Research Article / Araştırma Makalesi

Management and Outcomes of Displaced Fractures of the Acetabulum

Deplase Asetabulum Kırıklarının Yönetimi ve Klinik Sonuçları

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Abstract

Background: Surgical management of displaced acetabular fractures represents a challenge for orthopedic surgeons due to their biomechanical complexity. An open reduction with anatomical correction can provide good to excellent clinical results for these patients. However, this depends on several determinants, such as the center experience, surgical approach, patient age, and fracture mechanism. The purpose of this study was to evaluate the anatomical, radiologic and functional results of the acetabular fracture treatments in a level 1 trauma center of a university hospital.
Materials and Methods: This single-center retrospective clinical study was conducted between January 2011 and June 2015 at Harran University Medical School, Department of orthopedics, and traumatology. Patients who presented to the emergency department with acetabular fractures and managed surgically were included in the study. Demographic variables, mechanisms of injury, surgical approach, complications, radiographic and functional outcomes were recorded from patient charts. Anatomical results were examined on standard x rays of the pelvis and Judet`s oblique radiographs. Clinical results were analyzed according to the Postel-Merle d'Aubigne criteria.
Results: Forty-eight patients presented to our emergency department with acetabular fractures. Seventeen of these patients were treated surgically, whereas 31 were managed conservatively. The most common type of injury was motor vehicle accidents. In the surgical reduction of these fractures, mostly the Kocher-Langenbeck approach was preferred by the surgeons. The mean follow-up of patients was mean 4.2 years. According to Matta's criteria, the reduction was considered anatomical in 5 patients, acceptable in 10 patients, and poor in 2 patients. During the last postoperative follow-up of these patients, eight were evaluated as excellent, four good, two fair, and three poor according to Matta`s radiologic criteria. Overall, twelve patients in the study cohort presented good or excellent clinical and functional results (70.5%).
Conclusions: This study adds additional data to the growing body of clinical research and validates open reduction as the treatment of choice in selected high energy injuries of the acetabulum. Additionally, in the long-term follow-up, this strategy has shown satisfactory clinical and functional results.

Keywords: Acetabulum fracture, Kocher Langenback, Pelvis fracture

Öz

Amaç: Yer değiştirmiş asetabular kırıkların cerrahi yönetimi, biyomekanik karmaşıklıkları nedeniyle ortopedik cerrahlar için bir zorluk teşkil etmektedir. Anatomik düzeltme ile açık redüksiyon bu hastalar için iyi ila mükemmel klinik sonuçlar sağlayabilir. Ancak, bu durum merkez deneyimi, cerrahi yaklaşım, hasta yaşı ve kırık mekanizması gibi çeşitli belirleyicilere bağlıdır. Bu çalışmanın amacı, bir üniversite hastanesinin 1. seviye travma merkezinde asetabulum kırığı tedavilerinin anatomik, radyolojik ve fonksiyonel sonuçlarını değerlendirmektir.
Materyal ve Metod: Bu tek merkezli retrospektif klinik çalışma Ocak 2011 ile Haziran 2015 tarihleri arasında Harran Üniversitesi Tıp Fakültesi Ortopedi ve Travmatoloji Anabilim Dalı'nda gerçekleştirildi. Acil servise asetabulum kırığı ile başvuran ve cerrahi olarak tedavi edilen 48 hasta çalışmaya dahil edildi. Demografik değişkenler, yaralanma mekanizmaları, cerrahi yaklaşım, komplikasyonlar, radyografik ve fonksiyonel sonuçlar hasta dosyalarından kaydedildi. Anatomik sonuçlar standart pelvis grafileri ve Judet'in oblik grafileri ile incelendi. Klinik sonuçlar Postel-Merle d'Aubigne kriterlerine göre analiz edildi.
Bulgular: Araştırmaya dahil edilen 48 hasta acil servisimize asetabulum kırığı ile başvurdu. Bu hastaların 17'si cerrahi olarak tedavi edilirken, 31'i konservatif olarak tedavi edildi. En sık görülen yaralanma tipi motorlu araç kazalarıydı. Bu kırıkların cerrahi redüksiyonunda cerrahlar tarafından çoğunlukla Kocher-Langenbeck yaklaşımı tercih edildi. Hastaların ortalama takip süresi 4,2 yıldı. Matta'nın kriterlerine göre redüksiyon 5 hastada anatomik, 10 hastada kabul edilebilir ve 2 hastada kötü olarak değerlendirildi. Bu hastaların ameliyat sonrası son takiplerinde Matta'nın radyolojik kriterlerine göre sekizi mükemmel, dördü iyi, ikisi orta ve üçü kötü olarak değerlendirildi. Genel olarak, çalışma kohortundaki on iki hasta iyi veya mükemmel klinik ve fonksiyonel sonuçlar sundu (%70,5).
Sonuç: Bu çalışma, artan klinik araştırmalara ek veriler eklemekte ve asetabulumun seçilmiş yüksek enerjili yaralanmalarında tercih edilen tedavi olarak açık redüksiyonu doğrulamaktadır. Ayrıca, uzun dönem takipte, bu strateji tatmin edici klinik ve fonksiyonel sonuçlar göstermiştir.

