(International Print/Online Journal)

SJIF IMPACT FACTOR: 6.829
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 9, Issue 2 , Page No: 515-523
March-April 2026

IJMSCR

Clinical and Radiological Outcome of Modified Stoppa Approach for Surgical Treatment of Acetabular Fracture

[1]Dr Barkha Rani, [2]Dr Anand Kumar Singh*
[1,2]Assistant Professor,
[1]Department of Physiology, [2]Department of Orthopaedics,
BIMSR, Khunti, Jharkhand, India

***Corresponding Author:**
Dr. Anand Kumar Singh
Assistant Professor, Department of Orthopaedics, BIMSR, Khunti, Jharkhand, India

Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Background: We analysed the clinical and radiographic results, and the complications after a minimum 2 years 8 months follow-up of the modified Stoppa approach for the treatment of acetabular fractures, and we attempted to evaluate the efficacy of the operative technique.

Methods: All of the 24 patients, who needed the anterior approach for the treatment of acetabular fractures at our hospital from January 2018 to December 2021, were subjected to surgery via the modified Stoppa approach. Fracture pattern, operative time, blood loss during the operation, quality of reduction, and postoperative complications were assessed by clinical the radiographic examinations. The results after the operation were analyzed based on the criteria of Matta.

Results: Among the 16 patients with anatomical reduction, 14 patients exhibited good and excellent results and 01 patient fair and 01 patient exhibited a poor result. 04 out of the 06 patients with imperfect reduction exhibited good & excellent results while the other 2 patients exhibited poor results. 02 patients with poor reduction exhibited a poor result.

Conclusion: The modified Stoppa approach for the treatment of pelvic and acetabular fractures has advantages of less trauma, adequate and rapid exposure, convenient and effective fracture reduction and fixation, less complications and better postoperative recovery.

Keywords: Acetabulum, Acetabular fracture, Stoppa approach, Matta's system, Harris hip score (HHS)

Introduction

Based on the tremendous work by Emile Letournel and Robert Judet, several limited and extended approaches addressing open reduction and internal fixation of acetabular fractures became standard in the 60ies, 70ies, and 80ies [01,02,03] e.g.:

1. Kocher-Langenbeck approach.
2. ilioinguinal approach.
3. iliofemoral approach.
4. extended iliofemoral approach.

Treatment of acetabular fractures became of increasing relevance since the 1960ies, when Emile Letournel developed a new approach especially to anterior fractures of the acetabulum – the ilioinguinal approach [01, 04, 05]

Especially, the second window offers a different access to the anterior border of the bone from the iliopectineal eminence as far as to the middle of the superior pubic ramus, the middle part of the pelvic brim and digital access to the quadrilateral surface, [01, 02] compared to the Smith-Peterson approach[06] and the iliofemoral approach.[07]

The primary view of the ilioinguinal is from above the iliopectineal line, e.g. the pelvic brim. Thus, the ilioinguinal can be considered as an extrapelvic approach (at the level of the joint).

Acetabular fracture is an intra-articular fracture of the most important weight-bearing joint, the hip joint, and in order to obtain optimal results, accurate anatomic reduction, firm fixation, and early rehabilitation are essential.[08-10] However, the treatment of acetabular fractures is quite difficult not only due to the associated major organ injuries but also due to the complicated fracture type and difficulties in the operative approach for reduction. Marked progress has been made after a systematic approach and treatment algorithm were proposed by Judet et al.[11] and Letournel and Judet[12] in the 1960s.

Until now, diverse surgical approaches have been used for the reduction of acetabular fractures and they are categorized into anterior, posterior, extensile, and combined approaches. The surgeon should become familiar with the technical tips and the advantages and disadvantages of each approach. Currently, the ilioinguinal approach[08] or the modified Stoppa approach[13-14] is used as the anterior approach, and the ilioinguinal approach is used more commonly and its outcomes have been reported more extensively among these two approaches. The modified Stoppa approach is an intrapelvic approach initially used for inguinal hernia surgery by Stoppa et al.[14] and Rives et al.[15] in the early 1990's, and was introduced as the method for approaching the anterior acetabulum and pelvic bone by Cole and Bolhofner[16] and Hirvensalo et al.[17]. Short- and long-term results of acetabular fractures using the modified Stoppa approach have not been reported to any meaningful extent until now. Therefore, we aimed to evaluate the efficacy of the operative technique via the modified Stoppa approach by analyzing the results and the complications of acetabular fractures treated with the modified Stoppa approach. Moreover, we evaluated the effect of comminution of fractures on the final results, considering the recent increase in the frequency of comminuted acetabular fractures along with the increase in the cases of high-energy trauma.

