



Assessing the Outcomes of Displaced Acetabular Fracture Management Using A Single Non-Extensile Surgical Approach

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ABSTRACT

Background: Displaced acetabular fractures are complex injuries that significantly impact hip function and quality of life, often requiring surgical intervention to restore stability and mobility. Traditional surgical approaches can lead to complications and prolonged recovery, prompting the exploration of less invasive techniques.

Objective: This study aims to evaluate the efficacy and safety of a single non-extensile surgical approach for managing displaced acetabular fractures, assessing clinical and radiological outcomes.

Methods: An observational and prospective study was conducted involving 30 patients with displaced acetabular fractures treated at a tertiary care hospital in eastern India from February 2023 to February 2024. Patients underwent open reduction and internal fixation using standard non-extensile techniques, with outcomes evaluated through clinical grading and radiological assessments over a minimum follow-up of six months.

Result: Of the 30 patients, clinical outcomes were categorized as excellent (23.33%), good (60%), fair (10%), and poor (6.67%). Associated injuries significantly correlated with poorer outcomes ($p = 0.009$). Radiological findings indicated that comminution and intra-articular fragments were significant predictors of poorer outcomes ($p = 0.0009$ and $p = 0.023$, respectively). The posterior surgical approach yielded better outcomes compared to the anterior approach, and shorter surgery duration was associated with improved results.

Conclusion: The study highlights that while demographic factors like age and sex do not significantly affect outcomes, associated injuries and specific radiological findings are critical determinants of clinical success. The posterior approach and reduced surgery duration are linked to better outcomes, emphasizing the potential benefits of a non-extensile surgical strategy in managing displaced acetabular fractures.

Keywords: Displaced acetabular fractures, non-extensile surgical approach, clinical outcomes, radiological outcomes.

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INTRODUCTION

Displaced acetabular fractures represent one of the most formidable challenges in orthopaedic trauma management. The acetabulum serves as a critical anatomical component of the hip joint, facilitating mobility and weight-bearing activities. When fractured, it can significantly compromise both functionality and quality of life.¹

Surgical intervention remains the cornerstone of management for these complex injuries, with the primary objective being the restoration of articular congruity, stability, and subsequently, hip function. However, the management of displaced acetabular fractures has evolved over the years, with various surgical approaches developed to enhance outcomes while minimizing complications.²

Thus, the present study aims to critically assess the efficacy and safety of a single non-extensile surgical strategy in the treatment of these challenging fractures.

Acetabular fractures typically occur from high-energy trauma, such as motor vehicle accidents or falls from height, and are frequently associated with other orthopaedic injuries, particularly in polytrauma patients.³ The management of these fractures is challenging due to the critical role the acetabulum plays in hip stability and function. Traditional surgical techniques often require extensile approaches, which not only yield considerable soft tissue dissection but also carry a heightened risk for complications, including nerve injuries, hematomas, and prolonged recovery periods. Furthermore, these extensile approaches may lead to joint stiffness and suboptimal recovery of hip function.⁴

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In contrast, a non-extensile surgical approach seeks to minimize soft tissue disruption while providing adequate exposure for fracture fixation. The rationale for adopting a single non-extensile approach is grounded in principles of minimizing surgical trauma, preserving periosteal blood supply, and ultimately enhancing postoperative functional outcomes. Preliminary studies suggest that this strategy may lead to reduced complication rates and shorter rehabilitation periods. However, rigorous evaluations comparing this technique with traditional methods are scarce in the literature.⁵

The findings from this study have the potential to substantially impact clinical practice. If it can be demonstrated that a single non-extensile approach is associated with superior outcomes in terms of complication rates, postoperative recovery, and functional results, it may prompt a paradigm shift in the management of displaced acetabular fractures. A shift towards less invasive surgical techniques would not only minimize patient morbidity but could also optimize resource utilization and enhance overall healthcare delivery.⁶

Moreover, generating robust data on the efficacy and safety of such an approach can inform clinical guidelines and enhance training programs for orthopedic surgeons. As medical professionals continually strive to adopt evidence-based practices, the results of this study can contribute to a growing body of literature aimed at refining surgical interventions for one of the most intricate fractures encountered in orthopedic trauma.⁷

By systematically evaluating the efficacy, safety, and cost-effectiveness of this innovative approach, the research aimed to elucidate the potential benefits associated with reduced soft tissue disruption and enhanced functional outcomes. In doing so, it is anticipated to provide crucial insights that could lead to refining treatment algorithms, improving patient outcomes, and ultimately promoting more effective and humane care for individuals suffering from displaced acetabular fractures. The main aim of this study is to assess the outcomes of operative management for displaced acetabular fractures using a single, non-extensile surgical approach.

