TO ANALYSE THE EFFECT OF POSTERIOR CONDYLAR OFFSET ON RANGE OF MOVEMENTS AND FUNCTIONAL OUTCOME FOLLOWING TOTAL KNEE ARTHROPLASTY

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ABSTRACT

Background

Osteoarthritis of knee (OAK) is a chronic and major disease affecting geriatric population, characterized by the breakdown of joint cartilage. Arthritis of the hip and knee is the 12th highest contributor to global disability and the 38th highest contributor to disability-adjusted life years. The management includes

amalgamation of pharmacological action, surgery as well as osteotomy, arthroplasty, stem cell therapy & physiotherapy.

AIMS

To evaluate the influence of posterior condylar offset on range of movements following a total knee Arthroplasty. Further, to assess the functional outcome following a total knee Arthroplasty according to Knee Society Score.

Methodology

A prospective hospital-based study with 40 patients was conducted. Patient will then undergo surgery and post operatively, all patients will be subjected to an x-ray to measure the posterior condylar offset. Post operatively all patients were be subjected to x-ray imaging and evaluated clinically at 3 weeks, 3 months and 6 months for the range of movements and Knee Society Score.

Results

In this study, 11 patients were male and 29 were females. Subject distribution as per the outcome result after treatment; into good, fair and excellent with 25, 2 and 13 subjects respectively. The pre and post-operative mean PCO value with it being 26.4 ± 1.9 and 26.0 ± 1.9 and pre and post-operative mean PCOR value with it being 0.44 ± 0.1 and 0.45 ± 0. It was found to be statistically significant.

Conclusion

The flexion angle after Knee Arthroplasty is predictor of the functional outcome as well as its prognosis over the long-term. Posterior Condylar Offset as well as Posterior Condylar Offset Ratio is key variable for the assessment of knee function. It is important to consider other variables to predict the associated complications as well as outcome of the disease process.

Keywords Trauma, Fracture, Surgery, Disability, Pain, Knee, Joint

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Introduction:

Osteoarthritis of knee a chronic disease characterized by the breakdown of joint cartilage is one of the major diseases affecting geriatric population.1 In India, osteoarthritis scores top 5 chronic disease affecting 4-6 % adult population. Globally more than 100 million people suffer from osteoarthritis; with knee osteoarthritis being the 4th most significant causes of incapability in women and 8thin men.2

The management includes a combination of pharmacological treatment, surgery including osteotomy, arthroplasty/knee replacement, stem cell therapy and physiotherapy.3

Amongst the surgical management options total knee arthroplasty (TKA) is considered as the most effective method of treating end-stage degenerative osteoarthritic disease in the knee as it reduces pain and also has good results in allowing the recovery of functional status.4

According to reports about 400,000 primary TKA surgeries are performed annually in the United States.5 There has been a dramatic increase in utilization of TKA over the last two decades both in developed and developing countries. This increase can be attributed to the rising epidemic of obesity, increased life span, higher acceptability for this procedure, and broadening indications for TKA.6 The indications of TKA other than for the treatment of primary OA include inflammatory arthritis, fracture (post-traumatic OA and/or deformity), dysplasia, and malignancy.7

As failed total joint replacements are associated with a large burden both at the individual patient level and at the level of the broader healthcare system, it is critical to understand the factors that lead to unsatisfactory outcomes.8 Numerous factors have been studied to influence the functional outcome of

TKA. Some of the factors that have been studied globally are social and demographic characteristics of patients, medical comorbidities, and surgical technique.9

The association of intrinsic factors like obesity, cardiovascular disease, mental health disorders, hepatic disease, nutritional deficiencies, bone metabolic disease and diabetes mellitus, as well as external factors such as nicotine use, corticosteroid injections, and discharge disposition has also been studied with the success of TKA outcomes.10

In 2002 Bellemans et al proposed that alterations in posterior condylar offset (PCO) can also influences the maximal flexion achieved after TKA.11Since then, numerous studies have evaluated the effect of these alterations.

This could also be due to the fact that there are several other factors play crucial role in the function al success of surgery. Some of the other factors that needs to be considered are

-The characteristics of the implant, specifically the type of bearing mobility (fixed bearing [FB] versus mobile bearing [MB])

- Whether the implant sacrifices PCL or not (cruciate retaining [CR] versus posteriorly stabilized [PS]) also play a crucial role in the functional success of TKA.

