

A STUDY OF 100 CASES OF BILATERAL TOTAL KNEE REPLACEMENTS WITH ASYMMETRY OF COMPONENT SIZE

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ABSTRACT

Objective: Many studies have described the normal variations in the anatomy of the knee, however very few studies have reported the asymmetry of component size in bilateral total knee arthroplasties. Our study is the first one to find out the incidence of asymmetry of component size in bilateral total knee arthroplasties in Pakistan.

Study Design: Prospective analysis.

Place and Duration of Study: Rai Medical College, Sargodha, from Oct 2016 to Oct 2018.

Methodology: We conducted a prospective analysis of 100 patients presenting to the orthopedic department of Doctors Trust Teaching Hospital affiliated with Rai Medical College, Sargodha between October 2016 and October 2018. Out of these 89 patients were operated in a single staged procedure whereas 11 were operated in a two staged (second knee at a 2-3 day interval) procedure. Implants used were Nexgen (Zimmer Biomet, Warsaw, IN, USA), Genesis II (Smith and Nephew, Memphis, TN, USA) and PFC-Sigma (DePuy, Warsaw, IN, USA). Data was analyzed using SPSS v.25.

Results: Out of 100 patients 20% were found to have component size asymmetry with 12% in the femoral component only, 2% only in tibial component only, 3% in patellar component only, 2% having asymmetry in both femoral and tibial components and 1% having asymmetry in both femoral and patellar components. There was a similar incidence of component size asymmetry in all three different types of implants. Incidence of component size asymmetry in male and female patients was found to be 15.8% and 21% respectively.

Conclusion: Since, 20% of the cases showed asymmetry of component size, we recommend that both knees should be measured for implant size individually rather than using the measurement of a single knee for both knees before a bilateral total knee arthroplasty.

Keywords: Arthroplasty, Bilateral, Component asymmetry, Joint Replacements, Knee, Total.

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INTRODUCTION

Numerous studies identify the asymmetry in the anatomy of knee joints that occur naturally in the population¹⁻⁵, particularly in the females⁶.

Total knee arthroplasty is a surgical procedure indicated mainly for relieving the pain associated with osteoarthritis which is refractory to non-operative treatments⁷. Other indications include other inflammatory arthritis and some cases of osteonecrosis⁷. Studies show that total knee arthroplasty is a cost effective procedure that not only relieves pain but also improves the quality of life⁸⁻¹⁰. It is also known that single staged (simultaneous) bilateral total knee arthroplasties are

more cost-effective than two-staged bilateral total knee arthroplasties¹¹ however there is paucity of evidence to support superiority of either of the two procedures¹⁶. Advancing patient age, underlying disease and obesity negatively affect the outcome of the prosthetic joint⁷. Components in articular cavity, depending on their size and material can cause foreign body reaction thus resulting in asymmetrical recovery between limbs following surgery^{12,13}. Thus asymmetry of component size is a major risk factor for incongruent recovery between the two limbs following TKA¹³. A femoral component of the incorrect size can lead to a flexion extension gap mismatch for example a femoral component of small size may lead to flexion instability whereas, component of a large size may reduce the flexion space leading to the postoperative loss of flexion and overstuffing

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of the patellofemoral joint resulting in a painful knee^{14,15}.

METHODOLOGY

We conducted a prospective analysis of 100 patients presenting to the orthopedic department of Bajwa Trauma Centre in Sargodha between October 2016 and October 2018 after getting approval from our Institutional Ethics Review Board. During this period, a total of 124 bilateral TKAs were done either in a single staged procedure (both knees operated under a single anesthesia simultaneously) or as a two staged procedure at an interval of 2-3 days (single hospital admission). We included only those cases (a) where implant of the same type and manufacturer was used in both knees, (b) who did not develop any postoperative complications and (c) had a follow up for one year. Cases excluded were (a) those whose knees were operated separately under separate hospital admissions, (b) those who developed any postoperative complication in the knees, (c) those lost to follow-up.

One Hundred patients out of a total 124 patients operated during this time period met our inclusion and exclusion criteria. We had collected their data prospectively as a part of a planned study but analyzed the data retrospectively.

All patients were preoperatively evaluated by taking their complete history, clinical examination, routine investigations and anteroposterior and lateral X-rays. We conducted the two staged procedure for patients older than 70 years or for those whose comorbid conditions did not allow a single day procedure. Component asymmetry was first assessed preoperatively under direct vision.