MATERIALS AND METHODS

This observational and prospective study involved patients who had acetabular fractures who presented to the orthopedics department of a tertiary care hospital of eastern India. These patients had comprehensive history-taking as well as examination, as well as conventional X-ray as well as CT scanning. Radiologically confirmed instances of displaced acetabular fractures were incorporated from February 2023 to February 2024 and underwent open reduction with internal fixation via “standard single non-extensile surgical techniques”. The study encompassed a total of 30 patients. The cases were examined prospectively, with a minimum follow-up duration of six months. We aimed to assess the clinical and radiological outcomes of these treatments using established “clinical and radiological grading systems”.

Inclusion Criteria: The inclusion criteria for this study consist of patients having displaced acetabular fractures impacting the superior weight-bearing dome, resulting in “hip instability or joint incongruity”. Furthermore, these fractures must have transpired within three weeks

preceding the study’s beginning, and the patients must be medically appropriate for participation.

Exclusion Criteria: The exclusion criteria for this study include patients with un-displaced or minimally displaced acetabular fractures, as well as fractures involving the non-weight-bearing dome of the acetabulum that do not compromise hip joint stability, such as “small posterior wall fractures, low infra-tectal transverse fractures, and low anterior column fractures”. Additionally, patients presenting more than three weeks post-injury and those with severe systemic illnesses are excluded from the study.

Initially, the patients were treated in accordance with the ATLS protocol at the emergency room, and once their vital signs were stabilized, a comprehensive history along with examination were conducted.¹⁹ A comprehensive radiological assessment was conducted with prior radiographic images including a CT scan including 2D reconstructions. The condition of the acetabulum was assessed radiographically using “anteroposterior, obturator oblique, and iliac oblique views.”

Radiological assessment was conducted on factors such as “fracture displacement, comminution, concomitant chondral injury to the femur head or acetabulum, peripheral impaction, intra-articular fragments, and femoral head lesions.” “Judet and Letournel’s classification” has been used for the categorization of fractures.²⁰

Patients underwent surgery by “the Kocher-Langenbeck, Iliioinguinal, or Iliofemoral approach,” depending on the fracture kinds.²¹ The intra-operative observations observed in various procedures included: “1) intra-operative blood loss, 2) time of surgery, 3) any vascular injury, 4) marginal impaction of the posterior wall, 5) related chondral damage to the femoral head, 6) comminution, and 7) intra-articular fragmentation”.

The radiographic outcome was evaluated using “the Modified Radiological Reduction Criteria of Matta *et al.*”^{9,10} based on immediate post-operative plain radiographs from 3 conventional views: “anteroposterior, obturator oblique, and iliac oblique.” The results were designated as:

Table 1: Radiographic outcome classification and displacement.

Classification	Displacement
Anatomical	0 to 1 mm
Imperfect	2 to 3 mm
Poor	Greater than 3 mm

The functional outcome was evaluated at 6 months using the clinical grading criteria established by “Modified Merle d’Aubigne and Postel,” which encompasses three parameters: “pain, ambulation, and range of motion.” The grading scale is as follows:

Statistical Analysis: The data was inputted into an MS Excel 2021, and analysis was conducted utilizing Graph Pad version 8.43. Categorical data were analyzed for correlation using the Chi-Square test or Fisher’s exact test. A *p-value* of less than 0.05 was deemed statistically significant.

Table 2: Functional outcome classification with score.

Classification	Score
Excellent	18
Good	15-17
Fair	13-14
Poor	< 13

OBSERVATIONS & RESULTS

Out of 30 patients recruited in our study, 7 cases had excellent clinical outcome, 18 with good, 3 with fair and 2 with poor clinical outcomes.

Age and sex did not significantly affect clinical outcomes, with *p-values* greater than 0.99 and 0.30, respectively. The mode of injury also showed no significant impact ($p = 0.63$). However, associated injuries were significantly related to poorer outcomes ($p = 0.009$), with all patients having associated injuries falling into the fair or poor outcome categories. Hip dislocation did not show a significant correlation with clinical outcomes ($p = 0.36$). Overall, the presence of associated injuries was the most significant factor influencing poorer clinical outcomes.

