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Original Research Article

Assessment of Post-Operative Knee Range of Motion in Total Knee Arthroplasty in Relation to Preoperative Hip Range of Motion

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Abstract:

Background: Total knee arthroplasty (TKA) is one of the best surgical treatments for people with end-stage knee osteoarthritis (OA) because it relieves discomfort and helps them move around again. The range of motion (ROM) of the knee after surgery is a very important feature that affects how happy patients are. There has been a lot of research on preoperative factors such body mass index (BMI), tibiofemoral angle, and preoperative knee ROM. However, it is still not obvious how beforehand ROM affects postoperative knee flexion hip.

Aim: To find out how preoperative hip ROM affects knee flexion three months after surgery in people who have main TKA.

Methodology: This study was done at the Department of Orthopaedics at Justice K.S. Hegde Charitable Hospital in Mangalore from September 2022 to April 2024. We looked at 23 patients with primary knee OA who were having TKA. Before the surgery, they measured the hip and knee ROM, BMI, serum albumin, HbA1c, and tibiofemoral angle. Three months after the operation, the knee flexion was assessed. We used SPSS software to do statistical analysis and Spearman's correlation to find connections.

Results: The average knee flexion three months after surgery was 94.78° ± 8.46°. There were strong negative relationships between BMI ($r = -0.475$, $p = 0.022$) and tibiofemoral angle ($r = -0.421$, $p = 0.046$) and knee flexion after surgery. Preoperative hip flexion and postoperative knee flexion had a moderate positive connection ($r = 0.406$, $p = 0.054$), which was close to being statistically significant. There was no significant link between other hip motions, age, serum albumin, or HbA1c and surgical outcomes.

Conclusion: Hip flexion before surgery may affect knee flexion after TKA, which means that hip mobility should be taken into account during the preoperative evaluation. BMI and the tibiofemoral angle are still crucial factors that can help predict how much range of motion the knee will have after surgery. More research with bigger groups is needed to confirm these results.

Keywords: Total Knee Arthroplasty, Hip Range of Motion, Knee Flexion, Body Mass Index, Tibiofemoral Angle.

Introduction

Total knee arthroplasty (TKA) is one of the most common orthopaedic surgeries in the world, especially for people with end-stage knee osteoarthritis (OA). Over the past 20 years, TKA has become a very successful surgery, with long-term survival rates of about 95% [1]. The surgery not only helps with a lot of pain, but it also tries to restore functional mobility so that patients may do basic daily tasks [2]. Patients in various Asian and Middle Eastern nations who get TKA surgery generally hope to be able to bend their knees deeply again after the surgery so they can do traditional activities like squatting and sitting cross-legged [3].

Getting a good range of motion (ROM) after TKA is very important for patient satisfaction and functional results [4]. For example, it is usually thought that you need to be able to bend your knees at least 110° in order to comfortably do things like climb stairs and get up from a seated posture [5]. However, many things affect the amount of knee ROM after surgery, such as the amount of knee ROM before surgery, the patient's body mass index (BMI), age, gender, surgical technique, prosthesis design, and things that happen during the surgery, like the slope of the tibia, the offset of the posterior condyle, and the balancing of the ligaments. Preoperative knee ROM has always been one of the best ways to predict how well

the knee will flex after surgery [6]. There is a lot of research on different factors that can affect knee ROM after surgery, but not much has been done to look into how the range of motion in the ipsilateral hip joint might affect knee results [7]. New research suggests that the way the hip and knee joints work together, like in hip-spine syndrome and knee-spine syndrome, may have a big effect on how the joints line up, how the load is spread out, and how well people can move after lower limb procedures [8]. Limited hip range of motion, especially in flexion and abduction, might change how you walk and limit how much knee range of motion you can get after surgery. As more and more people with both hip and knee problems have TKA surgeries, it is becoming more important for doctors to understand how these two conditions affect each other [9].

Another problem for doctors is that TKA patients' early postoperative recovery paths can be significantly different from each other. Finding preoperative indicators of poor knee ROM can help create individualised rehabilitation plans, improve patient counselling, and make patients happier with the results of their surgery [10]. While previous studies have consistently shown that BMI, tibiofemoral angle, and preoperative knee ROM are important predictors, the function of preoperative hip ROM is still not well understood [11].

So, the current prospective observational study was done to look into the link between hip ROM before surgery and knee flexion three months after TKA [12]. The study's goal is to help improve the preoperative diagnostic methods and postoperative rehabilitation strategies for TKA patients by making this association clearer. It also wants to fill in a major vacuum in the literature and lay the groundwork for future research that looks at how biomechanical interactions between adjacent lower limb joints affect joint arthroplasty.

Methodology

Study Design: The Department of Orthopaedics at Justice K.S. Hegde Charitable Hospital, which is part of K.S. Hegde Medical Academy, a unit of Nitte University, Deralakatte, Mangalore, India, did this study. It was a prospective observational study.

Study Duration: The study was conducted over a period of 20 months, from September 1, 2022, to April 30, 2024.

