

Comparative study on effect of PCO on clinical results between Single-radius (SR) & Multi-radius (MR) femoral design implants in posterior stabilized TKA (PS TKA)

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Abstract

Introduction: This study was carried out to compare the effect of femoral Posterior Condylar Offset (PCO) on clinical results between single-radius (SR) and multi-radius (MR) femoral design components in posterior stabilized total knee arthroplasty. (PS TKA)

Material and methods: This hospital based prospective observational study was conducted at Department of Orthopaedic, Santokba Durlabhji Memorial Hospital, Jaipur, Rajasthan. Between 1 January 2018 to 31 December 2018 with 6 months follow up. 100 Knees were replaced, 50 knees each for single-radius (group A) and multi-radius (group B). Cases were evaluated pre-operatively and 6 months post-operatively by measurement of posterior condylar offset, flexion (non-weight bearing and weight bearing) and knee society scoring system. Posterior condylar offset measurement done by methods used by Bellemans *et al.* Patients were divided into two groups by chit-based method for randomization. Appropriate statistical tests were used and results were interpreted.

Results: The mean age 65.57 ± 8.07 years. The Mean age was 64.36 ± 7.63 years in group (A) and 66.78 ± 8.51 years in group (B). Female predominance (68%) was observed. The pre-operative mean values for PCO in group (A) and (B) were 27.66 ± 3.20 mm and 27.50 ± 2.24 mm respectively. This was statistically not significant. The post-operative mean values for PCO in groups (A) and (B) were 29.42 ± 2.52 mm and 29.20 ± 3.05 mm respectively. This data was statistically not significant. The pre-operative means non-weight bearing flexion in group (A) was 112.70 ± 8.09 degrees and in group (B) was 106.50 ± 12.83 degrees. The post-operative means non-weight bearing flexion in group (A) was 121.60 ± 3.97 degrees and in group (B) was 119.90 ± 3.27 degrees. The pre-operative mean value for knee flexion (weight bearing) in group (A) and (B) were 102.70 ± 7.37 degrees and 96.70 ± 10.13 degrees respectively. The post-operative mean value for knee flexion (weight bearing) in group (A) and (B) were 124.50 ± 3.81 degrees and 123.60 ± 2.86 degrees respectively. The mean difference between post-operative and pre-operative values were significant in all variables in group (A). The mean difference between post-operative and pre-operative values were significant in all variables in group (B). Between the two groups, the mean difference in KSS knee score and flexion (weight bearing and non-weight bearing) were statistically significant (P-value <0.05) whereas mean difference in KSS functional score and PCO were not significant. Between the two groups, statistically significant difference was observed in grading of post-operative KSS knee score. Between the two groups, no significant difference was observed in grading of post-operative KSS functional score. In Group (A), the not significant, negative and poor correlation was observed between change in PCO and other variables like non-weight bearing flexion, KSS knee score, KSS functional score, and weight bearing flexion (Pearson correlation values were -0.004 , P value $=0.976$; -0.224 , P value $=0.118$; -0.036 , P value $=0.805$ and -0.057 , P value $=0.694$ respectively. In Group (B), the not significant, negative and poor correlation was observed between change in PCO and other variables like non-weight bearing flexion, KSS knee score, KSS functional score, and weight bearing flexion (Pearson correlation values were -0.208 , P value $=0.148$; -0.029 , P value $=0.843$; -0.223 , P value $=0.12$ and -0.251 , P value $=0.079$ respectively).

Conclusion: Between the two groups, there was significant difference observed in terms of comparison of increase in flexion (weight bearing and non-weight bearing) and KSS knee score but not in terms of PCO and KSS functional score. Between the two groups, statistically significant difference was observed in grading of post-operative KSS knee score but not in grading of post-operative KSS functional score.

