

GENDER, AGE, AND SURGICAL APPROACH: EXAMINING OSTEOARTHRITIS INCIDENCE AND FUNCTIONAL OUTCOMES IN SIMULTANEOUS AND STAGED KNEE ARTHROPLASTY

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Abstract

Background: Osteoarthritis (OA) is a common condition that predominantly affects women aged 55 years and older. While women are more likely to develop OA, it has been observed that they undergo knee replacement surgery at a later stage compared to men. This delay may be attributed to gender bias among physicians. Simultaneous bilateral total knee arthroplasty (BTKA) is an option for patients with bilateral knee OA, offering benefits such as improved rehabilitation and cost savings. However, the procedure carries the risk of post-operative complications, including limb length discrepancy (LLD). This study aims to evaluate the influence of gender and age on functional outcomes in patients undergoing simultaneous BTKA compared to staged bilateral procedures. **Materials and Methods:** A prospective study was conducted on patients who underwent total knee replacement, either simultaneous bilateral or staged bilateral procedures. Preoperative evaluations included medical history, physical examinations, and diagnostic tests. Postoperative limb length measurements were obtained, and the Knee Society Score was used to assess knee joint function and patient satisfaction. **Results:** The study included a total of 60 patients, divided into two groups: Group A (staged bilateral) and Group B (simultaneous bilateral). The average age for male patients was 67.42 years and females 65.60 years. Results showed that 76.7% of the patients in Group A were women, while 83.3% were women in Group B. The functional outcomes, as measured by the Knee Society Score, were comparable between the two groups, with no significant difference in knee joint function and patient satisfaction. However, post-operative limb length discrepancy was more prevalent in the simultaneous BTKA group. **Conclusion:** Simultaneous bilateral total knee arthroplasty can be a viable option for patients with bilateral knee osteoarthritis, offering comparable functional outcomes to staged procedures. However, the risk of post-operative limb length discrepancy should be considered. Further research is needed to explore the impact of gender and age on surgical outcomes in patients undergoing simultaneous BTKA.

INTRODUCTION

In individuals aged 55 years and above, women are more likely to be affected by osteoarthritis compared to men.^[1] However, it has been observed that women tend to undergo arthroplasty at a later stage compared to men.^[2] This delay in surgical intervention may be attributed to gender bias on the part of physicians recommending knee surgery, as suggested by Katz.^[3] et al. Knee osteoarthritis often affects both knees in the later stages of the disease, leading patients to consider simultaneous or staged replacement, each with their own advantages and disadvantages. The

benefits of simultaneous replacement include improved rehabilitation, shorter hospital stay, reduced anesthesia time, and significant cost savings for the healthcare system.^[4] However, this approach also carries the risk of peri and post-operative complications, such as deep vein thrombosis (DVT), pulmonary embolism, and surgical site problems. Studies have reported that LLD is a common finding after TKR, with varying degrees of severity.^[5] Hence post-operative LLD was analyzed while evaluating functional outcome in this study

An analysis of outcomes between unilateral and bilateral total knee arthroplasty, involving over

250,000 patients, revealed that patients undergoing simultaneous BTKA were younger than those undergoing staged procedures.^[6] A study by Stefansdoltir A et al showed Simultaneous BTKA patients had higher in-hospital mortality compared to knee replacement in staged patients. Moreover, an evaluation of the safety and efficacy of simultaneous bilateral total knee arthroplasty by Leonard.^[7] et al. showed a 98% 7-year survivorship for unilateral procedures and 97% for bilateral procedures.

In carefully selected patients, Bilateral Total Knee Arthroplasty (BTKA) performed simultaneously is considered a safe procedure.^[8] Several clinical studies have confirmed the safety of simultaneous BTKR, particularly in low-risk subgroups classified as ASA 1 and ASA 2 according to the American Society of Anesthesiologists. A study conducted by Jenny JY.^[9] et al. found that the clinical outcomes of simultaneous BTKA were comparable to those of unilateral or sequential procedures, with no increased risk of severe complications. However, the unilateral group did show significantly lower scores than the simultaneous bilateral group across all post-operative time intervals, although there was no significant difference in prosthesis failure rates.

Sanjeev Jain.^[10] et al. retrospectively studied the efficacy and safety of bilateral total knee replacement and found that patients undergoing simultaneous BTKR had better economic outcomes, improved functional outcomes, and higher satisfaction levels, with a shorter duration of hospital stay compared to staged procedures. On the other hand, Mangaleshkar SR.^[11] et al. suggested that staged bilateral total knee replacement might be a better option for older patients, as a retrospective review of surgeries performed over a three-year period indicated a higher post-operative mortality rate in patients undergoing simultaneous bilateral total knee replacement.