Material And Methods

Study Participants

A total of 60 patients were treated for acetabular fractures at our hospital from January 2018 to December 2021. Among them, 46 cases underwent the operation. The modified Stoppa approach to the anterior pelvis was used in 24 cases, which is the most widely used anterior approach. Patients were followed up at 1 month, 3 months and 6 months, 1 year, 2 years and 4 years.

The average follow-up was 2 years and 8 months. The average age of the patients, including 18 males and 6 females, was 41 years (range, 18 to 68 years). Road traffic accident, in 21 cases (87.5%), was the most frequent cause of injury. The average anaesthesia plus surgery time was 168 minutes (range, 90 to 225 minutes), and the average blood loss was 1,225 mL (range, 450 to 2,580 mL).

Preoperative Assessment and Management

Simple anteroposterior radiographs of the obturator foramen and iliac wing, inlet-outlet views of the pelvis, and computed tomography (CT) images were taken in the emergency room as long as the systemic status of the patients allowed their acquisition.

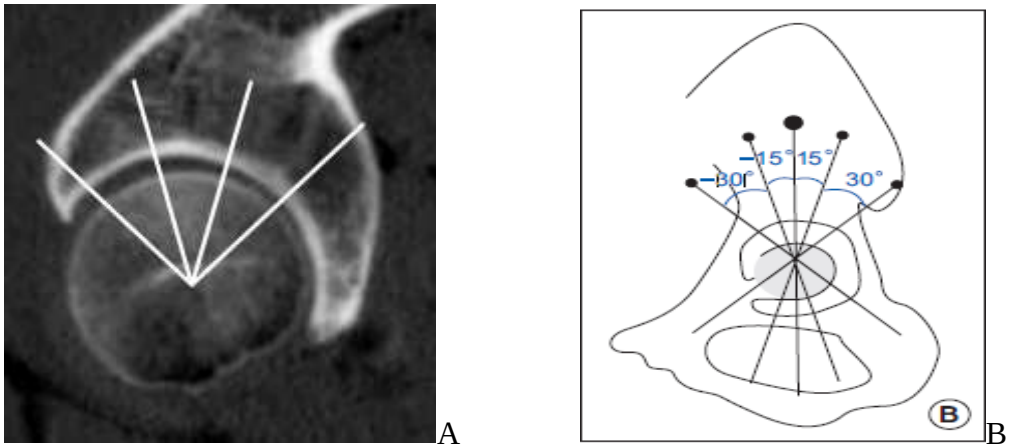
The fracture patterns were categorized into 5 "elementary" and 5 "associated" fracture patterns based on the criteria of Judet et al.[18] There were 05 cases of elementary fractures, which were all anterior column fractures. The remaining 19 cases were associated fractures, including 07 cases of transverse and posterior wall fracture, 04 case of T-shaped fracture, 06 cases of anterior column and posterior hemitransverse fracture, and 02 cases of both-column fractures.

In addition, the fractures were further classified into non-comminuted or comminuted fracture. A comminuted acetabular fracture was defined when 3 or more fracture fragments were identified in the acetabular weight-bearing area on the midsagittal view of CT (Fig. 1).[19] 10 cases were classified as comminuted fractures, and the other 14 cases were classified as non-comminuted fractures.

