ORIGINAL ARTICLE

HOW CUP POSITION AFFECTS DISLOCATION RATE IN PROXIMAL FEMORAL REPLACEMENT ARTHROPLASTY

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Background: Revision as well as primary Arthroplasty with proximal femoral replacement has increased a lot in recent time. Due to increasing surgery rate the complication rate also increases and the main concerning thing in Proximal femur replacement Arthroplasty (PFRA) is rate of dislocation. Hip stability in Arthroplasty is multifactorial like cup position, abductor function capsular repair. In PFRA the dislocation rate is high due to absent or weak abductor function, so cup position plays an important role in reducing dislocation rate in such cases. **Methods:** This prospective longitudinal study was conducted at department of orthopaedic surgery, Ghurki trust and teaching hospital, Lahore on those patients that had proximal femoral replacement arthroplasty either as primary surgery or revision surgery through standard Hardinge Approach, the cup position in term of Inclination and Ante version was measured postoperatively on x-ray and patient was followed for 12 weeks for any dislocation. **Results:** Our study comprised of 42 patients having 71.4% male and 28.6% female. The mean inclination was 41.23°, ranging from 21–67°, and the mean ante version was 16.43°, ranging from 4–40°. The dislocation rate was 21.42% and the inclination in dislocated patients was 44.05±9.02° and ante version was 17.44±6.42°. While, the inclination in non-dislocated group was 39.5±10.69° and ante version was 16.43±7.37°. **Conclusions:** Our study concludes that proper cup version and a more horizontal cup inclination plays a major role in preventing dislocation even in the absence of abductors in proximal femoral replacement arthroplasty.

Keywords: Proximal femoral replacement; Cup version; Cup inclination; Hip arthroplasty

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INTRODUCTION

As a result of the ongoing increase in life expectancy and the growing practice of performing total hip arthroplasty (THA) in younger, more physically active patients, there has been a notable escalation in the number of THA procedures.[1] This surge is expected to lead to a proportional increase in both primary revision and subsequent re-revision rates. Projections indicate that, during the period spanning from 2005 to 2030, there will likely be a substantial rise of approximately 137% in the proportion of THAs requiring revision procedures.[2]

Revision total hip arthroplasty (THA) is a substantial component of the surgical procedures conducted at advanced referral centres specializing in hip surgery. A significant portion of these cases presents formidable challenges, particularly concerning the restoration of structural bone integrity, which has been compromised by prior hip arthroplasty and subsequent implant loosening. Strategies employed for addressing femoral reconstruction in cases of proximal bone loss have encompassed the utilization of extensively porous-coated stems, aiming to secure stable fixation within the distal region of the femoral diaphysis.[3,4]

There are many complications of THA but Hip Dislocation is one of most common complication after Total Hip Arthroplasty (THA). In patient with proximal femoral replacement arthroplasty (PFRA), stability is difficult to achieve and can lead to dislocation more frequent than normal THA.[5] Abductors and cup position are the main factors in hip stability after THA as studies suggest that decrease in muscle strength of Abductors causes THA dislocation.[6]

PFRA is a technically very demanding procedure performed in territory care referral centres only, because of high expertise and less patients the surgery is performed rarely in few centres of Pakistan. Only 1 study with 19 patients was previously conducted in Pakistan with PFRA.[5]

The aim of this study was to find out dislocation rate in proximal femoral replacement arthroplasty and its association with cup position.

MATERIAL AND METHODS

This prospective longitudinal study was conducted from 13th December 2023 to 12th August 2024 in department of orthopaedic surgery Ghurki Trust Teaching hospital, Lahore. Consecutive sampling technique was used and all patients who underwent proximal femoral replacement arthroplasty and met inclusion criteria were included. A standard Hardinge Approach was used, after dissection the proximal femur along with greater trochanter (GT) was cut or GT with attached muscles was spared depends on the case, the abductors were marked with vicryl, the femur stem was reamed and prepared, the Acetabulum was exposed and prepared. AK medical Implant was placed in ideal position as per Lewinnek safe zone.[7] Abductors were reattached to the implant using vicryl, or GT with attached muscles fixed to the implant, stability was checked and wound was closed in reverse order. Depending on bone status (osteoporosis and osteopenia), cemented or cement-less implant was used with simple cup metal on poly system.

