Results of a review study showed that rotational alignment is important for a good functional outcome and long-term success of TKA. To accurately determine the rotational alignment of femoral and tibial components, various studies have already been performed, which also discuss the advantages and disadvantages of the methods. Combined knowledge obtained from multiple sources and different methods can reduce component turnover in TKA [25]. Based on Thomas Heise's study in 2018, on six fresh cadavers, three movement patterns were examined on the normal knee and the knee under PS TKA, which included passive movement, Open Chain Extension and Squatting, and infrared cameras showed the paths of the markers connected to the femur and tibia. recorded that three femoral prostheses were tested, which included the common PS femoral component and the femoral component with 5° of internal and external rotation, in the PS TKA prosthesis, in the squat movement (33°-70°), the internal rotation of the tibia was low, and the internal condyle of the femur was towards the posterior It moved especially in high flexion (squat 111°-84°). The femoral component in 5° of internal rotation causes internal rotation and abduction of the tibia in flexion (squat 111°-33°) and the rise of the medial condyle (111°-43°) and Medial condyle advancement (126°-61° passive movement) and posterior and inferior lateral condyle (111°-73° squat) were more common than TKA. The external rotation of the femoral component causes a little internal rotation and adduction of the tibia (squat 33°-111°) and the medial condyle is more towards the posterior (59°-97°) and the lateral condyle is more towards the superior (54°-105°) compared to TKA in the newer state. Finally, it was concluded that there is a big difference in the tibiofemoral kinematics in the internal rotation of the femoral component and in the neutral state, and the tibiofemoral kinematics in the external rotation state and in the neutral state are different, but this difference is less compared to the internal rotation of the femoral component and internal rotation should be avoided during PS TKA [11]. Based on the study of Jerome Morgir in 2022 on 287 cases of TKA, the angle between the posterior femoral cut and the posterior condylar axis was collected using Brainlab software. Functional scores were collected in two years. Femur rotation varied from 7° of internal rotation to 8° of external rotation relative to the posterior condylar axis. The average rotation was 1.1° of external rotation. No significant difference was observed in Oxford Score, WOMAC Score, Forgotten Knee Score, KOOS Joint Replacement Score, and patient satisfaction in variable femur rotations compared to Posterior Condylar Axis [9]. According to the study of Carl Jones in 2016 on one hundred and eight TKA knee replacement surgeries including 59 men and 49 women with an age range of 93 years-35 years, 91% of patients with femoral valgus between 5° and 7°, significant difference in mal tracking and ROM Not considered [26]. According to Sharma et al., 2017 study on the role of CTA calculation by preoperative CT scan on the improvement of femo-ral component rotation during TKA in 53 TKAs with an age range of 49 years to 78 years, preoperative and postoperative CTA size was taken and it was concluded that the rotation of the femo-ral component was parallel to a TEA with an average error of 0.77% and the average angle between sTEA and aTEA was four and sixty five hundred percent and it was concluded that the cal-culation of CTA by means of CT scan before the operation is im-proved and idealizing femoral component rotation during TKA. According to Roland Becker et al.'s study in 2019 on 88 patients with PS TKA whose femoral component had 3° of external rota-tion compared to PCL, WOMAC, KSS, SF-36 and range of mo-tion criteria six and twenty-four months after surgery were investi-gated. They came to the conclusion that after six and twelve months in the Womac criterion, physical performance had a sig-nificant relationship with the rotation of the femoral component, but no significant relationship was observed with the range of mo-tion (r=0.004) as confirmed by the results of our study.

CONCLUSION

Our study showed that malrotation of the femoral component clinically affects the patient's satisfaction after surgery by affecting the tibiofemoral and patellofemoral kinematics, the increase in the prevalence of TKA highlights the increasing need for proper evaluation of the postoperative result, the satisfaction and the function of the patients. The correct selection of the rotation of the femoral prosthesis in a variable manner (according to each person) based on the surgical transepicondylar line improves the physical function and reduces the pain after surgery compared to the selection of the rotation of the femoral prosthesis in a fixed manner based on the posterior condylar line.

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