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FUNCTIONAL ASSESSMENT OF ALL POLYETHYLENE TIBIAL MONOBLOCK COMPONENT IN TOTAL KNEE ARTHROPLASTY

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ABSTRACT

Background: In a developing country like India the cost effectiveness of all polyethylene tibial components is a major boon, without compromising the functional outcome. In this study we have attempted to evaluate the functional outcome of all polyethylene tibial monoblock component in total knee arthroplasty. **Methodology:** The study was carried out on 86 patients who are operated for total knee arthroplasty with all polyethylene tibial monoblock component. Demographic, surgical and follow up data was collected from case sheets of patients and copied in Performa. The patients were called for five years follow up and examined in the outpatient department. **Results:** The mean age of study population was 62.8 years (range 50 – 72 years) with mean BMI of 27.6 kg/m^2. Statistically significant improvement was seen in the range of movements in all the age groups. Both male and female patients had insignificant difference in knee scoring. Assessment of clinical functional abilities of knee scoring have observed to be higher in patients with lower BMI. **Conclusion:** Significant improvement in range of motion as well as knee score in all age range, emphasizes the fact that total knee arthroplasty with all polyethylene design in osteoarthritis is an excellent surgery to restore near normal life style.

INTRODUCTION

Musculoskeletal disorders are the second leading cause of years lived with disability globally [1]. One of the extensive causes of disability in Indian population is knee arthritis due to various indigenous habits peculiar to the people of Indian subcontinent. The cartilage damage of patellofemoral joint, medial, lateral compartment causes severe pain in the joints and risk of deformity, which necessitates the total joint replacement. The surgical management of arthritis has two options. One is soft interposition arthroplasty and second is surface replacement arthroplasty [2].

Total knee arthroplasty is greatly acceptable, satisfying and reproducible orthopaedic surgical procedures in the world. Many patients suffering from rheumatoid arthritis, osteoarthritis and

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traumatic arthritis have overcome the severe pain due to total knee replacement procedure [3].

While the popularity of total knee arthroplasty and its acceptance by the general population has seen exponential rise in the recent years some complications associated with the surgery still persists such as infection, loosening of implant, bone collapse and malalignment [4].

The benefits of modern all polyethylene tibial monoblock component are the cancellation of backside wear, avoidance of locking mechanism issues and cost-effective implantation compared to modular metal backed components [5]. Thus, potential advantages combined lower costs renewed interest in modern all polyethylene tibial designs in a developing country like India. The reduced cost of all polyethylene tibial components is a major boon, without compromising the functional outcome. The present study is aimed at evaluation of clinical functional abilities in operated for total knee arthroplasty specially with all polyethylene tibial monoblock component.

MATERIAL AND METHODS

The study was done in tertiary care centre of Bangalore, India specialising in trauma, arthroplasty, plastic surgery, microvascular surgery and maxillofacial surgery. It is a referral centre for orthopaedic related problems from various parts of India especially from Karnataka, Tamil Nadu and Andhra Pradesh. This was a combined (retrospective-prospective study). Patients who underwent total knee arthroplasty with all polyethylene tibial monoblock component during 2016-17was obtained from medical record section and data was noted in the proforma. Follow up visits data which was scheduled at6 weeks,3months, 6months, 1year, 2year, 3year and 4 year was also obtained from medical record section. The patients were called for five years follow up (2021-2022) and examined in the outpatient department. All patients were assessed for Range of motion and Knee Society Knee score.

Inclusion Criteria: Patients who underwent Primary Total Knee Arthroplasty using all polyethylene tibial monoblock component.

Exclusion Criteria: Patients less than 5 years of follow up, elderly patients with >80years, who are operated Total Knee Arthroplasty with metal block, history of Rheumatoid Arthritis or Metabolic bone disease were excluded from the study. Institution Ethical committee and Scientific committee approval was cleared (SNHC/IEC/15/BNLR) and informed consent was obtained from all included patients.

