**ORIGINAL RESEARCH**

# Clinical and functional outcome comparison between all poly and metal backed tibia component in total knee arthroplasty

[1]Dr. Pawan Kumar Mishra, [2]Dr. Vibhas Gupta, [3]Dr. Ashish Kumar Singh

[1,2,3]Department of Orthopaedics, Chirayu Medical College and Hospital, Bhopal, Madhya Pradesh, India

**Corresponding author**
Dr. Ashish Kumar Singh
Department of Orthopaedics, Chirayu Medical College and Hospital, Bhopal, Madhya Pradesh, India

Received: 31 October, 2023 Accepted: 19 November 2023

## ABSTRACT

**Introduction:** Osteoarthritis of knee is most common chronic degenerative disease requiring total knee replacement in advanced stage.TKR is being performed in high numbers in developing countries as well. Initially, tibial components were cemented all polyethylene monoblock constructs. Subsequent studies showed excellent long term follow up in terms of durability up to 20 years. **Purpose: Aim of the study:** 1) to compare the functional outcomes of All Poly tibial components to Metal Back tibial components in patients aged over 60 years. 2) Cost-effectiveness analysis(based on outcome and pricing)

**Methods:** A retrospective study was done in Orthopaedic Department of chirayu medical college and Hospital, Bhopal, M.P. & evaluated 120 patients operated from January 2018 onwards. 60 cases of OA knee treated with cemented TKR with Metal backed prosthesis and 60 cases with all polyethylene prosthesis. The patients were followed up at 1st, 3rd, 6th months &1year post-operative. Functional outcome was assessed prospectively by(KSS) Knee Society Score and range of motion at 6th month & 1 year. **Results:** In this study, 76 knees of 60 patients were replaced by polyethylene tibial component implant & 78 knees of 60 patients were replaced by metal backed tibial component implant. 40 (52.63%) out of 76 operated knee in allpolyethylene group were male & 37(47.43%) out of 78 operated knee in metal backed group were male. Mean age of all polyethylene group was 66.8 ± 4.6 years & of Metal backed group was 68.3 ± 5.8 years. Mean flexion deformity of knee in both groups was statistically not significant (P value >0.05). Mean Knee functional score,mean knee clinical score & mean knee range of movement in both group at pre-operative, at 6 month post op. ,at 1 year post op. time was statistically not significant (P value >0.05). **Conclusion:** The functional outcome comparison of the polyethylene tibial component with metal-backed component, was excellent (majority) and good (few cases) & had no significant outcome difference. Considering the limitations, we suggest that APT components are equal to metal-backed ones across the age categories, it should be used more frequently implantation of TKRs due to cost-effective option, even in younger patients.

**Keywords:** Total knee replacement (TKR), Polyethylene, Metal backed, Knee clinical score, Knee functional score



## INTRODUCTION

Osteoarthritis (OA) is one of the leading causes of global disability and one of the most common degenerative conditions affecting kneejoint, limiting its motion and necessitating surgical intervention [1,2]. The disease process of osteoarthritis is characterized by the progressive destruction of the articular cartilage, leading to joint space narrowing, subchondral cyst, synovial inflammation and marginal osteophyte formation.[3] The available reports suggest that almost 13% of the women and 10% of the men aged more than 60 year have symptomatic osteoarthritis. The estimates of symptomatic osteoarthritis (OA) are likely to increase due to ageing of the population and the rate of obesity or overweight in the general population.[4] The treatment of OA includes non-pharmacological interventions and surgical interventions such as total knee replacement. The concept of improving knee joint function by modifying the articular surfaces has received attention since the 19th century. The surgical techniques have varied from soft tissue interposition arthroplasty to resection arthroplasty to surface replacement arthroplasty. In surface replacement arthroplasty different types of prosthesis were developed to address the complex knee kinematics.[5] In recent decades, most totalknee replacements have been performed with modular metalbacked tibia (MBT) components [6]. All-polyethylenetibia (APT) implants are primarily recommended forolder and low-demand patients [7]. Nevertheless, clinicalevidence has shown no significant differences between APTand MBT. The available literature indicates that the two implants have similar results in assessing survivorshipand functional outcomes [8]. However, the use of APT inprimary TKR is regaining interest considering the economic strain on health care.One of the main factors affecting clinical