Keywords: Posterior condylar Offset (PCO), single-radius (SR) femoral design, multi-radius (MR) femoral design, posterior stabilized total knee arthroplasty (PS TKA)

Introduction

Osteoarthritis (OA) is one of the most prevalent condition resulting in disability particularly in elderly population. It results from articular cartilage failure induced by complex interplay of genetic, metabolic, biochemical and biomechanical factors with secondary components of inflammation.

Osteoarthritis of knee is common clinical problem that affects elderly and few young individuals associated with symptoms like pain, stiffness and limitation of activity and

associated clinical sign like swelling, effusion, crepitus, instability and malalignment^[1].

OA is more prevalent in developed than in developing regions of the world. Age and female gender are invariant risk factors associated with increased incidence of knee OA. OA knee is the leading cause of functional disability^[2].

Radiographic hallmarks of primary osteoarthritis are: asymmetrical joint space narrowing, subchondral sclerosis (increased bone formation around joint), subchondral cyst formation, and osteophytes.

Kellgren and Lawrence system^[3] classifies severity of knee osteoarthritis using five grades:

- **Grade 0:** No radiographic features of OA.
- **Grade 1:** Doubtful joint space narrowing (JSN) and possible osteophytic lipping.
- **Grade 2:** Definite osteophytes and possible JSN on anteroposterior weight-bearing radiograph.
- **Grade 3:** Multiple osteophytes, definite JSN, sclerosis, possible bony deformity.
- **Grade 4:** Large osteophytes, marked JSN, severe sclerosis and definite bony deformity.

Treatment consists of physical therapy and drug therapy. Many patients require weight reduction. Prolonged use of corticosteroids should be avoided. Osteotomies to change the mechanical axis of weight bearing are useful for unicompartmental arthritis^[4]. Gold standard treatment of choice is total knee arthroplasty (TKA)^[5]. TKA gives good subjective and objective results during first 15 years.

Range of flexion or motion of knee obtained after TKA is often limited and may be determined by several factors, including pre-operative range of movements, posterior femoral condylar offset,^[6] posterior tibial slope,^[7] surgical technique, joint line elevation, postoperative physiotherapy and design of implant.

Posterior condylar offset (PCO)

In 2002, Belleman *et al* was the first to propose concept of PCO. Authors defined it as vertical distance from most prominent point of posterior femoral condyle to the tangent of posterior cortex of femoral shaft as seen on true lateral radiographs. They found that 93% (27/29) of patients experienced abnormal forward sliding of femur during deep flexion in weight-bearing position after cruciate-retaining (CR) TKA. In addition, impingement of posterior aspect of tibial insert against shaft of femur in deep squat position was noted in 72.4% patients. On the contrary, when a sufficient PCO is reconstructed, a larger posterior clearance may be obtained that helps delay impingement on posterior aspect and maximizes range of flexion (ROF). However, potential correlation between PCO and ROF, especially after posteriorly stabilized (PS) TKA, remains controversial.

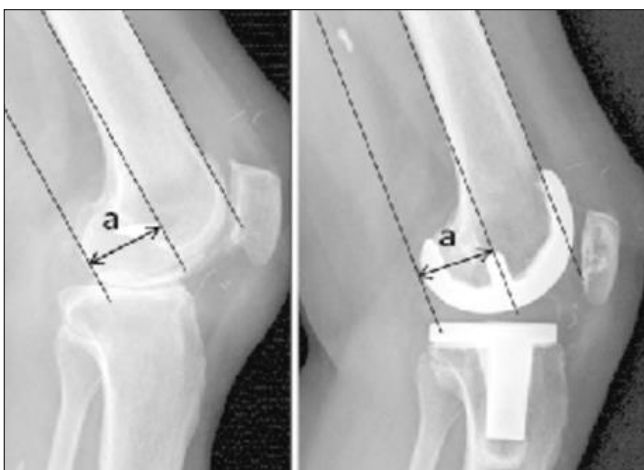


Fig 1

The difference in the weight-bearing status can markedly affect the flexion angle.^[8] Except for Bellemans *et al*, other authors explored impact of PCO only on non-weight-bearing ROF after TKA, even though weight-bearing ROF is a better indicator of knee function.