Quadrilateral plate involvement did not significantly affect outcomes ($p = 0.30$). However, comminution was significantly associated with

poorer outcomes ($p = 0.0009$), with 40% of cases in both fair and poor categories. Marginal impaction and intra-articular fragments also showed notable associations, with *p-values* of 0.17 and 0.023, respectively, indicating a trend towards poorer outcomes. Head lesions did not significantly impact outcomes ($p > 0.99$). Overall, comminution and intra-articular fragments were the most significant radiological factors influencing poorer clinical outcomes.

The posterior surgical approach was associated with better outcomes, with 71.43% of patients achieving excellent results compared to 28.57% for the anterior approach. Conversely, the anterior approach had a higher percentage of poor outcomes (100%). The duration of surgery also influenced outcomes; surgeries lasting 2-3 hours were associated with better results, with 85.71% of patients achieving excellent outcomes, while surgeries lasting 3 or more hours had a higher percentage of poor outcomes (100%).

The absence of complications was associated with better outcomes, though not statistically significant ($p = 0.13$). Hardware complications and marginal impaction showed no significant impact on outcomes ($p = 0.17$). However, nerve injuries were significantly associated with poorer outcomes ($p < 0.0001$), with 60% of cases in the fair category and 40% in the poor category. Loss of reduction and surgical site infections also showed significant associations with poorer outcomes, with *p-values* of 0.023 and 0.0025, respectively. Overall, nerve injuries, loss of reduction, and surgical site infections were the most significant factors influencing poorer clinical outcomes.

Table 3: Comparison of baseline demographic and clinical variables with respect to clinical outcome.

Parameter	Category	Clinical Outcome (%)					P-Value*
		Excellent (n=7)	Good (n=18)	Fair (n=3)	Poor (n=2)	Total	
Age	≤ 30 Years	4 (57.14)	8 (44.44)	2 (66.67)	0	14 (46.67)	>0.99
	> 30 Years	3 (42.86)	10 (55.56)	1 (33.33)	2 (100.0)	16 (53.33)	
Sex	Female	1 (14.29)	6 (33.33)	1 (33.33)	2 (100.0)	10 (33.33)	0.30
	Male	6 (85.71)	12 (66.67)	2 (66.67)	0	20 (66.67)	
Mode of Injury	R. T. A	3 (42.86)	12 (66.67)	2 (66.67)	2 (100.0)	19 (63.33)	0.63
	Fall from height	4 (57.14)	6 (33.33)	1 (33.33)	0	11 (36.67)	
Associated Injury	Yes	1 (14.29)	7 (38.89)	3 (100.0)	2 (100.0)	13 (43.33)	0.009
	No	6 (85.71)	11 (61.11)	0	0	17 (56.67)	
Hip Dislocation	Yes	2 (28.57)	7 (38.89)	1 (33.33)	2 (100.0)	12 (40)	0.36
	No	5 (71.43)	11 (61.11)	2 (66.67)	0	18 (60)	

*Fisher's Exact Test (Excellent + Good vs Fair + Poor)

Table 4: Comparison of radiological findings with clinical outcome.

X-Ray and CT Findings		Excellent	Good	Fair	Poor	Total	P-Value*
Quadrilateral Plate	Frequency	0	7	2	1	10	0.30
	%	0.00	70.00	20.00	10.00		
# Communion	Frequency	0	1	2	2	5	0.0009
	%	0.00%	20.00%	40.00%	40.00%		
Marginal Impaction	Frequency	0	0	0	1	1	0.17
	%	0.00%	0.00%	0.00%	100.0%		
Intra articular Fragment	Frequency	0	0	1	1	2	0.023
	%	0.00%	0.00%	50.00%	50.00%		
Head Lesion	Frequency	0	1	0	0	1	>0.99
	%	0.00%	100.0%	0.00%	0.00%		

*Fisher's Exact Test (Excellent + Good vs Fair + Poor)

Table 5: Comparison of surgical factors with respect to clinical outcome.