outcomes isthe age at implantation [9]. As MBT and APT TKRs areprimarily recommended for different age categories, thisfactor needs to be carefully monitored. Also, in the availableliterature, clinical comparison in younger patients has notbeen specifically done. Previous biomechanical analysis onAPT demonstrated, using the finite element method, thatAPT in patients of the 60- and 70-year age groups showeda similar induced mechanical response. Moreover, APTwas shown to induce remodelling and modelling of theperiprosthetic tibia which is a beneficial factor in implantsurvivorship. As a result, more frequent implantation of APTin younger patients was suggested [10]. Considering the cost saving, all polyethylene tibia components are of potential interest in developing countries like India. The survivorship comparison of all polyethylene and metal backed tibia components in posterior cruciate ligament substituting (PS) total knee arthroplasty (TKA) had not been studied in detail by any studies. Pomeroy et al. examined 298 APTC (average follow-up, 2.9 years)and mentioned no statically significant difference in clinical and functionalscores between patients with APTC and cohorts with metalBacked tibia component designs [11]. The primary aim of this study was to compare the functional outcomes of All Polyethylene tibia components to Metal Backed tibia components in patients aged over 60 years. Secondary outcomes were to assess gain in range of motion (ROM), and cost-effectivenessanalysis between the two different components.

## MATERIALS AND METHODS

We conducted this retrospective study in Orthopaedic Department of chirayu medical college and Hospital, Bhopal,M.P.& evaluated 120 patients operatedfrom January 2018 onwards. 60 cases of OA knee treated with cemented TKR with Metal backed prosthesis and 60 cases with all polyethylene prosthesis, of all the ages and both sexes, were included in the study after obtaining informed, written consent.

## INCLUSION CRITERIA

1. Primary osteoarthritis with moderate to severe knee pain, angular knee deformity( kellgren& Lawrence classification, Grade 3 &4 OA knee),
2. knee stiffness (extension lags and flexion contractures) with decreased range of motion,
3. unilateral/bilateral knee involvement, and patients who will give consent for study
4. Knee operated(T.K.R)from January 2018 onwards

## EXCLUSION CRITERIA

1. Active infection anywhere in the body,
2. post traumatic/post infection,
3. Patient having neurological, psychological, vascular disorder,
4. Revision arthroplasty, patients having periprosthetic fracture, and secondary osteoarthritis.
5. Total knee replacements before January 2018

Formal ethical approval was not required as data were routinely collected for clinical audit purposes. All patients who filled out patient-reported outcome measures (PROMs) consented on the form to their results being used for audit and research purposes.

## SURGICAL TECHNIQUE

Under general or spinal anaesthesia &under tourniquet control the patients were operated. Surgeons used standard midline incision and medial parapatellararthrotomy. Haemostasis was achieved, knee was extended. Patella was everted and knee was flexed with preserving patellar tendon and removed soft tissue and osteophyte that lead to soft tissue imbalance and component malposition. Intramedullary referencing was used for the femoral cuts and extramedullary referencing for the tibia. Gap balancing was done. Trail of implant was done, stability and range of motion confirmed. For final implantation, pulsatile lavage was used prior to applying bone cement with cemented tibial knee component in all procedures. Patellar resurfacing was done in all the cases. The wound was closed in layers. Postoperative IV antibiotic and DVT prophylaxis was given as per protocol. Patients were actively mobilized on day one postoperatively as part of a standardized enhanced recovery protocol.

## FOLLOW-UP

Follow up protocol consisted of visit at 1st, 3rd, 6th months &1year post-operative. Post-operative functional outcome was assessed at six month &one year with operated knee range of motion & Knee Society Score**[12]**and graded as Excellent(80 to 100 score),good(70 to 79),fair(60 to 69) and poor(<60).

## STATISTICAL ANALYSIS

We analyzed our data with SPSS version 22, chi square test was used, P-value of less than 0.05 was statistically significant.

## RESULTS

In this study, 76 knees of 60 patients were replaced by polyethylene tibial component implant. 16 patients had bilateral side knee involvement in all polyethylene group. 78 knees of 60 patients were replaced by metal backed tibial component implant. 18 patients had bilateral side knee involvement in metal backed group. Side distribution of both group is shown in table 1.

**Table1: Distribution of the study group according to operated side**

| Operated side | All polyethylene group | Metal backed group |
|---|---|---|
| Right side | 20 | 19 |
| Left side | 24 | 23 |

| | | |
|---|---|---|
| Bilateral side | 16 | 18 |
| Total knee operated | 60 +16 = 76 | 60 +18 = 78 |

31 (51.66%) patients out of 60 were male in Allpolyethylene group & 9 out of 31 had b/l knee involvement. So 40 (52.63%) out of 76 operated knee in allpolyethylene group were male. 27 out of 60 patients in metal backed group were male & 10 out of 27 had b/l knee involvement. 37(47.43%) out of 78 operated knee in metal backed group were male.