After approval from hospital ethical committee, data was collected after applying strict inclusion and exclusion criteria. Inclusion criteria was defined and all patients of both gender with minimum age of 30 years who underwent proximal femoral replacement arthroplasty as primary or revision surgery were included in this study. Patients with active infection, bipolar endoprosthesis, house hold ambulant with normal acetabulum, lost to follow-up and not consenting to participate in study were excluded. Old age was not an exclusion factor if they were community ambulant.

After surgery standard x-ray of pelvis was taken on the same day once patient got stabilized and Post-operative inclination and version of the acetabular cup of all the patients were calculated. It was done by a single resident orthopaedic surgeon to confront bias. Inclination of the cup was calculated using standard antero-posterior radiograph and ante-version was calculated using Liaw method.[8] In this method 2 lines are drawn, line AB across the maximal diameter of the elliptical femoral neck cross-section and for line CD, point "C" is determined which is midpoint of line AB and then perpendicular line to line AB is drawn and angle β is calculated and then femoral version is calculated on formula, i.e., ¼ inverse sine tan (β) as shown in Figure-2. Patients were followed for 12 weeks for any atraumatic dislocation. All the data from patient including demographic to 12 weeks' follow-up was recorded on a predesigned questionnaire. Data was analysed using SPSS 23. Qualitative variables like age were described as mean+ standard deviation

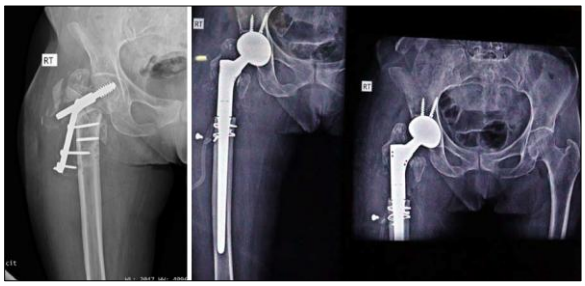

Figure-1: Preop x-ray and postop x-ray of Proximal femoral replacement arthroplasty.

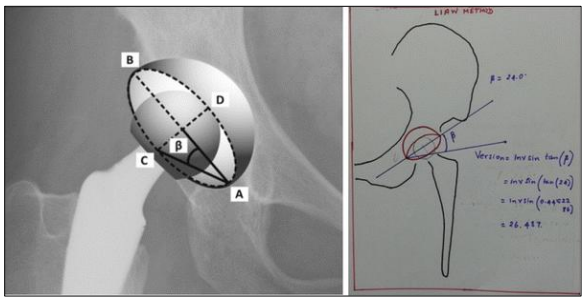

Figure-2: Liaw method of Ante version calculation[13]

RESULTS

Total patient in our study was 42 with majority of patients were male 30(71.4%) and 12(28.6%) were female, and the average age was 53.71±15.23 years. In 7 patients there was proximal femur tumor, in 5 patients it was primarily done in trauma due to extensive comminution of proximal femur fracture unable to reconstruct in 22 patients there was implant failure and previous infection leading to proximal femoral resection while in 8 patients as revision arthroplasty surgery. The dislocation rate was 21.42% with 78.57% of patients experiencing no dislocation. In terms of cup position, the mean inclination was 41.23°, ranging from 21–67°, and the mean ante version was 16.43°, ranging from 4–40°.

