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SHORT-TERM ANALYSIS OF SURGICALLY FIXED ACETABULAR FRACTURES-FACTORS AFFECTING OUTCOME AND CORRELATION OF OUTCOME WITH RADIOLOGICAL SCORE

Trauma and Orthopaedics

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ABSTRACT

Introduction: The relative infrequency and complexity of acetabular fractures make them the most challenging fractures to deal with. These fractures are the result of high velocity injuries, most common in the young males, and very disabling if not treated well. Operative treatment is the standard for displaced acetabular fractures. Aim of treatment is to maintain a stable congruent joint. The purpose of this study is to analyse the functional outcome and assess the complications of surgically treated acetabular fractures.

Materials & Methods: We analysed 32 patients who were operated from August 2015 onwards and had completed at least one year of follow-up by October 2017 with The Department of Orthopaedics at Nizam's Institute of Medical Sciences, Hyderabad. Specific criteria were used to choose the treatment modality. Clinical outcome was graded using Merle D'Aubigne-Postel scoring system and Harris Hip Score. Radiological outcome was evaluated by Matta's criteria.

Results: Posterior wall fracture was most common. We had good to excellent functional outcome in 24 patients, fair to poor results in 8 and good to excellent radiological outcome in 25 patients, fair outcome in 7.Two patients had infection, two had heterotopic ossification, one patient had AVN of femoral head and four had OA of hip joint.

Conclusion: The clinical outcome depends on multiple factors out of which many are not under the surgeon's control like co-morbidities, delay in presentation, compliance, associated injuries and type of fracture. Delayed presentation is common. Severe polytrauma is associated. Hence, strict adherence to ATLS protocols is essential. "Life first, limb next."

KEYWORDS

functional, radiological outcome, factors affecting

INTRODUCTION

Owing to their complex anatomy, controversies in management,proximity to the hip joint, difficulty in surgical access and theconsequences they leave, **"acetabular fractures"** occupy an importantplace in Orthopaedics and Traumatology. The understanding of acetabularanatomy and fracture patterns has developed over time and led tooperative treatment being preferred these days. Operative treatmentinvolves a steep learning curve, hence, acetabulum fractures are bestoperated at specialized center by experienced surgeons who routinely treatsuch injuries. Kebaish, Roy, and Rennie demonstrated this by comparingthe reductions obtained by experienced pelvic trauma surgeons with thoseobtained by less experienced surgeons, who had a much lower rate ofanatomical reduction **[1]**.

Acetabular fractures usually occur in younger age group due to highvelocity injury. These injuries are most often associated with other seriousinjuries or polytrauma. But over recent years, the incidence of acetabularfractures has increased, especially in elderly population due to increasedlongevity of life, as also an increase in their involvement in high velocityinjuries. Trivial fall in old age is also a cause of acetabulum fracture inold age owing to osteoporosis.

Acetabular fractures occur when the head of the femur is driven into thepelvis, either by a blow on the side of hip or by a blow on the front of kneewith the hip in flexion and abduction (Dash board injury). The fracturepattern depends on the position of hip, direction of impact, magnitude ofimpact, and strength of the bone at the time of injury.

The studies by Letournel and Judet**[2]** and by Matta **[3]** have shownthat to attain the best results, hip joint congruity and stability must beaccompanied by an anatomic reduction (defined as less than 2 mm ofresidual displacement) of the displaced articular surface. Therefore,accurate reduction of the intra-articular fracture fragments is critical for asuccessful outcome, as is maintenance of this reduction by internalfixation. It has been stressed that in a displaced fracture, this anatomicreduction is difficult. In addition, standard plate and screw fixationconstructs, which require open surgery, have been shown to be strongerthan their percutaneous counterparts, demonstrating greater yield strengthand maximal load at failure. Therefore, open anatomic reduction andinternal fixation continue to serve as the mainstay in treatment ofdisplaced fractures of the acetabulum.

However, there are some new trends that have developed over the past 5to 10 years, most of which serve to expand on principles advocated byLetournel and Judet. Such trends include the advancements in preoperative three-dimensional computed tomography (CT), perioperativeimaging, systematic classification of acetabular fractures, based on theanatomic pattern of the fracture.

No matter what the method, obtaining an excellent long-term result in the treatment of acetabular fractures is dependent on restoring a congruent and stable hip joint with an anatomically reduced articular surface. The achievement of these objectives should minimize pain, prevent post-traumaticosteoarthrosis, and thereby improve long-term functionaloutcome. Several factors are implicated to affect outcome after surgery. Hence present study aimed to analyze and report the short term outcome of acetabular fractures which were surgically fixed. Our study is an attempt to analyze the short term outcome in a tertiary care center given the lack of dedicated/specialized facilities or surgeons dealing with Pelvi Acetabular Trauma in the states of TS and AP.