Sample Size: A total of 23 patients who underwent primary total knee arthroplasty (TKA) were included. The sample size was calculated based on a prior study by Naoki et al. [22], assuming a 95% confidence level, a standard deviation of 7.2 degrees for postoperative knee flexion angle, and a margin of error of 4.3 degrees. The estimated sample size was 23.

Inclusion Criteria

- Patients with primary osteoarthritis of the knee undergoing TKA

Exclusion Criteria

- Patients undergoing TKA for valgus deformity of the knee.
- Patients undergoing simultaneous bilateral TKA.
- Patients with a history of surgery on the ipsilateral knee or hip.
- Patients with severe bony defects requiring bone grafting or augmentation.
- Revision TKA cases.
- Patients undergoing TKA for indications other than primary osteoarthritis.
- Patients with active knee joint infection.

Procedure: Before the surgery, all of the patients in the study had a full clinical evaluation. Before surgery, the doctors measured the range of motion (ROM) in the knees and hips, the body mass index (BMI), the serum albumin, the HbA1c, and the tibiofemoral angle. We used Kellgren-Lawrence grading on weight-bearing knee X-rays to figure out the osteoarthritis grade. A goniometer was used to measure the range of motion in the knees and hips while the patient was lying down. The angle between the anatomical axes of the femur and tibia was used to figure out the tibiofemoral angle. All of the surgeries were done by the same surgeon, and all of the patients followed the same rehabilitation plan after the surgery. Three months after surgery, we measured how much the knee could bend.

Statistical Analysis: We put all the data into Microsoft Excel and used SPSS to look at it. We produced descriptive statistics for all the variables that explained and the outcomes. Mean and standard deviation were used to show continuous variables like knee flexion and hip ROM. We used Spearman's correlation coefficient to look at how preoperative factors affected knee flexion three months after surgery. A p-value of less than 0.05 was thought to be statistically significant.

Result

There was a lot of variation in a number of clinical and demographic factors when patients were assessed before and right after knee surgery. The average amount of knee flexion before surgery for the 23 patients was 94.13 degrees, with a range of 60 to 130 degrees. This shows that the patients had different amounts of mobility before surgery. Hip flexion was generally well preserved, with an average of 100.87 degrees. On the other hand, hip extension was very limited, with an average of only 0.87 degrees. The average range of hip abduction and adduction was almost the same (38.26 degrees), but adduction showed a little more variation.

Internal and external hip rotations were likewise limited to an average of 27.83 and 25.65 degrees, respectively. The average age of the group was 63.74 years, which suggests that most of them were older, and the average BMI was 25.83 kg/m², which means that most of the patients were overweight. Even though fewer patients were tested for serum albumin and HbA1c, the average results were 4.05 g/dL and 5.97%, both of which are within acceptable clinical ranges. This suggests that the nutritional and glycaemic status of the subset tested was rather constant. The average tibiofemoral angle was 8.28 degrees, which could suggest that the knees were deformed in different ways before the surgery. Three months after surgery, the average knee flexion improved slightly to 94.78 degrees, with a narrower range of 80 to 110 degrees. This shows that mobility gains were generally stable during the early recovery phase, although there was still a lot of individual variances.

Table 1: Preoperative variables and postoperative knee flexion at three months

Variable	N	Minimum	Maximum	Mean	SD
Knee flexion (pre-op)	23	60	130	94.13	18.75
Hip flexion	23	50	120	100.87	15.93
Hip extension	23	0	10	0.87	2.88
Hip abduction	23	20	60	38.26	10.72
Hip adduction	23	10	60	38.26	11.54
Hip internal rotation	23	10	40	27.83	8.5
Hip external rotation	23	10	40	25.65	9.45
Age	23	45	77	63.74	8.68
Body mass index (BMI)	23	20.1	38.4	25.83	4.63
Serum albumin	19	1.18	4.84	4.05	0.87
HbA1c	11	3.16	8.7	5.97	1.53
Tibiofemoral angle	23	3.75	21.75	8.28	4.39
Knee flexion at 3 months	23	80	110	94.78	8.46

The Spearman's correlation analysis shows how strong and in what direction certain preoperative factors are related to knee flexion results three months after surgery. Body mass index (BMI) and tibiofemoral angle were two of the variables evaluated that had statistically significant links to knee flexion after surgery. BMI showed a moderate negative connection ($r = -0.475$, $p = 0.022$), which means that a higher BMI is linked to less knee flexion after surgery. The tibiofemoral angle also had a strong negative connection ($r = -0.421$, $p = 0.046$), which means that a larger angular deformity before surgery could make it harder for the knee to move after surgery. Other factors, like hip flexion ($r = 0.406$, $p = 0.054$), were positively related to knee flexion after surgery, but not strongly enough to be statistically significant. This suggests that there may be a pattern where improved hip mobility leads to better knee results. Preoperative knee flexion had a slight, not statistically significant positive correlation ($r = 0.271$, $p = 0.211$) with postoperative flexion, which means it wasn't very useful for making predictions. Most of the other variables, like hip extension, abduction, adduction, internal/external rotation, age, serum albumin, and HbA1c, had weak and statistically non-significant correlations ($p > 0.05$). This means that they probably didn't have much of an effect on how well the knees recovered after surgery in the sample we looked at.

