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Analysis of Acetabular Cup Positioning and Functional Outcome in Total Hip Replacement

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ABSTRACT
Study Design: *Prospective study*
Objective: *To analyze acetabular cup placement and functional outcome in Total Hip Replacement (THR)*
Methods: *Total 30 patients were selected for the study. These were assessed based on the CT examination of the pelvis for acetabular cup positioning based on anteversion angle and inclination angle. The patient's functional outcome was also analysed based on Harris Hip Score. Patients were followed up post operatively every month for a period of 24 Months. The results were compared and analyzed in these randomly selected patients.*
Result: *On comparison of the mean values of Pre-OP range of motion (ROM) and Post Op Hip range of motion (ROM) is higher with a mean difference of 27.17 which is statistically significant with a p value of <0.001. With the adequate acetabular cup positioning the total number of post op complications such as Hip dislocation , Ant. Hip Pain , Neuropraxia, Revision THR can be minimized to an great extent.*
Conclusion:

- *In our study, 43.33% of patients had excellent functional outcome, 36.66% of patients had good functional outcome and 6.66% of patients had fair functional outcome and 13.33% had poor functional outcome.*
- *In our study, mean CT anteversion was 15.3 degree. Anteversion was within safe zone in 29 out of 30 patients. In our study, mean CT inclination angle was 42.7 degree.*

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I. Introduction

Total hip replacement; nowadays have become commonly performed reconstructive hip procedure for various hip disorders [1].

Although Total Hip Replacement (THR) is considered a very successful surgical intervention, a proportion of patients experience persistent pain or disability, and /or dissatisfaction with the outcome of surgery. Our aim is to determine whether post- operative radiographic variables are predictive of patient-reported pain, function and satisfaction after primary THR [2].

Implant positioning is a major factor in the post - operative outcome of Total Hip Arthroplasty. Implant malposition such as impingement of neck on the cup liner may be a causative factor for dislocation, decreased range of motion, loosening and polyethylene wear. Therefore, accurate positioning of implant is necessary to prevent impingement and long-term stability of implants [3].

The optimum position of acetabular cup to be aimed during Total hip arthroplasty has been proposed in a number of studies. Lewinnek et al [4] proposed safe zone of cup anteversion as 15°±10° (AV) and cup alignment as 40°±10° and showed a 4-fold increase in dislocation rate outside this safe zone. Biedermann et al [5] proposed cup anteversion of 15° and cup inclination of 45° were associated with decreased rate of dislocation. Wixson [6] through his studies proposed an optimum target position of cup inclination of 40-45° and anteversion of 17-23° in computer navigated total hip replacement performed through the posterior approach.

Combined anteversion is the major criteria for stability of total hip replacement.

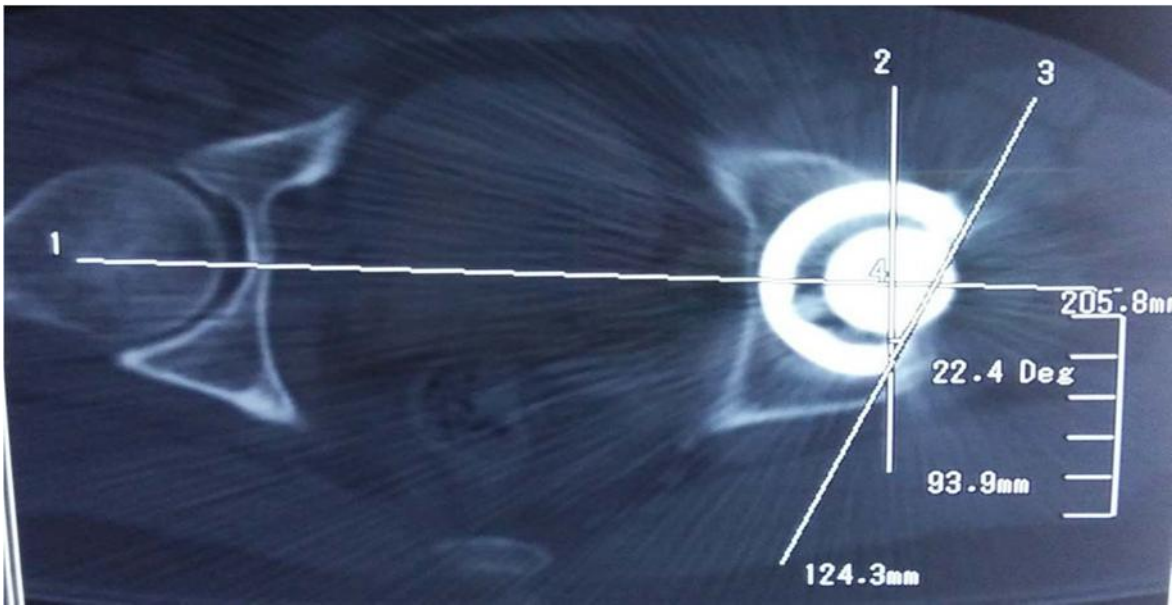
Acetabular cup position alone is not a cause for dislocation.

