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High Heterotopic Ossification Occurs in Acetabulum Fracture Patients Undergoing Combined Hip Surgery with Plate Fixation

Enver Ipek,[1] Ali Erkan Yenigul,[2] Kemal Durak,[2] Muhammet Sadik Bilgen[2]

[1]Department of Orthopedics, Sisli Hamidiye Etfal Training and Research Hospital, Istanbul, Türkiye
[2]Department of Orthopedics and Traumatology, Uludag University Faculty of Medicine, Bursa, Türkiye

ABSTRACT

Objective: Acetabular fractures, often resulting from high-energy traumas, are serious orthopedic injuries that significantly affect both the stability and function of the hip joint. This study aims to evaluate the functional, clinical, and radiological outcomes of various fixation materials (cables, plates, and screws) used during acute total hip arthroplasty (THA) in patients with acetabular fractures. By comparing different fixation techniques, it seeks to determine their relative efficacy and their contributions to achieving stable fixation and improved clinical outcomes.

Materials and Methods: This retrospective study analyzed data from 57 patients treated with acute THA between 2007 and 2018. Patients were grouped based on the fixation method used: Cables, plates, or screws. Clinical outcomes were assessed using the Harris Hip Score (HHS) and Merle d'Aubigne-Postel scoring systems, while radiological evaluations focused on stability, heterotopic ossification (HO), and component alignment. Statistical analyses were performed to compare functional and radiological outcomes among groups.

Results: The mean HHS was 85.5, and the overall mobility rate was 86%. While no statistically significant differences were found in functional scores, complication rates, or radiological outcomes among the fixation groups, trends were observed. Cable fixation was associated with lower HO rates (39% vs. 61% overall), while plate fixation showed slightly higher mobility rates. The overall complication rate was 26.3%, with HO observed in 61% of patients. Despite these challenges, patient outcomes were generally satisfactory, with stable fixation achieved in all cases.

Conclusion: Acute THA is a viable treatment option for acetabular fractures, particularly when open reduction and internal fixation alone cannot ensure adequate stability. Stable fixation is the primary determinant of successful outcomes, irrespective of the fixation method used. Future studies with larger cohorts are needed to validate these findings and optimize fixation strategies based on patient-specific factors such as bone quality and fracture complexity.

Keywords: Acetabulum, Fracture fixation, Functional outcomes, Hip prosthesis, Orthopedic implants

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INTRODUCTION

Acetabular fractures are serious orthopedic injuries that typically occur due to high-energy trauma (e.g., traffic accidents) in young adults and low-energy trauma (e.g., falls from standing height) in elderly individuals. The treatment of these fractures ranges from conservative methods to surgical approaches.[1] Among the surgical options, open reduction and internal fixation (ORIF) is considered the gold standard for managing acetabular fractures.[2] The primary objectives of ORIF are to achieve anatomical alignment of the joint sur-

Address for correspondence: Enver Ipek. Department of Orthopedics, Sisli Hamidiye Etfal Training and Research Hospital, Istanbul, Türkiye
E-mail: enveripek88@gmail.com **ORCID ID:** 0000-0001-6205-1207
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face, restore stability, and prevent long-term complications such as post-traumatic osteoarthritis. However, post-traumatic osteoarthritis (12–57%) remains the most common cause of failure[3,4] and even in the hands of experienced surgeons, the 10-year incidence of total hip arthroplasty (THA) varies between 8% and 35%, depending on factors such as fracture type and patient age.[5]

Patients requiring acute THA following ORIF are often confronted with complications such as heterotopic ossification (HO), scar tissue formation, contractures, avascular necrosis (AVN) of the femoral head and acetabulum, vascular injury, and occult infections.[6] These complications render secondary THA procedures challenging and negatively impact surgical outcomes. Despite the possibility of such complications, ORIF is generally the first-line treatment choice. However, acute THA may be preferable in cases involving osteoporosis, severe comminuted fractures, extensive wear of the femoral head, fractures of the femoral head that cannot be reconstructed, pre-existing hip arthritis, and articular impaction of the medial wall.[2,7-10]

Mears et al.[8] have reported that acute THA could be a treatment option for selected acetabular fractures. Acute THA confers the advantage of immediate post-operative weight-bearing, thereby reducing the risk of thrombotic events, decubitus ulcers, and pulmonary complications.[11-16] Moreover, by stabilizing the fracture in a single operation, it minimizes complications associated with soft tissue.

In acetabular fractures, the acetabular component alone may not provide sufficient stability, and supplementary methods (e.g. cables, plates, and screws) may be required. The present study aims to evaluate the functional, clinical, and radiological outcomes of implants used for additional stabilization in patients undergoing THA.

MATERIALS AND METHODS

This retrospective study was conducted at a university hospital between January 2007 and July 2018. The study protocol received approval from the Local Ethics Committee (No: 2018-13/23) and informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki.