In light of these considerations, our study aimed to assess the influence of gender and age on functional outcomes in patients with knee osteoarthritis undergoing Simultaneous Bilateral Total Knee Replacement (BTKR) compared to staged Bilateral Procedures.

MATERIALS AND METHODS

The present study was a prospective study. All patients enrolled in the study underwent total knee replacement, either bilateral simultaneous or staged bilateral procedures. Thorough preoperative evaluations were conducted, encompassing detailed medical history, comprehensive assessment of the patients' overall medical status, age, functional capacity, and socioeconomic factors. A meticulous physical examination was performed to detect concomitant ligamentous injuries, quantify

deformities, and assess knee range of motion. Scanograms and lateral roentgenograms were obtained for further diagnostic evaluation. Preoperative routine blood examinations and checkups were conducted to exclude any ongoing infections from sources such as the ear, dental region, throat, skin, or urine. Cardiac fitness evaluations were carried out for patients requiring a prior assessment before the surgical procedure. Uniform skin preparations were meticulously implemented for all cases. Combined spinal epidural anesthesia was administered to all patients in the supine position. Cemented, cruciate-substituting total knee replacements were performed utilizing standardized implants from reputable manufacturers such as Zimmer or Stryker. Postoperative limb length measurements were acquired with patients in the supine position. The pelvis was squared, ensuring that the line connecting the anterior superior iliac spines remained perpendicular to the longitudinal axis of the body, extending from the xiphisternum to the pubic symphysis. The lower limbs were positioned parallel to the longitudinal axis of the body, and limb length was measured (in centimeters) from the anterior superior iliac spine to the medial malleolus using a measuring tape. Two different observers independently recorded the measurements, and the mean of the two values was documented as the limb length. Postoperative limb length discrepancy was assessed and documented.

The evaluation of knee joint function, clinical outcomes, and patient satisfaction was performed using the Knee Society Score, comprising the Knee Society Knee Score (KS) and the Knee Society Function Score (FS). The KS encompassed the clinical aspects of the knee joint, including pain assessment, range of motion evaluation, and assessment of stability. The FS focused on the functional ability of the patients and their satisfaction with knee function. Subscales within the KS included pain, range of motion, and stability, while the FS incorporated components related to walking distance and activities of daily living. Higher scores on both the KS and FS indicated improved knee function and overall outcomes. The comprehensive assessment provided by the Knee Society Score enabled a thorough evaluation of knee joint function, clinical outcomes, and patient satisfaction, particularly following total knee replacement surgery.

RESULTS

The patients were divided into two groups: Group A underwent staged and Group B underwent simultaneous bilateral total knee replacement. A comparison of age and sex between the two groups was done.

Age (Years)	Group A (N = 30)	Group B(N = 30)	Total (N = 60)
61 – 65	12 (40.0%)	19 (63.3%)	31 (51.7%)
66 – 70	14 (46.7%)	8 (26.7%)	22 (36.7%)
> 70	4 (13.3%)	3 (10.0%)	7 (11.7%)

The presented data indicates that approximately 51.7% of the cases fell within the age group of 61-65 years, while 36.7% of the cases belonged to the age group of 66-70 years. Additionally, around 11.7% of the cases involved patients older than 70 years. The average age of the patients in the study was 65.97 years, with a standard deviation of 4.075. The minimum recorded age was 61 years, while the maximum age observed was 77 years.

Sex	Group A (N = 30)	Group B (N = 30)	Total (N = 60)
Male	7 (23.3%)	5 (16.7%)	12 (20.0%)
Female	23 (76.7%)	25 (83.3%)	48 (80.0%)

The results revealed that the majority (80.0%) of the cases were female, while 20.0% of the cases were male. For male patients, the average age was found to be 67.42 years, with a standard deviation of 4.100. The minimum recorded age for males was 61 years, while the maximum age observed was 75 years. On the other hand, female patients had an average age of 65.60 years, with a standard deviation of 4.030.

Descriptive Statistics of Functional Score in Group A

	Mean	Median	SD	Range
Knee Score	84.77	85	4.400	74 – 93
Pain	46.33	47	2.354	42 – 50
Range of Flexion	16.80	17	1.064	15 – 19
Stability	22.80	23	1.562	20 – 25
Flexion Contracture	-0.433	0	0.774	-2 – 0
Extension Lag	-1.000	0	1.509	-5 – 0
Functional Score	67.90	70	3.111	58 – 70
Walking	34.60	33	1.993	33 – 37
Stairs	33.57	33	2.373	30 – 37
Walking Aid	-0.533	0	1.358	-5 – 0
Total Functional Score	76.37	77	3.459	68 – 81

In Group A, the descriptive statistics of the Functional Score showed the average knee score to be 84.77% with a 95% confidence interval ranging from 83.12% to 86.41%. The standard deviation for the knee score was 4.400. The median knee score was found to be 85%. The minimum recorded knee score was 74%, while the maximum knee score observed was 93%. For the functional score, the average was calculated to be 67.90% with a 95% confidence interval ranging from 66.74% to 69.06%. The standard deviation for the functional score was 3.111. The median functional score was 70%. The minimum functional score recorded was 58%, and the maximum functional score observed was 70%.