In future the safe zone for total hip replacement is based on combined anteversion rather than cup position alone. Combined anteversion of 25 to 50 degrees is the safe zone [7].

In this study, we analyzed the post-operative radiographic variables following Total hip arthroplasty and its correlation with functional outcome.

II. Methods

All patients were assessed for functional outcome and acetabular cup position. Clinical examination at the latest follow up was evaluated with Harris hip score. The corresponding hip score were entered against the all the parameters mentioned in the hips score Performa.



CT EXAMINATION OF ACETABULAR CUP ANTEVERSION

Draw a first line connecting the Centre of the two hips and a second line perpendicular to the first line. Third line from the most anterior point of the acetabular cup component to its most posterior point.

The angle between the second and third line is the version of acetabulum.

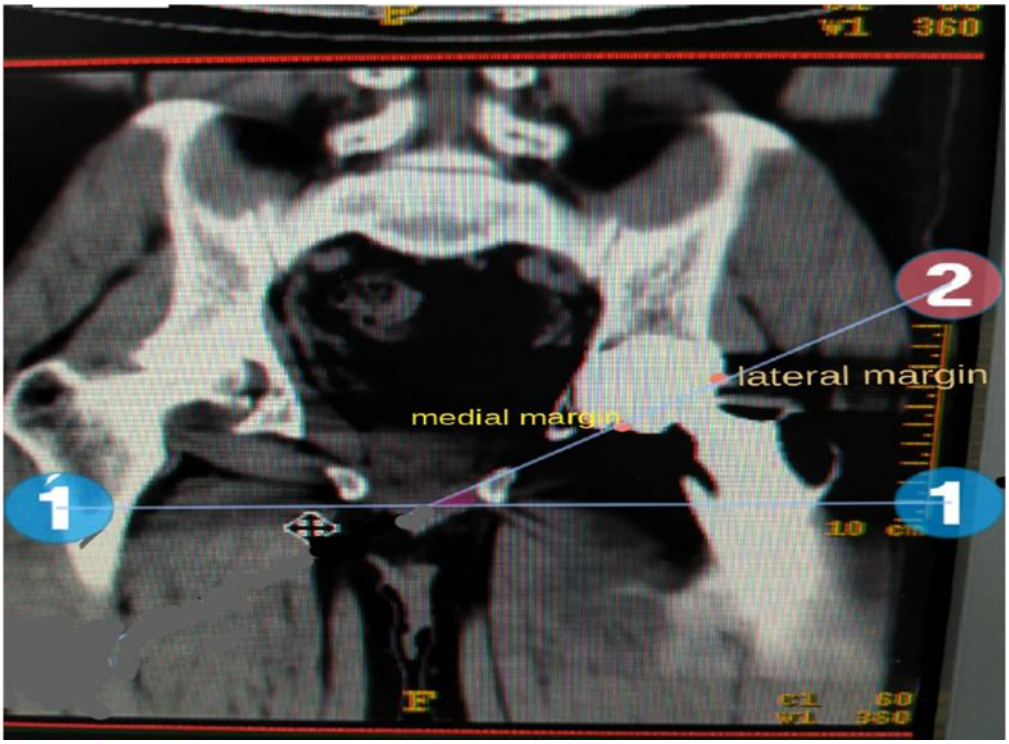
After obtaining the CT picture of the hip, the version of the acetabular cup was assessed by using the Modified MURRAY method.