Anahtar Kelimeler: Asetabulum kırığı, Kocher Langenback, Pelvis kırığı

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Introduction

Acetabular fractures are among the most complex fractures in orthopedic surgical practice (1). Anatomic reduction of these fractures was shown to provide excellent functional outcomes. In 1964, Robert Judet and Emile Letournel described an anatomical reduction technique for these fractures (2). Subsequently, Matta worked on the reduction and fixation techniques and emphasized the force distribution on the acetabulum and its specific arcs (3). The measurements described in this report were used as a guide to decide for an open versus closed management (3). In the short-term, the anatomical and functional results of surgical management were reported as satisfactory by several trauma centers (4-6). However, the risk of inadequate reduction, nerve injury, and heterotrophic ossification continued to be a primary cause of morbidity after surgery (7). Besides, long-term follow-up results are yet to be shared by some centers with a relatively high caseload.

The purpose of this study was to evaluate the long-term anatomical and functional results of the acetabular fractures treated with surgery in a level 1 regional trauma center of a University Hospital in Turkey.

Materials and Methods

This retrospective clinical study was conducted between January 2011 and June 2015 at Harran University Medical Faculty, Department of Orthopedics and Traumatology. It was approved by the local Ethical Review Committee of the same university. All patients were previously asked to sign a consent form to use their medical and surgical data in the context of this study. The data of the patients who signed these forms were reviewed. Patients who presented with acetabular fractures to the emergency department and underwent surgeries for acetabular reduction were included in this study. Patients younger than 15 and those with recoil time less than 36 months were excluded. Additionally, patients with incomplete data or those who were lost to follow-up were omitted.

Patients suspected of having an acetabular trauma at the emergency department were evaluated with the plain anteroposterior pelvis and Judet oblique radiographs. This evaluation was followed by three-dimensional computed tomography (CT) scans in case of a fracture. These radiological images and their reports were recorded in PACS (Picture Archiving and Communication System). Fracture patterns were classified according to Judet and Letournel (2). Indications for surgical treatment comprised of fractures presenting with more than 3mm of displacement, joint instability, and marginal articular impaction with loose bodies. Surgical interventions were initiated as soon as the patients` general condition permitted, and diagnostic evaluations were completed. The primary determinant of the surgical approach was the fracture pattern.