The indications for performing acute THA operations on patients are detailed in Table 1[3,10,17,18] which elucidates the necessity of the procedure and summarizes the patient selection criteria. The patients underwent acute THA and open reduction internal fixation (ORIF) using cables, plates, or screws. These procedures were collectively classified as a combined hip procedure (CHP). Patients who were followed up for a minimum of 12 months were included in the study. The exclusion criteria comprised patients who had undergone surgical interventions at other centers during the follow-up period or those who did not adhere to follow-up appointments regularly.

The patients were assessed for various parameters, including age, gender, weight, body mass index (BMI), the affected side, additional injuries, the cause of trauma, and the need for post-operative intensive care. The patients were categorized into three groups based on fixation methods – Group 1: THA fixation with cable (Fig. 1), Group 2: THA fixation with plate (Fig. 2), and Group 3: fixation with screws (Fig. 3).

Table 1. Acute total hip arthroplasty indications[3,10,17,18]

Absolute	n	Relative	n
Femoral head impaction	3	Delayed presentation	3
Acetabular impaction – especially. If >40%	3	High risk fracture types; t type, posterior column/ posterior wall, and transverse posterior wall	10
Inability to adequately reduce fracture	2	Comorbidities	
İntraarticular comminution	3	Obesity	
Full-thickness abrasive loss of the articular cartilage	2	Advanced age	2
Displaced fracture of the femoral neck or fracture of femoral head	3	Somatosensory, neurologic, or psychiatric impairment	
Loss of joint congruity	2		
Osteopenia or osteoporosis	16		
Pre-existing severe osteoarthritis or AVN	7		
Pathological	1		

n: Patient number; AVN: Avascular necrosis.

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Figure 1. A patient applied with total hip arthroplasty with cable fixation.

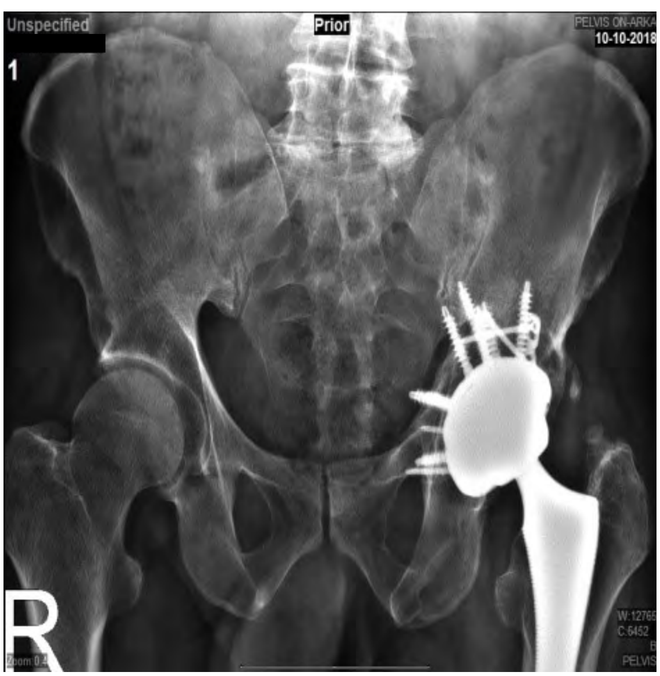

Figure 2. A patient applied with total hip arthroplasty with plate fixation.

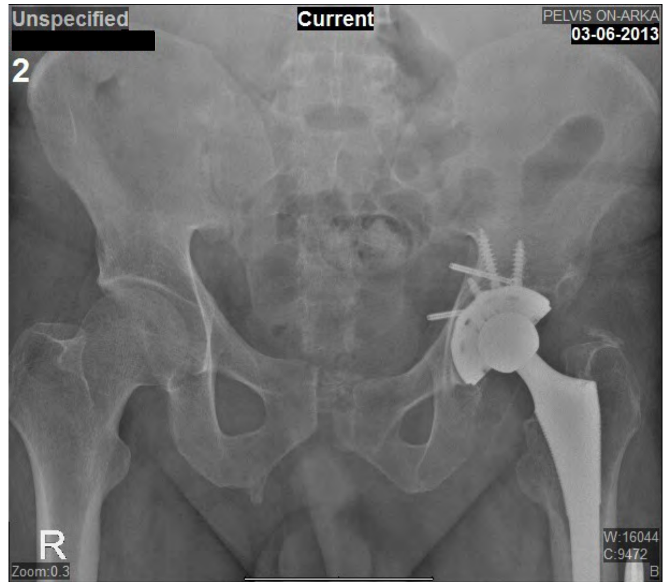

Figure 3. A patient applied with total hip arthroplasty with screw fixation.