All patients were administered prophylactic antibiotics (vancomycin or cefotaxime) before the skin incision and then after every 8 hours for 24 hours. The same surgical team performed all the operations. 89 cases were operated as a single staged procedure whereas 11 were operated as a two staged procedure (at a 2 or 3 day interval). A median incision was given at the knee to expose the capsule. No drainage tube was placed.

Medialparapatellar approach is a standard approach which was used on all patients. Femur was prepared first by drilling the entry point of the femoral step reamer 1 cm above the insertion of posterior cruciate ligament. After inserting the intramedullary drill guide, the distal femoral cut was carried out after measuring the valgus angle at right angles to the mechanical axis from the posterior anterior radiograph view of standing leg. Anterior cruciate and posterior cruciate ligaments were removed. The tibia was approached in an extramedullary guided fashion, and proximal tibial cut was made. Ligaments were balanced to make a rectangular extension gap which was checked with a spacer block. After measuring lower extremity alignment, stability of the knee was tested in fully extended position. We chose the posterior referencing system for the anteroposterior femoral cut. After completing the AP cut, we checked the balancing of the flexion gap using a spacer lock in full flexion. After this femoral, patellar and tibial component sizes were determined after final cutting by using the implant size which was closest to the respective component.

The pneumatic tourniquet was applied to both sides at 350 mmHg from the beginning of the incision to the end of the procedure and then released following the end of procedure. Hemostasis was secured. The component sizes were measured perioperatively after their removal and final cutting. Patients received epidural analgesia during post-operative 48 hours. All patients were routinely administered with ketorolac 15mg I/V three times a day during hospitalization and diclofenac 50mg thrice daily following discharge for relieving postoperative pain. Anticoagulant therapy (10mg rivaroxaban daily) was started 24 hours after operation and was continued for 14 days thereafter.

RESULTS

The data was entered using Microsoft Excel and SPSS version 25 and analyzed accordingly. For all practical purposes the *p*-value was set at

0.05. The *p*-value above 0.05 was considered to be statistically insignificant.

All the patients were operated for the complaint of osteoarthritis. Out of 100 cases included

Table-I: Component of knee with frequency of incidence of asymmetry.

Component of Knee	Incidence of Asymmetry
Femoral component only	12 (12%)
Tibial component only	2 (2%)
Patellar component only	3 (3%)
Both femoral and tibial components	2 (2%)
Both femoral and patellar components	1 (1%)

n=89 were done as a simultaneous (single staged) procedure whereas n=11 were done as a two staged procedure but in a single hospital admission. The total average age was found out to be 61.7 years with a minimum age of 48 years and a max-

Table-II: The incidence of component size asymmetry by type of implant used.

Implant	No. of Cases (% of Total Cases)	Femoral Asymmetry (%)	Tibial Asymmetry (%)	Patellar Asymmetry (%)
PFC-Sigma (DePuy, Warsaw, IN, USA)	4 (4)	1(1)	1 (1)	None
Nexgen (Zimmer, Warsaw, IN, USA)	53 (53)	11 (11)	2 (2)	2 (2)
Genesis-II (Smith and Nephew, Memphis, TN, USA)	43 (43)	3 (3)	1 (1)	2 (2)
Total	100	15	4	4

imum age of 82 years (range= 48-82). The female average age was found out to be 59.7 whereas the male average age was a little higher at 66.7 years. The male to female ratio was 19:81. Incidence of component size asymmetry in males and females is shown in figure. Out of total 20 cases of component size asymmetry (n=20), 6 cases (n=6) were males whereas 14 (n=14) cases were females. The difference of incidence of asymmetry was found to be statistically insignificant between males and females (*p*=0.323).

Out of 100 patients 20% were found to have component size asymmetry with 12% in the femoral component only, 2% in tibial component only, 3% in patellar component only, 2% having asymmetry in both femoral and tibial components and 1% having asymmetry in both femoral and patellar components (table-I).

Out of the 15 cases of femoral asymmetry, component of the right knee was larger in 9 cases (n=9) whereas component of left knee was larger in 6 cases (n=6). In 11 cases (n=11) of femoral component asymmetry the size difference was 2.5mm whereas in 3 cases (n=3) it was 1mm and in one case (n=1) of a young female of 49 years it was found to be 0.5mm.

In all 4 cases (n=4) of tibial component asymmetry the component of left knee was found to be larger with 2 cases (n=2) having a size difference of 4mm and 2 cases (n=2) having a 1mm difference.

All 4 cases (n=4) of patellar component asymmetry were found to have the right sided component larger than the left one out of which 3 cases (n=3) had a 3mm difference whereas one case (n=1) had a 2mm difference.

The incidence of component size asymmetry by type of implant used is described in table-II.