For examples several studies reported a definite correlation between PCO alteration and maximal flexion in CR knees,12 whereas two studies did not find this association in MB-CR knees.13 This association was not found in studies involving PS prosthesis also.13 Studies have also reported that flexion kinematics and thus the ultimate flexion achieved differ between CR and PS TKAs.14 There are also reports that states Asian patients have greater preoperative and postoperative maximum flexion than Western patients do.15

These findings in literature where results are different with different prostheses suggest that there is need for studies using different representative population, using relevant prostheses to determine whether the effect of PCO alteration varies by implant type.

There is little information available on the influence of PCO alteration on outcome scales, such as American Knee Society (AKS) scores, Patellofemoral scores and the Western Ontario and McMaster Universities Arthritis (WOMAC) Index scores. There is also need for more studies to investigate the effects of PCO alteration on functional outcomes of TKA in Asian patients.

Therefore, the present study aimed to determine whether PCO alterations that follow TKA influence functional outcomes including maximal postoperative flexion in Indian (South Asian population) population.

MATERIAL AND METHODS

SOURCE OF DATA

This prospective hospital-based study was conducted on all patients of either sex undergoing only Primary Knee Arthroplasty of the lower limbs, in the department of Orthopedics.

METHODOLOGY

All patients fulfilling the inclusion and exclusion criteria will be screened and included in the study after their consent of participating and willingness to undergo required investigations as a part of the study.

A common protocol of history taking, clinical examination, routine blood investigations and pre-operative x-ray imaging will be performed as a part of the pre- operative preparation. Patient will then undergo surgery. Post operatively, all patients will be subjected to an x-ray to measure the posterior condylar offset.

Post operatively all patients will be subjected to x-ray imaging and evaluated clinically at 3 weeks, 3 months and 6 months for the range of movements and Knee Society Score.

Posterior Condylar Offset (PCO) and Ratio (PCOR)

PCO and PCOR were calculated using the software called IPACS which is an image

processing application used in our hospital for viewing radiographs and calculating the radiographic variables.

INCLUSION CRITERIA

All patients of either sex undergoing primary Total Knee Arthroplasty (TKA) in the department of Orthopedics.

EXCLUSION CRITERIA

1. Patients who have got pre-operative fixed Valgus/Varus deformity of >300.
2. Patients previously undergone surgery in this study.
3. Patients planned for revision of previously operated Arthroplasties.
4. Patients with <900 pre-operative ROM
5. Traumatic
6. Infectious arthritis.

Operative Procedure

Under Spinal anaesthesia with Epidural analgesia, patient in supine position scrubbed, painted and draped in sterile manner using disposable drapes. 3 grams of injection cefuroxime was given before inflation and 30 minutes before incision.

Medial Para patellar approach was taken using 14 cm incision with knee in flexion. Skin flaps created with superficial dissection and incision taken over the quadriceps tendon and extended distally around the medial border of patella and along the medial border of patellar tendon.

Medial side of the knee exposed with sub periosteal elevation of anteromedial capsule and deep medial collateral ligament. Then the knee is positioned in flexed position to remove ACL, PCL and the menisci along with the osteophytes.

Distal femoral cuts were made at a valgus angle of 5 to 7 degrees with the anatomical axis of femur. The amount of femoral cuts was determined by the thickness of the distal femoral prosthesis

The tibial cuts were taken perpendicular to its mechanical axis with the cutting block oriented by an intramedullary or extramedullary cutting guide. Tibial resection was performed to produce 7 degree to 10 degree of postoperative PTS irrespective of the previous value.

Flexion and extension gap balancing was done at this time by placing spacer blocks with the knee in flexion and extension. Varus-valgus balancing can be done with further medial or lateral releases.

Flexion and extension gaps were made equal.

The anteroposterior cuts were performed for insertion of prosthesis by approximating the anteroposterior diameter of the femur measured intraoperatively.

Distal femoral preparation was completed by making anterior and posterior chamfer cuts for the implant. Similarly intercondylar box cuts were taken to accommodate cam and post mechanism.

The entry portal was placed a few millimetres medial to the midline, at a point anterior to the origin of the PCL.

Then the trial implants were used to check for medio lateral, antero posterior stability throughout the range of movements and patellar tracking, thus confirming the sizing of the implants.

