Vol 4 | Issue 2 | Pages 406-413

Journal of Orthopedic Surgery and Techniques

ISSN: 2578-7187

Original Article

DOI: 10.36959/453/580

Simultaneous Bilateral Versus Staged Bilateral Total Knee Arthroplasty: Risks and Benefits

Tarek A Saad[1], Mohamed Mostafa[2] and Molham M Mohammad[1]*

[1]*Department of Orthopedic Surgery, Cairo University, Egypt*

[2]*Department of Orthopedic Surgery, Khalifa hospital, Dubai*

Abstract

Objective: To determine if simultaneous bilateral total knee arthroplasty TKA carries additional risk on the patient and to provide guidelines for adequate perioperative measures to achieve the proper patient outcomes.

Design: Randomized single-blinded controlled clinical trial. Patients and methods: This study was carried out on 40 patients diagnosed with end-stage osteoarthritis and underwent TKA. Patients are randomly allocated into 2 equal groups: Simultaneous bilateral total knee group and staged bilateral total knee group. All patients were operated on through a universal midline approach of the knee and posterior cruciate stabilized cemented bi compartmental total knee prosthesis was inserted. Patients were subjected to a thorough preoperative clinical examination and radiological evaluation. Patients were followed postoperative for a minimum period of one year both clinically and radiologically.

Intervention: Comparisons were made with respect to the operating time, total estimated intra-operative blood loss, postoperative narcotic requirements, length of hospitalization and the pre and post-operative range of movement. Complications and the incidence of component malalignment were also recorded for each group.

Results: There was a significant decrease ($p<0.001$) in the length of hospital stay and the mean operative time in the simultaneous bilateral TKA group. No significant differences were seen as regards the clinical outcome at 6 and 12 months post-operative using the OKS and VAS scores, the radiological results and incidence of intra or postoperative complications between both groups.

Conclusions: Simultaneous bilateral TKA is a relatively safe, beneficial procedure and a reliable alternative to a two-stage procedure Therefore, simultaneous replacement is recommended for appropriate patients.

Keywords

Simultaneous, Staged, Total knee arthroplasty, Bilateral, Osteoarthritis

Introduction

Total knee arthroplasty (TKA) is one of the most successful and effective surgical management in relieving pain and restoration of function in severely affected degenerative knee osteoarthritis (OA) [1]. As primary knee osteoarthritis is degenerative bilateral disease that usually affects both knees to a nearly equal degree, so in the late stages of knee OA the patients usually have a great concern to have a simultaneous bilateral total knee replacement [2]. Simultaneous bilateral TKA in the same sitting allows symmetrical rehabilitation of both knees, while that is not possible in the staged bilateral TKA as one knee is still diseased [3]. One study reported that for the sake of early recovery, 98% of those who have bilateral knee OA may accept a higher risk of complications in simultaneous bilateral TKA in one session instead of having staged bilateral TKA in two separate sessions [4].

There is a big debate around the advantages and the disadvantages of the simultaneous bilateral TKA. Many meta-analyses have proposed that there is an increased risk of pulmonary embolism (PE), cardiac complications and mortality in the simultaneous bilateral TKA and decreased risk of deep periprosthetic joint infection and postoperative failure. Actually, there is no consensus about the true rate of these

***Corresponding author:** Tarek A Saad, Department of Orthopedic Surgery, Cairo University, Egypt, Tel: 010-611-688-03

Accepted: November 08, 2021

Published online: November 10, 2021

Citation: Saad TA, Mostafa M, Mohammad MM (2021) Simultaneous Bilateral Versus Staged Bilateral Total Knee Arthroplasty: Risks and Benefits. J Orthop Surg Tech 4(2):406-413

complications among studies [5]. Recently, it is accepted that old age and preoperative comorbidity are the critical factors for increased postoperative morbidity and mortality in the bilateral TKA, rather than doing it simultaneously or staged [6]. In this study, we compared the clinical results between the simultaneous bilateral TKA in one session and the staged bilateral TKA in two separate sessions Comparison between the two groups was performed regarding the pre and post-operative VAS and OKS scores. All TKAs were performed by the same orthopaedic team in the same institution to find out the perioperative risk and the benefits of simultaneous bilateral TKA.

