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Clinical and Radiological Evaluation of Surgically Treated Acetabulum Fractures

Cerrahi Olarak Tedavi Edilen Asetabulum Kırıklarının Klinik ve Radyolojik Değerlendirmesi

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ABSTRACT

Aim: Acetabular fractures were evaluated by Judet and Letournel in two main groups as elementary and associated fractures. There are publications in the literature that the results are worse as the complexity of the fracture increases. The aim of this study was to evaluate whether clinical outcomes are worse in associated fractured patients.

Material and Methods: The study included 48 acetabular fractures admitted to the emergency room and treated surgically between December 2011 and October 2020. Patient's trauma, additional injuries, surgical method, early or late complications, and range of motion at the last follow-up were documented. Clinical and radiological results of the patients were evaluated by modified Merle d'Aubigné, functional capacities by Harris hip scoring systems.

Results: There were 25 elementary fractures and 23 associated fractures in patients. When the complication rates were examined, the rate of those without complications was 52.0% (n=13) among elementary fractures, while the rate was 34.8% (n=8) in associated fractures. When the fracture types were evaluated according to the Harris hip score, elementary fractures have better score than associated fractures, but no statistically significant difference was observed between them (p=0.056). When evaluated according to Merle d'Aubigne score, it was observed that elementary fractures had significantly better scores (p=0.004).

Conclusion: As the complexity of the fracture increases, it can be predicted that the clinical outcomes of the patient will be worse. It is also concluded that the elementary fracture type had better clinical outcomes than the associated fracture type in our own surgically treated acetabular fractures.

Keywords: Acetabular fractures; acetabular fracture types; elementary type fractures; surgical treatment.

ÖZ

Amaç: Asetabulum kırıkları Judet ve Letournel tarafından elementer ve kompleks kırıklar olmak üzere iki ana grupta değerlendirilmiştir. Literatürde kırığın kompleksitesi arttıkça sonuçların daha da kötüleştiğine dair yayınlar bulunmaktadır. Bu çalışmanın amacı, kompleks kırıklı hastalarda klinik sonuçların daha kötü olup olmadığını değerlendirmektir.

Gereç ve Yöntemler: Çalışmaya, Aralık 2011 ve Ekim 2020 tarihleri arasında acil servise başvuran ve cerrahi olarak tedavi edilen kırk sekiz asetabulum kırığı dahil edildi. Hastaların travmaları, ek yaralanmalar, cerrahi yöntem, erken ve geç komplikasyonları ve son takipteki hareket açıklıkları kaydedildi. Hastaların klinik ve radyolojik durumları modifiye Merle d'Aubigné skoru ile ve fonksiyonel kapasiteleri ise Harris kalça skoru ile değerlendirildi.

Bulgular: Yirmi beş hastada elementer kırık ve 23 hastada kompleks kırık mevcuttu. Komplikasyon oranları incelendiğinde elementer kırıklar içerisinde komplikasyon olmayanların oranı %52,0 (n=13) iken, kompleks kırıklarda oran %34,8 (n=8) idi. Kırık tipleri Harris kalça skoruna göre değerlendirildiğinde, elementer kırıklar kompleks kırıklardan daha iyi skora sahip olmakla birlikte aralarında istatistiksel olarak anlamlı bir farklılık gözlenmemiştir (p=0,056). Merle d'Aubigné, skoruna göre değerlendirildiğinde elementer kırıkların anlamlı derecede daha iyi skorlara sahip olduğu görüldü (p=0,004).

Sonuç: Kırığın kompleksitesi arttıkça hastanın klinik sonuçlarının daha kötü olacağı tahmin edilebilir. Cerrahi olarak tedavi edilmiş asetabulum kırıklı kendi olgularımızda da, elementer kırık tipinin kompleks kırık tipine göre daha iyi klinik sonuçlara sahip olduğu sonucuna ulaşıldı.

Anahtar kelimeler: Asetabulum kırıkları; asetabulum kırık tipleri; temel kırık tipleri; cerrahi tedavi.

