

# **RESEARCH ARTICLE**

#### COMPARATIVE STUDY OF TOTAL KNEE REPLACEMENT USING ALL POLYETHYLENE AND METAL BACKED TIBIAL PROSTHESIS

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Manuscript Info	Abstract
Manuscript History Received: 23 March 2023 Final Accepted: 27 April 2023 Published: May 2023	<b>Introduction:</b> Osteoarthritis is the result of mechanical and biological events that destabilize the normal processes of degradation and synthesis of articular cartilage chondrocytes, extracellular matrix, and subchondral bone. All-polyethylene (AP) tibial components were largely abandoned in favour of metal-backed (MB) components in the 1980s. metal backing is now the predominant design in total knee arthroplasty (TKA). The present study aimed to assess and compare the functional outcome, in patient with total knee replacement using all polyethylene and metal backed tibial prosthesis in Primary Total Knee Replacement.
	<b>Material And Methods:</b> Our is an analytical cross-sectional study in which we have included 36 patients with primary knee osteoarthritis kellgren -lawrence grade III, IV 18 patients in all poly group and 18 patients in metal backed group. In which during follow up X-rays and functional outcome was evaluated using the American Knee Society Score at 1, 3, and 6-month follow-ups for patients of both the groups and compared.
	<b>Result:</b> In all polyethylene groups the functional score at 1, 3 and 6 months were $51.39 + 8.1$ , $76.67 + 8.1$ and $89.72 + 4.6$ respectively. While in metal group, the mean functional scores were $50.28 + 5.8$ , $77.22 + 5.7$ and $988.61 + 4.1$ at 1 month, 3 months and 6 months respectively. The most common complication was stiffness in 13.9% of patients of both the groups followed by extension leg (5.6%), infection (2.8%) and proximal tibial fracture (2.8%) in both groups. In present study, 75% of the patient did not have any post operative complications among all study subjects.
	<b>Conclusion:</b> There is no statistically significant difference in clinical outcome between all polyethylene and metal backed, improved values in terms of functional and clinical scores preferably in both the group metal backed and all polyethylene group. This study is not without limitations. Even though it is prospective study, patients were followed for shorter duration only. Hence, a study with elegant methodology and long follow up period can accurately assess the efficacy of all

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polyethylene and metal backed prosthesis used in knee replacement

surgery.

# Introduction:-

Osteoarthritis is the result of mechanical and biological events that destabilize the normal processes ofdegradationandsynthesisofarticularcartilagechondrocytes, extracellularmatrix, and subchondralbone. Until the late 1980s, failure of the tibial component was considered to be the major reason fixation forrevisionintotalkneearthroplasty(TKA). This couldbeattributedtopoorcementing, malalignment, and, in some cases, design problems related to component size, degree of constraint and lack of sufficientlyaccurate surgical instruments. TKAs of early design were always all-polyethylene (AP) single plateau.Excellent 10–20year survival rates of 91–98% of the gold standard "total condvlar" and its derivates were difficult to achieve with APplateaus, which we reproposed to inferiorly accommodate and improperly distribute stresses at theinterfaces<sup>[3]</sup>.

In the 1980s all-polyethylene (AP) tibial components were largely abandoned in favour of metal-backed(MB) components. Studies suggested that there was improved load transmission and greater heatsinkcapacitywithmetalwhichledtobetterresults.Metalbackingalsoofferedgreaterintraoperativeflexibility, with modularity and the use of stems and augments. For these reasons, metal backing is nowthepredominant design in total kneearthroplasty (TKA).<sup>[4]</sup> Excellent long-term results with AP components have also been reported, although only with the TotalCondylar prosthesis. The popularity of metal backing was enhanced because it opened the way for modular designs. At that time, the potential negative properties of these constructs-such as backside wear and wear of thin polyethylene inlays-were unknown or were disregarded. Modular polyethylene inserts still dominate the market. The femoral component, in particular, is vulnerable to rapid plastic degradation with the thinnest inserts, which could necessitate revision in the future.<sup>5</sup> Further research into the complete condylar design is warranted in light of the positive outcomes obtained with the monobloc tibial component made of polyethylene <sup>6,7.</sup> Reasons for the renewed interest in all- polyethylene parts include their lower price to manufacture.<sup>8</sup> The present study aimed to assess and compare the functional outcome, in patient with total knee replacement using all polyethylene and metal backed tibial prosthesis in Primary Total Knee Replacement using American knee society score at 1month, 3 month and 6 month respectively.