Material and methods

Study area: It was conducted in Department of Orthopaedics, Santokba Durlabhji Memorial Hospital, a tertiary care centre, Jaipur.

Study population: Admitted cases of posterior stabilizing TKA. Cases were selected from patients visiting outdoor department. Cases were evaluated pre-operatively and post-surgery at 6 months follow up by measurement of posterior condylar offset, flexion (weight bearing and non-weight bearing) and knee society scoring system. Points scored were added up to give a net pain and functional score. Primary TKA was carried out in 100 knees under spinal / epidural anaesthesia. All patients were operated by a single surgeon. Patients were divided into two groups by chit-based method for randomization.

- **Group-1:** Single radius femoral design implant (SR) - Stryker Scorpio NRG PS design.
- **Group-2:** Multi radius femoral design implant (MR) - Maxx Orthopaedics PS design.

Criteria of selection of patients

Inclusion criteria

- Patients with age (>50 years) with end stage osteoarthritis and varus deformity of knee were selected for this study who were willing to undergo TKA.

Exclusion criteria

- Patients with revision TKA.
- Patients with knee arthrodesis.
- Patients with compromised limb vascularity.
- Patients with valgus deformity knees.
- Patients with psychiatric illness or non-compliant patient.
- Patients with any disease that may affect movement of knee or hip joint, cause pain in lower limbs, or affect lower limb function.
- Patients with body mass index (BMI) more than 35 kg/m².

Sample size

A pilot study was conducted on 20 cases where mean difference in KSS was observed 1.92 with standard deviation 3 in between groups, so considering this result, minimum sample size was calculated 40 in each group. It was further enhanced to 50 cases as final sample for each group, assuming 20% dropout / attrition.

Study design: Hospital based, prospective observational study.

Study duration: One year (1 January 2017 to 31 December 2017) including six months follow up period.

Data Collection Technique & Tools: 100 Knees were replaced, 50 knees each for single-radius and multi-radius group. Posterior condylar offset measurement done by methods used by Bellemans *et al.* A standard hand-held goniometer was used for measurement of flexion. Points scored were added up to give net pain and functional score. Patients were divided into two groups by chit-based method for randomization.

Outcome Variables

- Posterior condylar offset (PCO)
- Flexion (Weight bearing and non-weight bearing)
- Knee Society Score (KSS): Knee Score and Function score

Statistical Analysis: The data was analyzed by using SPSS Version 23 and PRIMER software. Continuous variables were summarized as mean and standard deviation and nominal /categorical variable were presented as proportion. T test, paired-t test, chi-square test and correlation coefficient were used as statistical method for analysis. P-value <0.05 was considered statistically significant.

Results

In this prospective observational study, 100 knees were operated, 50 each with a single radius and a multi radius femoral design component.

Group A: Patients operated using a single radius femoral design implant. (N=50)

Group B: Patients operated using a multi radius femoral design implant. (N=50)

Table 1: Age Distribution

Age in years	Group A (SR)		Group B (MR)		Grand total	
	NO.	%	NO.	%	NO.	%
50-60	22	44	17	34	39	39
60-70	15	30	12	24	27	27
>70	13	26	21	42	34	34
TOTAL	50	100	50	100	100	100

The mean age was 65.57 ± 8.07 years. Mean age in group (A) and (B) were 64.36 ± 7.63 years and 66.78 ± 8.51 years respectively. No statistically significant difference was observed among groups. (P value = 0.240)

Gender Distribution

In group A, there were 35 females (70%) and 15 males (30%). In group B, there were 33 females (66%) and 17 males (34%).

In all, out of 100 knees, there were 68 female knees (68%) and 32 male knees (32 %), demonstrating a female predominance in our study population.

Side Distribution

In group A, there were 27 (54%) left and 23 (46%) right side. In group B, there were 23 (46%) left and 27 (54%) right side.