Skeletal traction was applied prior to the operation in selected cases to reduce the pain or maintain the reduction. Surgical procedure was performed on the average 6th day after injury (range, 1 to 14 days). Preoperatively, systemic conditions and accompanying injuries in the patients were evaluated sufficiently. Surgical indication was displaced fractures through the weight-bearing dome. More specifically, the operation was performed in cases with

Volume 9, Issue 2; March-April 2026; Page No 515-523
© 2026 IJMSCR. All Rights Reserved

free fragment(s) within the joint space, the roof arc angle less than 45°, and displacement more than 2 mm.



A B

Fig. 1. (A) Acetabular weight-bearing area was divided into three 30° ranges on the midsagittal view according to Nishii et al.[19] (B) Drawing of the weight-bearing area with 15° intervals at the center of the femoral head.

Operative Planning

In all events of application of the anterior approach in accordance with the fracture pattern, surgery was performed via the modified Stoppa approach instead of the ilioinguinal approach. Methods of reduction and fixation were determined and illustrated in the diagram by using CT images prior to the operation, and the diagram was printed out and pasted on the wall of the operating room prior to the operation.

Operative Technique (Modified Stoppa Approach) and Postoperative Management

The patient was positioned supine on the operating table. The entire lower limb and the lower abdomen were aseptically draped for the operation, and hip flexion was performed to relax the iliopsoas muscle, the external iliac/ femoral neurovascular bundle, and the abdominal muscles by placing a large sandbag underneath the knee, and this also enabled multi-directional traction of the limbs for fracture reduction. The surgeon performed the operation from the contralateral side of the injured acetabulum. A transverse skin incision of 10–12 cm was made 2 cm proximal to the superior pubic ramus. The incision was deepened to the abdominal fascia. The exposed rectus abdominis muscle was divided along the linea alba to approach the internal aspect of the pelvis.

On approaching the inside of the pelvis, corona mortis was identified and ligated first and subperiosteal dissection was performed along the pelvic brim to expose the fracture fragments. The obturator nerve and vessels that pass through the obturator foramen were usually identified easily and were protected during the further procedure (Fig. 2). Extreme precautions were taken to protect the external iliac artery and vein which lie just over the iliopsoas muscle which was retracted upwards. Once the fracture site was exposed, reduction was attempted and internal fixation was performed.

If the modified Stoppa approach alone was insufficient for reduction or internal fixation, a lateral window was made along the iliac crest to fix the high anterior column fracture (exiting the iliac crest) or to fix the posterior column with a lag screw. In addition, for fractures which could not be reduced using only the anterior approach such as those with an associated posterior wall fracture, the posterior approach (the Kocher-Langenbeck approach[18] was used concurrently or a week later. A screw, cable, and/or plate were used singly or in combination for fixation of the fracture (Fig. 3).

Postoperatively, passive hip joint range of motion exercise using the continuous passive motion device was encouraged as early as possible in the patients in whom solid fixation was achieved. Patients with severe comminution of the acetabulum were subjected to skeletal traction for 2–3 weeks. For determining the timing or extent of weight-bearing, the general condition of the patients, the severity of the

Volume 9, Issue 2; March-April 2026; Page No 515-523
© 2026 IJMSCR. All Rights Reserved

accompanying injuries, the extent and quality of reduction, and stability of fixation were considered.

A pelvic reconstruction plate and lag screws was used most frequently, and the other types of plates such as a hook plate were also used whenever necessary.