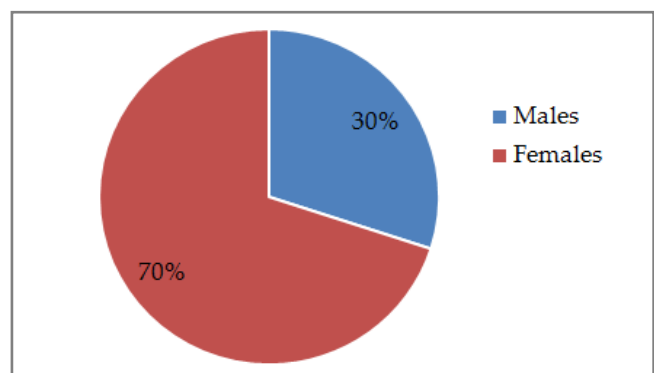


Figure: Incidence of asymmetry.

There is a similar incidence of asymmetry in the different types of implants. The difference of incidence between Nexgen and Genesis-II is not very significant at *p*=0.057. The difference of incidence

with PFC-sigma was not computed since there is a very small amount of data for it which cannot be computed for statistical significance.

DISCUSSION

As mentioned earlier, many studies can be found describing the normal variations in anatomy of the knee joint¹⁷ however very few studies have described the incidence of component size asymmetry in patients undergoing bilateral total knee arthroplasties. Its significance can be analyzed by the fact that altered alignment of the mechanical axis of the knee joint can be brought about by the incomplete seating of either of the components of the knee joint during arthroplasty which undermines the primary goal of doing a total knee arthroplasty which is restoration of knee joint movement besides relieving pain¹⁸. Furthermore, unbalanced soft tissues resulting from improper placement of the asymmetric components may cause higher strains in the surrounding tissues producing pain as a consequence¹⁹, hence component sizing is very important before bilateral total knee arthroplasty. Brown and Diduch reported asymmetry rates for femoral, tibial, and patellar components as 6.7%, 1.1% and 0.3% respectively²⁰.

In another review²¹ of 253 patients undergoing simultaneous bilateral TKA, the rates of asymmetry were 8.7%, 6.7%, and 5.1% for femoral, tibial and patellar components respectively, which was comparatively higher than the previous study.

A study of 289 bilateral TKAs by Reddy shows femoral and tibial component asymmetry to be 9.2% and 8.7% respectively²².

Another study found out the incidence of asymmetric femoral components to be under 10% while reporting the risk factors and outcomes of bilateral total knee arthroplasties²³. The same study also showed that the size of the asymmetric femoral component was not determined by its preoperative anatomy, but instead it was determined by the flexion of the component.

Our primary finding was the incidence of component size asymmetry in a subset of Pakistani population. In our study 20% were found to have component size asymmetry with 12% in the femoral component only, 2% only in tibial component only, 3% in patellar component only, 2% having asymmetry in both femoral and tibial components and 1% having asymmetry in both femoral and patellar components. Overall 15% of the patients had femoral component asymmetry, 4% had tibial component and 4% had patellar component asymmetry. Our study reports an increased incidence of femoral component asymmetry as compared to previous studies and this might be of use to guide surgeons to select the appropriate sized components for each knee separately in future especially focusing on best angle for cutting the distal femur to ensure that the right sized femoral component is selected for implantation²⁴.

The strengths of our study include a prospective study design and both the surgeons who performed the bilateral total knee arthroplasties in this study measured the individual component size for each knee independently hence effectively portraying the difference in bony anatomy between the two knees that existed in some patients. Limitations of our study include a relatively small sample size which might have failed to represent the total population of patients undergoing bilateral total knee arthroplasties effectively, but it was mainly because most people in Pakistan can not afford to undergo this rather expensive and complicated procedure. We did not analyze the data regarding risk factors of this asymmetry or the possible outcomes of this asymmetry on the function of the knee joint. The variables responsible for interlimb asymmetry have been analyzed in a previous study like gender, old age, increased levels of anxiety, diagnostic differences, high BMI, and asymmetry of component sizes, 13 however, our study aimed only in identifying the relatively high incidence of component size asymmetry which is one of the risk factors for interlimb asymmetry.

CONCLUSION

We conclude that the incidence of asymmetry of component sizes between the two knees of the patients undergoing bilateral total knee arthroplasties is very high, in our study being 20%. Hence orthopaedic surgeons must keep this difference in mind before inserting the implant of the appropriate size after measuring the component sizes of each knee separately rather than using the measurements of one knee for the other erroneously. This might improve functional outcomes for patients undergoing this procedure.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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