Fixation Method

Cable fixation is a preferred method in cases where the fracture line is located at the upper level of the greater sciatic notch. It has proven to be particularly effective for high posterior column fractures, transverse fractures with high anterior or posterior extensions, and complex fractures involving both columns. In addition, cable fixation has been utilized to provide supplementary stability in cases of osteoporosis, where conventional plate and screw applications fail to offer adequate fixation due to poor bone quality.[18,19]

In situations where the anatomical restoration of the joint surface is necessary and stability is of critical importance, plate fixation is applied.[20] This method has played a significant role, particularly in anterior column and posterior hemitransverse fractures. Plate fixation is the preferred approach when maintaining the anatomical integrity of the anterior and posterior columns, as well as the posterior wall, is required to ensure the proper placement of the acetabular component.

Screw fixation, conversely, is employed to secure small fracture fragments or to provide supplementary stability, and it has been particularly beneficial in stabilizing fracture fragments in posterior wall fractures, thereby creating a stable foundation for implant placement.[21]

Surgical Method

The patients underwent surgery under anesthesia, spinal anesthesia, or a combination of spinal and epidural anesthesia. A standard posterolateral approach through Kocher-Langenbeck incision or a modified Gibson incision was used with the patients in the lateral decubitus position. All patients received antibiotic prophylaxis with first-generation cephalosporins, commencing 12 h preoperatively, administered every 4 h during the operation, and continued for 24–48 h postoperatively.

Pre-operative thromboembolic prophylaxis was initiated, and this was continued up to the 4th week postoperatively. In addition to this, the use of anti-embolic stockings was required for a period of 1 month postoperatively. Drains were removed on the 1st post-operative day, and knee and hip isometric exercises were initiated. With the exception of patients with other fractures that prevented mobilization, all patients were mobilized with a walker, stick, or crutches.

Functional and Radiological Evaluation

Postoperative clinical and radiographic evaluations were conducted at 6 and 12 weeks, 6 months, 1 year, and 2 years. Patients were questioned about satisfaction with the operated hip, use of assistive devices when walking, and any limping. Data on hospital stay length, follow-up period, complications, mortality, and time to return to work were recorded.

The functional assessment of the patients was conducted using the hip joint range of motion (ROM), Harris Hip Score (HHS), and the Postel-Merle d'Aubigné (PMA) score. These scoring systems were used to evaluate pain, mobility, and daily activity levels. Mobility was also assessed as part of the functional evaluation. The assessment was performed preoperatively and at the final follow-up to monitor functional improvements. Patients' movement limitations, pain levels, and walking ability were recorded and analyzed to determine overall functional outcomes.

Radiological evaluations included the measurement of the acetabular and femoral component values on radiographs, with a comparison of early post-operative and final follow-up radiographs using Callaghan's parameters.[22] The acetabular component inclination angle was measured, in conjunction with assessments of medialization, loosening, polyethylene insert wear, vertical and horizontal migration, and osteolysis presence according to Delee and Charnley.[23] The acetabular cup angle was determined by the angle between the line joining both teardrops and the line joining the two ends on the joint side of the acetabular component, with normal values ranging from 35°to 55°.

The vertical migration of the component was evaluated by measuring the distance between the line joining the teardrops and the inferior corner of the acetabular component, while horizontal migration was measured from the Kohler line to the center of the outer wall of the acetabular component. Instability was defined as a change of >2° in the acetabular cup angle, vertical and horizontal migration of >2 mm, and radiolucent lines >2 mm around the component zones, with clinical findings indicating loosening.

The femoral component evaluation process involved the division of the femur into seven zones as defined by Gruen et al.[24] and the assessment of stability employing criteria from Engh et al.[25] The vertical migration of the femoral component was measured by the distance between the superomedial corner of the femoral component and the trochanter minor or the superolateral corner of the femoral stem and the peak of the trochanter major. A change >5 mm was indicative of migration. The angle between the line parallel to the femoral stem axis and the line joining the femoral metaphysis midpoints (the diaphysis angle) was assessed using Berli et al.'s[26] method, and the angle between the line parallel to the femoral stem axis and the line joining the femoral metaphysis midpoints (diaphysis angle) was appraised as varus, valgus, or neutral.

Statistical Evaluation

The data obtained in the study were analyzed statistically using SPSS version 23.0 software (SPSS Inc., Chicago, IL, USA). The Shapiro–Wilk test was employed to assess the conformity of the data to a normal distribution. In instances where more than two groups of independent categories were being compared, the Kruskal–Wallis test was applied. Categorical variables were compared using the Chi-square test or the Fisher–Freeman–Halton test. The kappa agreement analysis was used to evaluate the agreement between the clinical and radiological evaluation results. A value of $p<0.05$ was accepted as the level of statistical significance in all the tests.

