



## The outcomes of acetabular fractures treated surgically and factors affecting the result

The results of acetabular fractures

Necip Güven<sup>1</sup>, Mehmet Ata Gökalp<sup>2</sup>, Seyyid Şerif Ünsal<sup>2</sup>, Tülin Türközü<sup>1</sup>, Savaş Güner<sup>2</sup>

<sup>1</sup>Van Training and Research Hospital,

<sup>2</sup>Department of Trauma and Orthopedic Surgery, Medical School of Yüzüncü Yıl University, Van, Turkey

### Abstract

**Aim:** The aim of this study was to evaluate the radiological and clinical outcomes of surgically treated acetabular fractures. **Material and Method:** A total of 30 patients with acetabular fracture who had presented to the Orthopedics and Traumatology Department of Yüzüncü Yıl University Medical Faculty between January 2009 and December 2013 and undergoing surgery were included in the study. The number of males was 25 (83.3%), and the number of females was 5 (16.7%). The ages of the patients varied between 18 and 68 (mean: 40) years. The indications for surgery were: more than 3 mms of dislocation in one of the three X-Rays obtained (antero-posterior, obturator oblique and iliac oblique), intra-articular piece of the fracture and posterior instability. **Results:** 20 (66.7%) and 10 (33.7%) patients had acetabular fractures in the right and left hips, respectively. The most common cause of trauma was falling from a height. According to the classification of Letournel, 18 patients (60%) had complex and 12 patients (40%) had simple fractures. 13 patients (43.5%) had additional traumatic hip dislocation. Following the surgical intervention, 13 patients (43.3%) had anatomical reduction and 4 (13.3%) had poor reduction. The patients were followed-up for a mean duration of 28 months. According to the radiological criteria of Matta, 13 patients (43.3%) had excellent, 11 (36.6%) had good, 4 (13.3%) had moderate, and 2 (6.6%) had poor outcomes. According to the clinical recovery criteria of Merle d'Aubigne and Postel, 7 patients (23.3%) had very good, 15 (50%) had good, 4 (13.3%) had moderate, and 4 (13.3%) had poor outcomes. **Discussion:** It was concluded that the quality of reduction affected the clinical and radiological outcomes, and that this effect depended on the simple or complex nature of the fracture. Successful and satisfactory results may be obtained by selecting the correct incision method for the fracture type, advanced surgical experience and careful post-operative patient follow-up.

### Keywords

Acetabular Fracture; Clinical Outcome; Radiological Outcome; Letournel Classification

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Corresponding Author: Mehmet Ata Gökalp, Department of Orthopedics and Traumatology, Yüzüncü Yıl University, Medical Faculty, Van, Turkey.  
T.: +905055037613 E-Mail: doktorata@hotmail.com

## Introduction

Acetabular fractures are observed as a result of high energy traumas. Recent increases in the number of car accidents have increased the frequency of acetabular fractures as well.

Acetabular fractures are more complicated compared to other regions of the body, and their treatment necessitates a better experience. Until the last quarter of the last century, acetabular fractures were mostly treated via conservative methods [1]. However, immobilization-related systemic complications were encountered. Fractures united as malunion resulted in arthrosis. Following the definition and classification of acetabular fractures, and contribution to the surgical approach and reduction techniques of the French surgeon Emile Letournel, the surgical treatment of displaced acetabular fractures has gained extensity all over the world [2].

The aim of the surgical approach in acetabular fractures is to achieve complete anatomical reduction in the innominate bone and the acetabular joint surface. However, providing acetabular reduction is generally difficult due to the 3-dimensional anatomy of the acetabulum and the pelvis. Improper reductions may impair the articular functions in acetabular fractures. Even millimetric displacements may lead to progressive post-traumatic osteoarthritis [3].

In this study, we evaluated the surgical outcomes in 30 patients undergoing open reduction and internal fixation through surgical intervention under the light of the literature.