Tibial tray was implanted first using polymethylmethacrylate (PMMA) cement applied over the cut surfaces at its doughy state after making sure that the blood and fat doesn't get mixed with the cement. Similarly the femoral component was implanted with the cement. Excess cement was then removed from the periphery of the component.

After the femoral component has been seated, carefully extend the knee with a trial tibial spacer in place to ensure complete seating of the femoral prosthesis. Knee was kept in extension till the cement was set. Meanwhile, patellar resurfacing was done with the removal of osteophytes from the borders of patella.

Thorough wash given again using pulse lavage and the appropriate sized polyethylene spacer was used after checking the stability in extension.

Mediolateral stability, ROM, extensor lag with patellar tracking was checked throughout the ROM.

Postoperative rehabilitation protocol includes ROM exercises, lower extremity muscle strengthening, concentrating on the quadriceps; gait training, and instruction in performing basic activities of daily living. Postoperative scanograms were taken once the patient was able to walk weight bearing comfortably. Follow up will be done at 1, 3 and 6 months.

Figure 1: PREOPXRAY

PreOpKSS:47

PreOpPCO:27.6

PreOpPCOR:0.43

Figure 2: POSTOPXRAY

Post Op PCO :26.4
Post Op PCOR : 0.45
Post Op KSS : 82

RESULTS

In this study the age groups were 41-50, 51-60, 61-70 and 71-80 with 4, 21, 10 and 5 cases respectively. In this study male and female were 11 and 29 subjects respectively. (Table 1) (Figure 3)

In this study male's age groups were 41-50, 51-60, 61-70 and 71-80 with 0, 4, 5 and 2 cases respectively.

In this study female age groups were 41-50, 51-60, 61-70 and 71-80 with 4, 17, 5 and 3 cases respectively.

In this study the distribution of subjects were divided as per the affected side into left and right with 20 subjects each respectively.

In this study the distribution of subject were divided as per the complications into late onset infection (superficial infection) and no complications with 2 and 38 subjects respectively.

In this study the distribution of subjects were divided as per the outcome result after treatment into good, fair and excellent with 25, 2 and 13 subjects respectively.

In this study the comparison of pre and post-operative mean PCO value with it being 26.4 ± 1.9 and 26.0 ± 1.9. However, it was found to be statistically insignificant (Table 2) (Figure 4)

In this study the comparison of pre and post-operative mean PCOR value with it being 0.44 ± 0.1 and 0.45 ± 0. However, it was found to be statistically insignificant (Table 3) (Figure 5)

In this study the comparison of pre and post-operative mean range of motion was 94 ± 9 and 95.5 ± 9. Further, it was found to be statistically significant.

In this study the comparison of pre and post-operative mean range of motion was 94 ± 9 and 111.3 ± 9.4. Further, it was found to be statistically significant.

In this study the comparison of pre and post-operative mean range of motion was 94 ± 9 and 113.8 ± 18.9. Further, it was found to be statistically significant (Table 4) (Figure 6)

In this study the comparison of pre and post-operative mean knee society score was 39.8 ± 11.9 and 72.2 ± 4.9. Further, it was found to be statistically significant.

In this study the comparison of pre and post-operative knee society score was 39.8 ± 11.9 and 75.6 ± 4.1. Further, it was found to be statistically significant.

In this study the comparison of knee society score in the duration of pre-op, after 3 weeks, 3months and 6 months.

We found that 39 patients with <60 (poor) outcome noted preoperatively and further improved to nil by the end of 6 months.

We found that 1 patient with 60-69 (fair) outcome noted preoperatively and had 9 patients at 3 weeks, 5 patients after 3 months and 2 patients at the end of 6 months.

We found that 0 patient with 70-79 (good) outcome noted preoperatively and had 31 patients at 3 weeks, 27 patients after 3 months and 24 patients at the end of 6 months.

We found that 0 patient with 80-100 (excellent) outcome noted preoperatively and had 0 patients at 3 weeks, 8 patients after 3 months and 14 patients at the end of 6 months.

DISCUSSION

In our study the maximum number of patient were seen in the age group of 51- 60 years.

In our study the maximum number of patients were females, almost thrice more common than males (29 VS 11).

Amongst males, 41-50 & 51-60 age group patients were mostly affected and in females 51-60 & 61-70 and age group was most commonly affected. The results were found to bestatistically significant

Most of the patients in our study showed no complications (38) with only 2 patients showed delayed infection.