In all, out of 100 knees, there were 50 left side knees (50%) and 50 right side knees (50%).

Table 2: Pre-operative and post-operative PCO in millimeters (mm)

Flexion		Pre-Operative	Post-Operative
Group A (SR)	Mean	27.66	29.42
	SD	3.2	2.52
GROUP B (MR)	MEAN	27.5	29.2
	SD	2.24	3.05
TOTAL	MEAN	27.58	29.31
	SD	2.75	2.79
P-VALUE		0.773	0.695

Pre-operative PCO in group (A) was 27.66 ± 3.20 mm and in group (B) was 27.50 ± 2.24 mm. (P value = 0.77)

Post-operative PCO in group (A) was 29.42 ± 2.52 mm and in group (B) was 29.20 ± 3.05 mm. (P value = 0.69)

No significant difference was observed in pre-operative and post-operative PCO.

Table 3: Pre-operative and post-operative non-weight bearing flexion in degrees

Flexion		Pre-Operative	Post-Operative
Group A (SR)	Mean	112.7	121.6
	SD	8.09	3.07
Group B (MR)	Mean	106.5	119.9
	SD	12.83	3.27
Total	Mean	109.6	120.8
	SD	11.12	3.72

Pre-operative flexion in group (A) was 112.70 ± 8.09 degrees and in group (B) was 106.50 ± 12.83 degrees.

Post-operative flexion in group (A) was 121.60 ± 3.97 degrees and in group (B) was 119.90 ± 3.27 degrees.

Table 4: Pre-operative and post-operative weight bearing flexion in degrees

Flexion		Pre-Operative	Post-Operative
Group A (SR)	Mean	102.7	124.5
	SD	7.37	3.81
Group B (MR)	Mean	96.7	123.6
	SD	10.13	2.86
Total	Mean	99.7	124.1
	SD	9.32	3.39

The mean pre-operative weight bearing flexion in group (A) was 102.70 ± 7.37 degrees and in group (B) 96.70 ± 10.13 degrees.

The mean post-operative weight bearing flexion in group (A) was 124.50 ± 3.81degrees and in group (B) 123.60 ± 2.86 degrees.

Table 5: Pre- and post-operative KSS

Scores		Pre-op KSS Knee Score	Post-op KSS Knee Score	Pre-op KSS Function Score	Post-op KSS function Score
Group A (SR)	Mean	55.88	84.86	28.4	82.6
	SD	3	2.07	10.42	4.43
Group B (MR)	Mean	55.92	82.98	29.4	83.2
	SD	3.28	2.45	12.11	4.71
Total	Mean	55.9	83.92	28.9	82.9
	SD	3.13	2.45	11.25	4.56

Mean pre-op knee score in group (A) was 55.88 ± 3.00 while mean pre-op function score was 28.40 ± 10.42

Mean pre-op knee score in group (B) was 55.92 ± 3.28 while mean pre-op function score was 29.40 ± 12.11
 Mean pre-op knee score of the entire sample size was 55.90 ± 3.13 while mean pre-op function score was 28.90 ± 11.25
 Mean post-op knee score in group (A) was 84.86 ± 2.07 while mean post-op function score was 82.60 ± 4.43
 Mean post-op knee score in group (B) was 82.98 ± 2.45 while mean post-op function score was 83.20 ± 4.71
 Mean post-op knee score of the entire sample size was 83.92 ± 2.45 while mean post-op function score was 82.90 ± 4.56

Table 6: Grading of post-operative KSS knee score

KSS Knee Score	Group A (SR)		Group B (MR)	
	NO.	%	NO.	%
Excellent (>85)	31	62	16	32
Good (70-84)	19	38	34	68
Total	50	100	50	100

In group (A), excellent and good KSS knee scores were found in 31 knees (62 %) and 19 knees (38 %).
 In group (B), excellent and good KSS knee scores were found in 16 knees (32%) and 34 knees (68%).
 Statistically significant difference was observed in grading of post-operative KSS knee score between the groups. (P value = 0.005)