## Material and Method

A total of 30 patients undergoing surgery due to acetabular fracture in the Orthopedics and Traumatology Department of Yüzüncü Yıl University Medical Faculty between January 2009 and December 2013, among 50 patients with sufficient follow-up duration and accessible file data, were included in the study. The duration of follow-up was between 6 and 56 months (mean: 28). The number of males was 25 (83.3%) and the number of females was 5 (16.7%). The ages of the patients differed between 18 and 68 (mean: 40) years. Twenty patients had right (66.7%) and 10 patients had (33.7%) left acetabular fractures. The etiological reasons included: falling from a height in 13 patients (43.3%), in-vehicle traffic accident in 8 (26.6%) (ICTA), out-of-vehicle traffic accident in 4 (10%) (OCTA) and being trapped under a wreck in 2 (6.6%).

Examination in the emergency unit included evaluation of an additional hand injury, hip dislocation or ischiadic nerve injury. On admission, all patients with acetabular fractures underwent antero-posterior pelvic X-Rays, and 45-degree oblique pelvic X-Rays (obturator and iliac) defined by Judet [4]. The fractures of all patients were classified according to the criteria of Judet and Letournel [5] with the help of the X-Rays and computed tomography (CT) images prior to the surgery (Image 1). Until the surgical intervention, 28 patients were followed-up with skeletal traction and 2 with cutaneous traction. Post-op skeletal traction was performed on only one patient. The mean duration between the date of the accident and surgery was 5.5 days (distribution: 1-13 days) and the mean duration of hospital stay was 12 days (distribution: 6-23 days).

Administration of low molecular weight heparin was begun for all patients for thromboembolism prophylaxis. Antibiotics

prophylaxis was provided for all patients prior to surgery. All patients were told to wear antiembolism stockings in the post-operative period.

Physiotherapy including isometric exercises was begun right after the surgery in all patients undergoing stable osteosynthesis. The patients were mobilized using double crutches until the 6th week without weight bearing. From the 6th week, they were mobilized with partial weight bearing until the 12th week. They were permitted to walk without crutches with complete weight bearing after the 12th week.

The qualities of the reduction and internal fixation were evaluated using post-op A-P pelvis and Judet X-Rays (Image 2). Matta's radiological criteria were used to evaluate the radiological data. Matta's modified criteria of Merle d'Aubigne and Postel were used for the clinical evaluation [5,6]. Brooker's classification was used in heterotrophic ossification follow-ups [7].



Image 1. Acetabulum, fractures of both columns, pre-operative X-Rays, axial and 3-dimensional CT image



Image 2. Post-op pelvis AP and Judet X-Rays

## Statistical Analysis

The descriptive statistics for the continuous variables were expressed as mean, standard deviation, minimum and maximum values, and the categorical variables were expressed as count and percentages. The one-way variance analysis was performed for the comparisons performed according to the categorical variables with regard to continuous variables. The Pearson or Spearman coefficient of correlation was calculated for determining the relationship between the continuous variables. The Chi-square test was used to determine the relationship between the categorical variables and the Z test was used for comparison of the ratios. Statistical significance was accepted as 5%, and the SPSS program package was used for the statistical calculations.

## Results

Additional organ-fracture involvement was present in 19 (63.3%) patients. Among these, 16 had one or more additional bone fractures. Two patients had thoracic and 1 patient had orbital injuries.

According to the classification of Letournel, 12 of the fractures (40%) were simple (elementary) and 18 (60) were complex. Seven of the simple fractures (23.3%) were posterior wall, 3 (10%)

were transverse, and 2 (6.6%) were posterior column fractures. Two of the complex fractures (6.6%) were posterior wall and column fractures, 4 (13.3%) were transverse and posterior wall fractures, 4 (13.3%) were T-type fracture, 2 (6.6%) were anterior column and posterior hemitransverse fractures, and 6 (20%) were fractures of both column.

According to the evaluation of fracture reductions of 30 patients undergoing the operation, 43.3% (13 patients) had anatomical reduction, 43.3% had (13 patients) successful reduction, and 13.3% (4 patients) had poor reduction. The quality of the reduction differed according to the structure of the fracture as simple or complex. 12 of 30 patients had simple fracture and 10 (83.3%) were evaluated as anatomical reduction. Among the 18 complex fractures, 3 (16.6%) were evaluated as anatomical reduction. 4 patients evaluated as poor reduction belonged to the complex type.