### Materials And Methods:-

This is an analytical cross-sectional study conducted at Sri Aurobindo Medical College and Post Graduate Institute, Indore from 1.04.2021 to 30.09.2022 . 36 patients were included in the study.

An informed written consent was taken from all the patients after the approval of institutional ethics committee. All patients who presented to orthopaedic OPD during the study period with primary knee osteoarthritis kellgren – lawrence grade 3, 4 were included in the study.

Patients with active infection around knee, Revision Total Knee Arthroplasty, Patients not giving consent for surgery /study, Patients who had distal femoral or proximal tibial osteotomies, requiring augmentation in total knee arthroplasty, patients with diagnosis of malignant disease or infection in the knee, patients with previous patellectomy and with Extra-articular deformities were excluded from the study.

Preoperative planning is of paramount importance in primary total knee replacement.

History was taken to rule out secondary cases. The patient were evaluated for the integrity of the soft tissues, the neurovascular status, range of motion, limb deformity, and the status of the collateral ligaments to help determine the soft-tissue balancing and constraint strategy required. Routine standing AP and lateral radiographs of the knee were obtained. Pre-Op scoring systems American Knee society score was calculated.<sup>9</sup>If patients had any other comorbidities, concerned specialist opinion was obtained prior to surgery. Patients were kept fasting for 6 hours before surgery.

Post operatively patient's knee was immobilized in a compressive bandage and a long knee brace, they were started on IV antibiotics for 5 days followed by oral antibiotic till staple removal <sup>10</sup>. DVT prophylaxis in the form of subcutaneous low molecular weight heparin 0.6 ml OD was given for the first three days followed by oral dabigatran. Patient was made to walk full weight bearing within the limits of pain with the long knee brace immobilizer and advised to continue static quadriceps exercises. 14th post op day, staples were removed and patient was advised to continue regular physiotherapy.





Intra-operative images

#### **Follow Up Protocol**

X-rays and a functional evaluation using the American Knee Society Score were taken during the 1-, 3-, and 6-month follow-ups.

Both the Clinical AKSS (or "Knee Score") and the Functional AKSS (or "Function Score") are based on a total of 100 points; the former evaluates the clinical state of the knee through a physical examination, and the latter evaluates the individual's ability to perform daily activities. The split was done to ensure that factors like comorbidities and advanced age wouldn't skew the results of the Clinical AKSS assessment. The Clinical AKSS assigns a total of 50 points to pain evaluation and 25 points each to stability and mobility. There must be no pain, adequate alignment of the knee in extension, at least 125 degrees of range of motion, and no anteroposterior or mediolateral instability for a score of 100.

Case 1



Pre-operative

Immediate post-op



6 months



Case 2



6 months clinical images



Pre-operative

Immediate post-op



6 months



6 months clinical images

### **Result:-**

Majority of the patients in both the groups belongs to 61-71 (50%) years of age followedby 51-60(25%) years and more than 70(13.9%) years which was not statistically significant.

Theproportionofmalepatient(55.6%)washigherinnumbercomparedtofemale(44.4%)inallpolyethylenegroups.Whilein metalgroupproportionofthefemalepatients(72.2%)washigher ascompared to malepatients (27.8%).

55.6% allpolyethyleneimplantsweredoneonleftkneeascomparedtorightknee(44.4%). Metalimplant wasused in similarproportion in boththeknee(50-50%). Mostcommoncomorbidities of the patients were diabetes and hypertension. Majority of the patients had hypertension (36.1%)followed bydiabetes (8.3%). Majorityofthepatientshadgrade4KellegrenandLawrence's(83.3%)followedbygrade3(16.7%). Thepreoperativemeankneescoreswere 45.61+4.13 and 46.67+2.9 in all polyethylene and metal group respectively. In all polyethyle negroup there mean knees core at 1,3 and 6 months were 58.17 + 4.2,76.72 + 4.2 and 5 months and 5 monthes and 5 months and 5 months and 5d90.89+3.4respectively.Whileinmetalgroup,the meankneescoreswere 59.56+4.0,77.28+4.4and90.11+3.3at1month,3months and 6 months respectively. The mean knee scores in both the groups statisticallysignificantatprewere not operative, 1 month, 3 months and 6 months A's revealed by insignificant pvalue (>0.05). Thepreoperative mean functionals coreswere 33.05+3.4 and 34.17+4.6 in all