**Table2: Distribution of the study group according to sex**

| Sex | All polyethylene group | Metal backed group |
|---|---|---|
| Male (bilateral side) | 31 (9) | 27 (10) |
| Female (bilateral side) | 29 (7) | 33 (8) |
| Total Patients (Total knee operated) | 60 (76) | 60 (78) |

Age distribution of this study is shown in table 3. Mean age of all polyethylene group was 66.8± 4.6 years & of Metal backed group was 68.3±5.8 years. Difference in mean age was statistically not significant (P value – 0.218).

**Table3: Distribution of the study group according to age**

| AGE DISTRIBUTION(in years) | All polyethylene group (Percentage) | Metal backed group (Percentage) |
|---|---|---|
| 50 - 60 | 26 (34.2%) | 20 (25.6%) |
| 60-70 | 34 (44.73%) | 36 (46.1%) |
| >70 | 16 (21%) | 22 (28.2%) |
| Total Knee operated | 76 | 78 |

35 knees in All polyethylene group had flexion deformity of 18.23 ± 10.69 (Mean ± SD) & 34 knees of Metal backed group had flexion deformity of 16.90 ± 11.95 (Mean ± SD). Difference in mean was statistically not significant (P value >0.05).Mean Knee functional score in **both group** at pre-operative, at 6 month post op. ,at 1 year post op. time was statistically not significant (P value >0.05).

**Table4: Distribution of the study group according to knee functional score**

| Time | Pre-operative (mean ± SD) | 6 months (mean ± SD) | 1 year (mean ± SD) |
|---|---|---|---|
| All polyethylene group | 38.28 ± 2.18 | 81.46 ± 2.16 | 82.86 ± 2.71 |
| Metal backed group | 39.51 ± 2.37 | 82.97 ± 2.29 | 83.12 ± 2.93 |
| P value | 0.527 | 0.349 | 0.410 |

Mean Knee clinical score in **both groups** was at pre-operative, at 6 month post op. ,at 1 year post op. timestatistically not significant (P value >0.05).

**Table5: Distribution of the study group according to knee clinical score**

| Time | Pre-operative (mean ± SD) | 6 months (mean ± SD) | 1 year (mean ± SD) |
|---|---|---|---|
| All polyethylene group | 34.42 ± 3.40 | 85.23 ± 2.31 | 89.46 ± 2.64 |
| Metal backed group | 34.71 ± 3.56 | 85.96 ± 2.42 | 89.88 ± 2.76 |
| P value | 0.691 | 0.421 | 0.396 |

Mean Knee range of motion in **both groups**at pre-operative, at 6 month post op. ,at 1 year post op. timewas statistically not significant (P value >0.05).

**Table 6: Distribution of the study group according to range of motion (in degree)**

| Time | Pre-operative (mean ± SD) | 6 months (mean ± SD) | 1 year (mean ± SD) |
|---|---|---|---|
| All polyethylene group | 97.54 ± 14.46 | 112.0 ± 14.10 | 122.35 ± 10.43 |
| Metal backed group | 98.20 ± 16.23 | 112.68 ± 14.02 | 122.60 ± 10.25 |
| P value | 0.780 | 0.746 | 0.739 |

## DISCUSSION

This is retrospective study in which 76 knees of 60 OA knees patients were treatedby cemented TKR &tibial component replaced by polyethylene tibial component implant. 78 knees of 60 OA knees patients were treated by cemented TKR &tibial component replaced by metal backed tibial component implant. Post-operative functional outcome was assessed at six month & one year with operated knee range of motion & Knee Society Score. Mean age of all polyethylene group was 66.8 ± 4.6 years with youngest age 53 years & oldest age 75 years. Mean age of Metal backed group was 68.3 ± 5.8 years with youngest age 54 years & oldest age 77 years. Similar study by Hamersveld et al, which shows mean age of all polyethylene group was 69 years &metal backed group was 68 years.[13] 31 (51.66%)

patients inAllpolyethylene group were male & 33 (55%) patients in metal backed group were female. Similar study by Senthilanathan et al, shows equal involvement of males and females in the study. [14]