RESULTS

The demographic characteristics of the patients are comprehensively detailed in Table 2, which shows that there were no statistically significant differences in height, weight, and BMI among the groups ($p>0.05$). Isolated acetabulum fractures were observed in 10 (17.5%) patients, while the remaining 47 (82.5%) had additional injuries accompanying the acetabulum fracture. The rationale for performing acute THA on 18 elementary fractures is outlined below: Advanced osteoporosis in 11 patients, pathological fracture in 1 patient, pre-operative osteoarthritis in 5 patients, and advanced age-related indications in 1 patient. Intensive care was required for 22 patients, with an average intensive care unit stay of 14 days.

The etiology of trauma resulting in acetabular fractures was as follows: In-vehicle traffic accidents were responsible in 33 (57.9%) cases, out-of-vehicle traffic accidents in 6 (10.5%) cases, falls from height in 9 (15.8%) cases, simple falls in 6 (10.3%) cases, workplace accidents in 3 (5.3%) cases, and electric shock in 1 (1.8%) case.

Elementary fractures included 6 (10.5%) posterior wall fractures, 3 (5.3%) posterior column fractures, 3 (5.3%) anterior column fractures, 5 (8.8%) transverse fractures, and 1 (1.8%) anterior wall fractures. Complex fractures included 6 (10.5%) T-shape fractures, 2 (3.5%) posterior column and posterior wall fractures, 10 (17.5%) transverse and posterior wall fractures, 2

(3.5%) anterior column or posterior hemitransverse with anterior wall fractures, and 19 (33.3%) both column fractures. The AO classification system categorized the fractures into distinct types, with type C1 being the most prevalent, accounting for 26% of cases, followed by type B1, which accounted for 23%.

The overall mortality rate during the follow-up period was 8% (n=5), with no perioperative mortality. The shortest time to mortality was 21-month post-operation. Among the 31 patients who were employed before the trauma, 25 (81%) returned to work after an average of 9.3 months (range 2–33 months), while 6 patients did not return to work. The outcomes were considered excellent or very good in 83% of patients.

PMA scoring revealed an average pain score of 5.3 in Group 1, 5.4 in Group 2, 5.3 in Group 3, and 5.3 overall. Walking function scores averaged 4.8 in Groups 1 and 2, 4.6 in Group 3, and 4.7 overall. The ROM scores averaged 5.6 in Group 1, 5.1 in Group 2, 5 in Group 3, and 5.1 overall (Table 2). The total scores were 5.2 in Group 1, 5.1 in Group 2, 5 in Group 3, and 5.1 overall.

Table 2. Demographic, trauma mechanism and surgical treatment, patient-reported outcome measure score, complication data

	Group 1	Group 2	Group 3	Total
Patient numbers (n)	11	11	35	57
Age, Range	46 (23–80)	49 (37–75)	57 (39–85)	54 (23–85)
Gender, female %	4 (36)	4 (36)	6 (17)	14 (25)
Side-left	5 (46)	5 (46)	21 (60)	31 (54)
BMI	24.4	27.6	28.1	27.3
Type of trauma	-	1 (9) LET	5 (14.2) LET	6 (10.5) LET
	11 (100) HET	10 (91) HET	30(85.8) HET	51 (89.5) HET
Type of acetabular fracture according to	1 (9) Elementary	1 (9) Elementary	16 (45) Elementary	18 (31) Elementary
Letournel and Judet	10 (91) Complex	10 (91) Complex	19 (55) Complex	39 (69) Complex
Head injuries	2	-	4	6
Dislocation-Displaced fracture of the femoral neck or head	2	4	10	16
Mean time from injury to surgery (day)	14	21	20	20
Operation time (min)	162	169	152	157
Follow-up (months, range)	22.0	53.1	62.7	53.0
Hospitalization (days)	6.2	11.7	14.4	12.3
HHS-Mean±SD/ (range)	89.2±6.4	86.2±14.6	84.2±13.9	85.5±12.9
PMA Mean±SD/ (range)	5.2±0.73	5.1±0.74	5±0.77	5.1±0.72
Mobility (%)	81.8	90.9	85.7	86.0
Complication rate n (%)	2 (18.1)	3 (27.2)	10 (28.5)	15 (26.3)
Dislocation	-	-	4	4 (7)
İnfection-DAİR	2	1	2	5 (8.7)
Neurological deficit	-	-	4	4 (7)
Periprosthetic fracture	-	2	-	2 (3.5)
HO (any grade)	5	9	21	35 (61)
HO (grade III or IV)	-	3	13	16 (28)
Revision n (%)	2	-	2	4 (7)
Mortality (%)	-	-	14.3	8.7

BMI: Body mass index; PMA: Merle d'Aubigne-Postel Scoring System; HO: Heterotopic ossification; DAİR: Debridement, antibiotics, and implant retention; SD: Standard deviation; LET: Low-energy trauma; HET: High-energy trauma; HHS: Harris Hip Score.