The most common infective organisms include Staphylococcus aureus, Staphylococcus epidermidis in acute cases taken place within 3 weeks of surgery and coagulase-negative

staphylococcus bacteria in long standing chronic cases.

Restoring a PCO is imperative to evade over resection of the posterior condyle during TKA and also to avoid impingement amid the posterior border of the tibial plateau and femur. An apt PTS is needed for providing sufficient space during knee flexion to prevent the knee joint becoming too tight.16

In the year 2002, Bellemans et al anticipated that alterations in posterior condylar offset (PCO), also has a role in influencing the maximal flexion which can be noted after TKA.11

The pre and post-operative mean PCO value was 26.4 ± 1.9 and 26.0 ± 1.9 in our study. The pre and post-operative mean PCOR value was 0.44 ± 0.1 and 0.45 ± 0. However, it was found to be statistically insignificant.

The comparison of pre and post-operative mean range of motion at 0, 3 & 6 months was 94 ± 9 and 95.5 ± 9, 111.3 ± 9.4 and 113.8 ± 18.9, which was found to be statistically significant.

Over the period of 6 months there was a significant increase in the range of motion which was quite evident in our results outcome.

In case of posterior condylar offset and range of motion, pre and post- operative level of correlation was found to be 0.536 & 0.668, which was found to be statistically significant, whereas posterior condylar offset ratio was not significant.

Mehta S et al. conducted a prospective study to Compare pre op and post op posterior condylar offset in study group. They concluded that in total knee replacement using posterior referencing technique, most of the cases posterior condylar offset is restored and chances of anterior femoral notching is negligible and the post op knee range of movements is also good.17

Another study done by Malviya A, et al., conducted a study on predicting the range of movement after knee replacement: the importance of posterior condylar offset and tibial slope. They found that restoration and/or increase of posterior condylar offset and/or gain of tibial slope was associated with maximum range of movement at 12 months following knee replacement.18

Another study done to evaluate the effect of the change of PCO to range of motion (ROM) and clinical results after total knee arthroplasty (TKA). The authors could not find significant difference between ROM or clinical results with computer-assisted cruciate-retaining mobile-bearing TKAs in the comparison amongst the groups according to the changes of posterior condylar offset.4

In case of posterior condylar offset and range of motion, pre and post- operatively at 3 & 6 months, the level of correlation was statistically significant in our study. The pre and post-operative mean PCOR value was 0.44 ± 0.1 and 0.45 ± 0.

The change in the levels of PCOR was not a significant change at the pre and post-operative stage. However, we had a statistical significance; studies have shown that PCOR has a direct influence on the flexion range of the individual being treated.

Bellemans J, et AL conducted a fluoroscopic analysis of the kinematics of deep flexion in total knee arthroplasty: influence of posterior condylar offset. A significant correlation was shown between operative restoration of posterior condylar offset and maximal flexion.19

Massin P, et AL conducted a study on optimization of the posterior condylar offset, tibial slope, and condylar roll-back in total knee arthroplasty. When the posterior condylar offset was reduced, the value of knee flexion at impingement was also reduced.20

Ajay Malviya, et al. did study on TKA and concluded that posterior condylar offset had the greatest impact upon final range of movement highlighting this as an important consideration for the operating surgeon at pre-operative templating.18

In case of knee society score, pre and post-operative level of correlation was found to be 0.468 which was found to be statistically significant and remained significant even at 3 & 6 months postoperative follow up intervals.

The comparison of pre and post-operative mean knee society score at 0, 3 & 6 months was 39.8 ± 11.9 and 72.2 ± 4.9, 75.6 ± 4.1 and 78.6 ± 4.3, which was found to be statistically significant.

In our study, most of the patients produced good results (25), followed by excellent results in 13 patients and fair results in 2 patients.

