

Factors affecting demonstration of intra-operative Coplanar test in Total Hip Arthroplasty

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Abstract

Context: Coplanar test measures intraoperative value of combined anteversion of femoral and acetabular components .

Aim: Purpose of this study was to investigate factors affecting demonstration of Coplanar test when the combined anteversion (CA) was kept within the safe zone in uncemented total hip arthroplasty (THA) in posterior approach .

Settings and Design: It's a prospective study design conducted in a tertiary care health centre.

Methods and Material: We analysed 80 cases of primary uncemented THA between October 2015 to Dec 2016 . Pre-operatively, we measured height of all patients and mid -thigh circumference . Transverse acetabular ligament was used as a reference for acetabular anteversion and implantation . We were able to demonstrate the coplanar test in 58 patients . Analysis of correlation of coplanar test with thigh circumference , height of the patient , Neck shaft angle of femoral stem and abduction angle of acetabular component was done .

Statistical analysis used: Baseline Data were described in mean and Interquartile Ratio compared to non parametric test. Pearson chi square test for correlation of abduction angle and neck shaft angle with coplanar test. Levene test for correlation of thigh circumference and height of the patient. Multiple logistic regression analysis for all factors .

Results: Inclination of cup and thigh circumference were statistically significant independent factors which could affect the test demonstration .

Key words: Co-planar test , Combined anteversion , uncemented total hip replacement , Ranawat coplanar test.

Introduction

Recreation of stable joint with good range of movement is the primary goal of total hip arthroplasty [1].

Impingement free range of motion (ROM) of a total hip replacement depends on the various parameters such as the inclination , anteversion of acetabular component and stem anteversion and cup containment [2-4] . Incorrect implant positioning leads to complications like dislocations, decreased range of motion, poly wear and loosening [5]. Impingement of

prosthetic femoral neck over acetabular rim /poly is one of the main causes of dislocation . Thus, implant positioning is the most critical factor influencing the outcome of total hip arthroplasty[6-8]. The concept of combined anteversion (sum of acetabular anteversion and femoral anteversion) has been proposed so as to quantify the prosthetic alignment [9]. C S Ranawat in 1991 proposed the co planar test to intraoperatively assess the combined anteversion of femoral component and acetabulum when cemented sockets were used [10]. Coplanar test measures intraoperative value of combined anteversion of femoral and acetabular components. If implants are fixed within the safe range of combined anteversion, it is proven that impingement of prosthesis will not occur and hence

decreased chance of dislocation. Safe zone of combined anteversion has been shown as $40^{\circ} \pm 15^{\circ}$ [7,9] Coplanar test was described in 1991 by Ranawat et al . Several authors have expressed their concerns regarding combined anteversion [11,12] but no investigator has revisited the co -planar test and went into details of factors affecting the test. This test was initially described for cemented sockets. However it is commonly taken as a guide for assessing intraoperative combined anteversion in both cemented and uncemented sockets when using posterior approach for THR . We hypothesize that the coplanar test depends upon multiple patient related and implant related factors apart from anteversion of acetabulum.

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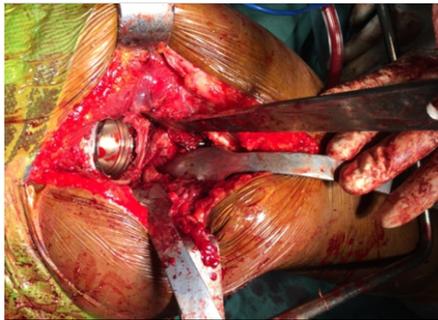


Figure 1: Transverse acetabular Ligament parallel to cup.

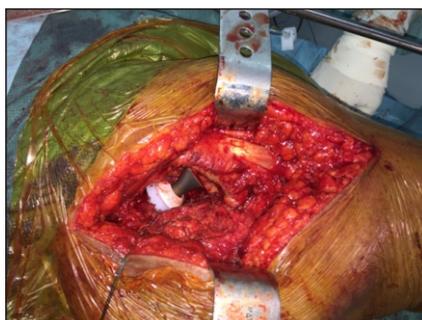


Figure 2: Co-planar test Positive.



Figure 3: Combined anteversion Angle.