Radiological evaluations confirmed complete bone union in all acetabular fractures. HO was absent in 22 (39%) hips. According to the Brooker classification, HO was observed at Type 1 in 11 (19%) hips, Type 2 in 8 (14%), Type 3 in 6 (10%), and Type 4 in 10 (18%). The mean acetabular inclination angle was 44° (range 23°–65°). Excluding patients who underwent revision for inclination changes, seven patients exhibited alterations: Two demonstrated a 3° decrease, three a 3° increase, and two a 5° increase. No acetabular loosening was detected.

Four patients underwent revision surgeries. Excluding these patients, radiolucent areas surrounding the acetabular component were examined. Radiolucent areas measuring >2 mm were identified in Zone 2 in two hips (3.7%) and Zone 3 in two hips (3.7%). No clinical signs of loosening were observed in these patients, and no radiolucent areas were identified in 46 hips. Vertical migration of the acetabular component was absent in 50 patients, with 1mm migration observed in two patients and >2 mm in one patient. Horizontal migration was absent in 51 patients, with 1 mm migration recorded in one patient and >2 mm in another.

Analysis of the femoral component using Gruen zones showed cortical thickening of 1 mm in 2 hips and >2 mm in 3 hips in Zone 1, 1 mm in 1 hip and >2 mm in 3 hips in Zone 2, 1 mm in Zone 3 and Zone 5, and the femoral component exhibited radiolucent areas of 1 mm and 2 mm, respectively. In addition, Zone 6 showed a 1 mm radiolucent area, while Zone 7 revealed a 1 mm radiolucent area and a 2 mm area. Acetabular vertical migration was observed to be <5 mm in six patients and more than 5 mm in one patient. No varus or valgus changes were detected in any femoral component.

Five patients underwent debridement for infection, while one patient exhibited early post-operative serous discharge at the wound site, which was successfully treated with antibiotics and dressings. Revision surgery due to infection was necessary for four patients. Sciatic nerve damage resulted in dropfoot in 11 patients, with spontaneous recovery in seven cases. Dislocation occurred in four patients, all treated with closed reduction without further issues. Two patients with late post-operative periprosthetic fractures were treated with plate fixation (Table 2).

DISCUSSION

The primary objective of treatment for acetabular fractures is to prevent complications such as post-traumatic osteoarthritis and functional loss. Although the gold standard treatment is considered to be ORIF, acute THA is preferred in specific patient groups during the early period. A study conducted by Salar et al.[27] demonstrated that acute THA provides favorable functional and radiological outcomes and is associated with high patient satisfaction when performed under appropriate indications. Tannast et al.[28] developed a set of criteria to predict survival after surgical treatment and identify the need for THA within 2 years (Table 3). According to these criteria, patients who undergo ORIF often present with complications such as post-traumatic arthritis, acetabular malreduction, femoral head AVN, and AVN of the acetabulum.[3]

The CHP is a surgical intervention that combines the principles of acute THA and ORIF, with the objective of providing a comprehensive solution to acetabular fractures that are deemed to have a poor prognosis. The primary benefits of this approach include the facilitation of expeditious post-operative mobilization, the initiation of rehabilitation processes in a more timely manner, and the circumvention of the necessity for further major revision surgery. However, challenges associated with CHP include high transfusion rates, prolonged anesthesia times, and technical difficulties.[29] CHP is a complex intervention that can result in significant complications and may be challenging even for experienced surgeons. In treating acute acetabular fractures, one disadvantage of using THR is the difficulty in achieving adequate stability of the acetabular fracture to minimize the risk of aseptic cup loosening.[8] Consequently, some authors advocate the use of cable fixation[8,30] or plates and screws[29] to ensure adequate implant stability. This study evaluated the outcomes of fixation methods used during CHP and determined the most suitable option for patients.

Despite the elevated risk of complications, including wound infection, soft tissue scarring, HO, and iatrogenic sciatic nerve injury, acute THA has been demonstrated to yield superior outcomes in comparison to delayed THA performed after ORIF.[5,17,31] Studies comparing ORIF and CHP applications have demonstrated that CHP provides enhanced outcomes, improved HHSs, and reduced reoperation rates in comparison to ORIF alone. However, patients undergoing CHP have reported experiencing more post-operative physical pain.[32]

Table 3. Negative outcome predictors following fixation for acetabular fractures[28]

Related to Injury	Related to surgery
Age over 40 years	Non-anatomic reduction
Anterior dislocation	Post-operative acetabular roof incongruence
Femur head cartilage loss (full thickness)	Use of extended iliofemoral approach
Posterior wall involvement	
Marginal impaction (40% acetabular cartilage)	
Initial displacement >20 mm	

In the present study, no statistically significant differences were observed between the groups with regard to age and BMI. Similarly, no significant differences were found between the groups with respect to operative time, hospital stay, and follow-up duration. In addition, no statistically significant differences were identified between the groups in functional assessments, including the HHS, PMA, and mobility score, in patients undergoing the CHP. This finding suggests that functional outcomes may be similar regardless of the method used, provided a stable hip is achieved.