76.67+8.1and89.72+4.6respectively.Whilein metalgroup,the meanfunctional scoreswere50.28 +5.8,77.22+5.7and988.61+4.1at 1 month, 3 months and 6 months respectively. The mean functional scores in both thegroupswerenotstatisticallysignificantatpre-operative,1month,3monthsand6monthsA'srevealed by insignificant p value(>0.05). The most common complication was stiffness in 13.9% of patients of both the groupsfollowed by extension leg (5.6%),infection (2.8%)and proximal tibial fracture (2.8%)inbothgroups.Inpresentstudy,75% of the patient did not have any post operative complications among all study subjects.

Table 1	l <b>:-</b> Comp	aringfur	nctionals	core.

Functionalscore	Typeof Implant		Pvalue		
	ALLPOLY		METAL		
	Mean	SD	Mean	SD	
Pre-Operative	33.06	3.489	34.17	4.618	0.421
1 Month	51.39	8.190	50.28	5.809	0.642
3Months	76.67	5.688	77.22	5.745	0.772
6Months	89.72	4.688	88.61	4.132	0.456

 Table2: Comparingknee score.

Kneescore	Typeof Imp	lant	Pvalue		
	All Poly		Metal		
	Mean	SD	Mean	SD	
Pre-Operative	45.61	4.132	46.67	2.910	0.382
1 Month	58.17	4.554	59.56	4.018	0.339
3Months	76.72	4.281	77.28	4.496	0.707
6Months	90.89	3.428	90.11	3.324	0.494

Table 3:- Comparing age distribution between groups.

		Typeof Implant		Total	Pvalue	
			All Poly	Metal		
Agegroup	≤50	Count	2	2	4	0.554
		%	11.1%	11.1%	11.1%	
	51-60	Count	3	6	9	
		%	16.7%	33.3%	25.0%	
	61-70	Count	11	7	18	
		%	61.1%	38.9%	50.0%	
	>70	Count	2	3	5	
		%	11.1%	16.7%	13.9%	

Table4:- Comparingsexdistributionbetween groups.

		Typeof Implant		Total	Pvalue	
			All Poly	Metal		
Sex	Female	Count	8	13	21	0.091
		%	44.4%	72.2%	58.3%	

	Male	Count	10	5	15					
		%	55.6%	27.8%	41.7%					
Table5:- (	Table5:- Comparingsidedistributionbetween groups.									
			Typeof Implant		Total	Pvalue				
		Γ	All Poly	Metal						
Side	Left	Count	10	9	19	0.738				
		%	55.6%	50.0%	52.8%					
	Right	Count	8	9	17					
		%	44.4%	50.0%	47.2%					

Table6:- Comparingcomorbiditiesdistributionbetween groups.

		Typeof Impla	nt	Total	Pvalue	
			All Poly	Metal		
Comorbidity	Diabetes	Count	3	0	3	0.064
		%	16.7%	0.0%	8.3%	
	mellitus					
	Hypertension	Count	8	5	13	
		%	44.4%	27.8%	36.1%	
	Nil	Count	7	13	20	
		%	38.9%	72.2%	55.6%	

#### Table7: ComparingKellegrenandLawrencegradedistributionbetweengroups.

	- · ·	-	-	Typeof Implant		Total	Р
				All Poly	Metal		
							value
Kellegren		Grade3	Count	2	4	6	0.371
	andL		%	11.1%	22.2%	16.7%	
awrence		Grade4	Count	16	14	30	
			%	88.9%	77.8%	83.3%	

Table09:- Comparing complications between groups.