INTRODUCTION

Today's technological advancements and widespread use of automobiles result in high-energy traffic accidents and an increase in acetabulum fractures (1,2). Anatomical reduction and internal fixation are the current treatments for displaced acetabular fractures to decrease the incidence of later complications (3). The successful surgical treatment of acetabular fractures is the result of a steep learning curve and lengthy experience, making these fractures particularly arduous to cure (4).

Judet et al. (5) described the radiographic classification of acetabular fractures and treatment options for fracture types and a thorough understanding of the fracture by radiological imaging and selection of the best surgical strategy for the fracture type determines the success of acetabulum fracture therapy (3). Numerous studies in the literature look at the severity of acetabular fracture complications and their prognosis after surgical treatment (6). This study evaluated the influence of fracture type on the prognosis of acetabular fractures after surgical treatment.

This study aimed to evaluate the radiological and clinical outcomes of acetabular fractures treated surgically, hypothesizing that surgical treatment would result in the best radiological and clinical outcomes in cases of elementary type fractures.

MATERIAL AND METHODS

This study was conducted retrospectively in accordance with the ethical standards of the SBU Istanbul Training and Research Hospital Clinical Research Ethics Committee and the 1975 Declaration of Helsinki revised in 2013. Ethics committee approval was obtained (Decision No. 1625, 04/01/2019). Patients admitted to the emergency department and treated for acetabular fractures between December 2011 and October 2020 were screened using digital data and hospital patient files. Acetabulum fractures were classified according to Judet's classification system (5) and those with a minimum 12-month follow-up were included in the study; those that were followed conservatively, that had a follow-up period of less than 12 months, and that had inaccessible data were excluded from the study. As pediatric acetabular fractures may require different clinical approaches, this study was again excluded.

Surgical Procedure

All surgeries were performed by two experienced (more than 15 years) pelvic surgeons, and depending on the preference of the treating surgeon, each surgery was performed using 3 different surgical techniques. If the anterior approach is preferred according to the location of the fracture, ilioinguinal or modified Stoppa; if the posterior approach is to be preferred, Kocher Langenbeck or combined approach is preferred depending on the type of fracture. All patients underwent surgery under pre-op 1 gram cefazolin-sodium antibiotic prophylaxis. Antibioprophylaxis was continued for 2 days after surgery. For the prophylaxis of heterotopic ossification after surgery, patients were given 3*25 mg of indomethacin for 3 weeks.

Data and Measurements

Patients' age, gender, mechanism of trauma, concomitant injuries, co-dislocation, accompanying neurological deficits included lateral femoral cutaneous nerve status, fracture type according to Judet and Letournel (5) classification as elementary (Figure 1) or associated (Figure 2), incision preferences were obtained from patient records in this study. Hip range of motion was measured at the last visit. Clinical results were evaluated through the scoring system of Merle d'Aubigné modified by Matta (7). Harris hip score was used to evaluate the functional outcomes.

Statistical Analysis

IBM SPSS v.21.0 for Windows statistical package was used for statistical analysis. Shapiro-Wilk test was used to evaluate the normality distribution of data. The comparisons of the two independent groups were made