General endotracheal anesthesia was performed for all surgical interventions. When possible, a urinary catheter and a gastric tube were placed. Prophylactic second-generation cephalosporin antibiotics were administered intravenously 30 minutes before the skin incision, and prophylactic antibiotherapy continued until the surgical drains were removed. Compression stockings were used by all patients preoperatively for deep vein thrombosis (DVT) prophylaxis. Additionally, 0.6 ml of low molecular weight heparin was administered subcutaneously daily until the patients were fully mobilized. The patients were mobilized from bed to chair on postoperative day 2. Limited weight-bearing on the involved leg (toe-touch 10 kg) was maintained for 8-12 weeks, depending on the injury pattern. Weight-bearing of the body weight was allowed on postoperative 14th week. The patients were evaluated clinically and radiologically in the early postoperative period, and the quality of fracture reduction was assessed by measuring the residual displacement. The maximum residual displacement was measured to grade the quality of reduction according to Matta's criteria as anatomical (i.e., displacement less than 2 millimeters), imperfect (i.e., a displacement between 2 and 3 mm), or poor (i.e., displacement more than 3 mm) (3). Postoperative complications such as surgical site infection, deep vein thrombosis (DVT), heterotrophic ossification, and nerve palsies were recorded from the patient charts. On postoperative 12th month and once a year afterward, patients were evaluated radiologically as per Matta's criteria and clinically according to Postel-Merle d'Aubigne criteria (Tables 1 and 2) (1, 3). Overall functional outcome was assessed based on pain, range of motion of the joint, and ambulation status of the patient.

Statistical Analysis

Descriptive statistics were used to present the data. As a measure of central tendency, mean values were calculated. Standard deviation and minimum-maximum values were displayed as measures of variability.

Results

Forty-eight patients presented to our emergency department with an acetabular fracture within the study period. Seventeen (35.4%) of these patients were treated surgically, whereas 31 (64.6%) were managed conservatively. Thirteen patients were injured due to motor vehicle collisions, 10 were inside the vehicle, and 3 were pedestrians (Table 3). The other causes of trauma were gunshot, motorcycle accident, and accidental high fall. Nine (52%) of the surgically treated patients had one or more additional injuries, and six of them underwent concomitant surgical interventions other than acetabular fixation.

The majority of these patients were male (n=12, 70%), while only five were female (30%). The mean age of these patients was 36.3 [15-78]. Nine (53%) patients had right-sided and 8 (47%) patients had left-sided acetabular fractures. Fracture types, classified according to Judet, are shown in Table 3. Nine of the fractures were classified as simple fractures of the acetabulum (53%), while complex fractures were encountered in 8 (47%) of these patients (Table 4).

Table 1. Radiological outcome according to Matta.

Grade	Osteophytes	Joint Space Narrowing	Sclerosis	Femoral Head Subluxation
Excellent	None	Normal	None	None
Good	Small	> 1mm	Minimal	None
Fair	Moderate	< 50%	Moderate	Minimal
Poor	Large	>50%	Severe	Moderate to Severe

mm: Milimeter

Table 2. Clinical outcome scoring system according to Postel-Merle d'Aubigne criteria

Score	Pain	Mobility	Ability to Walk
0	Intense and permanent	Ankylosis abnormal position	Impossible
1	Severe, disturbing sleep	Ankylosis normal position	Only with crutches
2	Severe, when walking	Flexion <40˚	Only with two canes
3	Severe, with limited activity	Flexion <40˚- 60˚	With one cane
4	Only with walking	Flexion <60˚- 80˚	Limited without a cane
5	Intermittent, normal activity	Flexion <80˚- 90˚, limited abduction	No cane with slight limp
6	None	Flexion >90˚, abduction	Normal

Table 3. Patient characteristics.