Table 7: Grading of post-operative KSS function score

KSS Function score	Group A (SR)		Group B (MR)	
	NO.	%	NO.	%
Excellent (>85)	13	26	16	32
Good (70-84)	37	74	34	68
Total	50	100	50	100

In group (A), excellent and good KSS functional scores were found in 13 knees (26 %) and 37 knees (74 %).
 In group (B), excellent and good KSS functional scores were found in 16 knees (32%) and 34 knees (68%).
 No significant difference was observed in grading of post-operative KSS function score for both the groups. (P value = 0.843)

Table 8: Paired differences and paired samples test (post-operative minus pre-operative analysis of the outcome variables) in group (A)

Post minus pre operative differences (Δ)	Mean	SD	P-Value
Δ PCO	1.76	1.74	<0.001
Δ Flexion (non-weight bearing)	8.9	8.41	<0.001
Δ KSS Knee Score	28.98	3.36	<0.001
Δ KSS Function Score	54.2	12.91	<0.001
Δ Flexion (weight bearing)	21.8	7.87	<0.001

This table showed the paired differences and paired samples test (post minus pre-operative analysis of the outcome variables) in group (A). Mean differences were statistically significant for all variables. Mean increased in PCO, non-weight bearing flexion, KSS knee score, KSS function score and weight bearing flexion were 1.76 ± 1.74 mm, 8.90 ± 8.41 degrees, 28.98 ± 3.36 , 54.20 ± 12.91 and 21.80 ± 7.87 degrees respectively.

Table 9: Paired differences and paired samples test (post-operative minus pre-operative analysis of the outcome variables) in group (B)

Post minus pre operative differences	Mean	SD	P-Value
Δ PCO	1.7	1.76	<0.001
Δ Flexion (non-weight bearing)	13.4	12.47	<0.001
Δ KSS Knee Score	27.06	4.08	<0.001
Δ KSS Function Score	53.8	13.38	<0.001
Δ Flexion (weight bearing)	26.9	9.99	<0.001

This table showed the paired differences and paired samples test (post minus preoperative analysis of the outcome variables) in group (B). Mean differences were statistically significant for all variables. Mean increased in PCO, non-weight bearing flexion, KSS knee score, KSS function score and weight bearing flexion were 1.70 ± 1.76 mm, 13.40 ± 12.47 degrees, 27.06 ± 4.08 , 53.80 ± 13.38 and 26.90 ± 9.99 respectively.

Table 10: Correlation between PCO and other variables in group (A)

Correlations	Δ PCO	
	Pearson Correlation	P-Value
Δ Flexion (non-weight bearing)	-0.004	0.976
Δ KSS Knee Score	-0.224	0.118
Δ KSS Function Score	-0.036	0.805
Δ Flexion (weight bearing)	-0.057	0.694

This table depicts the correlation between Δ PCO and other variables in group (A). Insignificant, negative and poor correlation was observed between change in PCO and other variables like non-weight bearing flexion, KSS knee score, KSS function score, and weight bearing flexion (Pearson correlation values were -0.004, P value = 0.976; -0.224, P value = 0.118; -0.036, P value = 0.805 and -0.057, P value = 0.694 respectively).

Table 11: Correlation between PCO and other variables in group (B)

Correlations	Δ PCO	
	Pearson Correlation	P-Value
Δ Flexion (non-weight bearing)	-0.208	0.148
Δ KSS Knee Score	-0.029	0.843
Δ KSS Function Score	-0.223	0.12
Δ Flexion (weight bearing)	-0.251	0.079

This table depicts correlation between Δ PCO and various variables in group (B). Insignificant, negative and poor correlation was observed between change in PCO and other variables like non-weight bearing flexion, KSS knee score, KSS functional score, and weight bearing flexion (Pearson correlation values were -0.208, P value = 0.148; -0.029, P value = 0.843; -0.223, P value = 0.12 and -0.251, P value = 0.079 respectively).