Table 1. presents the relationship between the quality of reduction and Matta's radiological evaluation criteria. Table 2 presents the relationship between the quality of reduction and the clinical evaluation criteria of Merle d'Aubigne and Postel.

Table 1. Relationship between the quality of reduction and Matta's radiological evaluation criteria.

		Reduction			
		Anatomical	Successful	Poor	
Radiology	count	13	10	1	
	Excellent+ good	Intra radiology %	54,2%	41,7%	4,2%
		Intra reduction %	100,0%	76,9%	25,0%
		Total %	43,3%	33,3%	3,3%
	Moderate+ poor	count	0	3	3
		Intra radiology %	0,0%	50,0%	50,0%
Intra reduction %		0,0%	23,1%	75,0%	
	Total%	0,0%	10,0%	10,0%	
Total	Count	13	13	4	
	Radiology%	43,3%	43,3%	13,3%	
	Intra reduction %	100,0%	100,0%	100,0%	
	Total%	43,3%	43,3%	13,3%	

Chi-square= 10,889 p= 0,004

Table 2. Relationship between the quality of reduction and clinical evaluation criteria of Merle d'Aubigne and Postel.

		Reduction			
		Anatomical	Successful	Poor	
Clinical	Count	13	8	1	
	Excellent + good	Intra clinical %	59,1%	36,4%	4,5%
		Intra reduction %	100,0%	61,5%	25,0%
		Total %	43,3%	26,7%	3,3%
	Moderate+ poor	Count	0	5	3
		Intra clinical %	0,0%	62,5%	37,5%
Intra reduction %		0,0%	38,5%	75,0%	
	Total %	0,0%	16,7%	10,0%	
Total	Count	13	13	4	
	Intra clinical %	43,3%	43,3%	13,3%	
	Intra reduction %	100,0%	100,0%	100,0%	
	Total %	43,3%	43,3%	13,3%	

Chi-square= 10,431 p=0,005

Eight patients among all patients had hip dislocation. Heterotrophic ossification was observed in 8 patients (26.6%) during the follow-up period. Among those, 5 were stage 1, 1 was stage 2, and 2 were stage 3 according to the classification of Brooker. Ischiadic nerve deficit was observed in 3 patients (10%) pre-operatively. Among these, 1 showed complete recovery during the follow-up. Ischiadic nerve deficit developed in 1 patient as a complication. In the 12<sup>th</sup> month visit of this patient, ischiadic nerve sensory site was observed to be healthy, but motor deficit persisted.

Femoral vein injury developed during the ilio-inguinal approach in a patient and repair was performed by the surgeons of the Cardiovascular Surgery Department. No problem was observed during the follow-up.

Deep vein thrombosis developed in the post-operative follow-up of a patient who was 68 years old. Complete recovery was observed in the 9th month visit of this patient.

Post-traumatic arthritis was observed in 4 patients (13.3%) and avascular necrosis was observed in 2 patients (6.6%) during the post-operative long term follow-up period.

## Discussion

Treatment of acetabular fractures forms a difficult part of developing orthopedics and necessitates a serious learning curve [8]. As in all intra-articular fractures, acetabular fractures necessitate anatomical restorations in order to prevent a possible arthrosis in the future [3].

Zhu et al. have demonstrated a significant relationship between hip dislocation and the prognosis [9]. In the long-term study of Lichte et al., a significant relationship was determined between hip dislocation and the radiological outcomes [10]. In our study, 8 patients had posterior dislocation. No significant relationship was determined between the presence of a posterior dislocation and the radiological outcomes.

Delays of three weeks or longer in the treatment of acetabular fractures via open reduction or internal fixation may result in iatrogenic nerve injuries at a rate of 12% [11]. Letournel and Judet [4] reported the rate of iatrogenic nerve injury following surgery via Kocher-Langenbeck incision in the first term as 18.4%, which regressed to 3.3% with the experience in time. Matta et al. [12] reported that iatrogenic nerve injury rates had regressed from 9% to 3.5% with the experience gained in time. In our study, post-operative ischiadic nerve deficit developed in one patient (3,3%). Positioning the the knee in flexion and protecting the nerve via lateral rotators and frequent control of separators have been recommended during surgery [13].