Patient no.	Gender	Age	Injury	Fracture type	Surgical Approach	Radiologic Score	Clinical Score
1	Male	15	High Fall	Complex	Extended Iliofemoral + Kocher Langenbeck	Fair	Excellent
2	Male	35	Gun Shot	Simple	Kocher Langenbeck	Good	Excellent
3	Female	40	MVA	Simple	Kocher Langenbeck	Excellent	Excellent
4	Female	32	MVA	Complex	Kocher Langenbeck	Fair	Fair
5	Female	34	MVA	Complex	Ilioinguinal + Kocher-Langenbeck	Poor	Good
6	Male	28	MVA	Complex	Ilioinguinal + Kocher-Langenbeck	Fair	Fair
7	Male	41	MVA	Simple	Kocher Langenbeck	Excellent	Excellent
8	Female	52	MVA	Complex	Ilioinguinal + Kocher-Langenbeck	Poor	Fair
9	Male	20	MVA	Simple	Kocher Langenbeck	Excellent	Excellent
10	Male	28	MVA	Simple	Ilioinguinal	Poor	Good
11	Male	78	MVA	Simple	Kocher Langenbeck	Excellent	Fair
12	Male	56	MVA	Complex	Kocher Langenbeck	Fair	Poor
13	Male	18	MC	Simple	Kocher Langenbeck	Good	Excellent
14	Male	73	MVA	Simple	Kocher Langenbeck	Excellent	Good
15	Female	24	MVA	Simple	Ilioinguinal	Excellent	Excellent
16	Male	28	MVA	Complex	Kocher Langenbeck	Good	Good
17	Male	15	MC	Complex	Kocher Langenbeck	Good	Excellent

MVA: Motor Vehicle Accident, MC: Motorcycle Crash

Seven of the patients had posterior hip dislocation at the time of admission, and reduction of the hip dislocations was performed under sedation at the emergency department. Skeletal traction was applied to these patients using a Schanz nail until the definitive surgical procedure. The mean interval between conclusive surgery and admission to hospital was 4. 9 [2-12] days. The most frequently used surgical approach was Kocher-Langenbeck, followed by the simultaneous ilioinguinal and Kocher-Langenbeck approach (Table 5).

The minimum and mean follow-up durations were 3 and 4.2 years. Radiographic fracture union was attained in all patients within a mean period of 3.5 months postoperatively. In the early postoperative period, the assessment revealed that the reduction was anatomical in 5, fair in 10, and poor in 2 patients as per Matta's criteria. During the last postoperative follow-up visit of these patients, 8 were evaluated as excellent, 4 as good, 2 as fair, and 3 as poor according to Matta`s radiological criteria.

Clinically, according to Postel-Merle d'Aubigne criteria, 8 (47%) of our patients had 'excellent' and 4 (23.5%) of our patients had 'good' clinical scores. On the other hand, 4 (23.5%) had fair, and 1 (6%) had poor scores. Overall, 12patients in the study cohort presented excellent or good clinical results (70.5%.) During the follow-up period, sciatic nerve paralysis was not encountered in any patients. Surgical site infections were detected in 4 (23.5%) of the 17 surgically treated patients. Three were superficial infections managed with daily wound care. One deep surgical site infection required systemic antibiotic treatment. This patient was eventually taken back to the operating room for washout and debridement. The infection improved with continued wound care and the use of antibiotics effective against the cultured bacteria. Deep vein thrombosis and heterotopic ossification were not detected in any study patients.

Table 4. Fracture types according to Judet classification.

Fracture Type	Number of Patients
Complex Fractures	8 (47%)
• T Shaped and Posterior Wall	2
• Posterior Wall and Anterior Colon	2
• Posterior Wall and Posterior Colon	1
• Posterior Column and Hemi- transverse	1
• Transverse and Posterior Wall	1
• Anterior and Posterior Wall	1
Simple Fractures	9 (53%)
• Posterior Column	4
• Posterior Wall	3
• Transverse	2

Table 5. Frequency of surgical approaches used for management of acetabular fractures.

Surgical Procedure	Number of Patients
Kocher-Langenbeck	11 (64.7%)
Ilioinguinal	2 (11.7%)
Extended Iliofemoral + Kocher-Langenbeck	1 (6%)
Ilioinguinal + Kocher-Langenbeck	3 (17.6%)

Discussion

With the advancements in technology and industry, the number and severity of traffic and work accidents increased (8). These accidents usually involve complicated high-energy injuries, and by its very nature, they can affect multiple organ systems (9). Since acetabular fractures may occur during these injuries, these fractures' rates increased over the last 15 years (10). However, since these cases are shared between different centers, the number of centers with comprehensive experience regarding complex acetabular fractures remains insufficient. These centers' clinical and radiological results are also highly variable, and mostly their long-term outcomes are lacking in the literature. One of the primary reasons for this variability and underrepresentation is the discrepancy among the acetabular fracture classifications (11, 12). Since the Judet-Letournel classification is most widely used in the literature, we used this classification in our study (11). We routinely obtain anteroposterior, Judet's 45˚ iliac, and obturator radiographs preoperatively in our clinical practice. This approach was useful for classifying the acetabular fractures as per the Judet-Letournel classification system.