In this study Mean knee functional score improved from 38.28 to 82.86 in allpolyethylene group & from 39.51 to 83.12 in metal backed group at 1 year followup. Mean Knee clinical score improved from 34.42 to 89.46 in allpolyethylene group & from 34.71 to 89.88 in metal backed group at 1 year followup. Mean Knee range of motion improved from 97.54 to 122.35 in allpolyethylene group & from 98.20 to 122.60 in metal backed group at 1 year followup. In a randomized study, Gioe TJ compared 111 polyethylene TKR and 102 metal backed TKR with a minimum follow up of three years. The pre-operative Knee Society clinical score improved from 38 to 84 in the poly ethylene group and from 35 to 85 in the metal back group. The knee functional score improved from 56 to 74 in all-poly ethylene group and from 57 to 72 in metal backed group. Range of motion was 106 degrees in poly ethylene group and 107 in metal back group.[15] In this study most of the patients have excellent score in both group, similar results shown in other studies from Senthilanathan et al [14] &Hamersveld et al [13]. There were no cases of intraoperative and postoperative complications in both group. There were no cases of fixation failure in both group. Our study demonstrates nearly equal clinical outcomes in both group.All polyethylene tibia component is cheaper in comparison to metal backed tibial component. This fact may support the use of the cheaper but reliable implant, especially where economical burdens affect implant selection considering the difference in cost.

## LIMITATION OF STUDY

Retrospective study design, small sample size and short follow up period (1 year).

## CONCLUSION

In summary, we have compared the functional outcome of the polyethylene tibial component with metal-backed component,both group had excellent (majority) and good functional outcome & had no significant outcome difference. As all-polyethylene TKR is less expensive implant, it is an excellent alternative to metal backed TKR.Considering the limitations, we suggest that APT components are equal to metal-backed ones across the age categories,it should be used more frequently implantation of TKRs due to cost-effective option, even in younger patients.

## REFERENCES

1. M. Cross, et al., The global burden of hip and knee osteoarthritis: estimates from theglobal burden of disease 2010 study, Ann. Rheum. Dis. 73 (7) (2014) 1323–1330.
2. J.X. Ma, W.W. He, M.J. Kuang, L. Sun, B. Lu, Y. Wang, X.L. Ma, Efficacy of bicompartmentalknee arthroplasty (BKA) for bicompartmental knee osteoarthritis: ameta analysis, Int. J. Surg. 46 (2017) 53–60.
3. Buckwalter JA, Mankin HJ. Articular cartilage: degeneration and osteoarthritis, repair, regeneration, and transplantation. Instr Course Lect. 1998;47:487-504.
4. Zhang Y, Jordan JM. Epidemiology of osteoarthritis. ClinGeriatr Med. 2010;26:355-69.
5. Kadam RV, Yadav S, Chhallani A, Sharma C. Prospective study of clinical and functional outcome of total knee replacement in osteoarthritic knee. Int J Res Orthop. 2016;2:240-4.
6. Gudnason A, Hailer NP, W-Dahl A, et al (2014) All-polyethyleneversus metal-backed tibial components—an analysis of27,733 cruciate-retaining total knee replacements from theSwedish Knee Arthroplasty Register. J Bone Joint Surg 96:994–999.
7. Gustke KA, Gelbke MK (2017) All-polyethylene tibial componentuse for elderly, low-demand total knee arthroplastypatients. J Arthroplasty 32:2421–2426.
8. Longo UG, Ciuffreda M, D'Andrea V et al (2017) All-polyethyleneversus metal-backed tibial component in total knee arthroplasty.Knee Surg Sports TraumatolArthrosc 25:3620–3636.
9. Passias PG, Bono OJ, Bono JV (2020) Total knee arthroplasty inpatients of advanced age: a look at outcomes and complications.J Knee Surg 33:001–007.
10. Apostolopoulos V, Tomaš T, Bohač P et al (2022) Biomechanicalanalysis of all-polyethylene total knee arthroplasty on periprosthetictibia using the finite element method. Comput MethodsPrograms Biomed 220:106834.
11. D.L. Pomeroy, et al., Results of all-polyethylene tibial components as a cost-savingtechnique, Clin. Orthop. Relat. Res. 380 (2000) 140–143
12. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. ClinOrthopRelat Res. 1989(248):13-4.
13. Hamersveld VKT, Van MD, Mheen PJ, Nelissen RGHH, Larsen TS. Migration of all-polyethylene compared with metal-backed tibial components in cemented total knee arthroplasty. ActaOrthopaedica. 2018;89(4):412-7.
14. Senthilnathan A, Prabhakar R, Piriyan TP. Functional outcome of patients with osteoarthrosis of knee in south Indian population treated with total knee arthroplasty using all polyethylene tibial component: a prospective analysis. IJOS. 2018;4(3):652-9.
15. Gioe TJ, Bowman KR. A randomized comparison of all-polyethylene and metal-backed tibial components. ClinOrthopRealt Res.2000;380:108-115.