In the present study, the single-incision technique was favored over the double-incision method on the grounds of its ability to reduce operative times, minimize blood loss, and decrease the necessity for transfusions.[17,33] The mean operative time for surgeries conducted using the single-incision technique was 157 min/patient, which is comparable to the operative times reported in similar CHP cases in the literature, ranging from 159 to 232 min.[34] The average follow-up period in our study was 53 months, which closely resembles the average reported in the literature (53.7 months).

The present study's limited number of patients precluded the execution of statistically significant comparisons between fixation methods, which is considered a significant limitation of the research. However, the data obtained provide valuable insights into the technique's effectiveness.

A comparison of the results of the present study with those from other research indicates that HHS for functional outcomes was found to be 85.5 in the present study, in comparison to reported values of 87 for acute THA, 86.7 for delayed THA, 85.3 for CHP, and 81.7 for ORIF alone. With regard to mobility rates, acute THA was reported at 74%, delayed THA at 77%, and our study observed a mobility rate of 86%. Meta-analyses examining complication rates reported ranges of 0–59% (20.1%) for acute THA, 0–25% (13.8%) for delayed THA, 0–36.8% (12.2%) for CHP, and 6.5–74% (50.3%) for ORIF alone. The complication rate of 26.3% observed in the present study is consistent with the reported range but exceeds the mean for analogous acute THA procedures. It is noteworthy that the complication rate associated with CHP remains high. With regard to HO rates, a meta-analysis reported 51% for acute THA and 59.3% for delayed THA, while another meta-analysis indicated 20% for acute THA and 24% for delayed THA. The overall HO rate in this study was 61%. The highest incidence of HO was observed in patients treated with plate-combined procedures, while the lowest incidence was observed in those treated with cable-combined procedures, suggesting that HO tends to occur at high rates following these surgical interventions. The observed variations in HO rates may be attributed to differences in acetabular fracture types, injury severity, and surgical approaches. Revision rates in this study were 7%, compared to reported rates of 4.3% for acute THA, 17.1% for delayed THA, and 8.4% for CHP. Meta-analyses of mortality rates reported values of 17.9% for acute THA, 10.8% for delayed THA, and 11.9% for CHP. The mortality rate of 8.7% observed in the present study is consistent with the findings reported in the extant literature.[5,17,18,34] A comparative analysis of the results obtained in the present study with those reported in the literature reveals that similar outcomes are generally observed. Mears et al.[8] recently reported the 8-year outcomes of 57 patients treated with ORIF and primary THA using cementless acetabular components. The study reported an average HHS of 89 and concluded that acute THA is a promising treatment option for selected acetabular fracture cases.

In the present study, 31% of patients underwent surgery for elementary fractures, while 69% were treated for complex fractures. A review study reported that among patients undergoing acute THA, 43% had elementary fractures and 57% had complex fractures.[34] However, this does not imply that THA is appropriate for elementary fractures. The decision to perform THA should be based on a careful evaluation of appropriate indications and negative predictors.

A further limitation of the present study is the inclusion of patients in younger age groups, despite the fact that this decision was taken on the basis of suitable indications, as previously mentioned. The literature generally indicates that THA is more frequently preferred in older patients, although some studies have reported its use in younger populations.

The present study is subject to several limitations. First, it is retrospective in design, which relies on the accuracy of medical records. Second, more extended follow-up periods are required to assess the long-term survival of hip arthroplasties. Third, the limited number of patients included in the study restricts the generalizability of the results.[35-37]

The CHP procedure carries significant risks, including high complication rates, HO, revision surgery, and mortality, even for experienced surgeons. Therefore, the CHP procedure should be approached with caution, and a thorough pre-operative evaluation and patient preparation are essential to ensure optimal outcomes.

CONCLUSION

This study provides valuable insights into the management of acetabular fractures requiring acute THA. The findings emphasize the paramount importance of achieving stable fixation, irrespective of the method employed, as the primary determinant of clinical and functional outcomes. The investigation encompassed a range of fixation techniques, including cables, plates, and screws, and revealed no statistically significant disparities in post-operative functional scores, complication rates, or radiological outcomes. However, certain trends, such as the lower rates of HO observed with cable fixation and the higher mobility rates seen in plate fixation, require further investigation.

Despite the relatively high complication rate (26.3%) and the presence of HO in 61% of cases, the overall outcomes were satisfactory. The mean HHS of 85.5 and a mobility rate of 86% are consistent with findings from analogous studies, underlining the feasibility of acute THA as a treatment option.

