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Original Article

A PROSPECTIVE STUDY ON THE CLINICO-RADIOLOGICAL AND FUNCTIONAL RESULTS OF FIXING ACETABULAR FRACTURES WITH QUADRILATERAL PLATE INVOLVEMENT USING INTRAPELVIC REDUCTION AND BUTTRESS PLATE VIA MODIFIED STOPPA TECHNIQUE

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Abstract

Background

To achieve the best outcomes, precise reduction in anatomy, fixation of the firm, and rehabilitation are required. The most significant weight-bearing joint in the hip joint, and its fracture is intra-articular is the acetabulum. Several authors have suggested innovative fastening techniques to address these issues, such as an infra pectineal plate and many unique quadrilateral surface buttresses or spring plates to support the quadrilateral plate.

Objectives

The objective of this study was to assess instances of quadrilateral plate acetabular fractures that were treated with internal fixation and open reduction.

Materials and methods

The study was a prospective study that was performed at the Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, Bihar, India. The study was conducted from July 2023 to June 2024. Overall, 20 participants were enrolled in the study.

Results

The participants' age in this study was 39.2 ± 11.1 years on average. Most of the enrolled participants were male. On the right side of 11 (%) hips and the left side of 09 (%) hips, all fractures were unilateral. 05 (%) patients experienced a fall from a height, 07 (%) patients were run over by a pedestrian, and 08 (%) patients were involved in motor vehicle accidents. The surgery took an average of 154 ± 29.1 minutes.

Conclusion

The outcome of the study was that it was a simple, secure, and effective surgical method for pelvic stabilization in carefully selected patients with a quadrilateral plate of acetabulum fractures, which is shown to be reduced openly and fixed internally.

Recommendation

Open reduction and internal fixation were shown to be a better approach. Furthermore, future investigations may result in the assurance of use of the open reduction and internal fixation for acetabular fractures.

Keywords: *Quadrilateral plate, Acetabular Fracture, Hip joint Fracture fixation, modified Stoppa approach*
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Introduction

The optimum result depends on early rehabilitation, solid fixation, and precise anatomic reduction. An intra-articular fracture occurs in the acetabulum, the hip joint's most important weight-bearing component. Nevertheless, the intricate fracture pattern and challenges with the surgical method for reduction make treating acetabular fractures challenging, in addition to the significant organ damage that is often involved [1, 2, 3].

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Over the past ten years, the prevalence of polytrauma and pelvic injuries has grown due to an increase in high-velocity injuries, such as falls from heights and high-speed motor vehicle accidents. Improvements in trauma care centers and other healthcare services have simultaneously shown the growth in chances of survival. Most pelvic injuries involve the acetabulum, with over 80% resulting from car crashes and over 10% from falls [4].

Despite knowing that trauma injuries typically lead the cases of handicap, acetabular fracture treatment has advanced dramatically over the past three decades, leading to better results [4, 5, 6, 7, 8].

Fixing these fractures is crucial for a similar, steady, and pain-free hip joint, which allows preliminary mobilization and prevents subsequent osteoarthritis. It involves quadrilateral plates that are particularly challenging to treat because of their deep placement, the thin bone shell, the complexity of the fracture involving several walls or columns and comminution, and osteoporosis, particularly in the elderly. Recent improvements in surgical procedures have led to the employment of both direct and indirect reduction tactics. Screwing the quadrilateral plate directly is quite challenging, and even a small amount of incorrect handling might result in screws piercing the hip joint. The new fixing techniques proposed by many researchers to overcome these problems included several creative surfaces of quadrilateral buttresses or spring plates to support the plate that is quadrilateral [9, 10, 11].

The study aims to demonstrate instances of quadrilateral plate acetabular fractures that were treated with open reduction and internal fixation using this plate.

Methodology

Study Design

It was a prospective study carried out at the Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, Bihar, India. The study was conducted from July 2023 to June 2024.

Sample Collection

A total of 20 participants were enrolled in the study. Patients who were over the age of eighteen had a quadrilateral plate fracture that was unstable and involved a quadrilateral plate either with the presence of displaced anterior column and wall fracture or not, had a closed injury, or had a new fracture that was less than three weeks old were all eligible to enroll. Additionally, the exclusion criteria included patients with traumatic head injuries or abdominal injuries that affected rehabilitation, pathological fractures, and fractures that involved the back column that required the Kocher–Langenbeck approach.