The survival of the all-polyethylene tibial component was considered for calculation of sample size. According to study done by Faris et al the 10-year survival rate was 68.11% [6]. The sample size was calculated with 90% statistical power, 5% level of significance and an allowable error of 15% using the formula for proportion i.e.,

$$n = \frac{\left(Z_{\alpha}/_{2}\right)^{2} \times P \times (1-P)}{L^{2}}$$

Where Zα/2 is 1.96, P is 68.11% & L is 15% of P, the sample size was calculated to be 80.

Statistical Analysis

The data was collected and entered in the MS Excel master sheet. Data was tabulated and analysed using software SPSS (Statistical Package for the Social Sciences) for Windows version 20.0. Categorical data is presented as percentage (%). Variables have been presented in frequencies and percentages. Quantitative variables are presented using mean and standard deviation, analysed using ANOVA and Student T test. P value of less than 0.05 was considered statistically significant.

RESULTS

The study was conducted on 86 patients who underwent total knee arthroplasty using all polyethylene tibial monoblock components at Orthopaedic department of Sparsh hospital, Narayana health city Bangalore. The informed consent was taken from all the participants at the time of inclusion. The mean age of patients was 62.8 ± 5.7 years (range 50 – 72 years) and majority (62.8 %) of the patients were in 60 – 69 years of age group. The female patients were greatly affected (61.6%) than males (38.4%). The body mass index ranged from 19.6- 40.5 with 41.9% of patients were falling between 25 – 30 group. And meanBMI was 27.6 kg/m^2 **(table 1).** All polyethylene tibial components were used in all knees operated.

No significant difference in the range of motion was observed in between age groups during preoperative period. However, postoperatively from 6 weeks to 5years of follow up, the statistically significant difference in range of motion and knee score were observed in all age groups. The younger age groups had better range of movements and knee score **(Table 2).**

Table 1: Demographic profile of study subjects

Parameters	Cases		Mean (±SD)
	No	%	
Age group			
50-59 years	22	25.6	62.8 (±5.7)
60-69 years	54	62.8	
70-80 years	10	11.6	
Gender distribution			
Male	33	38.4	-
Female	53	61.6	
BMI			
Up to 25	28	32.6	27.6(±4.3)
25 – 30	36	41.9	
Above 30	22	25.5	
Total	86	100.0	

There was no statistically significant difference in range of motion as well as knee score between both genders. Mean pre-operative range of motion for men and women was 90.8 (±16.7) and 88.0 (±16.7) degrees respectively. At 5 years follow up males had a mean range of motion 119.5 degrees and females had mean range of motion 119.6 degrees **(table 3).**

Pre-operatively there was no statistically significant difference in range of motion between body mass index groups (p value 0.061). At 5 years follow up patients with <25 of body mass index had 121.9 degrees of mean range of motion. Furthermore, patients with body mass index 25 to 30 had mean range of motion 119.6 degrees and those with BMI of more than 30 had mean range of motion of 117.1 degrees (p value 0.028). It was observed that patients having BMI within normal range had comparatively better range of movements during all the follow-ups (table 4).