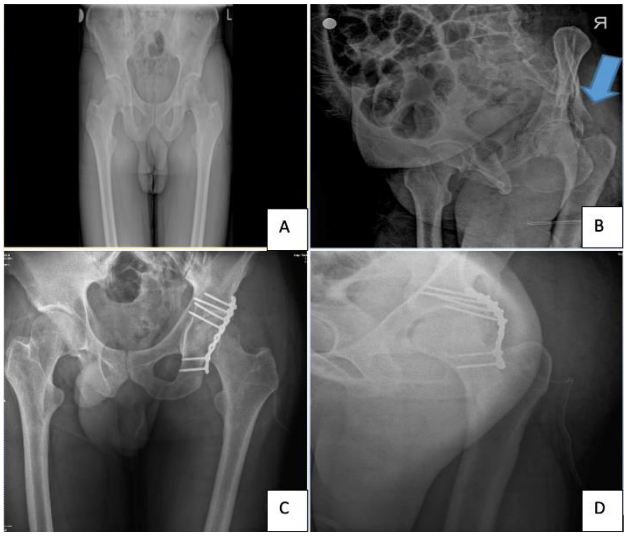

Figure 1. A) Pre-op anteroposterior view, **B)** Pre-op obturator oblique view (arrow shows "Gull Sign"), **C)** Post-op anteroposterior view, and **D)** Post-op obturator oblique view of posterior wall fracture

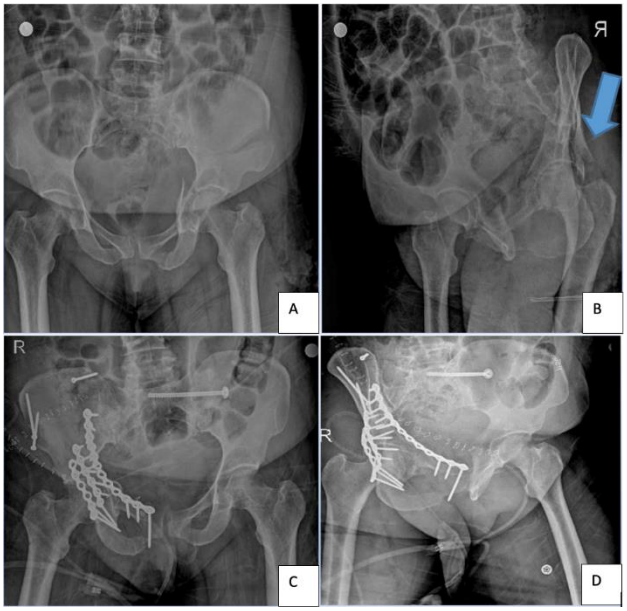

Figure 2. A) Pre-op anteroposterior view, **B)** Pre-op obturator oblique view (arrow shows "Spur Sign"), **C)** Post-op anteroposterior view, and **D)** Post-op obturator oblique view of both column acetabular fracture

with the Mann-Whitney U test, and the median, 25th and 75th percentiles, and minimum-maximum values were given. Categorical variables between groups were analyzed by Pearson chi-square, Fisher's exact, and Fisher-Freeman-Halton test, as appropriate. The statistical significance level was considered as $p<0.05$.

RESULTS

A total of 55 patients who had undergone acetabular fracture surgery were retrieved from hospital records. It was determined that 3 patients did not have up-to-date contact information and left their follow-up. It was observed that 2 patients died in the early post-op period (one with intracranial hemorrhage and the other with massive pulmonary embolism). It was observed that 1 patient was treated with the percutaneous method and 1 patient had bilateral acetabular fractures. These 7 patients were excluded from the study. A total of 48 (13 female and 35 male) patients were included in this study. There were elementary fractures in 25 patients and associated fractures in 23 patients. The median age at the time of surgery was 30 (range, 18-68) years for elementary fracture type and 39 (range, 18-73) years for associated fractures. Both groups were similar in terms of demographic and clinical characteristics (Table 1). Functional outcomes and complication rates are shown in Table 2. Fracture union was achieved in all patients.

There was no significant difference between fracture type in terms of gender, mechanism of injury, complication, and surgical approach (p=0.250, p=0.217, p=0.823, and p=0.847, respectively). While the male and female in elementary fractures was 20.0% (n=5) vs 80.0% (n=20), it was 34.8% (n=8) vs 65.2% (n=15) in associated fractures. Of the elementary fractures, 76.0% (n=19) resulted from traffic accidents, 20.0% (n=5) from falling from a height and 4.0% (n=1) from being struck by a weight. Of the associated fracture, 52.2% (n=12) resulted from traffic accidents, 34.8% (n=8) from falling from a height, 8.7% (n=2) from sports injuries and 4.3% (n=1) from being struck by a weight. A total of 10 cases were accompanied by posterior hip dislocation. While only 15 (31.3%) patients had isolated acetabulum fractures, 33 (68.8%) patients had additional injuries. As the accompanying traumas; the cases with acetabular fractures are mostly accompanied by lower extremity injuries (34%, n=19), followed by upper extremity injuries (20%, n=11) and non-acetabular pelvic ring injuries (20%, n=11).