Parameter	Category	Clinical Outcome (%)					P-Value*
		Excellent (n=7)	Good (n=18)	Fair (n=3)	Poor (n=2)	Total (n=30)	
Surgical Approach	Anterior	2 (28.57)	7 (38.89)	2 (66.67)	2 (100)	13 (43.33)	0.14
	Posterior	5 (71.43)	11 (61.11)	1 (33.33)	0 (0.00)	17 (56.67)	
Duration of Surgery	2- 3 hours	6 (85.71)	10 (55.56)	2 (66.67)	0 (0.00)	18 (60)	0.36
	≥ 3 hours	1 (14.29)	8 (44.44)	1 (33.33)	2 (100)	12 (40)	

*Fisher's Exact Test (Excellent + Good vs Fair + Poor)

Table 6: Comparison of incidence of complications with clinical outcome.

Complications		Excellent	Good	Fair	Poor	Total	P value*
Absent	Frequency	5	12	1	0	18	0.13
	%	28.57%	64.29%	7.14%	0.00%		
Hardware complication	Frequency	0	0	0	1	1	0.17
	%	0.00%	0.00%	0.00%	100.0%		
Nerve Injury	Frequency	0	0	3	2	5	<0.0001
	%	0.00%	0.00%	60%	40%		
Loss of reduction	Frequency	0	0	0	2	2	0.023
	%	0.00%	0.00%	0.00%	100%		
Surgical site infection	Frequency	0	0	1	2	3	0.0025
	%	0.00%	0.00%	33.33%	66.67%		

*Fisher's Exact Test (Excellent + Good vs Fair + Poor)

Patients with anatomical radiological grades had the best clinical outcomes, with 35% achieving excellent and 65% good outcomes, and none falling into the fair or poor categories (p = 0.0018).

Imperfect radiological grades were mostly associated with good outcomes (71.43%), but also included some fair outcomes (28.57%). Poor radiological grades were strongly linked to poorer clinical

Table 7: Correlation of clinical outcome with radiological outcome.

Radiological Grade		Excellent	Good	Fair	Poor	Total	<i>P-value*</i>
Anatomical	Frequency	7	13	0	0	20	0.0018
	%	35.00%	65.00%	0.00%	0.00%		
Imperfect	Frequency	0	5	2	0	7	
	%	0.00%	71.43%	28.57%	0.00%		
Poor	Frequency	0	0	1	2	3	
	%	0.00%	0.00%	33.33%	66.67%		

*Fisher's Exact Test (Excellent + Good vs Fair + Poor)

outcomes, with 33.33% fair and 66.67% poor outcomes. Overall, better radiological grades were significantly associated with better clinical outcomes.

DISCUSSION

Acetabular fractures continue to pose a significant difficulty for orthopedic surgeons. The intricate anatomy of the pelvis, the deeply located acetabulum, complicated fracture patterns, plus insufficient comprehension of these patterns and expertise are the primary factors contributing to the challenges.

"Open reduction and internal fixation for displaced acetabular fractures (DAF)" has emerged as a standard therapeutic approach over the past thirty years. Various surgical procedures and techniques have been delineated in recent decades, each possessing distinct benefits as well as drawbacks. Our study aims to evaluate the clinical as well as radiological outcomes using established grading systems in patients who underwent surgery for DAF via single non-extensile surgical methods. Our study comprised 30 patients with DAF who received surgical reduction at our hospital. Clinical grading was conducted in accordance with "the modified Merle d'Aubigne & Postel standards" established by Joel M. Matta.^{9,22} The level of pain, ambulation, as well as at the six-month follow-up were utilized for scoring. Each component received a score out of 6. The points were aggregated and the result was evaluated. Our series yielded 7 (23.33%) excellent outcomes, 18 (60.00%) good outcomes, 3 (10.00%) fair outcomes, and 2 (6.67%) poor outcome. Our investigation revealed a substantial relationship between radiological grade with clinical outcome. The results of other studies, such as Brueton *et al.* in 1993, indicated "19% excellent, 42.5% good, 11.5% fair, and 27% poor outcomes".²³ In 1994, Mayo achieved "14% excellent, 61% good, 16% fair, and 9% poor results".²⁴ In 1996, Matta *et al.* achieved "40% excellent, 36% good, 8% average, and 16% poor outcomes".⁹ Our series yielded a total of excellent and good outcomes of 83.33%, which is comparable to the 79.4% reported by Giannoudis *et al.*²⁵