MATERIALS AND METHODS:

We analysed 32 patients who were operated from August 2015onwards and had completed at least eighteen months of follow-up by October2017 with The Department of Orthopaedics at Nizam's Institute of Medical Sciences, Hyderabad.

Antero-posterior and Judet radiographs and CT scan with 3DReconstruction were taken for all cases. Anthropometric data, type of fracture, neuro-vascular status, associated injuries, surgical approach, fixation method used, complications and outcome were recorded.

Modified Merle d' Aubigne scoring system and Modified Harris Hip Scoring System was used to measure the functional outcome and Matta'scriteria used for evaluating accuracy of reduction.

INCLUSION CRITERIA:

- Patients with closed acetabular fractures managed with open reduction and internal fixation in our institute who have given

valid informed consent to take part in the study
- Patients who were operated from August 2015 onwards and have completed at least one year of follow up till October 2017

EXCLUSION CRITERIA:
- All Compound fractures are excluded from the study.
- Patients with pathological fractures
- Patients who don't consent to participate in study or lost to follow up
- Patients in whom surgery has been performed earlier on same hip
- Patients who were not fit for Surgery/treated conservatively

Preoperative evaluation:
On admission each patient was assessed-ATLS Protocol was strictly followed, with particular attention togeneral health, other co-morbid conditions and associated limb/systemic injuries. His/her social background was also taken into account.Patients were all evaluated adequately before surgery and operated onelective basis.Radiographs and CT were evaluated by a fixed team headed by a single Chief Surgeon. Fracture was classified and a draft of the fixation was prepared Anteroposterior and 45 degrees oblique view (Judet views) of the pelvis were obtained for all patients following admission. Computerized tomography with 3D reconstruction scans were performed in all cases.

Postoperative Management:
After the surgery, patients were usually shifted to the step-down ICU for one day. Bowel sounds and Toe/Ankle Movements were monitored. Injectable antibiotics were given for 5 days postoperatively.

We did not apply skin or skeletal traction for the stable fixations, and prophylaxis for heterotopic ossification was not given. Butprophylaxis against DVT (Inj. LMW Heparin- Dalteparin 5000 IUsubcutaneously bedtime) was started about 12 hours after the surgery.

Patients were encouraged to sit up in the bed & allowed to turn to either side in the bed to prevent bed sores & were given chestphysiotherapy. Drain was removed on second POD, Quadricepsstrengthening physiotherapy started & check radiograph was taken.

The quality of anatomic reduction was assessed by the parent surgeon using Matta's Criteria-Reduction of Fracture. Suture removal was done on 10th POD and discharged from hospital. Hospital stay is prolonged for the patients who had post-operative complications and other systemic complications.

All patients were advised absolute non weight bearing and physiotherapy for 3 months duration. All patients were reviewed after 6weeks postoperatively, for active and active assisted hip ROM exercises. Again reviewed at 3 months postoperatively and gradual weight bearing was started under surgeon and physiotherapist care.

All the patients who had completed at least 12 months of follow-up were included in the study. In the latest follow up the clinical and radiological outcomes were measured with the help of Modified MerleD'Aubigne and Postel score, The Modified Harris Hip Score and Mattaradiological scoring systems respectively.

Statistical Analysis:
Univariate ordinal regression is performed between the fracture reduction and the Modified Merle D'Aubigne and Postel scoring system in order to establish the effect of amount of reduction of fracture on ranked outcome with $p < 0.05$, without taking into account mutual confounding predictors.

RESULTS
In our study, we have analyzed the short term outcome in 32 patients with surgically fixed a acetabular fracture, who underwent surgery at NIZAM'S INSTITUTE OF MEDICAL SCIENCES after August 2015 and completed at least 18 months of follow up by October 2017.

Age, sex, co-morbidities, mode of injury, type of fracture, associated hip dislocation, time delay in reduction of hip dislocation, time delay for surgery, associated other system injuries, sciatic nerve injury, surgical approach, blood loss, complications and outcome were recorded and analyzed. Modified Merle D'Aubigne score, Modified Harris Hip Score and Matta radiological scoring systems were used to measure the outcome.

Demographic profile
Average age of study subjects was 35.1 years. Minimum age of patients was 18 years and maximum age was 60years. 97% of our study subjects were male patients. Major co-morbidities were DM (21.8%) and HTN (6.2%).Bronchial asthma was found in one patient and epilepsy in one patient.

