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A Comparison of Clinical Outcomes and Complications of Simultaneous TKR and Bilateral TKR Staged at a 48-hour Interval

Abstract

Background: Knee replacement surgery (Arthroplasty) is one of the most successful orthopedic procedures, and numerous studies have been conducted to determine the optimal approach and duration of this procedure. Nonetheless, few studies have been conducted to compare the outcomes and complications of simultaneous total knee replacement (TKR) and bilateral TKR staged at a 48-hour interval. As such, this study sought to determine the clinical outcomes and complications associated with simultaneous TKR and bilateral TKR staged at a 48-hour interval.

Methods: This study was a cohort study with two groups of patients undergoing simultaneous TKR and bilateral TKR staged at a 48-hour interval. Following surgery, postoperative complications, hospitalization duration, and clinical outcomes were evaluated two weeks, one month, and three months later.

Results: The Lysholm Knee Scoring Scale revealed no statistically significant differences in the variables studied between the patients in this study. Additionally, there was no significant difference in postoperative complications between the two groups (P>0.05).

Conclusion: The study's findings indicated no statistically significant difference between the two groups concerning pain rate, knee function, and surgical complications following the treatments.

Keywords: Total Knee Replacement, Postoperative Complications, Treatment Outcome, Knee, Time factors

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Mohamad Sheibani, MD; Mahmod Karimi Mobarakeh, MD*; Moslem Kalkali, MD****

*Assistant-professor of orthopaedic surgery . department , Kerman medical university, Iran
**Resident of orthopaedic surgery .orthopaedic department , Kerman medical university, Iran

Corresponding author:
Mohamod Karimi Mobarakeh, MD

Email:
drkarimi_m@yahoo.com

Introduction

Total Total knee replacement (TKR) is one of the most successful orthopedic procedures, with 99,093 procedures performed in the United Kingdom in 2018 [(1)]. By 2020 and 2040, the number of TKRs in the United States is expected to increase to 1,065,000 and 3,416,000 replacements, respectively [(2)]. TKR has been proved to be highly effective at alleviating pain and improving functional status in patients with severe osteoarthritis. The primary indication for TKR is to alleviate severe osteoarthritis-related pain. Additionally, demand for TKR increases with age, and nearly half of osteoarthritis patients are under the age of 85 [(3)]. Furthermore, approximately one-third of patients with osteoarthritis experience bilateral disease, and approximately 40% of patients undergoing unilateral TKR will require bilateral TKR of the opposite knee within eight years of the first procedure [(4)].

Despite numerous studies, there is no clear consensus regarding bilateral TKR or staged TKR. TKR was previously promoted as a risk-free procedure for patients with bilateral symptoms and suggested that the surgery could result in cost savings, increased patient satisfaction, and a shorter length of stay in the hospital. Nonetheless, these assertions have been contested over time[(5, 6)]. Several studies documented various complications associated with both of the surgeries mentioned above. Some studies found that simultaneous TKR resulted in a higher mortality rate and cardiopulmonary events, whereas others found a lower rate of complications such as deep prosthesis infections and mechanical dysfunction[(7, 8)].

In research conducted by Warren et al., simultaneous TKR was associated with an increased risk of complications in patients with healthier body conditions. These scholars left the physician and patient to decide whether to undergo simultaneously or staged TKR [9]. Despite the severe complications observed in patients undergoing simultaneous bilateral TKR (BTKR), the surgery's undeniable benefits include reducing costs and infections. To this end, the purpose of the current study was to present a technique for surgical treatment of patients and shorten the duration of bilateral surgery. Additionally, this technique was compared to simultaneous TKR.