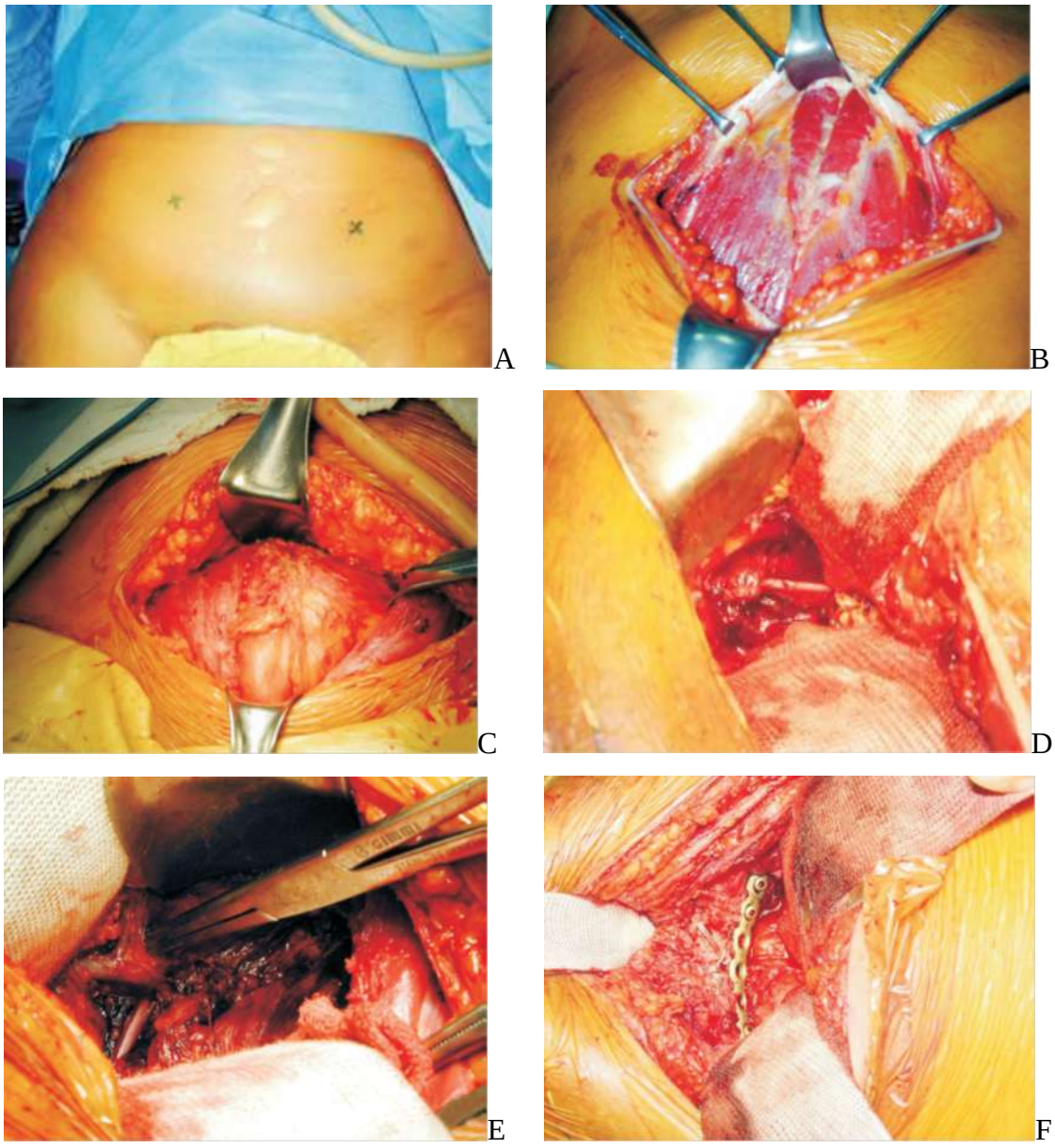


Fig. 2. (A) A transverse skin incision 2 cm above the pubic symphysis. (B) Elevation of abdominal fascia over the rectus abdominis. (C) Midline split of the rectus abdominis. (D) Identification of the obturator nerve. (E) Elevation of rectus insertion on the pubis and ligation of corona mortis. (F) Subperiosteal dissection and open reduction and internal fixation.

Outcome Evaluation and Statistical Analyses

Matta's system for radiological outcome, Harris hip score (HHS) and Merle d'Aubigné scores were used for assessment. The maximum displacement of the bony fragment was measured in the unit of mm by using PACS, Marosis m-view ver. 5.4 (Marotech Inc., Seoul, Korea) on the simple radiographs and the CT images for evaluation of the fracture reduction quality based on the criteria of Matta [09, 20] and Matta et al.[21-22] In this study, if the measured displacement was less than 0–1 mm, it was categorized as anatomical reduction, if it was in the range of 2–3 mm, it was categorized as imperfect reduction, and if it was > 3

Volume 9, Issue 2; March-April 2026; Page No 515-523
© 2026 IJMSCR. All Rights Reserved

mm, it was categorized as poor reduction. In addition, the radiographic and clinical results were categorized at the last follow-up as excellent, good, fair, and poor according to the criteria described by Matta[09] and Matta et al.[21] Finally, the accompanying injuries and complications were examined, and correlations between the clinical and radiographic results and between the fracture reduction quality and the extent of comminution were statistically analyzed. PASW ver. 18.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis and Pearson correlation analysis was performed.