However, the retrospective design and limited sample size of the study restrict the generalizability of the findings. Future research should aim to validate these results through larger, prospective studies and explore the long-term durability of the implants used in these procedures. Furthermore, the choice of fixation method should be tailored to patient-specific factors, such as bone quality and fracture complexity, to enhance outcomes and reduce complications.

In conclusion, acute THA represents a promising treatment option for selected acetabular fractures, particularly in cases where ORIF alone may not provide adequate stability or satisfactory functional outcomes. The decision to adopt this approach should be informed by meticulous patient selection, meticulous surgical planning, and consideration of individual patient needs. This study contributes to the growing body of evidence supporting acute THA as a viable and effective strategy for managing complex acetabular fractures.

DECLARATIONS

Ethics Committee Approval: The study was approved by Uludağ University Faculty of Medicine Clinical Research Ethics Committee Ethics Committee (No: 2018-13/23, Date: 16/07/2018).

Author Contributions: Concept – M.S.B., K.D.; Design – M.S.B., K.D.; Supervision – M.S.B., K.D.; Fundings – E.İ; Materials – E.İ.; Data collection &/or processing – E.İ., K.D.; Analysis and/or interpretation – E.İ., A.E.Y., K.D.; Literature search – E.İ., A.E.Y.; Writing – E.İ., A.E.Y.; Critical review – E.İ., A.E.Y., M.S.B., K.D.

Conflict of Interest: The authors declare that there is no conflict of interest.

Use of AI for Writing Assistance: Our study did not use artificial intelligence (AI)-assisted technologies (such as Large Language Models [LLMs], chatbots or image generators, ChatGPT).

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REFERENCES

1. Mears DC, Velyvis JH. Primary total hip arthroplasty after acetabular fracture. Instr Course Lect 2001;50:335–54.
2. Letournel E, Johnson EE. The treatment of acetabular fractures through the ilioinguinal approach. Clin Orthop Relat Res 1993;292:62–76.
3. Giannoudis PV, Grotz MR, Papakostidis C, Dinopoulos H. Operative treatment of displaced fractures of the acetabulum. A meta-analysis. J Bone Joint Surg Br 2005;87:2–9.
4. O'Toole RV, Hui E, Chandra A, Nascone JW. How often does open reduction and internal fixation of geriatric acetabular fractures lead to hip arthroplasty? J Orthop Trauma 2014;28:148–53.
5. Liang K, Gani MH, Griffin X, Culpan P, Mukabeta T, Bates P. Acute versus delayed total hip arthroplasty after acetabular fracture fixation: A systematic review and meta-analysis. Eur J Orthop Surg Traumatol 2023;33:2683–93.
6. Ferguson TA, Patel R, Bhandari M, Matta JM. Fractures of the acetabulum in patients aged 60 years and older: An epidemiological and radiological study. J Bone Joint Surg Br 2010;92:250–7.
7. Bhandari M, Matta J, Ferguson T, Matthys G. Predictors of clinical and radiological outcome in patients with fractures of the acetabulum and concomitant posterior dislocation of the hip. J Bone Joint Surg Br 2006;88:1618–24.
8. Mears DC, Velyvis JH. Acute total hip arthroplasty for selected displaced acetabular fractures: Two to twelve-year results. J Bone Joint Surg Am 2002;84:1–9.
9. Anglen JO, Burd TA, Hendricks KJ, Harrison P. The "Gull Sign": A harbinger of failure for internal fixation of geriatric acetabular fractures. J Orthop Trauma 2003;17:625–34.
10. Kreder HJ, Rozen N, Borkhoff CM, Laflamme YG, McKee MD, Schemitsch EH, et al. Determinants of functional outcome after simple and complex acetabular fractures involving the posterior wall. J Bone Joint Surg Br 2006;88:776–82.
11. Mears DC, Velyvis JH, Chang CP. Displaced acetabular fractures managed operatively: Indicators of outcome. Clin Orthop Relat Res 2003;173–86.
12. Mears DC. Surgical treatment of acetabular fractures in elderly patients with osteoporotic bone. J Am Acad Orthop Surg 1999;7:128–41.
13. Hepple S, Ward A. Early outcome of acute total hip arthroplasty following acetabular fracture. Orthop Procs 2003;85:98.
14. Pagenkopf E, Grose A, Partal G, Helfet DL. Acetabular fractures in the elderly: Treatment recommendations. HSS J 2006;2:161–71.