Methods

This was a prospective cohort study with two groups: one that underwent simultaneous TKR and another that underwent bilateral TKR staged at a 48-hour interval. Patients were assigned to one of the two groups at random. All patients underwent the same anesthesia procedure, during which they were instructed to abstain from food and liquids for six hours before surgery. Preoxygenation was used for three minutes with 100% oxygen, followed by premedication with fentanyl at a dose of 2g/kg IV and midazolam at a dose of 0.02 mg/kg IV. Following that, sodium thiopental 5 mg/kg and atracurium 0.5 mg/kg IV induction were used. Additionally, fentanyl ($50mg.kg^{-1}.min^{-1}$) and propofol ($1–2\ \mu g.kg^{-1}.hr^{-1}$) were used to maintain anesthesia.

Furthermore, patients were anesthetized to an American Society of Anesthesiologists (ASA) grade II level. In addition, a tourniquet was used throughout the procedure, and at the end of the procedure, homeostasis was performed in the absence of a tourniquet. The two groups were identical in terms of surgical approach (classic TKR), antibiotic prescription (cephalexin for 48 hours, followed by 30 cephalexin 500 mg tablets every six hours), analgesics (1g of Apotel every eight hours for 48 hours, followed by acetaminophen codeine tablets every 8 hours until five days after discharge), and anti-coagulants (subcutaneous injection of 1g of Clexane for 14 days after discharge and once a day during the hospitalization period).

An orthopedic resident collected data two weeks after surgery and subsequently a month and three months later. Data collection was performed using a checklist of demographic characteristics and postoperative complications such as infection (pus, redness, heat, pain, or tenderness at the surgical site), deep vein thrombosis (DVT) (as determined by clinical examination, body size difference, and ultrasound), as well as the length of hospitalization. Furthermore, clinical outcomes were compared using the scores from the tool presented in the annex.

Exclusion Criteria

Exclusion criteria included prior major knee surgery, a history of joint infection, chronic diseases such as diabetes, refusal to participate in the study, immunodeficiency, the infection of other body parts, and recent active infection.

SPSS version 20 was used to analyze the data. Additionally, the Lysholm scale was used to assess TKR outcomes. The instrument evaluated eight variables: limping, support, locking, instability, pain, swelling, stair climbing, and squatting. Numerous studies have previously used the tool to determine the status of damaged knees. At the end of the second week and the first and third months, patients and an orthopedic resident assessed the intensity of perceived pain during resting and slow walking using a visual analog scale (VAS). This tool featured a 10-cm line with anchor statements on the left (no discomfort) and right (extreme pain). The patient drew a line through the point that they believe best represents their current state. The pain level was calculated from the start of the continuum to the patient's mark using a meter graduated ruler.

Results

The study enrolled 100 participants, divided into two groups: those who received TKR simultaneously (first) and those who received bilateral TKR staged at a 48-hour interval (second). Each group consisted of 50

participants. Additionally, efforts were made to create age and gender homogeneous groups. In terms of gender, 19 patients in the simultaneous TKR group and 18 subjects in the bilateral TKR staged at a 48-hour interval group were male, while the remainder were female, indicating no statistically significant difference between the groups (P>0.05). The mean age of the participants was 59.75±4.96 years (59.48±4.87 years in the bilateral TKR staged at a 48-hour interval and 60.02±5.08 years in the simultaneous group), indicating that there was no statistically significant difference in age between the groups (P=0.540). Following the intervention, pain levels were assessed in all participants using the VAS, with the results presented in Table 2. In general, there was no significant difference in pain levels following treatment between the two groups (P>0.05) (Table 1).

Table 1. Mean pain scores of patients in the bilateral and simultaneous TKR groups

Pain Intensity	Group	Mean	Std. Deviation	Min	max	P-value
Second week	Staged at a 48-hour interval	7.7400	.87622	6	9	0.624
	Simultaneous	7.8200	.74751	5	10	
First month	Staged at a 48-hour interval	7.2600	.98582	5	9	0.383
	Simultaneous	7.4200	.83520	6	10	
Third month	Staged at a 48-hour interval	7.4400	.97227	6	10	0.090
	Simultaneous	7.1000	1.01519	5	9	