In a study with 379 patients who underwent primary total knee replacement was included in a prospective multicenter study and the effect of the posterior condylar offset on the postoperative knee flexion was assessed. No correlation was found between the posterior condylar offset or the tibial slope and the postoperative knee flexion.21

Another study done by Malviya A, et AL conducted a study on predicting the range of movement after knee replacement: the importance of posterior condylar offset and tibial slope. After adjusting for age, sex, diagnosis and type of prosthesis the only significant factors that determined postoperative range of movement were posterior condylar offset, tibial slope and to a lesser extent the pre-operative range of movement.18

Total knee Arthroplasty (TKA) has been found to offer the most favorable results with restoration of pain-free function with excellent long-term outcomes for patients with end-stage knee disease.22

CONCLUSION

The flexion angle after Knee Arthroplasty is predictor of the functional outcome as well as its prognosis over the long-term. Posterior Condylar Offset as well as Posterior Condylar Offset Ratio is key variable for the assessment of knee function,. It is important to consider other variables to predict the associated complications as well as outcome of the disease process. Post -operative Knee flexion after Total knee arthroplasty is an important factor to assess the functional outcome of the procedure. This maximum flexion angle depends on multiple factors. Out of which posterior condylar offset is a concept applied to predict maximum flexion angle after surgery.