15. Sermon A, Broos P, Vanderschot P. Total hip replacement for acetabular fractures. Results in 121 patients operated between 1983 and 2003. Injury 2008;39:914–21.
16. Tidermark J, Blomfeldt R, Ponzer S, Söderqvist A, Törnkvist H. Primary total hip arthroplasty with a Burch-Schneider antiprotrusion cage and autologous bone grafting for acetabular fractures in elderly patients. J Orthop Trauma 2003;17:193–7.
17. Hamlin K, Lazaraviciute G, Koullouros M, Chouari T, Stevenson IM, Hamilton SW. Should total hip arthroplasty be performed acutely in the treatment of acetabular fractures in elderly or used as a salvage procedure only? Indian J Orthop 2017;51:421–33.
18. Jauregui JJ, Weir TB, Chen JF, Johnson AJ, Sardesai NR, Maheshwari AV, et al. Acute total hip arthroplasty for older patients with acetabular fractures: A meta-analysis. J Clin Orthop Trauma 2020;11:976–82.
19. Kang CS, Min BW. Cable fixation in displaced fractures of the acetabulum: 21 patients followed for 2-8 years. Acta Orthop Scand 2002;73:619–24.
20. Saxer F, Studer P, Jakob M. Open stabilization and primary hip arthroplasty in geriatric patients with acetabular fractures: Combination of minimally invasive techniques. Unfallchirurg [Article in German] 2011;114:1122–7.
21. Boraiah S, Ragsdale M, Achor T, Zelicof S, Asprinio DE. Open reduction internal fixation and primary total hip arthroplasty of selected acetabular fractures. J Orthop Trauma 2009;23:243–8.
22. Callaghan JJ, Dysart SH, Savory CG. The uncemented porous-coated anatomic total hip prosthesis. Two-year results of a prospective consecutive series. J Bone Joint Surg Am 1988;70:337–46.
23. DeLee JG, Charnley J. Radiological demarcation of cemented sockets in total hip replacement. Clin Orthop Relat Res 1976;20–32.
24. Gruen TA, McNeice GM, Amstutz HC. "Modes of failure" of cemented stem-type femoral components: A radiographic analysis of loosening. Clin Orthop Relat Res 1979;17–27.
25. Engh CA, Bobyn JD, Glassman AH. Porous-coated hip replacement. The factors governing bone ingrowth, stress shielding, and clinical results. J Bone Joint Surg Br 1987;69:45–55.
26. Berli BJ, Schäfer D, Morscher EW. Ten-year survival of the MS-30 matt-surfaced cemented stem. J Bone Joint Surg Br 2005;87:928–33.
27. Salar N, Bilgen MS, Bilgen ÖF, Ermutlu C, Eken G, Durak K. Total hip arthroplasty for acetabular fractures: "Early Application". Ulus Travma Acil Cerrahi Derg 2017;23:337–42.
28. Tannast M, Najibi S, Matta JM. Two to twenty-year survivorship of the hip in 810 patients with operatively treated acetabular fractures. J Bone Joint Surg Am 2012;94:1559–67.
29. Herscovici D Jr, Lindvall E, Bolhofner B, Scaduto JM. The combined hip procedure: Open reduction internal fixation combined with total hip arthroplasty for the management of acetabular fractures in the elderly. J Orthop Trauma 2010;24:291–6.
30. Mouhsine E, Garofalo R, Borens O, Blanc CH, Wettstein M, Leyvraz PF. Cable fixation and early total hip arthroplasty in the treatment of acetabular fractures in elderly patients. J Arthroplasty 2004;19:344–8.
31. Nicol GM, Sanders EB, Kim PR, Beaulé PE, Gofton WT, Grammatopoulos G. Outcomes of total hip arthroplasty after acetabular open reduction and internal fixation in the elderly-acute vs delayed total hip arthroplasty. J Arthroplasty 2021;36:605–11.
32. Tu TY, Chen CY, Lin PC, Hsu CY, Lin KC. Comparison of primary total hip arthroplasty with limited open reduction and internal fixation vs open reduction and internal fixation for geriatric acetabular fractures: A systematic review and meta-analysis. EFORT Open Rev 2023;8:532–47.
33. Lannes X, Moerenhout K, Duong HP, Borens O, Steinmetz S. Outcomes of combined hip procedure with dual mobility cup versus osteosynthesis for acetabular fractures in elderly patients: A retrospective observational cohort study of fifty one patients. Int Orthop 2020;44:2131–8.
34. Jauregui JJ, Clayton A, Kapadia BH, Cherian JJ, Issa K, Mont MA. Total hip arthroplasty for acute acetabular fractures: A review of the literature. Expert Rev Med Devices 2015;12:287–95.
35. Malhotra R, Gautam D. Acute total hip arthroplasty in acetabular fractures using modern porous metal cup. J Orthop Surg (Hong Kong) 2019;27:2309499019855438.
36. Yang SH, Zhang YK, Xu WH, Li J, Liu GH, Yang C, et al. Early total hip arthroplasty for severe displaced acetabular fractures. Chin J Traumatol 2006;9:329–33.
37. Wang ZM, Sun HZ, Wang AM, DU QY, Wu SY, Zhao YF, et al. Primary total hip arthroplasty for acetabular fracture. Chin J Traumatol 2006;9:341–4.