Among 9 dislocated hip patients, cup revision was done in 4 (9.52%) cases, closed reduction was done in 5 (11.9%) cases. Table-2 compares mean inclination and ante-version based on demographic characteristics. While no statistically significant differences were observed in inclination based on gender (p=.314) or side (p=.196), the ante-version showed no significant variation either (p=.157 and p=.122, respectively). This suggests that gender and affected side may not be significant factors influencing cup position in the context of this study. There is significant difference observed in the mean inclination angle based on dislocation as p<.05. (Table-3)

Table-1: Patient demographic characteristics and clinical parameters

Parameters	*N*	%	Mean±SD (Range)
Gender			
Male	30	71.4	
Female	12	28.6	
Age (years)			53.71±15.23 (30–82)
Side effected			
Right	24	57.14	
Left	18	42.85	
Inclination			41.23±10.39 (21–67)º
Ante version			16.43±7.13 (4–40)º
Dislocation			
Yes	9	21.42	
No	33	78.57	

Table-2: Comparison of mean inclination and ante version based on demographic characteristics

	Inclination	*p*-value	Anteversion	*p*-value
Gender				
Male	40.50±10.39	.314	17.16±7.52	.157
Female	43.04±10.39		14.65±5.84	
Side				
Left	39.57±10.43	.196	15.00±9.27	.122
Right	42.53±10.29		17.51±7.80	

Table-3: Comparison of mean inclination and ante version based on dislocation rate

	Inclination	*p*-value	Anteversion	*p*-value
Dislocation				
Yes	44.05±9.02	<.05	17.44±6.42	.992
No	39.5±10.69		16.43±7.37	

DISCUSSION

Safe cup position in primary total hip arthroplasty (THA) is controversial as achieving stability and preventing dislocation is multifactorial, but it is still important in preventing dislocation in THA. In proximal femoral replacement arthroplasty with absent or weak abductors its position is of utmost importance.

We assess cup position, i.e., both inclination and ante version on a plain x-ray radiograph of pelvis with both hip joint visible, ante version was measured through Liaw method[8] with mean error of 0.96 degrees in calculating ante version.

Our study showed that the mean inclination of our cup was 41.23±10.39 which is in normal range of safe zone but still there was 21.42% dislocation. Though in PFRA the abductor has reduced function as compare to Primary THA but the dislocation was observed more in safe zone vertical cup which makes cup position an important parameter in preventing dislocation.

In a study conducted by Lubbeke A *et al*[9], they observed a dislocation rate of 14% while our study has a dislocation rate of 21.42% which is quite high in comparison to this study. The high rate of dislocation is due to difference in cup system as we use simple cup while Lubbeke A *et al* observed dislocation in dual mobility cup system.

The dislocation rate varies from study to study due to difference in population, it ranges from 20-28%. Which is comparable to our study.[10] while in primary hip replacement it ranges from 0.2 to 10%, it is lower than proximal femoral replacement arthroplasty due to intact abductors function and proximal bone stock.[11]

Safe zone for primary THA was defined by Lewinnek[7] and it is applicable for PFRA. In our study mean inclination was 41.23±10.39 and mean ante version was 16.43±7.13 while in those patient who had dislocation the inclination was 44.05±9.02 and ante version was 17.44±6.42. Though it lies within safe zone, so in our study those cases that had inclination in the upper limit of Lewinnek safe zone dislocated, so a more horizontal cup is required to prevent dislocation even in the absence of proper abductors.

Hip abductors play an important role in reducing hip dislocation rate as evident from primary, though we attached abductors to the implant but we were unclear of its functional recovery, measures must be taken to gain adequate abductor strength to restore its function to maximum.[12]

Our study emphasises that new safe zone for cup inclination and ante-version be designed for PFRA as the standard safe zone which was designed for THA does not fully restrict dislocation in such cases and as shown by the result that a more horizontal cup (39.5±10.69) has lower dislocation rate compare to a vertical cup (44.05±9.02) but in normal safe zone. It is a gateway for future research on such delicate issue.