Patients and Methods

Randomized single-blinded controlled prospective clinical trial. This study was carried out on 40 patients diagnosed with end stage osteoarthritis and underwent TKA in orthopaedic surgery department, Khalifa hospital, Dubai & Kasr Alainy hospital Cairo University. We included all patients above the age group of 50-years, both genders, American Society of Anesthesiologists (ASA) class II and I with severe bilateral primary osteoarthritis knees. We excluded all patients below the age of 50-years, (ASA) class III and IV, history of previous total knee operations, severe peripheral ischemic diseases or severe peripheral neuropathy and secondary osteoarthritis knees. Patients are randomly allocated into 2 equal groups: Simultaneous bilateral total knee group and staged bilateral total knee group. All patients were operated on through a universal mid line approach of the knee and posterior cruciate stabilized cemented bicompartmental total knee prosthesis was inserted. Patients were subjected to a thorough preoperative clinical examination and radiological evaluation. Patients were followed postoperative for a minimum period of one year both clinically and radiologically.

Intervention

Comparisons were made with respect to the operating time, total estimated intra-operative, blood loss, postoperative narcotic requirements, length of hospitalization and the pre and post-operative patient satisfaction which is measured by Oxford Knee Score (OKS) (Table 1) [7]. and assessment of pain using The Visual Analogue Scale (VAS: 0 = no pain and 10 = the worst possible pain) and range of movement. Complications and the incidence of component malalignment were also recorded for each group [8]. 1g of intramuscular cefazolin sodium was administered as antibiotic prophylaxis 2 hours before surgery. All operations were performed using a pneumatic tourniquet. A standard anterior longitudinal skin incision and medial parapatellar arthrotomy were performed. The posterior cruciate ligament was mostly sacrificed while the anterior cruciate ligament, if present, was divided. An intramedullary guide was used in cuttings for femoral surfaces and an extramedullary guide for tibial surfaces. A cemented prosthesis was used and the tibial component was placed first. The intraarticular drain will be inserted and the total amount of collection will be recorded.

Postoperative

In the event of pain, each patient in both groups received standard systemic analgesia in the form of perfelgan IV infusion 1g every 6 hours (maximum dose 4gm per day) and Intravenous pethidine in a dose of 1 mg per kg was given when the VAS was ≥ 3 or upon patient request. The need for IV analgesic supplementation was recorded. All the patients received mechanical and chemical prophylaxis of DVT. All the patients received a scheduled rehabilitation program starting from the first postoperative day. A drop of hemoglobin and units of blood given during hospital stay was recorded. Early postoperative complications such as infection, dislocation, deep vein thrombosis, pulmonary embolism was recorded and treated. Late postoperative complications such as stiffness, late infection, loosening, and periprosthetic fractures were recorded. Radiological assessments had been performed using standard anteroposterior and lateral knee were obtained before, after surgery, and at the final follow-up. Postoperative radiographs were assessed according to the American Knee Society radiological evaluation criteria; a radiolucent area ≤ 4 mm was considered insignificant, a radiolucent area 5 to 9 mm should be monitored for potential loosening and a total radiolucent area of ≥10 mm with or without symptoms indicated possible loosening [9].

Comparison between categorical data was performed using Chi square test. Test of normality, Kolmogorov-Smirnov test, was used to measure the distribution of data measured pre-treatment. Accordingly, normally distributed variables were expressed as mean ± standard deviation and not normally distributed variables were expressed as median and IQR. Also, comparison between normally distributed variables in the two groups was performed using unpaired t test. In not normally distributed variables comparison between variables in the two groups was performed using Mann Whitney test. Statistical Package for Social Sciences (SPSS) computer program (version 19 windows) was used for data analysis. P value ≤ 0.05 was considered significant.

Results

The mean age for the simultaneous group was 66.70 ± 8.47 with a female\male ratio of 6/14 while for the staged group; it was 64.40 ± 8.96 with a female\male ratio of 16/4 (Table 2). 18 patients in the simultaneous group (90 %) had comorbidities versus 12 patients in the staged group (60 %) with a significant difference between both groups (p-value: 0.028) (Table 3). We used different types of prostheses; the most common type was the NEX-GEN of Zimmer in 50% of knees (40 knees) (Table 4). The mean operative time for both sides in the simultaneous group was 182.95 ± 49.54 while for the staged group, it was 233.15 ± 24.06 with a significant decrease in the simultaneous group (p-value: 0.001) (Table 2).