Although the scores of elementary fractures were higher than the associated fractures according to the Harris hip score at the last follow-up of the patients, no statistical significance was found (p=0.056). When the patients were evaluated according to the modified Merle d'Aubigné score, the scores of elementary fractures were found to be statistically significantly higher than those of associated fractures (p=0.004). When the two groups were evaluated according to the range of motion of the hip joint, no statistically significant difference was found.

When the relationship between complication and fracture type was examined, the rate of those with elementary fractures with no complications was 52.0% (n=13), with osteoarthritis was 16.0% (n=4), with infection was 4.0% (n=1), with heterotopic ossification was 12.0% (n=3), with neurological problems (including lateral femoral cutaneous nerve palsy) was 12.0% (n=3), and with AVN was 4.0% (n=1). The rate of those with associated fractures with no complications was 34.8% (n=8), with osteoarthritis was 26.1% (n=6), with infection was 8.7% (n=2), with heterotopic ossification was 8.7% (n=2), with neurological deficit (including lateral femoral cutaneous nerve palsy) was 17.4% (n=4), and with AVN was 4.3% (n=1).

DISCUSSION

In 1964, Judet and Letournel (5) proposed a classification for surgical treatment plan based on the anatomy of the pelvis and the biomechanics of the fracture. This classification is the most used classification today and we opted to use it in this study. This study grouped surgically treated acetabular fractures according to fracture type, elementary and associated, investigating the effects of fracture type on functional outcomes and complication rates after surgical treatment. We found that there is no significant range of motion difference between fracture types. In addition, the modified Merle d'Aubigné score is significantly better in the elementary group. The results of this study were compatible with the literature (8,9).

Acetabulum fractures are often accompanied by additional injuries. In one study, extremity fractures were associated

Table 1. Demographic and clinical characteristics of the patients in both fracture type

	Elementary Fracture (n=25)	Associated Fracture (n=23)	p
Age (years), median (25th -75th) [min-max]	30 (26-39) [18-68]	39 (24-56) [18-73]	0.219
Gender, n (%)			
Female	5 (20.0%)	8 (34.8%)	0.250
Male	20 (80.0%)	15 (65.2%)	
Mechanism of injury, n (%)			
Traffic accident	19 (76.0%)	12 (52.2%)	
Falling from high	5 (20.0%)	8 (34.8%)	0.217
Weight drop on	1 (4.0%)	1 (4.3%)	
Sport accident	0 (0.0%)	2 (8.7%)	
Time from injury to surgery (days)	5 (4-7) [1-16]	7 (4-10) [1-16]	0.285
Surgical incision preference, n (%)			
İlioinguinal	7 (28.0%)	5 (21.8%)	
Modified Stoppa	2 (8.0%)	4 (17.4%)	0.847
Kocher Langenbeck	15 (60.0%)	13 (56.5%)	
İlioinguinal + Kocher Langenbeck	1 (4.0%)	1 (4.3%)	

Descriptive statistics were presented as median, 25th and 75th percentiles, and minimum-maximum