Materials and Methods

We analysed 80 cases of primary uncemented Total Hip Arthroplasty between October 2015 to Dec 2016. There were 48 male patients and 32

female patients. The reason for surgery was neck of femur fracture 26 in patients, Arthritis of hip in 24 patients (Rheumatoid and primary osteoarthritis), avascular necrosis of hip in 14 patients, failed fixation of neck

Femur fracture in 9 patients, ankylosing spondylitis in 2 patients and 5 patients had dysplastic hip. Patients with type 1 defects of femur where we had used diaphyseal fitting stem were excluded from study. We have used implants of 2 different makes :Stryker and Zimmer. In accolade stem (Stryker) we have used two variants; standard (132°) and (127°)high offset depending upon soft tissue migration and to prevent impingement. In Zimmer , we have used two types of stems : CLS Stem and ML taper stem , both have same neck shaft angle 135°. We grouped patients into three groups for correlation of neck shaft angle. Group 1 ; - 127° ,Group 2;- 132° , Group 3;- 135°. Pre-operatively, we measured height of all patients and mid -thigh circumference of operative leg at 20 cm above the superior pole of patella. All patients were operated by Moore Approach with patient in lateral position . Pillow was not kept between thighs in any of the patient. Acetabular preparation was done first. Transverse acetabular ligament (TAL) was visualized in all patients .Transverse acetabular ligament was

used as a reference for acetabular anteversion (Fig 1). Cup was implanted in such a way that TAL was completely seen below the lower margin of the cup . We tried to implant the cup flush with TAL. We could do in maximum percentage of our cases .We excluded those cases where cup placement was not parallel to TAL . Each time after implanting the prosthesis before capsular closure we tried to demonstrate co-planar test (Fig 2). We took pictures of demonstrated co-planar test and at whatever angle it was demonstrated. We excluded those cases where cup was not parallel to TAL. Various studies have shown that TAL is an independent indicator of anteversion of acetabular component independent of position of patient. [14-17] Angle of implantation was based on OT table surface for inclination. We made all patients into three groups of acetabular inclination angle for comparison and for statistical correlation. Group 1 -30°- 40°, Group 2 ; - 41°-50°, Group 3 ; - >50°. The Combined Anteversion was assessed by rotating the hip at neutral flexion to a position where the prosthetic neck is perpendicular to the face of the acetabular socket . At this position ,the amount of internal rotation was recorded [10] (Fig3) . We were not able to demonstrate the coplanar test in 22 patients. Patients were analysed radiographically for cup inclination , implant positioning and the neck shaft angle of different stems.

Results

Demographic data				
Age Group	Gender		Rmr_j	
	Male	Female	Male	Female
1-45	3	1	4	0
46-60	61	45	106	0
61-75	4	1	5	0
76-90	44	11	55	0
>90	5	7	12	0
Total	22	33	55	0

Co planar test .			
Stem Type	Co planar test		Total
	Positive	Negative	
CLS Stem	40	0	40
ML taper stem	50	0	50
Total	90	0	90

Table 3: Coplanar test and its relation to thigh circumference and height of the patient				
Co planar test	Height (cm)	Thigh Circumference (cm)	Deviation	Mean
Positive	22	35.95	2.78	.594
	58	32.40	1.991	.261
Negative	22	156.50	7.190	1.533
	58	162.59	9.340	1.226

(50- 55 deg) intentionally in 3 cases. Two in dysplastic and one in grade 4 AVN with lateral subluxated proximal Femur with superolateral acetabular wall insufficiency to have complete coverage. In these cases we had to abduct the thigh to get co-planar test positive. It is an indirect evidence and supports our hypothesis that inclination of socket is an independent variable for demonstration of co planar test. Original description of the co planar test was done for cemented cups [10]. In original article they have expressed that test gives false negative or inability to properly demonstrate the test in those cases of elevated liners of acetabulum. As most available liners in

different systems comes with elevated liners (lipped liners) it is not always possible to do test to confirm coplanarity if we are orienting the liner of acetabulum. If shell of acetabulum is overhanging the acetabular margin, socket margin of shell itself can be used to match with head to achieve coplanarity. Weakness of our study is that we have not quantified the anteversion angle of acetabulum. Previous articles have used computer assistance to quantify the anteversion and combined anteversion is assessed using navigation [3,11,14]. We conclude that it's a complex entity and involves multiple factors. Coplanar test is a good indicator of ideal prosthesis

placement, however inability to demonstrate the test in the absence of impingement of components is acceptable and will not have any adverse impact on long term survival of prosthesis. On table test to assess the angle of anteversion is a rough guide and in itself it is not an accurate yardstick of combined anteversion. Goal of our surgery should be to have impingement free range of movement of hip joint to prevent dislocation and to have maximum stability to the joint. Angle can vary with change of any one of these discussed factors and might preclude us from successful demonstration of the test.

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