Table 2: Spearman's correlation between preoperative variables and postoperative knee flexion at three months

Variable	Spearman's r	p-value
Knee flexion (pre-op)	0.271	0.211
Hip flexion	0.406	0.054
Hip extension	0.008	0.971
Hip abduction	0.246	0.257
Hip adduction	-0.004	0.985
Hip internal rotation	-0.038	0.862
Hip external rotation	0.101	0.645
Age	-0.156	0.478
Body mass index (BMI)	-0.475	0.022*
Serum albumin	-0.037	0.88
HbA1c	0.485	0.131
Tibiofemoral angle	-0.421	0.046*

Discussion

This study looked at the link between the range of motion (ROM) in the hip before surgery and the ability to bend the knee after total knee arthroplasty (TKA). The results add to what we know about the things that affect how well people do after TKA. The average age of the patients in this study was 63.74 8.68 years, which is in line with what Leskinen et al. [19], Mutsuzaki et al. [20], and Oka [21] have said before: TKA is mostly done on those over 60. Obesity is a major risk factor for knee osteoarthritis (OA) and a factor that affects the results of TKA. The average BMI in this study was 25.83 ± 4.63 kg/m². There was a strong negative relationship between BMI and knee flexion after surgery ($p = 0.022$), which is in line with what Mutsuzaki et al. [20] and Kittelson et al. [22] found before. Marchant et al. [23] say that serum albumin is widely used to measure nutritional status and surgical risk. The average serum albumin level in the current study was 4.05 ± 0.87 g/dL, although there was no significant link between this level and knee flexion after surgery. Also, HbA1c, which shows how well blood sugar is controlled, did not have a strong relationship with knee ROM ($p = 0.131$), which is in line with what Jämsen et al. [24] and Adams et al. [25] found. The tibiofemoral angle is an important factor in TKA's mechanical alignment. The average tibiofemoral angle in this sample was 8.28 ± 4.39°, and it was strongly linked to less knee flexion after surgery ($p = 0.046$). This backs up what Marques Luís and Varatojo [26], Nam et al. [27], and Manjunath et al. [28] found: that precise alignment is important for the best results after surgery. The average knee flexion three months after surgery was 94.78 ± 8.46°, which is less than the 120° flexion that Nakano et al. [18] found after surgery. In this study, however, preoperative hip flexion was somewhat positively correlated with postoperative knee flexion ($r = 0.406$, $p = 0.054$), which suggests that hip mobility may have an effect on knee outcomes. Even though this link wasn't statistically significant, it fits with the idea that Offierski and MacNab [15], Murata et al. [20], Tsubosaka et al. [17], and Nakano et al. [18] put up that limited hip ROM may affect how the lower limbs work and how well they can be rehabilitated. There were no strong links between postoperative knee flexion and other hip movements, such as extension, abduction, adduction, or internal/external rotation. These results are in line with what other studies have found, which suggest that hip flexion may be more closely related to knee function after TKA since it directly affects activities like walking and ascending stairs, as Nakano et al. [18] have found. In general, the results show how important it is to think about a TKA patient's hip mobility before surgery as part of a whole examination. Finding hip stiffness early on may make it possible to use tailored prehabilitation treatments to improve postoperative results. Also, the strong links between BMI, tibiofemoral angle, and postoperative knee ROM show how important it is to deal with risk variables that may be changed before surgery, as Matsuda et al. [13], Noble et al. [14], and Nakano et al. [18] have shown. More study with bigger sample numbers and longer follow-ups is needed to better understand how hip ROM can predict TKA outcomes. Adding dynamic tests of the biomechanics of the lower limbs might also help us understand these complicated joint connections better.

Conclusion

This study looked at the link between hip range of motion (ROM) before surgery and knee flexion after surgery in people who were getting their first total knee arthroplasty (TKA). The results support the idea that there are several factors that affect how well people do after TKA. The average knee flexion three months after surgery was 94.78°, which is lower than what some other studies have found. Body mass index (BMI) and tibiofemoral angle were two of the variables that had a strong negative relationship with postoperative knee flexion. This shows how much they affect the results of surgery. It is important to note that preoperative hip flexion had a moderate positive link with postoperative knee flexion. This suggests that hip mobility may help knee function recovery; however, this relationship was very close to being statistically significant. Other hip movements, such as extension, abduction, adduction, and rotation, did not have strong links to knee flexion after surgery. These results are in line with what other studies have found: hip flexion, which directly affects walking and activities that require weight-bearing, may be more functionally connected to knee flexion after arthroplasty. The results show that patients who are about to have TKA need to be fully evaluated before the surgery. Adding an evaluation of hip ROM to standard criteria like BMI and lower limb alignment may help find patients who are at risk of having poor knee flexion after surgery. This, in turn, could make it easier to use focused prehabilitation procedures to improve joint mobility and functional recovery. More research with bigger sample numbers, long-term follow-up, and dynamic biomechanical assessments is needed to better understand how hip-knee joint interactions affect TKA outcomes and to improve rehabilitation techniques as a result.

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