Mode of injury
Road traffic accident was the most common mode (91%) of injury followed by fall from height, sports injury & assault (3%). Right side (68.75%) predominance was more compare to left (31.25%) side. There were no cases of pathological fractures. Average time to fracture union was 18 weeks (ranging from 16 to 20 weeks). There were no cases of delayed union or non-union.

PATIENT DATA

Type of fracture	Number of cases (%)
Posterior wall	15
Anterior wall	1
T Shaped	1
Transverse + Posterior wall	1
Posterior column + Posterior wall	6
Anterior column + Posterior hemi transverse	2
Both column	6
Associated hip dislocation & Reduction of dislocation:	
With Dislocation	13
Without Dislocation	19
Type of Dislocation:	
Central	1
Posterior	12
Associated injuries: (19 out of 32 patients had associated injuries)	
Ipsi-lateral extremity injuries	9
Contra lateral extremity injuries	2
Head injury	3
Blunt injury chest and abdomen	4
Spine	1

Fractures of acetabulum are a result of high energy trauma, hence commonly associated with other serious injuries.Most common dislocation seen in hip joint is posterior hip dislocation. Time to reduction of dislocation is directly related to the functional outcome, arthritis, AVN.Posterior wall fracture is the commonest seen in acetabulum fractures.

Table-2: Reduction and treatment methods

Reduced within 12 hours	9
Reduced after 12 hours	4
Approach	
Kocher-Langenbeck	26
Ilioinguinal	3
Combined approaches	3
Matta's Criteria-Reduction of Fracture:	
Reduction	No. of patients
Anatomic (0-1mm)	17
Imperfect (2-3mm)	10
Poor (>3mm)	5

Kocher Langenbeck is the most commonly used approach to address the fractures of posterior wall. Transverse fractures and all posterior column and wall trauma can be addressed from the posterior approach i. /e K-L approach

Combined approach is needed to address Both Column fractures. Patient is kept in floppy lateral position and posterior followed by anterior approach or vice versa is performed.

Anatomic reduction of fracturedirectly correlates with the functional outcome. “Marginal Impaction” needs to be addressed. The whole crux of surgery lies in reducing the articular surface without a step of >1mm.

Timing of surgery:
Average time from injury to surgery: 10 days
Shortest time: 3 days
Longest time: 18 days

Patients operated before 3 weeks: 32
Patients operated after 3 weeks: 0
Average Operative time was 97 minutes
Average blood loss was 270 ml
Average C- arm usage was 60 s
Average blood transfusion post op - 2 points

TABLE-3: OUTCOME DEPENDING ON DIFFERENT SCORING SYSTEMS

Modified Merle D'Aubigne and Postel Clinical Grading System:	
Clinical grade	No. of patients
Excellent	15
Good	9
Fair	4
Poor	4
Matta Radiological Scoring Systems:	
Radiographic assessment	No. of patients
Excellent	18
Good	7
Fair	4
Poor	3
Modified Harris Hip Score:	
Grade	No. of Patients
Excellent	15
Good	7
Fair	5
Poor	5

TABLE-4: Complications

POST-OP COMPLICATIONS	**No. of cases**
Infection	2
Heterotopic ossification	2
DVT	0
Iatrogenic sciatic nerve injury	0
AVN	1

5 patients had foot drop at the time of presentation, 4 of them recovered from foot drop and 1 patient has partial recovery at final follow-up. 2 patients developed ankle dorsiflexion weakness post-op which recovered fully at the end of one month.

DISCUSSION

Fractures of the acetabulum usually occur following high velocity trauma such as a fall from height and road traffic accidents [4]. Pain, deformity and inability to bear weight on the affected hip are the usual presenting features. Surgical treatment of acetabular fractures is technically demanding and the goals of surgery are to restore the anatomical configuration accurately and to maintain the stability and congruence of the hip. [5] The results of surgery correlate most closely with the quality of reduction of fracture fragments [6, 7]

A vast majority of studies reporting well to excellent outcome after surgical treatment of displaced acetabular fractures are from developed nations. The outlook of these fractures in a developing country like ours remains dismal, reasons being late referral from primary care centers, missed injuries, ignorance, treatment by quacks and poor socioeconomic status of patients. Attempts at surgical fixation by inexperienced surgeons with lack of expertise (infrastructure) to treat these injuries can worsen the picture. Our study is an attempt to evaluate the outcome of these severe injuries after surgical management at a tertiary care center, given the lack of specialized Pelvi-Acetabular surgeons or Pelvi Acetabular trauma centers in the two states of Telangana and Andhra Pradesh.