The acceptable range of the cup version is 15 ± 10.

All our patients were evaluated whether they fit into this range of cup version. The patients out of this range were examined particularly in rotational movements.

- CT EXAMINATION OF THE CUP INCLINATION ANGLE

Acetabular inclination is measured by measuring the angle between line connecting the lateral and medial margins of the cup with the trans ischial line drawn between the right and left ischial tuberosities



III. Observations And Results

All patients were assessed clinically using the HARRIS HIP SCORE SYSTEM [modified] for hip function in our study.

Range of Movements

- On comparison of the mean values of range of motion, Pre-operative and Post- operative hip are higher with a difference of statistically significant with a p value of <0.001.

ROM	PRE-OP. HIP	POST-OP. HIP
FLEXION-EXTENSION	81.5	108.6
ADDUCTION – ABDUCTION	24.8	43.1
IN. ROTATION - EX. ROTATION	10.8	45.8

COMPARISON OF THE PRE AND POST VALUES USING PAIRED T TEST

		N	Mean ± SD	Mean difference ± SD	t	P VALUE
Pair 1	Pre-OP Hip Flexion Extension ROM	30	81.5±18.39	- 27.17±19.86	-7.49	<**0.001**
	Post OP Hip Flexion Extension ROM	30	108.67±12.17			
Pair 2	Pre-OP Hip adduction abduction ROM	30	24.83±11.48	- 18.33±12.34	-8.14	<**0.001**
	Post OP Hip Abduction adduction ROM	30	43.17±8.25			
Pair 3	Pre-OP Hip IR ER ROM	30	10.83±10.59	-35±10.17	- 18.85	<**0.001**
	Post OP Hip IR ER ROM	30	45.83±8.52			

TOTAL HARRIS HIP SCORE

The mean Harris hip score was 85.23(SD = 8.99) with scores ranging from 63 to 93. Of the 30 patients analyzed 4 patients have poor outcome (%), 2 patients have fair outcome (6.6%),11patients with good outcome (36.66%) and 13 patients have excellent outcome (43.33%)

SCORE	**NO. OF PATIENTS**	**OUTCOME**	**VALID PERCENTAGE**
>90	13	EXCELLENT	43.33
89-80	11	GOOD	36.66

79-70	2	FAIR	6.66
<69	4	POOR	13.33
TOTAL	30		100

IV. Conclusion

- In our study, 43.33% of patients had excellent functional outcome, 36.66% of patients had good functional outcome and 6.66% of patients had fair functional outcome and 13.33% had poor functional outcome.
- In our study, mean CT anteversion was 15.3 degree. Anteversion was within safe zone in 29 out of 30 patient. Only one patient had retroveted cup.
- The case with retroverted cup had posterior hip dislocation of joint which was revised.
- In our study, mean CT inclination angle was 42.7 degree. 28 out of 30 patients had inclination angle within safe zone. Only two patients had inclination angle morethan 50 degree, which had no implication on functional outcome.
- CT scan based acetabular cup measurement has given good predication of our intra operative free hand assessment of acetabular cup positioning

V. Discussion

In our study we analyzed 30 cases of Total hip arthroplasty who turned out for follow up for at least 6 months.

The post-operative radiographic variables were measured and they were statistically analysed with Modified Harris hip score to find any significant difference in functional outcome following the placement of cup and stem position in Total hip arthroplasty patients.

In our study, it was found that measurements of acetabular inclination and cup anteversion are not significant predictors of patient reported outcome after primary THR.

The effect of absolute and relative position of the acetabular component in total hip replacements on functional outcomes has not been studied in literature. The ideal position of the acetabular component is still debated in literature. The "ideal" position classically discussed in the literature are based only on rates of dislocation. Recent literature discusses the importance of component position focusing on tribology to define best position for the cup [46,47]. Literature has not examined patient satisfaction as as primary outcome.

Within the ranges of anteversion and inclination angles observed in our study, we did not find strong correlations between the absolute position of the cup and patient satisfaction or functional outcomes scores. This study also shows that the Lewinnek's "safe zone" does not have any direct effect on patient outcome scores. Within the range of cup positions studied, patient satisfaction was not significantly affected. Nevertheless, precision in cup position remains important for tribology and hip stability.

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