In our research, 19 patients (76.67%) experienced fractures due to road traffic incidents, including injuries from pedestrian strikes. Only 4 patients (19.05%) developed fractures as a result of a fall from height. This figure is favorable when compared to data from other studies, such as the Letournel research, where the majority of fractures resulted from road traffic accidents (RTA).⁸ The proportion of DAF attributed to road traffic accidents (RTA) was recorded as "80% by Mayo, 83% by Matta, and 80% by Giannoudis".^{9,24,25}

Our investigation employed two surgical methodologies. The ilioinguinal route (anterior) was employed in 13 cases (43.33%), whereas the Kocher-Langenbeck technique (posterior) was utilized in 17 cases (56.67%). The technique employed was determined by the fracture pattern.⁹

Giannoudis *et al.* (2005) conducted a meta-analysis indicating that the Kocher-Langenbeck technique was utilized in 48.7% of patients, which was similar to our study.²⁵ There were 3 cases (10.0%) of superficial STI one of which involved a diabetic patient whose blood sugar was managed by initiating insulin on a sliding scale. Both infections resolved by the 14th postoperative day with serial wound dressings. Giannoudis *et al.* (2005) found a 4.4% incidence of local infection among 3,670 fractures, a finding corroborated by N. Briffa *et al.* (2011), who saw a 5.6% rate in his patient cohort.^{25,26} Hypoesthesia was observed in the course of the lateral cutaneous nerve of the thigh in 2 patients treated using the anterior (ilioinguinal) approach. T.A. El Khadrawe *et al.* (2011) observed lateral cutaneous nerve palsy in 12.8 percent of patients in their study.²⁷

The reduction was evaluated by measurements taken from anteroposterior and 45° oblique (Judet views) radiographs, following the criteria established by Matta *et al.* in 1996.⁹ In our series, the anatomical reduction was classified as anatomical (0-1mm) in 20 (66.67%) patients, imperfect (1-3mm) in 7 (23.33%) patients, and poor (>3mm) in 3 (10%) patients. Our findings are analogous to those of the study conducted by Matta *et al.* in 1996.⁹ In his research, anatomical outcomes were observed in 71% of patients, with 22% exhibiting unsatisfactory results and 7% demonstrating bad outcomes. Suboptimal outcomes were observed in patients exhibiting a "postoperative 4 mm articular step," with one patient experiencing loss of reduction during future follow-up. Our series demonstrated a substantial association among the radiological grade with the clinical outcome (*p*-value 0.0018).

One possible limitation of the study "Assessment of the Outcomes of Displaced Acetabular Fracture Management Using a Single Non-Extensile Surgical Approach" is the potential for selection bias. Since the study focuses on a single surgical approach, it may not account for variations in patient outcomes that could arise from different surgical techniques or approaches. Additionally, the study's findings might be influenced by the specific expertise and experience of the surgeons performing the procedure, which may not be generalizable to all clinical settings. The relatively narrow scope of the study could also limit its applicability to a broader patient population with diverse fracture patterns and comorbidities.

CONCLUSION

The study reveals several key factors influencing clinical outcomes. Demographic variables like age and sex, and the mode of injury, did not significantly impact outcomes. However, associated injuries were strongly linked to poorer outcomes. Radiological findings showed that comminution and intra-articular fragments were significant predictors of poorer outcomes. Surgical factors indicated that the posterior approach and shorter surgery duration were associated with better outcomes. Complications such as nerve injuries, loss of reduction, and surgical site infections were significantly correlated with poorer outcomes. Finally, better radiological grades were significantly associated with better clinical outcomes. Overall, the presence of associated injuries, specific radiological findings, surgical approach, duration, and complications were critical determinants of clinical outcomes. The implications of this study extend beyond improving clinical practices; they pave the way for future research aimed at optimizing the management of complex orthopedic injuries in an increasingly challenging healthcare landscape.