The mean blood loss in the simultaneous group was 4.92 ± 1.22 while in the staged group, it was 5.16 ± 1.15 with no significant difference between both groups (p-value: 0.532) (Table 2). The median and IQR of VAS preoperative and postoperative in the simultaneous group was 6.5 (6-9) & 1(0-3) respectively, while for the staged group it was 6 (4-8) & 0 (0-2) with no significant difference between both groups (p-value: 0.168&0.093) (Table 2). The mean OKS preoperative and postoperative in the simultaneous group was 15.30 ± 1.81&47.60 ± 4.38respectively, while for the staged group it

Table 1: The Oxford Knee Score (OKS):

1. How would you describe the pain you usually have in your knee?	7. Could you kneel down and get up again afterwards?
None	Yes, easily
Very mild	With little difficulty
Mild	With moderate difficulty
Moderate	With extreme difficulty
Severe	No, impossible

2. Have you had any trouble washing and drying yourself (all over) because of your knee?	8. Are you troubled by pain in your knee at night in bed?
No trouble at all	Not at all
Very little trouble	Only one or two nights
Moderate trouble	Some nights
Extreme difficulty	Most nights
Impossible to do	Every night

3. Have you had any trouble getting in and out of the car or using public transport because of your knee? (With or without a stick)	9. How much has pain from your knee interfered with your usual work? (including housework)
No trouble at all	Not at all
Very little trouble	A little bit
Moderate trouble	Moderately
Extreme difficulty	Greatly
Impossible to do	Totally

4. For how long are you able to walk before the pain in your knee becomes s eve re? (With or without a stick)	10. Have you felt that your knee might suddenly ï¿½give awayï¿½ or let you down?
No pain > 60 min	Rarely / Never
16 - 60 minutes	Sometimes or just at first
5 - 15 minutes	Often, not at first
Around the house only	Most of the time
Not at all - severe on walking	All the time

5. After a meal (sat at a table), how painful has it been for you to stand up from a chair because of your knee?	11. Could you do household shopping on your own?
Not at all painful	Yes, easily
Slightly painful	With little difficulty
Moderately pain	With moderate difficulty
Very painful	With extreme difficulty
Unbearable	No, impossible

6. Have you been limping when walking, because of your knee?	12. Could you walk down a flight of stairs?
Rarely / never	Yes, easily
Sometimes or just at first	With little difficulty
Often, not just at first	With moderate difficulty
Most of the time	With extreme difficulty
All of the time	No,Impossible

Grading for the Oxford Knee Score	
Score 0 to 19	May indicate severe knee arthritis. It is highly likely that you may well require some form of surgical intervention, contact your family physician for a consult with an Orthopaedic Surgeon.
Score 20 to 29	May indicate moderate to severe knee arthritis. See your family physician for an assessment and x-ray. Consider a consult with an Orthopaedic Surgeon.
Score 30 to 39	May indicate mild to moderate knee arthritis. Consider seeing your family physician for an assessment and possible x-ray. You may benefit from non-surgical treatment, such as exercise, weight loss, and /or anti-inflammatory medication
Score 40 to 48	May indicate satisfactory joint function. May not require any formal treatment.

The Oxford Knee Score is a 12-item patient-reported specifically designed and developed to assess function and pain after total knee replacement (TKR) surgery (arthroplasty). It is short, reproducible, valid and sensitive to clinically important changes.

Table 2: Pre, intra and post-operative parameters in the two studied groups.

	Simultaneous (n= 20)	Staged (n= 20)	t value	P value
Age (yrs.)	66.70 ± 8.47	64.40 ± 8.96	0.834	0.409
Gender (F/M)	6 (30.0%)/14 (70.0%)	16 (80.0%)/4 (20.0%)	χ^2= 10.101	0.004
Operation time (min.)	182.95 ± 49.54	233.15 ± 24.06	-4.076	0.001
Hb drop (mg/dl)	4.92 ± 1.22	5.16 ± 1.15	-0.630	0.532
VAS pre	6.5 (6-9)	6(4-8)	Z= -1.379	0.168
VAS post	1(0-3)	0(0-2)	Z= -1.680	0.093
OKS score pre	15.30 ± 1.81	15.40 ± 1.98	-0.167	0.869
OKS score post	47.60 ± 4.38	49.10 ± 2.75	-1.297	0.204
ROM. Rt. Pre	110.50 ± 12.66	110.75 ± 11.27	-0.066	0.948
ROM. Lt. pre	116.25 ± 9.01	105.75 ± 11.62	3.194	0.003
ROM. Rt. post	110.75 ± 9.77	118.25 ± 11.84	-2.185	0.035
ROM. Lt. post	112.00 ± 9.51	114.00 ± 8.83	-0.689	0.495
Hospital stay (days)	14.5(9-25)	18(12-27)	Z= -1.676	0.094
Radiology	3.25 ± 2.22	2.78 ± 0.75	-0.342	0.732