Fig. 3. Preoperative X rays (A), CT scan (B) and Postoperative x rays(C) showing plate application though modified Stoppa approach

Results

Quality of Reduction

There were 16 cases of anatomical reduction, 06 cases of imperfect reduction, and 02 case of poor reduction.

Correlation between Extent of Comminution and Reduction Quality

10 patients with comminuted fractures displaying more than 3 bony fragments in the acetabular weight-bearing area included 06 cases of anatomical reduction, 02 cases of imperfect reduction, and 02 case of poor reduction.

Correlation between Reduction Quality and Clinical Results

Volume 9, Issue 2; March-April 2026; Page No 515-523

© 2026 IJMSCR. All Rights Reserved

Among the 16 patients with anatomical reduction, 14 patients exhibited good and excellent results and 01 patient fair and 01 patient exhibited a poor result. 04 out of the 06 patients with imperfect reduction exhibited good & excellent results while the other 2 patients exhibited poor results. 02 patients with poor reduction exhibited a poor result (Table 1). The reduction quality correlated well with the clinical results (p = 0.03).

Table 1: Correlation between Reduction Quality and Clinical Results

Result	Total	Anatomical	Imperfect	Poor
Excellent	06	04	02	00
Good	12	10	02	00
Fair	01	01	00	00
Poor	05	01	02	02

Correlation between Reduction Quality and Radiographic Results

16 out of the 18 patients who exhibited good and excellent results had anatomical reduction at the time of the operation. In the 08 patients without anatomical reduction (i.e., imperfect or poor reduction), excellent & good radiographic results were obtained in 02 cases (Table 2). In the cases with good anatomical reduction, the final radiographic results were also satisfactory (p = 0.01).

Table 2: Correlation between Reduction Quality and Radiographic Results

Result	Total	Anatomical	Imperfect	Poor
Excellent	04	04	00	00
Good	14	12	02	00
Fair	01	01	00	00
Poor	05	01	02	02

Complications

06 cases showed arthritic changes based on the criteria for radiographic arthritis described by Letournel et al.[23] Sperficial infection seen in 03 cases which was controlled with lavage and antibiotics. 01 case developed deep infection for which debridement and local antibiotic delivery system used to control the infection. Three patients with ectopic bone formation did not complain of pain or limitation of motion (Table 3).

Table 3: Complications

Complications	Patients	Management
Arthritic changes	06	THR
Superficial infection	03	Lavage & Antibiotics
Deep infection	01	Debridement & LADS
Ectopic bone	03	Conservative

THR: Total Hip Replacement, LADS: Local Antibiotic Delivery System

Discussion

Volume 9, Issue 2; March-April 2026; Page No 515-523
© 2026 IJMSCR. All Rights Reserved

Surgical approach to the acetabulum and accurate reduction and internal fixation are difficult because of its complicated anatomical structure and its deep location. Therefore, it is necessary to perform a thorough radiographic analysis and determine the preoperative plan including the order of reduction and method of fixation. Moreover, sufficient surgical field must be secured by deciding which approach is to be applied and in what order during the actual surgical procedure.

In general, better results are obtained with greater extent of radiographic results in the acetabular fracture.[24] In particular, restoration of the upper weight-bearing dome [21,25] of the acetabulum is the key to successful treatment. With the recent increase in high-energy injuries, there is a tendency for gradual increase in comminuted fractures of the acetabulum rather than a simple fracture with one or two bony fragments. The authors of this study, under the premise that greater extent of comminuted fracture would result in greater difficulty in achieving anatomical reduction with an ensuing poor result, examined the correlation between the number of bony fragments in the weight-bearing area (extent of comminution) on CT images, the reduction quality, and the clinical and radiographic results.

