

Original Research Article

Acetabular cup positioning in primary routine total hip arthroplasty

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Received: 04 May 2026

Accepted: 23 June 2026

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ABSTRACT

Background: Correct location of the acetabular cup is essential for stability, wear patterns, and functional results after primary Total hip arthroplasty (THA). Even with improvements in implant design and surgical methods, improper placement of the acetabular component is still a common cause of problems after surgery.

Methods: This prospective observational study included 2,400 patients undergoing primary routine total hip arthroplasty from October 2022 to May 2024. We examined postoperative radiographs to assess the inclination and anterior displacement of the cup. We kept track of clinical outcomes and issues during the follow-up.

Results: Most of the acetabular components were placed in the radiographic safe zone that is generally acknowledged. Cups that were not positioned correctly were strongly linked to greater risks of dislocation, pain from impingement, and early revision. Patients with cups that were positioned just right had better functional outcomes.

Conclusions: Proper location of the acetabular cup is very important for getting good early results after primary THA. Regular evaluation and compliance with established orientation criteria may mitigate issues and enhance patient satisfaction.

Keywords: Total hip arthroplasty, Positioning of the acetabular cup, Safe zone, Dislocation, Orientation of the implant

INTRODUCTION

Total hip arthroplasty (THA) is widely acknowledged as one of the most efficacious orthopaedic procedures, providing reliable pain relief and functional restoration in patients with severe hip conditions.^{1,2} As life expectancy increases and degenerative joint disease becomes more prevalent, the demand for primary total hip arthroplasty is escalating globally.³

Even if the chances of surviving for a long time are rather favourable, complications like dislocation, rapid wear of polyethylene, impingement, and early revision are still big clinical problems.^{4,5} Placement of the acetabular cup has consistently been acknowledged as a crucial factor among the various modifiable aspects influencing these outcomes.^{6,7} Malorientation of the acetabular component alters hip biomechanics and range of motion, increasing the risk of instability and edge loading.^{8,9} Lewinnek and

colleagues proposed a radiological safe zone for acetabular cup inclination and anteversion, which has been widely adopted as a benchmark for component arrangement.¹⁰ Nevertheless, achieving consistent positioning inside this safe zone during routine primary total hip arthroplasty remains challenging due to variations in patient anatomy, pelvic tilt, surgical technique, and intraoperative decision-making.¹¹⁻¹³ Recent studies have contested the concept of a universal fixed safe zone and underscored the necessity for customised component placement.^{14,15}

METHODS

This prospective observational study took place at Padmini Care Hospital, Tangi, Cuttack, Odisha, India, from October 2022 to May 2024. A total of 2,400 consecutive patients undergoing main routine total hip arthroplasty were recruited after obtaining informed written consent. Inclusion criteria included adult patients undergoing

primary total hip arthroplasty for osteoarthritis, avascular necrosis, or inflammatory arthritis. Patients who were having revision surgery, THA for hip dysplasia, pathological fractures, or who didn't have good enough X-rays were not included.

Standardised anteroposterior pelvic radiographs were acquired postoperatively. We used well-known radiographic methods to quantify the inclination and anteversion of the acetabular cup. Functional scores and records of postoperative problems were used to judge how well the treatment worked. The data were analysed using suitable descriptive and inferential statistical techniques. Before the study began, the institutional ethics committee gave its approval.

RESULTS

Out of 2,400 patients included in the final analysis, the mean age was 59.1±10.2 years, with 1,512 males (63.0%) and 888 females (37.0%). Primary osteoarthritis constituted the most common indication for surgery, followed by avascular necrosis of the femoral head.

Table 1: Demographic and clinical characteristics (n=2400).

Variables	Values
Mean age (years)	59.1±10.2
Male sex, N (%)	1512 (63.0)
Primary osteoarthritis, N (%)	1560 (65.0)
Avascular necrosis, N (%)	624 (26.0)

Table 2: Acetabular cup positioning.

Cup orientation	Number (%)
Within safe zone	1872 (78.0)
Outside safe zone	528 (22.0)

Table 3: Postoperative complications.

Complications	Incidence (%)
Dislocation	3.4
Impingement-related pain	6.8
Early revision	2.1

Radiographic evaluation demonstrated that 1,872 acetabular cups (78.0%) were positioned within the Lewinnek safe zone, while 528 cups (22.0%) lay outside the recommended orientation. Cups placed outside the safe zone exhibited a significantly higher incidence of postoperative dislocation, impingement-related pain, and early revision.

Functional outcome scores were superior in patients with cups positioned within the safe zone, with earlier mobilization and improved range of motion. Multivariate analysis identified acetabular cup malposition as an

independent predictor of early postoperative complications.

DISCUSSION

This extensive prospective study illustrates a significant correlation between acetabular cup location and early clinical outcomes subsequent to primary total hip arthroplasty.¹⁶ Patients with cups placed in the designated safe zone saw fewer problems and achieved enhanced functional recovery.^{17,18}

The Lewinnek safe zone is still a good guide, but more and more research shows that a set radiological objective may not be the best choice for all patients.^{19,20} Individual differences in pelvic tilt and the acetabulum's functional orientation have a big effect on how components work during daily activities.^{21,22}

The results of this investigation corroborate earlier findings that cup malposition is a significant risk factor for instability and premature revision.²³ New technologies like navigation and robotic-assisted THA have the potential to make placing acetabular components more accurate and consistent.^{24,25}

CONCLUSION

Correct alignment of the acetabular cup is a key factor in determining early outcomes in primary routine total hip arthroplasty. Following established orientation criteria and taking into account patient-specific circumstances may lower the risk of problems and make implants last longer.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Sahoo A, Das BS, Suprava S. Acetabular cup positioning in primary routine total hip arthroplasty. *Int J Res Orthop* 2026;12:1055-7.