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List of Tables and Figures

TABLE 1:DISTRIBUTION OFCASES ACCORDINGTOSEX

SEX	Number	%
MALE	11	27.5
FEMALE	29	72.5
Total	40	100

TABLE2:COMPARISONOF PREOP& POSTOPMEAN PCO

PCO	Mean	SD	Mean	SD	p value
PREOP &POST OP	26.4	1.9	26.0	1.9	0.110

TABLE3:COMPARISONOF PREOP&POSTOPMEAN PCOR

PCOR	Mean	SD	Mean	SD	p value
PREOP &POST OP	0.44	0.1	0.45	0.0	0.560

TABLE 4:COMPARISONOF PREOP& POSTOPMEANROM

ROM	Mean	SD	Mean	SD	p value
PREOP &POST OP	94.0	9.0	95.5	9.0	0.205

PREOP&3MONTHS	94.0	9.0	111.3	9.4	<0.001*
PREOP&6MONTHS	94.0	9.0	113.8	18.9	<0.001*

FIGURE 3:DISTRIBUTION OFCASESACCORDINGTOSEX

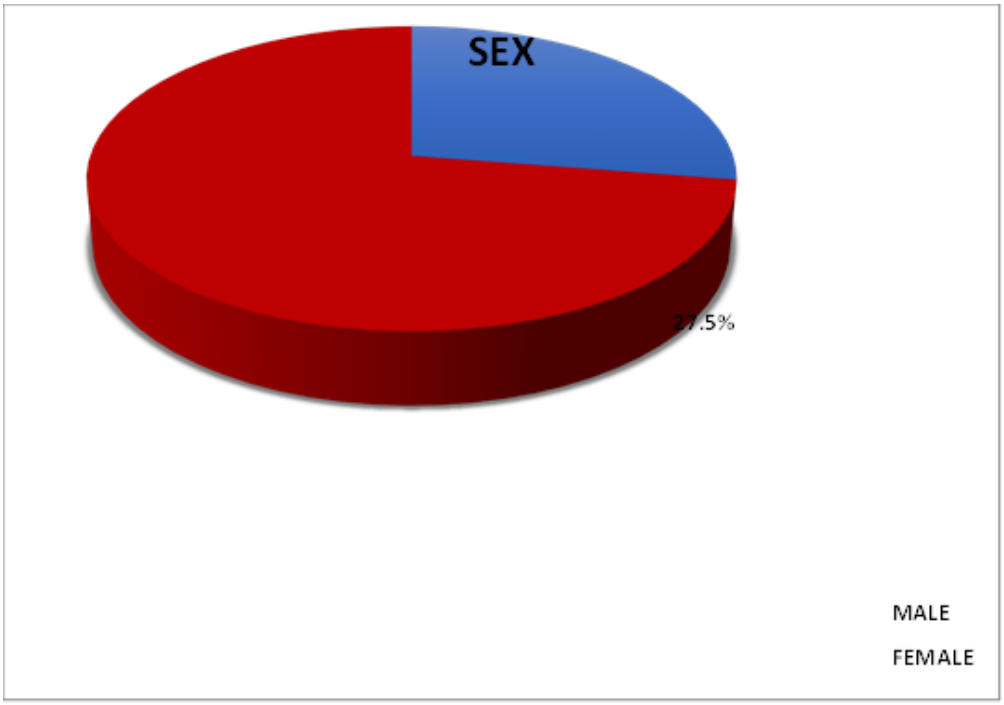

FIGURE4:COMPARISONOF PREOP& POSTOPMEANPCO

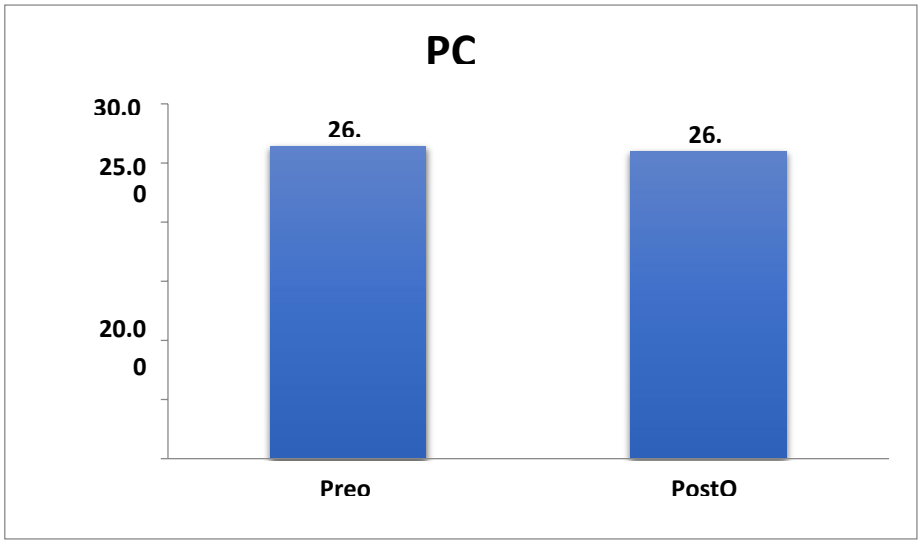

FIGURE5:COMPARISONOF PREOP& POSTOPMEANPCOR

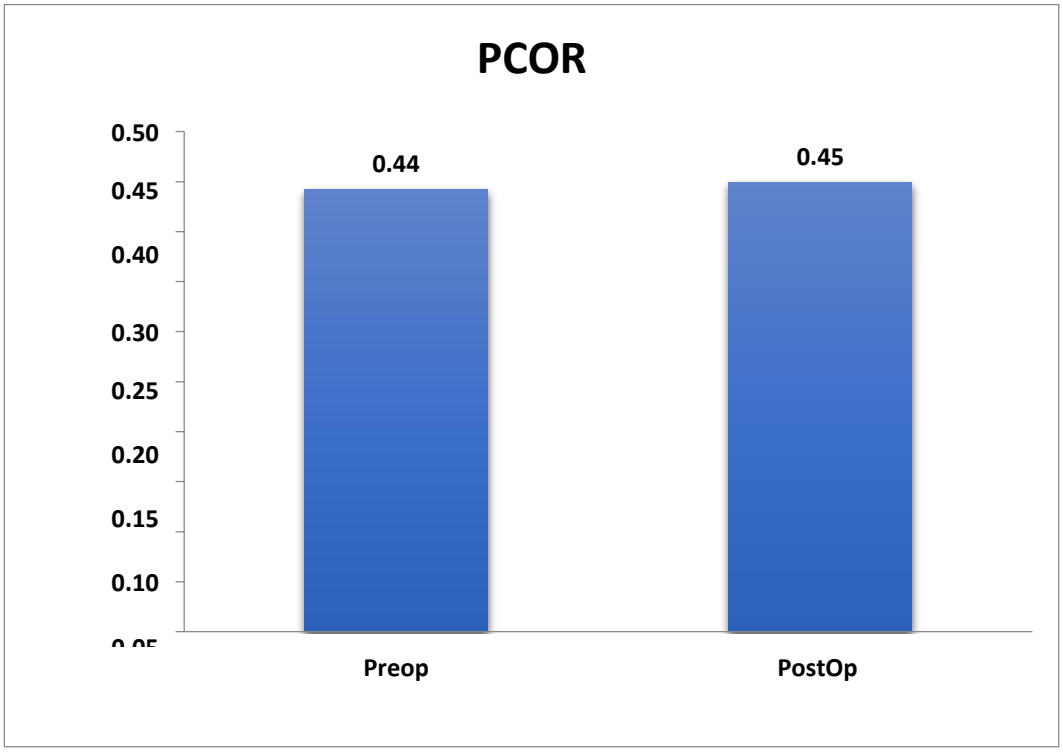

FIGURE 6:COMPARISONOF PREOP&POSTOPMEANROM