Table 2: Range of movements and knee score for different age groups

Range of motion at	Range of motion (Mean ±SD)			
	Age groups			
	50-59 years	60-69 years	70 & above	'p'
Pre-operative	93.2 ± 14.9	88.9 ± 16.4	79.9 ± 11.4	0.061
6 weeks	88.3 ± 4.5	86.1 ± 6.9	82.1 ± 8.9	0.018
3 months	102.9 ± 8.6	98.1 ± 9.8	92.1 ± 14.6	0.005
6 months	113.6 ± 7.4	107.9 ± 9.6	102.9 ± 18.2	0.004
1 year	120.2 ± 6.6	116.2 ± 8.6	110.7 ± 12.7	0.004
2 years	120.2 ± 5.8	117.8 ± 7.2	112.1 ± 11.7	0.006
3 years	120.2 ± 5.8	118.5 ± 7.2	113.2 ± 11.0	0.017
4 years	120.5 ± 6.1	119.1 ± 7.1	114.6 ± 9.3	0.041
5 years	121.0 ± 6.0	119.8 ± 7.4	115.4 ± 8.7	0.054
p value of within the group	0.001	0.001	0.001	
Knee score at	**Knee score (Mean ±SD)**			
Pre-operative	23.5 ± 4.4	25.6 ± 6.9	24.1 ± 5.1	0.270
6 weeks	62.3 ± 5.2	60.6 ± 4.6	55.6 ± 7.6	0.001
3 months	75.0 ± 6.3	71.4 ± 4.6	65.2 ± 7.5	0.001
6 months	79.7 ± 6.4	77.1 ± 4.8	70.1 ± 8.5	0.001
1 year	84.8 ± 5.9	81.0 ± 5.3	73.7 ± 9.3	0.001
2 years	87.7 ± 5.5	86.4 ± 4.1	77.9 ± 10.1	0.001
3 years	88.6 ± 5.4	87.9 ± 4.3	80.1 ± 8.7	0.001
4 years	88.7 ± 5.4	87.9 ± 4.3	82.9 ± 6.5	0.003
5 years	89.1 ± 5.0	87.9 ± 4.3	85.9 ± 4.5	0.082
p value of within the group	0.001	0.001	0.001	

Table 3: Range of movements and knee score among both genders

	Range of motion (Mean ±SD)				**Range of motion at**		
Range of motion at	**Male**	**Female**	**'p'**		**Male**	**Female**	**'p'**
Pre-operative	90.8 ± 16.7	88.0 ± 15.3	0.365	2 years	118.3 ± 7.4	117.4 ± 8.2	0.578
6 weeks	86.7 ± 8.0	85.9 ± 6.1	0.572	3 years	118.4 ± 7.5	118.3 ± 7.8	0.920
3 months	99.0 ± 9.7	98.5 ± 11.2	0.792	4 years	119.0 ± 7.3	118.9 ± 7.3	0.925
6 months	109.5 ± 10.4	108.4 ± 11.3	0.606	5 years	119.5 ± 7.6	119.6 ± 7.2	0.961
1 year	117.2 ± 8.5	116.3 ± 9.5	0.599				
p value of within the group	0.001	0.001	0.001				
Knee score at	**Knee score (Mean ±SD)**						
Pre-operative	23.3 ± 5.3	25.7 ± 6.5	0.082	2 years	86.3 ± 6.8	85.3 ± 6.0	0.447
6 weeks	60.9 ± 6.0	60.2 ± 5.3	0.545	3 years	88.0 ± 6.5	86.6 ± 5.5	0.214
3 months	71.7 ± 6.4	71.6 ± 6.0	0.910	4 years	88.4 ± 5.5	86.9 ± 5.0	0.148
6 months	77.0 ± 6.9	76.9 ± 6.2	0.945	5 years	88.8 ± 4.6	87.5 ± 4.5	0.139
1 year	81.0 ± 7.2	81.2 ± 6.7	0.900				
p value of within the group	0.001	0.001	0.001				