Table 2. Mean score of Lysholm scale's items in the two bilateral and simultaneous TKR groups

Lysholm scores	Group	Second week Mean ± Std. Deviation	First month Mean ± Std. Deviation	Third month Mean ± Std. Deviation	P-value
Limping	Staged at a 48-hour interval	4.20 ± .88	4.38 ± .80	4.52 ± .90	0.910
	Simultaneous	4.10 ± .90	4.44 ± .78	4.54 ± .86	
Support	Staged at a 48-hour interval	4.22 ±1.05	4.32 ±1.01	4.42 ±1.01	0.766
	Simultaneous	4.34 ±1.04	4.46 ±.97	4.48 ±.99	
Locking	Staged at a 48-hour interval	11.38 ±1.22	11.48 ±1.23	11.96 ±1.49	0.149
	Simultaneous	11.12 ±1.02	11.34 ±.93	11.54 ±1.38	
Instability	Staged at a 48-hour interval	19.00 ±1.24	19.42 ±1.08	19.48 ±1.03	0.929
	Simultaneous	19.14 ±1.16	19.24 ±1.22	19.50 ±1.19	
Swelling	Staged at a 48-hour interval	9.20 ±.90	9.28 ±.88	9.56 ±1.01	0.206
	Simultaneous	9.08 ±.92	9.20 ±.83	9.32 ±.86	
Stair-climbing	Staged at a 48-hour interval	8.18 ±.84	8.44 ±.78	8.64 ±.80	0.157
	Simultaneous	8.06 ±.89	8.36 ±.80	8.84 ±.58	
Squatting	Staged at a 48-hour interval	4.26 ±.87	4.32 ±.76	4.36 ±.77	0.452
	Simultaneous	4.16 ±.93	4.24 ±.91	4.48 ±.81	

Evaluation of Clinical Outcomes Based on Lysholm Scale Results

The Lysholm scale was used to determine and compare the mean value of variables, including limping, support, locking, instability, swelling, stair-climbing, and squatting among patients. Finally, the results indicated that there was no statistically significant difference between the groups (P>0.05) (Table 2).

According to the findings, there was no significant difference in postoperative complications between the two groups. Three and six DVT cases were observed in the case and control groups within three months, respectively. Moreover, four patients in the case group and two subjects in the control group were infected at the surgical site (P>0.05) (Table 3).

Table 3. Frequency of complications in the simultaneous and bilateral TKR groups				
		Group		P-value
		Staged at a 48-hour interval	Simultaneous	
Infection	Yes	4	2	0.678
	No	46	48	
DVT	Yes	3	6	0.487
	No	47	44	

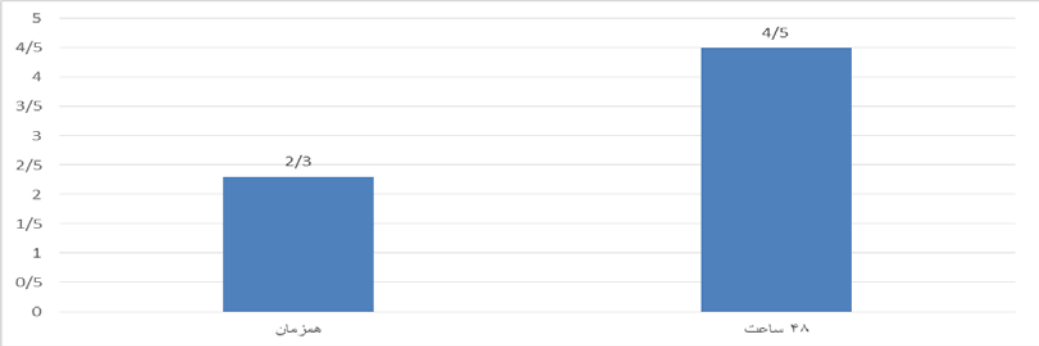

Diagram 1. Mean hospitalization duration of patients

In total, patients in the simultaneous TKR and bilateral TKR groups staged at a 48-hour interval spent a mean value of 2.3±0.46 and 4.5±0.50 days in the hospital, respectively, indicating a significantly extended hospitalization period in the second group compared to the first group (P=0.000) (Diagram 1).