Study Procedure

Advanced Injuries Life Support (ATLS) guidelines were followed in the first treatment of acetabular injuries. Following stabilization, the patients underwent a comprehensive history and clinical examination with a focus on neurological evaluation. Before surgery, standard laboratory tests were conducted. To help characterize the fracture more precisely, they were supplemented with anteroposterior and Judet view radiographs as well as a 3D CT scan of the pelvis.

Under general anesthesia, all of the patients had surgery. Participants were tended into a supine position on a surgical top with a reinforcement placed in the affected leg. A modified Stoppa technique was used to perform the procedure.

A 10-15 cm skin cut was made, two centimeters above the symphysis of the pubis. After being split vertically, the rectus fascia and linea alba were cut at the midline. Then, using a mop to protect the bladder, the rectus abdominis muscle was laterally retracted. Since the entire approach was through the pre-peritoneal region, care was made to avoid incising the peritoneum. To allow the rectus to retract, the anterior and higher parts of the symphysis on the fractured side were partially detached from the medial component of the rectus muscle. After that, the pelvic brim was laterally dissected with fingers bluntly without cutting the fascia. Here, the corona mortis was discovered, located, and closed. The fracture site was revealed by further dissecting the periosteum along the iliopectineal line using diathermy. At this level, the neurovascular bundle was discovered. During the entire surgical procedure, these structures were safeguarded. To ensure the plate was positioned correctly, the surgery was carried out to the ipsilateral sacroiliac joint. To avoid damaging the external iliac vessels, great care was taken. Anatomical reduction was tried once the fracture site was properly exposed, and the IRBP system was used for internal fixation. When selecting the appropriate plate size, the magnitude of the fracture and Perineal inlet geometry—where the plate can fit precisely—were taken into account. Under fluoroscopic guidance, intraoperative stability was assessed, and appropriate alignment and joint congruency were verified. Hemostasis was maintained. Layers of closure were applied to the surgical wound over an in-situ suction drain. The surgical incisions were covered with sterile cloth.

The participants were further assessed at follow-up periods of 4 weeks, 3 months, 6 months, and 12 months.

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Statistical Analysis

All the necessitated data were entered in Microsoft Excel. Categorical variables were expressed as no of patients along with the percentages. Continuous variables were expressed as mean and standard deviation.

Ethical Consideration

Informed consent was gathered from all participants.

Results

Table 1 shows patients' demographics. The age in this study was 39.2 ± 11.1 years on average. Among all, 14 (70%) of the participants were male, while other 06 (30%) of patients were female. Thus, the majority (70%) of patients were male. The time for surgery was 154 ± 29.1 mins. The average loss of blood was 275 ± 51.24 ml.

Table 1. Patients Demographics

Characteristics	Value
Age (in years)	39.2 ± 11.1
Male Participants	14 (70%)
Female Participants	06 (30%)
Right-side Fractures	11 (55%)
Left-side Fractures	09 (45%)
Types of Accidents	
Motor-Vehicle Accidents	08 (40%)
Pedestrian Run Over	07 (35%)
Accidental Fall	05 (25%)
Operating Time	154 ± 29.1
Blood loss (in ml)	275 ± 51.24

Data was presented as either mean±SD or n (%)

Table 2 shows Matta's fracture reduction criteria for the study. Two independent senior orthopedic surgeons evaluated the reduction criteria of fractures and hip joints using Matta's radiological fracture reduction criteria. As a result, 13 cases (65%) were classified as anatomical reduction, five cases (25%) as imperfect, and two cases (10%) as poor.

Table 2. Matta's fracture reduction criteria

Fracture Reduction	Values
Anatomic (0-1mm)	13 (65%)
Imperfect (2-3mm)	05 (25%)
Poor >3mm)	*02 (10%)*

Data was presented as n (%)

According to Matta, the radiographic data showed that the hips in 09 (45%) had excellent results, the hips in 07 (35%) had good results, the hips in 03 (15%) had good results, and the hips in 01 (5%) had poor results. Table 3 depicts Matta's radiological outcome grading.