Table 4: Range of movements and knee score for different BMI groups

Range of motion at	**Range of motion (Mean ±SD)**			
	Body mass index			
	Up to 25	**25.1 – 30**	**> 30**	**'p'**
Pre-operative	93.9 ± 13.5	89.7 ± 18.3	83.0 ± 12.6	0.061
6 weeks	87.6 ± 5.3	86.9 ± 7.0	83.8 ± 7.6	0.046
3 months	101.4 ± 10.0	99.8 ± 10.1	94.2 ± 10.8	0.013
6 months	110.6 ± 11.3	109.7 ± 9.4	105.8 ± 12.1	0.153
1 year	119.4 ± 8.5	116.9 ± 8.4	113.2 ± 9.7	0.017
2 years	119.6 ± 7.5	118.0 ± 7.1	115.5 ± 8.9	0.094
3 years	120.4 ± 7.3	118.4 ± 7.1	115.9 ± 8.32	0.050
4 years	120.9 ± 7.5	119.0 ± 6.9	116.8 ± 7.1	0.071
5 years	121.9 ± 7.3	119.6 ± 7.4	117.1 ± 6.7	0.028
Within group p value	0.001	0.001	0.001	
Knee score at	**Knee score (Mean ±SD)**			
Pre-operative	24.8 ± 6.5	24.7 ± 5.9	25.0 ± 6.3	0.986
6 weeks	62.4 ± 4.3	60.9 ± 5.2	57.6 ± 6.1	0.001
3 months	73.7 ± 6.2	72.3 ± 5.1	68.5 ± 6.4	0.001
6 months	78.5 ± 6.1	77.4 ± 5.4	74.5 ± 7.4	0.027
1 year	83.7 ± 6.3	81.2 ± 5.6	78.3 ± 8.0	0.004
2 years	87.4 ± 5.1	86.2 ± 4.6	83.1 ± 8.4	0.012
3 years	88.9 ± 5.0	87.7 ± 4.7	84.4 ± 7.3	0.004
4 years	88.9 ± 5.0	87.7 ± 4.7	85.6 ± 5.6	0.031
5 years	89.2 ± 4.6	87.7 ± 4.7	86.9 ± 4.2	0.104
Within group p value	0.001	0.001	0.001	

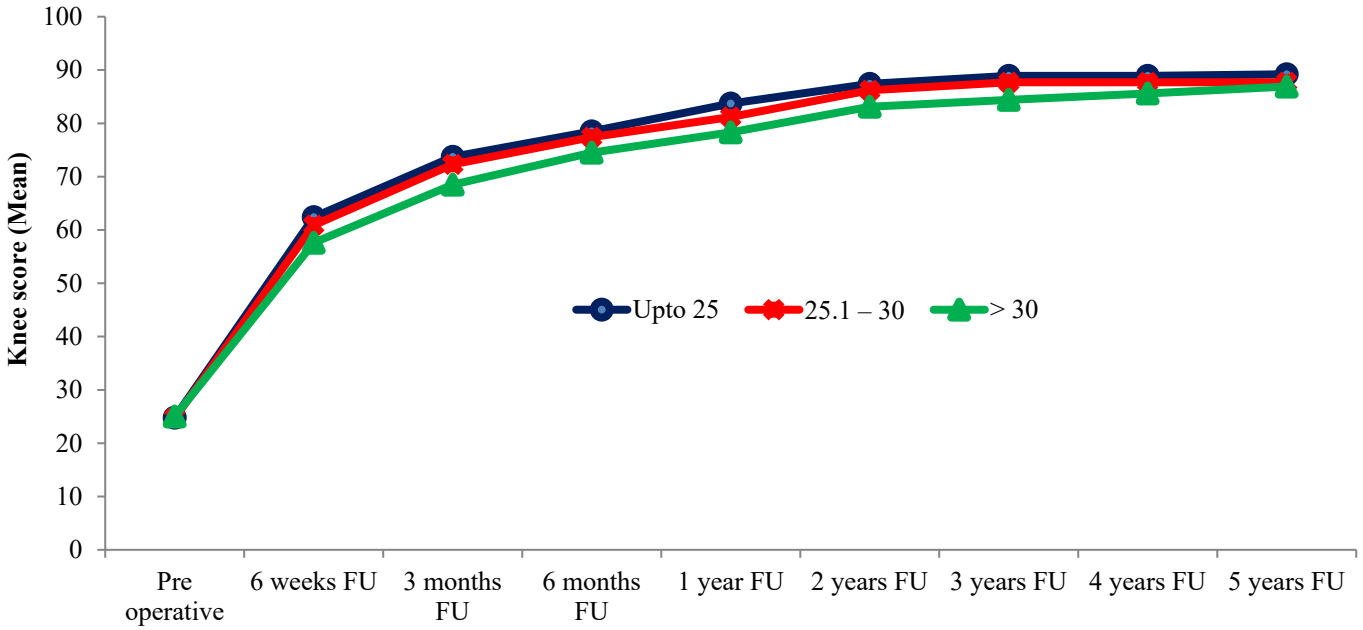

Figure 1: Comparison between mean knee score and BMI (kg/m^2)