In terms of the total functional score, the average was determined to be 76.37% with a 95% confidence interval ranging from 75.08% to 77.66%. The standard deviation for the total functional score was 3.459. The median total functional score was 77%. The minimum total functional score observed was 68%, while the maximum total functional score recorded was 81%.

Correlation between Functional Score and Limb Length Discrepancy in Group a Surgery

	Mean	SD	Correlation	p – value
Functional Score	76.37	3.459	-0.194	0.305
Limb Length Discrepancy	0.700	0.596		

The average limb length discrepancy across the cases was calculated to be 0.700 cm, with a standard deviation of 0.596 cm. The minimum recorded limb length discrepancy was 0 cm, indicating no discrepancy, while the maximum observed discrepancy was 2 cm.

In the statistical analysis conducted, the p-value was found to be greater than the significance level of 0.05. This indicates that there was no statistically significant correlation between the functional score and limb length discrepancy in this group.

The Spearman correlation coefficient, which measures the strength and direction of the correlation, was determined to be -0.194. However, with a p-value of 0.305, the correlation was not statistically significant. Therefore, based on the available data, there is no evidence to suggest a significant relationship between the functional score and limb length discrepancy in this group.

Descriptive Statistics of Functional Score in Group B

	Mean	Median	SD	Range
Knee Score	87.60	88.5	3.997	78 – 94
Pain	47.03	47	2.593	42 – 50

Range of Flexion	18.17	18	0.913	16 – 20
Stability	23.30	23	1.208	20 – 25
Flexion Contracture	-0.333	0	0.661	-2 – 0
Extension Lag	-0.700	0	1.208	-3 – 0
Functional Score	77.00	80	4.402	67 – 80
Walking	39.03	40	1.991	33 – 40
Stairs	38.37	40	2.484	33 – 40
Walking Aid	-0.433	0	1.104	-5 – 0
Total Functional Score	82.33	84	4.113	73 – 87

In the analyzed data, the average knee score was determined to be 87.60% with a 95% confidence interval ranging from 86.11% to 89.09%. The standard deviation for the knee score was 3.997. The median knee score was found to be 88.5%. The minimum recorded knee score was 78%, while the maximum knee score observed was 94%. For the functional score, the average was calculated to be 77.00% with a 95% confidence interval ranging from 75.36% to 78.64%. The standard deviation for the functional score was 4.402. The median functional score was 80%. The minimum functional score recorded was 67%, and the maximum functional score observed was 80%. Regarding the total functional score, the average was determined to be 82.33% with a 95% confidence interval ranging from 80.80% to 83.87%. The standard deviation for the total functional score was 4.113. The median total functional score was 84%. The minimum total functional score observed was 73%, while the maximum total functional score recorded was 87%.

Correlation between Functional Score and Limb Length Discrepancy in Group B

	Mean	SD	Correlation	p – value
Total Functional Score	82.33	4.113	-0.189	0.317
Limb Length Discrepancy	0.567	0.626		

The average limb length discrepancy across all cases was calculated to be 0.567 cm, with a standard deviation of 0.626 cm. The minimum recorded limb length discrepancy was 0 cm, indicating no discrepancy, while the maximum observed discrepancy was 2 cm.

In the conducted analysis, the p-value was determined to be greater than the significance level of 0.05. This indicates that there is no statistically significant correlation between the functional score and limb length discrepancy in this group.

The Spearman correlation coefficient, which measures the strength and direction of the correlation, was found to be -0.189. However, with a p-value of 0.317, the correlation was not statistically significant. Therefore, based on the available data, there is no evidence to suggest a significant relationship between the functional score and limb length discrepancy in this group.