Data are expressed as mean ± SD or number (%).
χ^2= Chi square test.
Z= Mann Whitney test. p> 0.05= not significant. p≤ 0.05= significant

Table 3: Comorbidities in the two studied groups.

	Simultaneous (n= 20)	Staged (n= 20)	χ^2 value	P value
No	2 (10.0%)	8 (40.0%)	4.800	0.028
Yes	18 (90.0%)	12 (60.0%)		
HTN	16 (80.0%)	10 (50.0%)	3.956	0.047
DM	8 (40.0%)	6 (30.0%)	0.440	0.507
Asthma	0 (0.0%)	1 (5.0%)	1.026	0.311
Hyperthyroidism	1 (5.0%)	1 (5.0%)	----	----
Hypothyroidism	1 (5.0%)	1 (5.0%)	----	----
COPD	0 (0.0%)	1 (5.0%)	1.026	0.311
CHB	1 (5.0%)	1 (5.0%)	----	----
Hemorroid	0 (0.0%)	1 (5.0%)	1.026	0.311
Renal impairment/ impairment	1 (5.0%)	1 (5.0%)	----	----
Old CVA	1 (5.0%)	0 (0.0%)	1.026	0.311
Prostatic hypertrophy	0 (0.0%)	1 (5.0%)	1.026	0.311

Data are expressed as number (%).
χ^2= Chi square test.
p> 0.05= not significant.
p≤ 0.05= significant.

Table 4: Prosthesis types used in the two studied groups.

	Simultaneous (n= 40)	Staged (n= 40)
SIGMA	13 (32.5%)	3 (7.5%)
Attune	1 (2.5%)	7 (17.5%)
Amplitude	0 (0.0%)	1 (2.5%)
DEPUY HP	2 (5.0%)	2 (5.0%)
Micropore	8 (20.0%)	1 (2.5%)
NEX GEN	13 (32.5%)	26 (65.0%)
PERSONA	1 (2.5%)	0 (0.0%)
PFC	1 (2.5%)	0 (0.0%)
VAGNUARD	1 (2.5%)	0 (0.0%)

Data are expressed as number (%).

was 15.40 ± 1.98&49.10 ± 2.75 with no significant difference between both groups (p-value: 0.869&0.204) (Table 2).

The mean American Knee Society radiological score in the simultaneous group was 3.25 ± 2.22, while in the staged group it was 2.78 ± 0.75 with no significant difference between both groups (p-value: 0.732) (Table 2). The median and IQR of hospital stay for both sides in the simultaneous group was 14.5(9-25) while for the staged group, it was 18(12-27) with an insignificant decrease in the simultaneous group (p-value: 0.094) (Table 2). The rate of complication in the simultaneous group was 40% versus 30% in the staged group with no significant difference between both groups (p-value: p = 0.507). Regarding the intraoperative complication, there was a case of notching in the simultaneous group and one case of MCL avulsion in the staged group and internally fixed by screws and staples with immobilization in a hinged Knee brace for 6 weeks. (Figure 1). Regarding the postoperative complication, there were three cases of superficial wound infection in the simultaneous group, which were treated by antibiotics and repeated dressing, one case of extension lag and another one of valgus malalignment in the staged group (Figure 2 and Figure 3) (Table 5).

Discussion

Primary knee osteoarthritis is a degenerative bilateral disease that usually affects both knees to a nearly equal degree, so in the late stages of knee OA the patients usually have a great concern to have simultaneous bilateral total knee replacement but the concern of the physician it is safe and cost-benefit or not. In our study, we found that there is no significant difference between the simultaneous and the staged bilateral total knee replacement regarding the functional and clinical knee scores, the visual analogue scores and the radiological evaluation that means doing bilateral

Table 5: Complications in the two studied groups.