The mean knee score for patients within normal range of BMI, overweight and obese was respectively 24.8 (±6.5), 24.7(±5.9) and 25.0(±6.3). During the follow-up from 6 weeks to 4 years post-operation, the knee scores were comparatively higher among patients with lower BMI. At 5 years follow up, patients with <25 kg/m^{2}of BMI had mean knee score 89.2. And the patients who had BMI between 25 to 30 kg/m^2 and more than 30 kg/m^{2}had mean knee score of 87.7 and 86.9 respectively. However, the same was not found to be statistically significant **(table 4 and figure 1).**

DISCUSSION

Life and times of total knee arthroplasty underwent a paradigm shift when John Insall came out with total condylar knee in 1970's. During last decade of 20th century and 1st decade of 21st century total knee arthroplasty became a household name in Asia in general and Indian subcontinent in particular. As more and more total knee arthroplasties were being performed, forthcoming long-term outcomes painted a balanced picture. In the present study the average age of the patient was 62.8 years (50-72 years). Comparison of these findings with other recent studies showed that the mean age was lower compared studies in the western world, Bettinson et al (average age 69.3 years) and Gioe et al (average age 69 years) [7,8]. This can be attributed to early osteoarthritis in Indian subcontinent due to their lifestyle which involves sitting cross legged and squatting for long time. Majority of patients undergoing total knee arthroplasty with all polyethylene tibial component were females (61.6%) which is reflected in study conducted by Vivek Mohan et al (63.7%) [9]. The mean body mass index in our study was found to be 27.6 ranging from 19.6 to 40.5. Majority of the patients had body mass index> 25. Similar results were noted by Holmberg S et al who suggested that an increase in body mass index leads to osteoarthritis [10].

In the present study it was observed that at the end of five years there was no statistically significant difference in range of motion between the age groups which is similar to study conducted by Farahini et al whose analysis showed no significant correlation between age and post-operative range of motion [11]. However, there is statistically significant improvement in preoperative and postoperative range of motion within all age groups (p 0.001). We found that gender did not significantly affect the final range of motion achieved. Similar conclusions are noted in the study conducted by Gatha NM et al [12]. We noted that body mass index had a statistically significantly effect on range of motion achieved. These results are contrary to study conducted by Kotani A et al but similar to Shoji et al who concluded that poor range of motion was greatly seen in obese patients [13,14].

In our study there was statistically significant improvement in preoperative and postoperative knee scores according to age (p 0.001). This emphasizes the fact that total knee arthroplasty in osteoarthritis patients is an excellent surgery to restore near normal life style. Our study when compared to study conducted

by Dojcinovic S et al has shown similar encouraging results [15]. There was no statistically significant difference in knee scores between ages (at five years follow up), gender and body mass index groups.

CONCLUSION

Our patient group comprised predominantly of women. It is a balanced statement to conclude that most of the knee problems requiring total knee arthroplasty occur more commonly in women compared to men. It will be worthwhile exercise to educate Indian middle-aged women about the natural history of knee diseases. Statistically significant improvement in range of motion and knee scores in all age groups, emphasizes the fact that total knee arthroplasty with all polyethylene design in osteoarthritis is an excellent surgery to restore near normal life style. Patients with BMI in normal range have comparatively better outcome than overweight and obese patients.

LIMITATION & RECOMMENDATIONS

Study was done for a limited time of five years of which data was obtained from the records for the first four years; we recommend a prospective study to know the functional outcome for 15-20 years. We recommend maintaining a registry of arthroplasty to study the long-term outcomes, its relevance and its impact on elderly citizen to improve quality of life in the society. Total knee arthroplasty in future will be greatly influenced by economics rather than surgeon, surgical technique or institutions where it is performed. Therefore, we recommend all polyethylene tibial monoblock components which will significantly reduce health care cost.