Table 12: Comparison of changes in Outcome variables in between both the groups

	MEAN			P-Value
	Group A (SR)	Group B (MR)	Total	
Δ PCO	1.76 \pm 1.74	1.7 \pm 1.76	1.73 \pm 1.75	0.865
Δ Flexion (non-weight bearing)	8.9 \pm 8.41	13.4 \pm 12.47	11.15 \pm 10.82	0.037
Δ KSS Knee Score	28.98 \pm 3.36	27.06 \pm 4.08	28.02 \pm 3.84	0.012
Δ KSS Function Score	54.2 \pm 12.91	53.8 \pm 13.38	54 \pm 13.08	0.879
Δ Flexion (weight bearing)	21.8 \pm 7.87	26.9 \pm 9.99	24.35 \pm 9.31	0.006

Mean difference for PCO, in group (A) was 1.76 \pm 1.74 mm and in Group (B) was 1.7 \pm 1.76 mm.

Mean difference for flexion (non-weight bearing), in group (A) was 8.9 \pm 8.41degrees and in Group (B) was 13.4 \pm 12.47degrees.

Mean difference in group (A) was 28.98 \pm 3.36 for KSS knee score and 54.2 \pm 12.91for KSS function score.

Mean difference in group (B) was 27.06 \pm 4.08 for KSS knee score and 53.8 \pm 13.38 for KSS function score.

Mean difference for flexion (weight bearing), in group (A) was 21.8 \pm 7.87 degrees and in Group (B) was 26.9 \pm 9.99 degrees.

Mean difference for KSS knee score, non-weight bearing flexion and weight bearing flexion were statistically significant between both the groups with P values 0.012,0.037 and 0.006 respectively (P value < 0.05)

Mean difference for KSS function score and PCO between both the groups were statistically not significant. (P value >0.05).

Complications

One patient from group a developed superficial skin infection which was managed with daily dressings and appropriate antibiotics as per the pus culture and sensitivity report. The infection subsided with the aforementioned treatment.

Discussion

TKA is well-established procedure performed to relieve pain and to improve range of movement (ROM) in patients with disabling osteoarthritis. ROM after TKA is a very important factor to determine functional outcome of procedure.

The aim of this study was to access the possible influence of femoral posterior condylar offset (PCO) reconstruction on flexion (weight bearing and non-weight bearing) and on clinical results (knee society score) between single radius and multi radius femoral design components in posterior stabilized TKA.

In this prospective observational study, 100 knees were operated and followed up during study period from January 2017 to December 2017. 50 knees each with a single-radius and a multi-radius femoral design component. On the day of final follow up at 6 months PCO, flexion (non-weight bearing and weight bearing) and KSS (knee score and function score) were evaluated as during the pre-operative stage. The results were compiled and analysed to arrive to a conclusion in this study.

Mean age in our study was 65.57 \pm 8.07 years. The Mean age was 64.36 \pm 7.63 years in group (A) and 66.78 \pm 8.51years in group (B). No statistically significant difference in mean age among the both groups was observed. (P value = 0.13).

There was a female predominance in this study (male to female ratio 32:68) which is also seen in studies of Barrena *et al.*^[9] and Cook *et al.*^[10]

In Group (A), insignificant, negative and poor correlation was observed between change in PCO and other variables like non-weight bearing flexion, KSS knee score, KSS function score, and weight bearing flexion (Pearson correlation values were -0.004, P value = 0.976; -0.224, P value = 0.118; -0.036, P value = 0.805 and -0.057, P value = 0.694 respectively).

In Group (B), insignificant, negative and poor correlation was observed between change in PCO and other variables like non-weight bearing flexion, KSS knee score, KSS function score, and weight bearing flexion (Pearson correlation values were -0.208, P value = 0.148; -0.029, P value = 0.843; -0.223, P value =0.12 and -0.251, P value = 0.079 respectively).