In our prospective study, the mean age of the patients at the time of injury was 35 years. This is in concordance with **Triantaphillopoulos et al** [8], **Moed et al** [9]and **Kumar et al** [10] literature. The major incidence in this age group can be explained by the fact that, majority of cases occurs due to road traffic accident (RTA).

The mode of injury was road traffic accidents (RTA) in majority of patients (91%) in our study. This correlates with the retrospective study done by **Almeida et al [**11] and **Giannoudis et al [**12]. The relatively high incidence of RTA as a mode of injury in our study can be explained by the fact that, in developing countries like India, the traffic is disorganized, and chaotic leading to significant RTA. Our Institute has a tertiary care apex trauma centre where complex trauma cases were referred from various part of the state and neighbouring states. This may be another reason for the higher incidence of RTAs in our study.

Majority of patients in our study were males (31 male, 1 female) which can be explained by the fact that males who are breadwinners and go out for earning, are more prone to RTA. The male preponderance in our study also correlates with the literature. [12,13]

In our study 19 patients (59.3%) presented with associated fractures other than acetabular fractures including fractures of upper and lower limbs and may be due to high velocity road traffic accidents. In a study by **Moed et al** out of 108 patients, 59 patients (54.62%) had associated injuries.[6]**Petsatodis et al** in a study of 50 patients found that 24 patients (48%) had associated injuries. [14]

Our study has 32 cases out of which there are 16 elemental and 16 associated type fractures. In elementary type fractures, 12 (out of 16) were operated within 2 weeks whereas in associated type fractures, 6 (out of 16) were operated within one week.

In our study, time interval between injury and surgery ranged from 3 to 18 days (mean 11 days). The decision to take up for surgery was based on the surgical fitness of the patient and on the severity of the associated injuries. The relatively increased delay in surgery in our study was due to late presentation of the patient and in some to control co morbidities (diabetes mellitus, hypertension, asthma, epilepsy) with regard to surgical fitness.

Sathappan et al reported a mean time of 7.3 days to definitive surgical fixation (range 0- 19 days) with a median of 7 days whereas a mean of 6 days (range 0-18 days) was reported by **Giannoudis et al [15,16]** In contrast **Ebraheim et al** mentioned a mean of 4 days (range 1-26 days) from injury to surgery.[**18**]

In our study, at the time of initial presentation, 12 out of 32 patients (37.5%) had a posterior dislocation of the hip and 1 out of 32 (3%) had a central dislocation. In contrast to this, in a study by **Triantaphillopoulos et al** [8] maximum percentage had posterior dislocation of hip (74.7%). and in **Giannouds et al** literature 93.10% (16). Very low rate of posterior dislocation was found by **Sathappanet al [**15] (26.66%) and **Kumar et al** (33%) [10].

Delay in reduction of dislocation can cause avascular necrosis of the femoral head. In our study we have encountered a single case of AVN, probably due to short study period. The rate of AVN has been reported to be between 3 and 10% in literature but the rate is higher for cases associated with posterior dislocation of the hip. [2,3,6,19-22] According to literature the incidence of sciatic nerve palsy in acetabular fractures is around 16% and the incidence increases to about 40% when there is posterior dislocation of the hip.[16,1] In our study at the time of initial presentation, 5 patients had foot drop, 4 of them recovered from foot drop and 1 patient has partial recovery at final follow-up. 2 patients developed ankle dorsiflexion weakness post-op which recovered fully at the end of one month and all had posterior dislocation of the hip.

We had employed the Kocher-Langenbeck approach for 26 cases (81.25%), Ilio-inguinal approach in 3 cases (9.37%), and combined approach in 3 cases (9.37%). Out of 3 cases with combined approach only one was done in same sitting.

In our study, the quality of reduction was assessed as per the Matta's criteria-Reduction of fracture; 17 patients (53.12%) had displacement 0 mm to 1 mm (Excellent), 10(31.25%) patients had displacement 2 mm to 3 mm (Imperfect) and 5(15.62%) patient had > 3 mm displacement (Poor).

The radiological outcome was graded according to Matta's Radiological scoring system and excellent results were found in 18(56.25%) patients, good in 7 patients (21.87%), fair results in 4(12.5%) patients and 3(9.37%) patients had poor result.

Matta et al achieved perfect anatomical reduction in 64% of cases in their series which was almost double the rates seen in a series by **Khadrawe et al** and reflects the higher experience of the earlier author. [3, 23]

Stockle et al achieved anatomical reduction in 79.5% of similar,

complex cases included in their series. [24] The relatively high rate of anatomical reductions may be due to the use of extensile approaches in most of these cases and to the fact that they selected non-comminuted cases, fit for their method of fixation with screws only.