DISCUSSION

Comparison of studies based on Age & Gender distribution

In the total study population, 80% of the sample population were females (n=48) and 20% were males (n=12). Within the simultaneous group, there were more females (n=25), accounting for 63.3% of the group. Among them, the majority (40%) were below 65 years of age. In the staged group, there were also more females (n=23), representing 40% of the group, and the majority of them were below 65 years of age

Sl.no	Study	No. of Knees	Mean Age	Sex distribution
1	Foren et al	68/78	66	79% female
2	Deshmukh et al	180/180	69	53% female
3	Spicer et al	285/326	64.6	62% female
4	Our study	120/120	65.97	80% female

Hawker et al. commented that the higher prevalence of osteoarthritis in females, with a female-to-male ratio of 1.76, was well-documented. However, it was concerning that previous studies had revealed a 22% lower likelihood for females to undergo total joint arthroplasty as a treatment for OA. Foren.^[16] et al. conducted a study on a matched control group for total knee replacement, where the majority of the study population was female (79%). The mean age of the patients in their study was reported to be 66 years. Similarly, Deshmukh.^[17] et al. conducted a study analysing the influence of body weight as a confounding factor on functional outcomes after total knee arthroplasty (TKA). In their study, 53% of the participants were female, and the average age of the patients was 69 years. Another study by Spicer.^[18] et al. explored body mass index (BMI) as a predictive factor for outcomes after TKA. Their study included 62% female participants, with an average age of 64.6 years. Comparing these studies to ours, it is evident that our study had a similar mean age presentation. However, we observed a higher proportion of females in our study (80%) compared to the other studies with a mean age of approximately 66 years. The study highlighted that age plays a crucial role in patient selection and subsequent functional outcomes. This difference in gender distribution highlights the unique characteristics of our study population and may warrant further investigation into

potential gender-related factors influencing outcomes in total knee replacement.

Comparison of studies based on Post-operative functional score

Sl.no	Study	No. of knees	Scoring system	Mean functional score
1	Pagnano. ^[19] et al	240/240	Knee society score	89
2	Branders. ^[20] et al	116/149	Knee society score	75
3	Goldberg. ^[21] et al	99/124	Knee society score	85
4	Sansone. ^[22] et al	102/110	Knee society score	74
5	Shih. ^[23] et al	187/235	Knee society score	87
6	Joshi. ^[24] et al	90/110	Knee society score	51
7	Banks. ^[25] et al	194/198	Knee society score	75.2
8	Our study	120/120	Knee society score	79.35

Brander et al. investigated the prediction of total knee replacement pain. The study group, which received effective analgesic management, showed a significant improvement in knee society score, with a score of 75 (range: 70-79). Joshi.^[26] et al. conducted a study on knee replacements in octogenarians and found poor functional outcomes based on knee society scoring system. We used cemented posterior stabilized prosthesis with polyethylene inserts and achieved favourable functional outcomes comparable to other studies. In the simultaneous group, the average Knee Society Score was 82.33, indicating an excellent outcome. On the other hand, in the staged group, the average Knee Society Score was 76.37. The mean post-operative functional outcomes following bilateral total knee replacement were similar to those reported in other studies.

In both the group, we observed a limb length discrepancy ranging from 0 to 2 cm, postoperatively which accounted for 63.3% after surgery in group A. In contrast, the one-stage group showed a limb length discrepancy of 50%. We found no statistically significant correlation between the functional scores and the limb length discrepancy in either group. The limb length discrepancy may be influenced by several factors, including correction of varus alignment after surgery, and postoperative flexion deformity. However, these variables were not the focus of our study and were not considered in our analysis. None of our patients exhibited malalignment, component malposition, patellar malt racking, or instability, so these factors did not confound our study results.

We observed that the functional outcomes of the one-stage cases were better than those of the two-stage cases. However, due to the lack of age and sex matching between these groups, a direct comparison of the improved functional outcomes could not be made. Additionally, the Knee Society scores for the one-stage bilateral total knee replacement were obtained 6 weeks after the surgery, considering the average scores of both knees. In contrast, the Knee Society scores for the two-stage cases were obtained 6 weeks after the initial surgery, with the second knee being only 2 weeks postoperative, as the interval between the two surgeries was 1 month. Therefore, a decreased score was expected for the two-stage cases.

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CONCLUSION

In conclusion, our study revealed a higher incidence of osteoarthritis necessitating bilateral knee arthroplasty, whether performed simultaneously or staged, among females over the age of 65. The simultaneous group demonstrated excellent outcomes, with an average Knee Society Score of 82.33, while the staged group achieved good outcomes, with an average score of 76.37. An intriguing observation was that the staged group displayed a higher prevalence of postoperative limb length discrepancy, ranging from 0 to 2 cm. These findings contradict previous studies that reported a lower incidence of arthroplasty procedures in females. Our findings indicate a potential predisposition to osteoarthritis in females aged 65 and above, culminating in the need for total knee arthroplasty. Further research is warranted to explore the factors contributing to these gender-based differences in osteoarthritis incidence and functional outcomes following knee arthroplasty.

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