	Simultaneous (n= 20)	Staged (n= 20)	χ^2 value	P value
Chest infection	0 (0.0%)	1 (5.0%)	1.026	0.311
Valgus	0 (0.0%)	1 (5.0%)	1.026	0.311
Chest pain	1 (5.0%)	0 (0.0%)	1.026	0.311
LOST FU	1 (5.0%)	0 (0.0%)	1.026	0.311
Epidural catheter broken	0 (0.0%)	1 (5.0%)	1.026	0.311
Extension lag	0 (0.0%)	1 (5.0%)	1.026	0.311
Loosening Lt	1 (5.0%)	0 (0.0%)	1.026	0.311
MCL avulsion Rt	0 (0.0%)	1 (5.0%)	1.026	0.311
Noncompliance PT	0 (0.0%)	1 (5.0%)	1.026	0.311
Notching Rt pain	1 (5.0%)	0 (0.0%)	1.026	0.311
Pain	0 (0.0%)	1 (5.0%)	1.026	0.311
Rt painfull walk with stick	1 (5.0%)	0 (0.0%)	1.026	0.311
Transient CVA,ICU	1 (5.0%)	0 (0.0%)	1.026	0.311
Wound infection	3 (15.0%)	0 (0.0%)	3.243	0.072

Data are expressed as number (%).
χ^2= Chi square test.
p> 0.05= not significant.

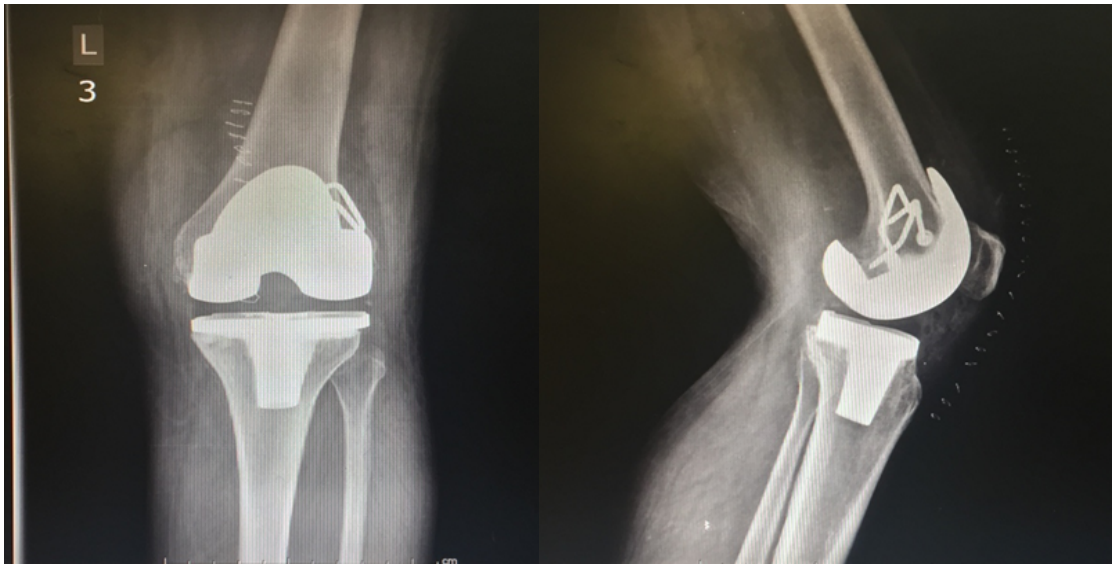

Figure 1: One case of MCL avulsion in staged group and internally fixed by screws and staples.

Figure 2: Preoperative, immediate and 1-year follow-up x rays of 66-years-old male with bilateral osteoarthritis knees who underwent a simultaneous bilateral TKR, preoperative right knee deformity (20 degree varus, 10 fixed flexion deformity, range of motion 10-130 degree), left knee deformity (15 degree varus, range of motion 0 - 130 degree), VAS score 8, OKS 14. Postoperative range of motion: 0-120 degree bilateral, VAS score 3, OKS 41.