Khadrawe et al achieved anatomical reduction in only 32.7% cases. The relatively low rate of anatomical reduction in their study indicates how steep the learning curve could be, especially in more challenging acetabular fractures. [23] They found that it was not easy to bring down every displaced, often multi-fragmentary acetabular fracture to a perfect reduction (i.e. <1 mm residual displacement).

Moed et al reported good-to-excellent results in 89 of 100 (89%) acetabular fractures treated by open reduction and internal fixation. [6] **Bhandari et al** evaluated 109 patients with fractures of the acetabulum and posterior dislocation of the hip and emphasized that the quality of reduction of the fracture is the only significant predictor of radiological grade, clinical outcome and the development of posttraumatic arthritis.[2]

The most common complication of acetabular fractures is traumatic arthritis of the hip, with the incidence reported to be between 20 and 50%.(3,12) In our study, no patient developed post-traumatic arthritis. It may be due to short term follow up period as it is a long term complication which needs years to develop. In our study 2(6.25%) patient developed superficial surgical site infection and required debridement followed by delayed secondary suturing and prolonged antibiotic coverage. Clinical score was poor in one and excellent in another. None of the cases show any evidence of deep infection. In a study by **Kim et al** infection was seen in three patients (out of a total of 33 patients).(17) Two patients required debridement and metal removal due to deep infection and they had early post-traumatic arthritis with poor clinical outcome. In contrast **Ebraheim et al** found infection in 2 patients out of 32 patients whereas **Moed et al** found infection in 1 out of 108 patients.(6,18) In both of these cases clinical score were poor. In our study, Morel-Lavallee lesions were present in 2 patients at the time of presentation to the hospital. We had inserted drains, under the supervision of Plastic Surgery, into the physiologically degloved area, prior to surgery, in both the patients and the final outcome after surgery was good.

In our study, two patients (one class I Brooker and another class II Brooker) developed heterotopic ossification in contrast to the study by **Kim et al** where heterotopic ossification was common (Seventeen patients had class I heterotopic ossification, 4 patients had class II heterotopic ossification and one patient had class III heterotopic ossification)(17). **Moed et al** found class I heterotopic ossification in 20 patients and class II heterotopic ossification in 17 patients. Radiographic evidence of heterotopic ossification after open reduction and internal fixation of acetabular fractures is usually apparent by three to six weeks and maximum heterotopic ossification is seen by six to twelve weeks. The surgical approach to the acetabulum (extensile approach) appears to be a major risk factor for heterotopic ossification. Overall the clinical outcome according to Merle d'Aubigne and Postel score at the time of final follow-up was graded as excellent in 15 patients (46.87%), good in 9 patients (28.125%), fair in 4 patients (12.5%), poor in 4 patients (12.5%) in our study. The excellent group in Merle d'Aubigne score was associated with anatomical reduction. The excellent result (46.87%) in our study is comparable to results seen by **Moed et al** i.e., 55% in a study of 100 patients.(6) In a retrospective study by **Petsetoidis et al**, excellent results were seen in 40% cases; 38.1% excellent results were seen by **Elmali et al** in a prospective study of 21 patients.[14,18] There was good coherence between Merle D'Aubigne and Modified Harris Hip Score. 15 cases had excellent result, 7 cases had Good result, 5 cases had a fair result, and 5 cases had poor result according to Modified Harris Hip Score at the end of one year of follow-up. The good result of our study could be attributed to the fact that most procedures were carried out by surgeons with more than five years experience in treating pelvi-acetabular trauma.

Most of our patients were encouraged to sit on the bed and do knee range of movements within 36 hours of the surgery and allowed to walk by 6 weeks after the surgery. In patients with poor bone quality and/or associated fractures, mobilization was delayed.

In our study, the short term follow up period did not cover any of the peaks. As a result the overall complications were also less as compared to other studies and hence this study need further follow-up of the cohort group.

Acetabular fractures are often a result of high energy trauma and patients with such fractures often have other associated injuries which from the greater trochanter or the posterior iliac crest.

In our study after anatomical reduction of fracture fragments, we used inter-fragmentary lag screw to fix fracture fragments and reconstruction plate to buttress the wall of acetabulum. The reduction was checked under fluoroscopy.

This study has some limitations. First of all, the sample size is relatively small (32 cases). We need to divide the patients into subgroups for statistical analysis and comparison. The paucity of patients per subgroup in this study did not allow multivariate statistical analysis and hence there was no control for the confounding factors.

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