Insignificant, negative and poor correlation was observed in both groups between PCO and flexion. This was supported by previous studies like Arabori *et al*, Hanratty *et al*, and Bauer *et al*. This may be explained by the fact that flexion angle is multivariate factor. It depends on implant design, the patient, surgical technique, knee kinematics, perioperative complications, and post-operative physiotherapy. According to Bauer *et al*, the most significant predictive factor for post-operative flexion after posterior-stabilized TKR without PCL retention was pre-operative range of flexion.

Mean difference between post-operative and pre-operative values were statistically significant in all variables in group (A). Mean increased in non-weight bearing flexion, KSS knee score, KSS function score and weight bearing flexion were 8.90 \pm 8.41 degrees, 28.89 \pm 3.36, 54.20 \pm 12.91 and 21.80 \pm 7.87 degrees respectively. These findings were supported by Palmer *et al.*^[14] and Jenny *et al.*^[15]

Mean difference between post-operative and pre-operative values were statistically significant in all variables in group (B). Mean increased in non-weight bearing flexion, KSS knee score, KSS functional score and weight bearing flexion were 13.40 \pm 12.47 degrees, 27.06 \pm 4.08, 53.80 \pm 13.38 and 26.90 \pm 9.99 respectively. These findings were supported by Palmer *et al*^[11] and Jenny *et al.*^[12]

Between two groups, mean difference in PCO (post-operative and pre-operative) was statistically not significant (P value > 0.05). This may be attributed to variability of cartilage thickness and asymmetry of medial and lateral femoral PCO.

Between two groups, mean difference in flexion (non-weight bearing and weight bearing) was statistically significant. (P value < 0.05)

Between the two groups, KSS knee score was found statistically significant (P-value 0.05). This may be attributed to the small sample size and to the short period of follow up.

Between the two groups, statistically significant difference was observed in grading of post-operative KSS knee score (P value=0.005) while no significant difference was observed in grading of post-operative KSS function score (P value=0.843).

Conclusion

1. At final follow-up, a negative, insignificant and poor correlation was observed between change in posterior condylar offset and knee flexion (both weight bearing and non-weight bearing) after PS TKA in both the groups.
2. A negative, insignificant and poor correlation was also observed between change in posterior condylar offset and Knee Society Score (Knee score and function score) after PS TKA in both the groups.
3. There was significant increase in PCO, flexion (both weight bearing and non-weight bearing), KSS knee score and function scores among the both groups after TKA.
4. Between two groups, there was significant difference observed in terms of comparison of increase in flexion (weight bearing and non-weight bearing) and KSS knee score.
5. Between two groups, there was no significant difference in terms of comparison of increase in PCO and KSS functional score.
6. Between two groups, statistically significant difference was observed in grading of post-operative KSS knee score (P value < 0.05) while no significant difference was observed in grading of post-operative KSS function score (P value > 0.05).

Limitations

- The value of PCO differs with body type of patient especially the size of the knee joint.
- Flexion angle after TKA is a multivariate hence Posterior Condylar Offset and posterior condylar offset ratio which was described by Soda *et al.* [14] cannot be used as independent variable for the quantification of functional outcome of TKA.
- Accurate radiographic measurement of pre-operative PCO is not possible as cartilage thickness remained was not accounted for and also there is inherent error in measurement techniques that accounts for inconsistent findings as reported by Clarke *et al.* [14]
- Asymmetry of medial and lateral femoral condyles causes difficulty in measurement of PCO.
- Six months of follow up is a relatively short period. A longer follow up would have been more beneficial in yielding accurate results.
- Larger number of sample size or multicentric study would have been more conclusive with respect to the conducted study,

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Conflict of Interest: Not declared

Ethical consideration: The approvals from the Medical Ethics Committee and Scientific Research Committee were taken before study was undertaken.

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