Numerous researchers reported that there is a close correlation between the radiographic results and the clinical results at the last follow-up.[26, 27] In this study, good and excellent radiographic results were obtained in 18 cases and good and excellent clinical results were obtained in 18 cases; thus, radiographic results equals the clinical results, and this enabled us to confirm the correlation between clinical and radiographic results ($p < 0.05$).

The lateral femoral cutaneous nerve is the most frequently injured nerve with the ilioinguinal approach.[08, 11] Nerve injury is thought to be due to excessive retraction or severing of the surgical window. The modified Stoppa approach avoids the middle window, which lessens the chances of injury to the inguinal canal, femoral nerve, and external iliac vessels. In this study, there was no episode of injury to these structures via the modified Stoppa approach.

The modified Stoppa approach provides the advantages of direct visualization of the entire pelvic brim from the pubic body to the anterior aspect of the sacral ala, direct visualization and access to the quadrilateral plate allowing for reduction and plating, and direct visualization and access to the posterior column from the greater sciatic notch to the ischial spine allowing for reduction and plating. In our study, the approach to these structures was easy and we were able to approach the upper section of the iliac bone and the iliac crest through an additional lateral window. In addition, the modified Stoppa approach enabled to extend the surgical field inside the pelvis for performing operations for bilateral acetabular fractures and the accompanying ipsilateral or contralateral pelvic fractures.

However, the modified Stoppa approach needs much more delicate dissection in the cases with intrapelvic adhesions (such as revision surgery including implant removal, and previous surgery in the lower abdomen). Compared to the other pelvic approaches, it is much easier to perform the modified Stoppa approach in patients with a thin body type. Severe obesity and previous repeated pelvic surgery could be relative contraindications for the modified Stoppa approach.

Excellent and good results could be achieved through the modified Stoppa approach for the treatment of acetabular fractures ($p < 0.05$). It can be concluded that the modified Stoppa approach could be used as an alternative to the classic ilioinguinal approach. In addition, comminution of the acetabular fracture was an important factor causing non-anatomic reduction ($p = 0.03$) and finally unsatisfactory clinical results ($p = 0.04$).

Conclusion

The modified Stoppa approach for the treatment of pelvic and acetabular fractures has advantages of less trauma, adequate and rapid exposure, convenient and effective fracture reduction and fixation, less complications and better postoperative recovery. Furthermore, this could be used as an alternative approach of the ilioinguinal approach. However, the clinical value of this approach remains to be verified by large sample cases due to the small number of cases and short follow-up time in this study.

References

1. Judet R, Letournel E (1974) Les fractures Du Cotyle. Masson & Cie, Paris
2. Letournel E, Judet R (1981) Fractures of the Acetabulum. Trans¬lated and Edited by R. A.

Volume 9, Issue 2; March-April 2026; Page No 515-523
© 2026 IJMSCR. All Rights Reserved