			TYPE		Total	Р
			OFIMPL	ANT		value
			ALL	METAL		
			POLY			
Complication	Extensionleg	Count	2	0	2	0.375
		%	11.1%	0.0%	5.6%	
	Infection	Count	0	1	1	
		%	0.0%	5.6%	2.8%	
	Nil	Count	13	14	27	
		%	72.2%	77.8%	75.0%	
	Proximal tibia	Count	0	1	1	
		%	0.0%	5.6%	2.8%	
	fracture					
	Stiffness	Count	3	2	5	
		%	16.7%	11.1%	13.9%	

# **Discussion:-**

Majority of the patients in both the groups belongs to 61-71 (50%) years of age followed by 51-60 (25%) years and more than 70 (13.9%) years. In Kriplani et al <sup>11</sup> the mean age of patients was 62.03 years in all poly and 60.38 years in MB group. In this study, the proportion of male patient's (55.6%) was higher in number compared to female (44.4%) in all polyethylene groups. While in metal group proportion of the female patients (72.2%) was higher as compared to male patients (27.8%).In a study by Senthilanathan et al <sup>[12]</sup>, there were equal number of males and

females. Regarding co morbidities of the patients, no significant difference was there in terms of prevalence of diabetes and hypertension. Majority of the patients had hypertension (36.1%) followed by diabetes (8.3%). In Kriplani et al<sup>11</sup> study, hypertension was found was common comorbidity in 31.03% of the all-polyethylene group and 34.3% of the metal backed group. It was followed by diabetes, hypothyroidism, asthma, prostate disease, varicose vein and bronchiectasis. The studies were not available to compare these result in our study, majority of the patients had grade 4 Kellegren and Lawrence's (83.3%) followed by grade 3 (16.7%). There was no statistically difference present in both the groups in terms of Kellegren and Lawrence's grade distribution as revealed by insignificant p value 0.371. We reported the pre-operative mean knee scores were 45.61 + 4.13 and 46.67 + 2.9 in all polyethylene and metal group respectively. In all polyethylene group there mean knee score at 1, 3 and 6 months were 58.17 + 4.2, 76.72 + 4.2 and 90.89 + 3.4 respectively. While in metal group, the mean knee scores were 59.56 + 4.0, 77.28 + 4.4and 90.11 + 3.3 at 1 month, 3 months and 6 months respectively. The mean knee scores in both the groups were not statistically significant at pre- operative, 1 month, 3 months and 6 months A's revealed by insignificant p value (>0.05). In Kriplani et al. study<sup>11</sup>, the mean pre-operative knee clinical score was 23.5 in poly ethylene group and 23.4 in metal backed group which was not statistically significant. After 1 month, the score increased to 84.65 in polyethylene group and 85.8 in metal backed group which was statistically significant. After 3 months, the score increased to 86.15 in polyethylene group and 87.7 in metal backed group which was statistically significant. After 6 months, the score increased to 87.47 in polyethylene group and 88.73 in metal backed group which was statistically significant.

The pre operative mean functional scores were 33.05 + 3.4 and 34.17 + 4.6 in all polyethylene and metal group respectively. In all polyethylene group the functional score at 1, 3 and 6 months were 51.39 + 8.1, 76.67 + 8.1 and 89.72 + 4.6 respectively. While in metal group, the mean functional scores were 50.28 + 5.8, 77.22 + 5.7 and 988.61 + 4.1 at 1 month, 3 months and 6 months respectively. The mean functional scores in both the groups were not statistically significant at pre- operative, 1 month, 3 months and 6 months A's revealed by insignificant p value (>0.05). In Kriplani et al. study<sup>11</sup>, before surgery, the mean knee function score (KFS) was 40.92 in the all-polyethylene group and 41.2 in the metal backed group which was not statistically significant. After 6 months, the mean KFS at 6 months was 86.95 in the all-polyethylene group and 87.29 in the metal backed group which was statistically not significant

The most commonly observed complication was stiffness in 13.9% of patients of both the groups followed by extension leg (5.6%), infection (2.8%) and proximal tibial fracture (2.8%) in both groups. In present study, 75% of the patients did not have any post operative complications among all study subjects. In Kriplani et al <sup>11</sup> study there were no cases of intraoperative and postoperative complications. There were no cases of osteolysis and synovitis in either group study. There were no cases of fixation failure in either group.

### **Conclusion:-**

This study had shown that majority of patients undergoing knee replacement surgery are agedabove 60 years, male sex and had comorbidity conditions. There is no statistically significant difference in clinical outcome between all polyethylene and metal backed, improved values interms of functional and clinical scores preferably in both the group metal backed and allpolyethylene group. This study is not without limitations. Even though it is prospective study, patients werefollowed for shorter duration only. Hence, astudy with elegant methodology and long follow up period can accurately assess the efficacy of all polyethylene and metal backed prosthesis used in kneereplacement surgery.

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