REFERENCES

- Hesp WL, Goris RJ. Conservative treatment of fractures of the acetabulum. Results after longtime follow up. *Acta Chir Belg*.1988; 88(1):27-32 p.
- Ragnarsson B, Jacobsson B. Epidemiology of pelvic fractures in a Swedish county. *Acta Orthop Scand*.1992; 63(3):297-300.
- Vaan Veen IHPA, Van Leeuwen AAN, Van Popta T, Van Luyt PA, Bode PJ, Van Vugt AB. Unstable pelvic fractures: a retrospective analysis. *Injury*.1995; 26(2):81-85.
- Schroeder WE. Fracture of the acetabulum with displacement of the femoral head into the pelvic cavity (Central dislocation of Femur). *Bulletin of the North Western Medical School*.1909:9-42.
- Knight RA, Smith H. Central fractures of the acetabulum. *J Bone Joint Surg Am* 1958; 40A:1-120.
- Rowe CR, Lowell JD. Prognosis of fractures of the acetabulum. *J Bone Joint Surg Am* 1961; 43A: 30-59.
- Stewart MJ. Discussion of prognosis of fractures of the acetabulum. *J Bone Joint Surg Am* 1961; 43A:59.
- Letournel E, Judet R. Fractures of the Acetabulum. 2nd Ed. New York: Springer-verlag, 1993: 565-581.
- Matta JM. Fractures of the acetabulum: accuracy of reduction and clinical results patients managed operatively within three weeks after the injury. *J Bone Joint Surg Am* 1996;78A:1632-1645.
- Matta JM, Anderson LM, Epstein HC, et al. Fractures of the acetabulum. A retrospective analysis. *Clin OrthopRelat Res*.1986; 205:230-240.
- Matta JM, Merritt PO. Displaced acetabular fractures. *Clin Orthop*. 1988; 230:83-97.
- Chang JK, Gill SS, Zura RD, et al. Comparative strength of three methods of fixation of transverse acetabular fractures. *Clin Orthop* 2001; 392: 433-441.
- Pohlemann T, Culemann U. Summary of controversial debates during the 5th "Homburg Pelvic Course" 13-15 September 2006. *Injury* 2007;38(4):424-30.
- Letournel E. Acetabulum fractures: classification and management. *Clin OrthopRelat Res* 1980;151:81-106.
- Mayr E, Braun W, Kogl F, Ruter A. Approach-related results following acetabular fractures. *Der Orthopade* 1997;26(4):384-93.
- Zeichen J, Pohlemann T, Gansslen A, Lobenhoffer P, Tschern H. Results of follow-up of surgical treatment of complicated acetabulum fractures with extended approaches. *Unfallchirurg* 1995;98(7):361-8.
- Ellis TJ, Beck M. Trochanteric osteotomy for acetabular fractures and proximal femur fractures. *Orthop Clin North Am* 2004;35(4):457-61.
- Hoffmann R, Stockle U, Nittinger M, Su`dkamp NP, Haas NP. Operative treatment of complex acetabular fractures through the modified extensile iliofemoral approach. *Unfallchirurg* 2000;103(1):12-21.
- James D, Pennardt AM. Trauma Care Principles. [Updated 2023 May 31]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK547757/>
- Alton TB, Gee AO. Classifications in brief: Letournel classification for acetabular fractures. *Clin OrthopRelat Res*. 2014 Jan;472(1):35-8. doi: 10.1007/s11999-013-3375-y. Epub 2013 Nov 9. PMID: 24214824; PMCID: PMC3889427.
- Gänsslen A, Grechenig S, Nerlich M, Müller M. Standard Approaches to the Acetabulum Part 1: Kocher-Langenbeck Approach. *Acta ChirOrthop Traumatol Cech*. 2016;83(3):141-6. English. PMID: 27484070.
- Ugino FK, Righetti CM, Alves DP, Guimarães RP, Honda EK, Ono NK. Evaluation of the reliability of the modified Merle d'Aubigné and Postel Method. *Acta Ortop Bras*. 2012;20(4):213-7. doi: 10.1590/S1413-78522012000400004. PMID: 24453605; PMCID: PMC3718401.
- Brueton RN. A review of 40 acetabular fractures: the importance of early surgery. *Injury*.1993;24:171-174.
- Mayo KA. Open reduction and internal fixation of fractures of the acetabulum. Results in 163 fractures. *Clin OrthopRelat Res*.1994 Aug;(305):31-7.
- Giannoudis PV, Grotz MRW, Papakostidis C, Dinopoulos H. Operative treatment of displaced acetabular fractures- A meta-analysis. *J Bone Joint Surg(Br)*.2005;87B:2-9.
- Briffa N, Pearce R, Hill AM, Bircher M. Outcomes of acetabular fracture fixation with ten years' follow-up. *J Bone Joint Surg Br*.2011 Feb;93(2):229-36.
- El-khadrawe TA, Hammad AS, Hassaan AE. Indicators of outcome after internal fixation of complex acetabular fractures. *Alexandria J Med*.2012;48:99-107.