Table 2. Comparison of postoperative results in both fracture type

	Elementary fracture (n=25)	Associated fracture (n=23)	p
Hip Joint extension	0° (0-0) [-10°-0°]	0° (0-0) [-10°-0°]	0.506
Hip Joint flexion	110° (110-120) [90°-120°]	110° (100-120) [90°-120°]	0.188
Hip Joint adduction	20° (15-30) [0°-40°]	15° (15-20) [0°-40°]	0.110
Hip Joint abduction	30° (20-40) [0°-30°]	25° (20-30) [0°-30°]	0.132
Hip Joint external rotation	20° (20-30) [0°-40°]	30° (20-35) [0°-35°]	0.372
Hip Joint internal rotation	20° (15-20) [0°-30°]	15° (10-20) [0°-25°]	0.055
Harris score	90 (88-91) [39-96]	82 (65-91) [22-96]	0.056
Merle d'Aubigné score	17 (16-17) [6-18]	15 (13-16) [7-18]	**0.004**
Complications, n (%)			
None	13 (52.0%)	8 (34.8%)	0.823
Osteoarthritis	4 (16.0%)	6 (26.1%)	
Infection	1 (4.0%)	2 (8.7%)	
Heterotopic ossification	3 (12.0%)	2 (8.7%)	
Neurological deficit	3 (12.0%)	4 (17.4%)	
Avascular necrosis	1 (4.0%)	1 (4.3%)	

Descriptive statistics were presented as median, 25th and 75th percentiles, and minimum-maximum

with acetabulum fractures at a rate of 42.7% (1). In this study, this rate was found to be 54%. The most common accompanying injury was fractures associated with the lower extremity, consistent with this study.

When we started to treat acetabular fractures surgically, we routinely preferred the ilioinguinal approach. As our experience increased, we started to prefer the modified Stoppa approach, where we had a better chance of approaching the fracture. In most of the fractures requiring an anterior approach, we use the modified Stoppa approach in our recent cases. In this study, we could not evaluate the success of the modified Stoppa approach, as we did not have the number of cases to be compared with the ilioinguinal approach. However, there are increasing numbers of studies in the literature stating that the modified Stoppa approach is a good alternative to the ilioinguinal approach (10-12).

One of the controversial issues is heterotopic ossification prophylaxis (13). We routinely administered indomethacin prophylaxis in our cases. Despite indomethacin, our heterotopic ossification rate is around 10%.

In general, acetabular fracture surgery is not emergent, and performing the surgery after taking 3-5 days to treat additional medical problems and minimize the possibility of increased bleeding (14) is appropriate. Madhu et al. (15) reported anatomical fracture reduction is easier if it occurs within 15 days for elementary fractures and within 5 days for associated fractures. Johnson et al. reported that the results of surgical treatment performed after 3 weeks were dramatically poor (16). In our series, the mean duration of surgery for patients was 6.4 days (1-16 days).

The factors affecting the prognosis of patients have been discussed in the literature. In many studies, it has been reported that the clinical outcomes of patients treated surgically in acetabular fractures depend on the quality of reduction and that the results are better than patients treated conservatively (6,17,18). Matta (19) reported in a study that the results were worse in cases where the complexity of the fracture increased. In another study, Johnson et al. (16) showed that good reduction positively affects clinical outcomes. In a recent study, the type of fracture, surgical time, and reduction quality were stated as the most important parameters (9). In this study, it could not be evaluated because the duration of the operation could not be reached from the records of the patients. Likewise, the step-off amount required to evaluate the reduction quality could not be evaluated because it could not be measured due to the lack of calibration. The increase in the complexity of the fracture affects the results negatively, which is consistent with this study.

This study has strengths and limitations. The strongest aspect of this study is the comparison of fracture types in the surgical treatment of acetabular fractures with similar patient distributions in the two groups; the weakest aspect is the limited sample size and retrospective study design.

CONCLUSION

Acetabular fractures are less common than other extremity injuries. Therefore, it is important that each treated case is well documented and followed up prospectively. In conclusion, we achieved better functional results after surgical treatment of acetabular fractures in cases of elementary type fractures; however, we believe that functional results are also good after surgical treatment of associated fractures.

Ethics Committee Approval: The study was approved by the Ethics Committee of İstanbul Training and Research Hospital (04.01.2019, 1625).

Conflict of Interest: None declared by the authors.

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