Eison; Springer-Verlag Berlin Heidel¬berg GmbH
3. Letournel E, Judet R (1993) Fractures of the Acetabulum. Second Edition. Springer Berlin Heidelberg etc.
4. Letournel E (1961) Les fractures du cotyle. Etude d'une serie de 75 cas. Medical Thesis. Arnette, Paris
5. Letournel E (1966) Die operative Versorgung der Hüftgelenkp¬fannenbrüche. (translated into German by B.G. Weber - St. Gal¬len/Sehweiz). Langenbecks Arch Chir, 316: pp. 422–437
6. Smith-Petersen M (1917) A new supra-articular subperiosteal approach to the hip joint. Am J Orthop Surg 15:59
7. Levine M (1943) Traitement Des fractures centrales de I'acetabulum. J Bone Joint Surg [Am] 25:900–901
8. Letournel E. The treatment of acetabular fractures through the ilioinguinal approach. Clin Orthop Relat Res. 1993; (292):62-76.
9. Matta JM. Fractures of the acetabulum: accuracy of reduc¬tion and clinical results in patients managed operatively within three weeks after the injury. J Bone Joint Surg Am. 1996;78(11):1632-45.
10. Min BU, Nam SY, Kang CS. Complications of surgical treat¬ment in patients with acetabular fractures. J Korean Hip Soc. 2000;12(3):253-60.
11. Judet R, Judet J, Letournel E. Surgical treatment of recent fractures of the acetabulum: apropos of 46 operated cases. Mem Acad Chir (Paris). 1962;88:369-77.
12. Letournel E, Judet R. Fractures of the acetabulum. Berlin: Springer-Verlag; 1974.
13. Andersen RC, O'Toole RV, Nascone JW, Sciadini MF, Frisch HM, Turen CW. Modified stoppa approach for acetabular fractures with anterior and posterior column displacement: quantification of radiographic reduction and analysis of in¬terobserver variability. J Orthop Trauma. 2010;24(5):271-8.
14. Stoppa RE, Rives JL, Warlaumont CR, Palot JP, Verhaeghe PJ, Delattre JF. The use of Dacron in the repair of hernias of the groin. Surg Clin North Am. 1984;64(2):269-85.
15. Rives J, Stoppa R, Fortesa L, Nicaise H. Dacron patches and their place in surgery of groin hernia: 65 cases collected from a complete series of 274 hernia operations. Ann Chir. 1968;22(3):159-71.
16. Cole JD, Bolhofner BR. Acetabular fracture fixation via a modified Stoppa limited intrapelvic approach: description of operative technique and preliminary treatment results. Clin Orthop Relat Res. 1994;(305):112-23.
17. Hirvensalo E, Lindahl J, Bostman O. A new approach to the internal fixation of unstable pelvic fractures. Clin Orthop Relat Res. 1993;(297):28-32.
18. Judet R, Judet J, Letournel E. Fractures of the acetabulum: classification and surgical approaches for open reduction: preliminary report. J Bone Joint Surg Am. 1964;46(8):1615-46.
19. Nishii T, Tanaka H, Nakanishi K, Sugano N, Miki H, Yo¬shikawa H. Fat-suppressed 3D spoiled gradient-echo MRI and MDCT arthrography of articular cartilage in patients with hip dysplasia. AJR Am J Roentgenol. 2005;185(2):379- 85.
20. Matta JM. Operative treatment of acetabular fractures through the ilioinguinal approach: a 10-year perspective. Clin Orthop Relat Res. 1994;(305):10-9.
21. Matta JM, Anderson LM, Epstein HC, Hendricks P. Frac¬tures of the acetabulum: a retrospective analysis. Clin Or¬thop Relat Res. 1986;(205):230-40.
22. Matta JM, Mehne DK, Roffi R. Fractures of the acetabulum: early results of a prospective study. Clin Orthop Relat Res. 1986;(205):241-50.
23. Letournel E, Judet R, Elson RA. Late complication of opera¬tive treatment within three weeks of injury. In: Letournel E, Judet R, Elson RA, eds. Fractures of the acetabulum. 2nd ed. Berlin: Springer-Verlag; 1993. 541-63.
24. Borrelli J Jr, Goldfarb C, Ricci W, Wagner JM, Engsberg JR. Functional outcome after isolated acetabular fractures. J Or¬thop Trauma. 2002;16(2):73-81.
25. Vrahas MS, Widding KK, Thomas KA. The effects of simu¬lated transverse, anterior column, and posterior column fractures of the acetabulum on the stability of the hip joint. J Bone Joint Surg Am. 1999;81(7):966-74.
26. Matta JM, Merritt PO. Displaced acetabular fractures. Clin Orthop Relat Res. 1988;(230):83-97.

Volume 9, Issue 2; March-April 2026; Page No 515-523
© 2026 IJMSCR. All Rights Reserved

27. Pantazopoulos T, Mousafiris C. Surgical treatment of central acetabular fractures. Clin Orthop Relat Res. 1989;(246):57- 64.

Volume 9, Issue 2; March-April 2026; Page No 515-523

© 2026 IJMSCR. All Rights Reserved