TKR simultaneously is successful as doing it separately. In addition, we found that there is no significant difference between both groups regarding the blood loss and rate of complications. Although there were two cases of systemic complications in the simultaneous group (one case had chest pain and the other had transient CVA and ICU admission) in comparison to one case of chest infection in the staged group, simultaneous bilateral TKR is still a safe procedure. Finally, we found that there is a significant decrease in the operative time and hospital stay in favour of the simultaneous group, which mean the simultaneous bilateral TKR, is cost-benefit.

Our findings is similar to Alghadir, et al. conducted a study with a total of 80 patients (bilateral 50, unilateral 30) aged 63.28 (9.4) years undergone total knee replacement [10] and Hutchinson, et al. who conducted a large study on 1304 patients (1867 knees) between 1992 and 2003. There were 438 patients in the simultaneous bilateral, 125 in the staged bilateral and 741 in the unilateral group [11]. Also T.-K. Liu and S.-H. Chen who conducted a study from January 1993 to June 1995, 88 patients (176 knees) divided into 2 groups. Group I (64 patients, 128 knees) underwent simultaneous bilateral TKA, while Group II (24 patients, 48 knees) had staged TKA at

Figure 3: Preoperative, immediate and 1-year follow-up x rays of 59-years-old Female with bilateral osteoarthritis knees who underwent a staged bilateral TKR.
Preoperative: Right Knee with 10-degree varus. Range of motion: 0-120 degree.
Left Knee Deformity: 15-degree varus. Range of motion: 0-120 degree. VAS Score: 7.OKS: 16. Left knee Operative time: 114 min. Range of motion: 0-120 degree. VAS Score 1. OKS36. Right knee Operative time: 121 min. Range of motion: 0-120 degree. VAS Score: 0.OKS: 53.

an average of 7.4 days apart they revealed that simultaneous bilateral total knee arthroplasty is a safe and successful procedure when compared with a staged bilateral procedure.

In addition to single anaesthesia, reduced costs and decreased total recovery time [12]. Odum, et al. used a Markov model to compare the simultaneous bilateral total knee arthroplasty and the staged bilateral total knee arthroplasty regarding the cost in the period from 2004 to 2007. They revealed that simultaneous bilateral total knee arthroplasty is more cost-effective than staged bilateral total knee arthroplasty [13]. Souza Borges, et al. conducted a reterospective study on 74 patients (40 bilateral TKR and 34 unilateral TKR) revealed that no increase in cost or complications in the bilateral TKR group [14].

Also Hart, et al. found that there is no higher rate of major complications and 30-day readmission in the simultaneous group compared to the unilateral group (1771 simultaneous (same-day) bilateral TKA and control group of 6790 unilateral TKA) [15]. On the other hand, Yoon, et al. conducted a study that included 119 patients undergoing simultaneous bilateral TKA and an additional 119 patients undergoing staged bilateral TKA [16]. Also, Bullock, et al. who retrospectively reviewed 514 unilateral total knee arthroplasties and 255 bilateral total knee arthroplasties [4]. and Lombardi, et al. who retrospectively reviewed 1498 patients (1090 simultaneous bilateral total knee arthroplasties and 958 unilateral total knee arthroplasties) in a 3-year period. All revealed that systemic complication in the simultaneous bilateral TKA was significantly higher statistically than that in the staged bilateral TKA especially in elderly or high-risk patients [3]. Fu, et al. conducted a systematic review of eighteen retrospective comparative studies. Pooled results showed that the prevalence of mortality at 30 days postoperatively, pulmonary embolism, blood transfusion rate were significantly higher in the simultaneous TKA group [17]. While Huang, et al. among 144 bilateral TKR patients included in their study, 93 (64.6%) unilateral TKR and 51 (35.4%)

bilateral TKR, found no difference in the functional outcome between both groups and didn't recommend any of both as better than the other one [18]. Also, Liu, et al. conducted a metanalysis on 18 studies published from 2001 to 2018, covered 73617 simultaneous BTKA and 61838 staged BTKA, and revealed that each technique has risks and benefits and should be tailored according to the patient's concerns and needs [19,20].

Our study is the only prospective study comparing simultaneous bilateral TKR and staged bilateral knee in degenerative OA in the Middle East region, there was a study in Dubai but comparing simultaneous bilateral TKR and unilateral TKR not the staged one. 16 One of our difficulties was to guard the patients in the staged group to do the other side without being lost in follow up. One of the limitations in our study was the unequal gender distribution between both groups which may affect the results to some extent. We recommend further research with prolonged follow up and a larger number of patients to answer the question of the simultaneous bilateral TKR can be a routine procedure for all patients with bilateral end-stage knee OA or it should be only for selected patients with optimum health conditions.