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Table 3. Matta's Radiological Outcome Grading

Radiological Outcome	Values
Excellent	09 (45%)
Good	07 (35%)
Fair	03 (15%)
Poor	01 (5%)

Data was presented as n (%)

Various complications have been observed in participants including Superficial Wound Infection, Pre-operative sciatic nerve neuropraxia, Malunion, Post-traumatic secondary osteoarthritis, Vascular Injury, Implant Breakage or screw loosening, Deep Vein Thrombosis. Table 4 represents complications among participants.

Table 4. Complications in Participants

Complications	Values
No Complications	07 (35%)
Superficial Wound Infection	01 (5%)
Pre-operative sciatic nerve neuropraxia	02 (10%)
Malunion	01 (5%)
Post-traumatic secondary osteoarthritis	01 (5%)
Vascular Injury	01 (5%)
Implant Breakage or screw loosening	00 (0%)
Deep Vein Thrombosis	01 (5%)

Data was presented as n (%)

The average Modified Merle d'Aubigné and Postel score of 20 patients at the end of the 01-year follow-up was 14.21 ± 1.23

Discussion

The present study was conducted to assess instances of quadrilateral plate acetabular fractures treated with internal fixation and open reduction. The mean age in our study was 39.2 ± 11.1 years. It has been observed earlier those fractures of the acetabulum were most prevalent in younger participants [12].

In this study, 13 instances (65%) were classified as reduction in anatomy, five cases (25%) were considered imperfect, and two cases (10%) as poor based on Matta's radiological fracture reduction criteria. Prior research has demonstrated that the surgical outcome was significantly influenced by the reduction of the quadrilateral plate fracture, and complications, including joint dysfunction or post-traumatic arthritis, result in the quadrilateral plate's inability to be rebuilt with adequate reduction and stable attachment [13, 14, 15].

Optimal treatment of the quadrilateral fracture is crucial since the existence of quadrilateral surface injury likely determines the outcome. However, quadrilateral plate fractures have traditionally presented difficulty to orthopedic surgeons because of their deep placement, thin plate of bone, and numerous vital blood arteries and nerves around them [16, 17].

The study comprised 20 patients. Among all participants, the majority of the patients were young males. The main reasons for fractures involve trauma due to speed, and young men are more likely to be involved in sports and other related activities, which increases their risk of trauma and accidents. The operational problems were similar to those of other worldwide acetabular fracture studies and other major orthopedic surgeries.

The radiological results for Matta were as follows: Excellent for 09 (45%) hips, Good for 07 (35%), Fair for 03 (15%), and Poor for 01 (5%) hips. Compared to other published results, ours is comparable. Applying the Modified Postel and Merle d'Aubigné grading scheme, another researcher, Briffa N et al., found that 75 patients (47%), 41 patients (25%), 12 patients (7%), and 33 patients (20%) had excellent, good, and poor scores [18].

Additionally, the process is straightforward, dependable, and very successful due to the plate design. Traditionally, most surgeons find that changing the recon plate's shape during surgery is a difficult and time-consuming process, which this approach can avoid. In a less intrusive modified Stoppa method, another fixing technique for limiting movement of the fracture area and medial subluxation is provided by this plate's twin function of neutralizing anterior column fractures and strongly supporting the entire quadrilateral plate.

Conclusion

The study concluded that for patients having acetabulum fractures of the quadrilateral plate, an approach of open reduction and internal fixation was used. This approach appears to be an easier, simpler, more secure, and effective method for the stability of the pelvis. It possesses guaranteed results with less probability of failure. Long-term clinical and functional effects are good, and morbidity is low. Standard reconstruction plates yield comparable results. With its short operating time, reduced pre-operative planning effort, ability to treat multiple acetabulum fractures with a single technique, reduced intraoperative bleeding, and reduced need for blood transfusions, the IRBP-screw system is worth further promotion for increased use.

Limitations

The limitation of the study was that the sample size was too small. Also, the study was a single institution bias.

Recommendation

Open reduction and internal fixation were shown to be a better approach. Furthermore, future investigations may result in the assurance of use of the open reduction and internal fixation for acetabular fractures.

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Data Availability

Data is available upon request.

Author contributions

All authors contributed to the design of the research. KR and NKA collected and analyzed the data. AA and SK wrote the manuscript. NKA edited the paper. All authors read and approved the paper.

List of abbreviations:

Indira Gandhi Institute of Medical Sciences (IGIMS)
Advanced Injuries Life Support (ATLS)

Source of funding

No funding was received.

Conflict of interest

The authors have no conflicting interests to declare.

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