In the long-term study of Aşık et al. on a series including 240 patients, the clinical outcomes of simple fractures were excellent or good in 71% of the patients; however, no significant relationship was determined between the type of the fracture and the clinical outcome [14]. In our study including 30 patients, 12 patients (40%) had simple and 18 (60%) had complex fractures. Although no relationship was determined between the fracture type and radiological or clinical well-being ( $p>0.05$ ); simple and complex fractures showed very good or good recovery in 92% and 61% of the patients, respectively.

In the study of Matta on 259 patients, the quality of reduction was anatomically graded in 185 hips (71%). It was determined that the complex type of fracture affected the quality of reduction [3]. In the study of Aşık et al. on 240 patients, 168 patients (70%) had anatomical reduction, 48 (20%) had insufficient re-

duction, 17 (7%) had poor reduction and 7 (3%) had secondary nonunion. A significant relationship was determined between the quality of reduction and the type of the fracture, and observed that poor reductions had all developed in complex fractures [14]. In our study, 13 patients (43,3%) had anatomical and 13 (43,3) had successful reduction, and 4 (13,3%) had poor reduction. The rate of anatomical and successful reduction was observed to be 100% among simple fractures, whereas it was 77.7% in complex fractures. A significant relationship was determined between the degree of fracture reduction and the radiological outcomes ( $p<0,05$ ). Accordingly, anatomical and successful fracture reductions had better outcomes.

A complication that may be frequently encountered in acetabular fractures is heterotrophic ossification. Use of indomethacin in the prophylaxis of heterotrophic ossification and its effects are controversial in the literature. In the prospective study of Matta and Siebenrock [15] on 107 patients, indomethacin prophylaxis was observed to be ineffective in preventing the development of heterotrophic ossification. Kinik et al. [16] performed prophylactic indomethacin therapy on 39 patients with acetabular fracture, and determined heterotrophic ossification in 9 (23%). Alexa et al. [17] performed prophylaxis on 42 patients treated via the Kocher-Lagenback incision, and determined grade 1 and 2 heterotrophic ossifications in 8 (21%) and 6 patients (15,7%), respectively. In our study, indomethacin prophylaxis was not performed routinely. According to the classification of Brooker, grade 1, 2 and 3 heterotrophic ossifications were determined in 5, 1 and 2 patients, respectively, and a total of 8 patients (26.6%). Heterotrophic ossification did not affect the clinical manifestation in any of the patients. It was concluded that heterotrophic ossification may be reduced significantly through a careful soft tissue dissection in acetabular fracture surgery by experienced surgeons.

Femoral head avascular necrosis (AVN) is an important problem that may be encountered following acetabular fractures especially in young patients [18]. Osteonecrosis was determined at a rate of 5.3% in the study of Thompson and Epstein, and at a rate of 4.7% in the study of Alexa et al. [13,17]. In our study, osteonecrosis developed in 2 (6.6%) patients. These patients had complex fractures. In 1 of these patients, an additional ipsilateral femoral neck fracture was present.

Post-traumatic osteoarthritis has been reported as the most serious primary late complication of acetabular fractures [2]. In the study of Heeg et al. (19) on 56 patients, 10 patients (17,8%) had post-operative osteoarthritis. In our study, 4 patients (13,3%) had post-traumatic arthritis, all of whom had complex type fractures.

Deep vein thrombosis and related pulmonary embolism are important complications that may lead to death. Letournel [2] has reported that venous thrombosis may be encountered at a rate of 3% and pulmonary embolism may be encountered at a rate of 1%. In our study, deep vein thrombosis developed in 1 case (3,3%).

The cases not responding well to surgical treatment were retrospectively investigated and it was observed that the main cause was insufficient reduction, in addition to the highly complex structure of the fracture. Thus, the type and localization of the fracture should be determined via a detailed pre-operative radiographic examination and the type of the incision should be determined [20].

In conclusion, we believe that a successful surgery of acetabu-

lar fractures is dependent on a disciplined team-work, a careful peri- and post-operative follow-up of the patients and the experience that can be gained within years.

#### Scientific Responsibility Statement

*The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.*

#### Animal and human rights statement

*All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.*

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#### Conflict of interest

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