LIMITATIONS

Though our study highlighted an important aspect of dislocation in PFRA, but it has certain limitations. Our study had a small sample size with less follow-up time. Therefore, a large scale study with longer follow-up is required to establish a proper safe zone for cup position in PFRA patients in previously defined safe zone is required. We also calculated the version and inclination on the basis of X-ray only due to logistic reasons and to provide an alternate to CT in resource constraint settings, a CT base study will be more accurate to exclude bias and accurate calculation of cup inclination and version and heterogeneity of implant.

CONCLUSION

It is concluded that the dislocation rate is high in PFRA and is more significant in vertical and more anteverted cup, even in defined safe zone. Which shows that horizontal cup and less anteverted cup in safe zone has low dislocation rate even with weak or absent abductors.

AUTHORS' CONTRIBUTION

SKK: Write-up, data collection. NA: Literature review, data collection. MUF: Data analysis. NA: Proof reading, statistical review. AUR: Data interpretation. AA: Proof reading, drafting.

REFERENCES

1. Park KS, Jin SY, Lim JH, Yoon TR. Long-term outcomes of cementless femoral stem revision with the Wagner cone prosthesis. J Orthop Surg Res 2021;16(1):375.
2. Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am 2007;89(4):780–5.
3. Malkani AL, Lewallen DG, Cabanela ME, Wallrichs SL. Femoral component revision using an uncemented, proximally coated, long-stem prosthesis. J Arthroplasty 1996;11(4):411–8.
4. Puchner SE, Funovics PT, Hipfl C, Dominkus M, Windhager R, Hofstaetter JG. Incidence and management of hip dislocation in tumour patients with a modular prosthesis of the proximal femur. Int Orthop 2014;38(8):1677–84.
5. Ali M, Sahito B, Rajput IM, Kumar D, Hussain N, Kumar S. The Wagner Modular (S2) Prosthesis for Proximal Femur Bone Loss; Prospective Study of 19 Cases. PJMHS 2021;15(10):351–3.
6. Hu X, Zheng N, Hsu WC, Zhang J, Li H, Chen Y, *et al*. Adverse effects of total hip arthroplasty on the hip abductor and adductor muscle lengths and moment arms during gait. J Orthop Surg Res 2020;15(1):315.
7. McLawhorn AS, Sculco PK, Weeks KD, Nam D, Mayman DJ. Targeting a New Safe Zone: A Step in the Development of Patient-Specific Component Positioning for Total Hip Arthroplasty. Am J Orthop (Belle Mead NJ) 2015;44(6):270–6.
8. Liaw CK, Hou SM, Yang RS, Wu TY, Fuh CS. A new tool for measuring cup orientation in total hip arthroplasties from plain radiographs. Clin Orthop Related Res 2006;;451:134–9.
9. Lubbeke A, Roussos C, Barea C, Kohnlein W, Hoffmeyer P. Revision total hip arthroplasty in patients 80 years or older. J Arthroplasty 2012;27(6):1041–6.
10. Dargel J, Oppermann J, Brüggemann GP, Eysel P. Dislocation following total hip replacement. Dtsch Arztebl Int 2014;111(51-52):884–90.
11. Iljazi A, Sørensen MS, Ladegaard TH, Overgaard S, Petersen MM. Dislocation rate after hip arthroplasty due to metastatic bone disease: a retrospective cohort study evaluating the postoperative dislocation risk across different articulating solutions. Acta Orthop 2023;94:107–14.
12. Gusho CA, Clayton B, Mehta N, Colman MW, Gitelis S, Blank AT. Survival and outcomes of modular endoprosthetic reconstruction of the proximal femur for primary and non-primary bone tumors: single institutional results. J Orthop 2021;25:145–50.
13. Manjunath KS, Soruban V, Gopalakrishna KG. Evaluation of radiological methods of assessing cup anteversion in total hip replacement. Eur J Orthop Surg Traumatol 2015;25(8):1285–92.

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