Discussion

In total, 100 individuals were enrolled in the study, divided into groups of 50, and efforts were made to create identical groups concerning age and gender. According to the findings, there was no statistically significant difference between the two groups concerning postoperative pain intensity. Additionally, no significant difference in the Lysholm scale items was observed between the groups. Furthermore, there was no significant difference in postoperative complications between the case and control groups. In addition, three and six DVT cases were observed within three months in the case and control groups, respectively.

Moreover, four patients in the case group and two subjects in the control group were infected at the surgical site (P>0.05). Van Hove et al. reported that 2.2% of patients who underwent major orthopedic surgery developed thromboembolism within the first 90 days of discharge after reviewing data from US databases. According to this study, 60% of cases encountered this issue following discharge [10]. Recent studies have emphasized the importance of minimizing antibiotic prescription duration. The duration of routine antibiotics is reduced from a few days to 24–48 hours following surgery [11]. Pain is the primary indication for TKR. According to the findings, the subjects' mean pain scores decreased significantly following surgery [12, 13]. Simultaneous TKR was associated with a lower risk of infection and a shorter hospital stay in research conducted by N.S. Makaram et al. [14]. However, this procedure was associated with a higher rate of mortality, neural disorders, and DVT. Both techniques were similar regarding early revision, and no difference in complication occurrence was observed between the two surgical methods. However, larger sample sizes may yield different results.

According to Fu et al. [15] and Hussain et al. [16], patients undergoing simultaneous TKR had a significantly higher mortality rate than other participants. Additionally, those undergoing simultaneous TKR had a significantly increased risk of PTE and DVT. One of the causes of PTE during simultaneous surgery is the requirement to implant high-pressure

orthopedic cement twice, which justifies the embolism events in these patients [17]. Other factors contributing to an increased risk of embolism include longer duration of surgery, a more extended rehabilitation phase, and a more prolonged recovery period following surgery [18].

In another study, N.S. Makaram et al. [15] reported an increased risk of superficial and deep infection in staged TKR, which was confirmed by Fu et al. [16] and Lui et al. [19]. This may be justified since patients selected for simultaneous TKR are frequently younger, more active, and have fewer medical complications, which reduces the risk of infection. Another issue was that the bilateral surgery group required a more extended hospital stay. Poultsides et al. reported in a study that a longer postoperative hospital stay might be associated with an increased infection rate [20]. Additionally, the risk of infection increases as the number of procedures performed in the operating room increases [21]. Patients in this study were hospitalized only once, which may reduce the risk of nosocomial infections compared to discharge and readmission.

N.S. Makaram et al. [15] reported a mean reduction in hospitalization time of 2.1 days in patients undergoing simultaneous TKR. Simultaneous surgery also has a financial benefit for the health care system, as it results in fewer readmissions, fewer rehabilitation programs, and lower anesthesia costs [22, 23]. Wyles et al. [24] reported a 50% reduction in hospital costs associated with simultaneous surgery versus staged surgery.

In the present study, both simultaneous surgery and surgery staged over 48 hours were performed during a single hospitalization, and rehabilitation on both knees was performed simultaneously, resulting in cost savings. It is therefore recommended that additional research be conducted to gain a better understanding of this issue.

One of the study's major limitations was its small sample size. As a result, it is recommended that studies employ larger sample sizes to obtain more accurate results. Additionally, participants were selected from ASAI grade II patients, who may have a lower risk of complications, and thus may not represent the true sample of this community. Additional clinical trials with higher grade patients and larger sample sizes are recommended to compare surgical outcomes and complications.

Conclusion

According to the present study's findings, there was no significant difference in pain intensity, knee function, or postoperative complications between the two treatment methods.

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