Matta and Letournel, who are the leading advocates of surgical management in acetabular fractures, reported satisfactory clinical results in more than 80% of their patients (12, 13). Subsequently, Ridder and Ruesch shared their own experiences on the surgical treatment of acetabular fractures, which were consistent with Letournel and Matta's results. In this study, we obtained 'excellent' or 'good' clinical results in 70.5% of our patients. This finding is compatible with the literature (12, 13).

It is widely accepted that these patients' clinical results were correlated with the quality of the articular reduction and radiologic correction (14). In 2012, Matta published the most extensive single surgeon series of patients surgical treated for acetabular fractures (3). This study demonstrated that the postoperative radiographic findings were strong indicators of the long-term clinical outcomes. The radiological classification system proposed in this report has been accepted as established evaluation criteria for articular reductions. In a meta-analysis including 3249 patients with acetabular fractures, only 6.9% of patients demonstrated poor radiological results according to the Matta classification (15). In this study, poor radiological results were encountered in only 3 patients according to the Matta criteria, and a total of 15 patients had satisfactory radiological results.

Anatomical reduction of these fractures is necessary to obtain optimal radiologic outcomes. However, the achievement of anatomical reduction depends on the surgical exposure, and surgical exposure is directly affected by the surgical technique (16). The ideal surgical technique is the one that provides adequate exposure and permits anatomical reduction of the fracture with good control over the fracture fragments. It also has low complication rates. The Kocher-Langenbeck approach was widely used to fix acetabular fractures with relatively low complication rates (16, 17). The reliability of this approach was proven by Letournel and Matta (2, 3). In our center, the most frequently performed technique was Kocher-Langenbeck; 11 of the 17 surgically treated patients underwent this procedure.

Complications that may occur during the treatment of acetabular fractures may significantly impact clinical outcomes (18, 19). Inadequate anatomical reduction, intraarticular implant, heterotopic ossification, vascular nerve injuries are the most frequent complications encountered after the surgery of acetabular fractures. Deep venous thrombosis, heterotopic ossification, infection, chondrolysis, avascular necrosis of the femoral head, and posttraumatic osteoarthritis are the other complications reported in the literature

(20, 21). In our study, we did not encounter DVT or heterotopic ossification in any of our patients. However, we detected infection in 4 patients (23.5%). The underrepresentation of possible complications in this study may be due to its small sample size.

Additionally, since this is a retrospective study, there might have been an information bias leading to inaccurate data analysis regarding complications. However, it must also be considered that our refined surgical technique, paying close attention to anatomical planes during surgery, and insight into acetabular injury's mechanism might have a significant impact on these positive clinical outcomes. The mean patient age was 36.3 years in our study, indicating that our patients were younger than those reported in other series. This fact might also have contributed to the favorable clinical outcomes of our study population.

Conclusion

This study adds data to the growing body of clinical research and validates open reduction as the treatment of choice in selected high-energy injuries of the acetabulum. Additionally, in the long-term follow-up, this strategy has shown satisfactory clinical and functional results.

***Ethical* Approval:** For the study, approval dated 12/12/2014 and numbered HRU/14.12.05 was obtained from the Research Ethics Committee of Harran University and the article was produced from the thesis (master's/doctoral) study. Our study was planned in accordance with the ethical standards specified in the Declaration of Helsinki.

Author Contributions:
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Data acquisition: M.Y.
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Writing manuscript: M.Y.
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