FINANCIAL ASSISTANCE

Nil

CONFLICT OF INTEREST

The authors declare no conflict of interest

AUTHOR CONTRIBUTION

Moinuddin Nadaf designed the entire work. Sharan S Patil and Raghavendra R Huchchannavar contribute in making necessary correction and revision of the manuscript. The final draft was checked by all the authors.

REFERENCES

[1] Stenquist DS, Elman SA, Davis AM, Bogart LM, Brownlee SA, Sanchez ES, Santiago A, Ghazinouri R, Katz JN. Physical activity and experience of total knee replacement in patients one to four years post-surgery in the Dominican Republic: a qualitative study. *Arthritis care & research*, **67(1)**, 65-73 (2015).

[2] Venkatesan AS, Jayasankar P, Williams S. An assessment of clinical and functional outcomes in the patients undergoing total knee arthroplasty during postoperative period. *J Orth Joint Surg*, **2(2)**, 57–61 (2020).

[3] Salgotra KR, Kohli S, Vishwakarma N,Chavan S. Early results of total condylar knee arthroplasty using Indian-designed prostheses. *MGM J Med Sci*, **4(1)**, 19-22 (2017).

[4] Boyd Jr AD, Ewald FC, Thomas WH, Poss R, Sledge CB. Long-term complications after total knee arthroplasty with or without resurfacing of the patella. *JBJS*, **75(5)**, 674-81 (1993).

[5] Ranawat AS, Mohanty SS, Goldsmith SE, Rasquinha VJ, Rodriguez JA, Ranawat CS. Experience with an all-polyethylene total knee arthroplasty in younger, active patients with follow-up from 2 to 11 years. *The Journal of arthroplasty*, **20**, 7-11 (2005).

[6] Faris PM, Ritter MA, Keating EM, Meding JB, Harty LD. The AGC all-polyethylene tibial component: a ten-year clinical evaluation. *JBJS*, **85(3)**, 489-93 (2003).

[7] Bettinson KA, Pinder IM, Moran CG, Weir DJ, Lingard EA. All-polyethylene compared with metal-backed tibial components in total knee arthroplasty at ten years: a prospective, randomized controlled trial. *JBJS*, **91(7)**, 1587-94 (2009).

[8] Gioe TJ, Glynn J, Sembrano J, Suthers K, Santos ER, Singh J. Mobile and fixed-bearing (all-polyethylene tibial component) total knee arthroplasty designs: a prospective randomized trial. *JBJS*, **91(9)**, 2104-12 (2009).

[9] Mohan V, Inacio MC, Namba RS, Sheth D, Paxton EW. Monoblock all-polyethylene tibial components have a lower risk of early revision than metal-backed modular components: A registry study of 27,657 primary total knee arthroplasties. *Acta Orthopaedica*, **84(6)**, 530-6 (2013).

[10] Holmberg S, Thelin A, Thelin N. Knee osteoarthritis and body mass index: a population-based case–control study. *Scandinavian Journal of Rheumatology*, **34(1)**, 59-64 (2005).

[11] Farahini H, Moghtadaei M, Bagheri A, Akbarian E. Factors influencing range of motion after total knee arthroplasty. *Iranian Red Crescent Medical Journal*, **14(7)**, 417 (2012).

[12] Gatha NM, Clarke HD, Fuchs R, Scuderi GR, Insall JN. Factors affecting postoperative range of motion after total knee arthroplasty. The Journal of Knee Surgery, **17(04)**, 196-202 (2004).

[13] Kotani A, Yonekura A, Bourne RB. Factors influencing range of motion after contemporary total knee arthroplasty. *The Journal of Arthroplasty*, **20(7)**, 850-6 (2005).

[14] Shoji H, Solomonow M, Yoshino S, D'Ambrosia R, Dabezies E. Factors affecting postoperative flexion in total knee arthroplasty. *Orthopedics*, **13(6)**, 643-9 (1990).

[15] Dojcinovic S, Ait Si Selmi T, Servien E, Verdonk PC, Neyret P. A comparison of all-polyethylene and metal-backed tibial components in total knee arthroplasty. *Rev Chir Orthop Reparatrice Appar Mot*, **93**, 364–372 (2007).