Conflict of Interest

There is no conflict of interest.

References

1. Choi YJ, Ra HJ (2016) Patient satisfaction after total knee arthroplasty. Knee Surg Relat Res 28: 1-15.
2. Patil N, Wakankar H (2008) Morbidity and mortality of simultaneous bilateral total knee arthroplasty. Orthopedics 31: 780-789.
3. Lombardi AV, Malory TH, Fada RA, et al. (2001) Simultaneous bilateral total knee arthroplasties. Who decides? Clin Orthop Relat Res 392: 319-329.
4. Bullock DP, Sporer SM, Shirreffs Jr TG (2003) Comparison of simultaneous bilateral with unilateral total knee arthroplasty in terms of perioperative complications. J Bone Joint Surg Am 85: 1981-1986.
5. Restrepo C, Parvizi J, Dietrich T, et al. (2007) Safety of simultaneous bilateral total knee arthroplasty. A meta-analysis. J Bone Joint Surg Am 89: 1220-1226.
6. Insall J, Scott WN, Ranawat CS (1979) The total condylar knee prosthesis. A report of two hundred and twenty cases. J Bone Joint Surg Am 61: 173-180.
7. Murray DW, Fitzpatrick R, Rogers K, et al. (2007) The use of the Oxford hip and knee scores. J Bone Joint Surg Br 89: 1010-1014.
8. Wewers ME, Lowe NK (1990) A critical review of visual analogue scales in the measurement of clinical phenomena. Res Nurs Health 13: 227-236.
9. Insall JN, Easley ME (2001) Surgical techniques and instrumentation in total knee arthroplasty. In: Insall JN, Scott WN, Insall & Scott Surgery of the knee. (3rd edn), New York, NY: Churchill Livingstone, 1553-1620.
10. Alghadir AH, Iqbal ZA, Answer S, et al. (2020) Comparison of simultaneous bilateral versus unilateral total knee replacement on pain levels and functional recovery. BMC Musculoskelet Disord 21, 246.
11. Hutchinson JRM, Parish EN, Cross MJ (2006) A comparison of bilateral uncemented total knee arthroplasty. J Bone Joint Surg Br 88: 40-43.
12. Liu TK, Chen SH (1998) Simultaneous bilateral total knee arthroplasty in a single procedure. Int Orthop 22: 390-393.
13. Odum Susan M, Troyer Jennifer L, Kelly Michael P, et al. (2013) A cost-utility analysis comparing the cost-effectiveness of simultaneous and staged bilateral total knee arthroplasty. J Bone Joint Surg Am 95: 1441-1449.
14. Borges JH, Lobo Júnior P, Dias DM, et al. (2019) Cost and safety evaluation of simultaneous bilateral total knee arthroplasty versus unilateral knee. Rev Bras Ortop (Sao Paulo) 54: 709-713.
15. Hart A, Antoniou J, Brin YS, et al. (2016) Simultaneous bilateral versus unilateral total knee arthroplasty: A comparison of 30-day readmission rates and major complications. J Arthroplast 31: 31-35.
16. Hang Seob Yoon, Chang Dong Han, Ick Hwan Yang (2010) Comparison of simultaneous bilateral and staged bilateral total knee arthroplasty in terms of perioperative complications. J Arthroplasty 25: 179-185.
17. Fu D, Li G, Chen K, et al. (2013) Comparison of clinical outcome between simultaneous-bilateral and staged-bilateral total knee arthroplasty: A systematic review of retrospective studies. J Arthroplasty 28: 1141-1147.
18. Huang YH, Lin C, Yang JH, et al. (2018) No difference in the functional improvements between unilateral and bilateral total knee replacements. BMC Musculoskelet Disord 19: 87.
19. Liu L, Liu H, Zhang H, et al. (2019) Bilateral total knee arthroplasty: Simultaneous or staged? A systematic review and meta-analysis. Medicine (Baltimore) 98: e15931.
20. Ghasemzadeh F, Mateescu C, Chand Bansal U (2009) Comparison of bilateral and unilateral total knee arthroplasty in Iranian hospital, Dubai. Iranian Red Crescent Medical Journal 11: 76-80.

DOI: 10.36959/453/580