A review of acetabular fracture patterns, etiologies, and management in Jordan

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ABSTRACT

الأهداف: تقييم ومراجعة أنماط كسورعظم الحُق وعلاجها في الأردن وبناء أساس للدراسات المتقدّمة في المستقبل.

المنهجية: تمّت مراجعة مائة وواحد وأربعين حالة كسر في عظم الحُق أدخلت إلى مدينة الحسين الطبية في عمان، عاصمة الأردن، في الفترة من يوليو 2018م إلى ديسمبر 2022م بأثر رجعي. تم تصنيف الكسور وفقًا لتصنيف جوديت وليتورنيل وتم تحليلها فيما يتعلق بالعمر والجنس وسبب الإصابة وتصنيف الكسر وطريقة العلاج والإصابات المرتبطة بالعصب الوركي والإصابات المصاحبة في أجزاء الجسم الأخرى.

النتائج: مثّل الذكور 84.4% من المرضى بمتوسّط عمر 42.52 (± 17.655) سنة ، وكانت الفئة العمرية من 20 إلى 39 تمثّل 54.6% من المرضى. تسبّبت حوادث الطرق في 56.7% من الإصابات وعانى 53.9% من المرضى من اصابات مصاحبة لكسر عظم الحُق. كانت كسور الجدار الخلفي لعظم الحُق هي الأنماط الأكثر شيوعًا (37.6%)، تم تشخيص خلع رأس الفخذ في 28.4% من الإصابات. تم تشخيص إصابات العصب الوركي بسبب الإصابة الأصلية وكمضاعفة للتداخل الجراحي في 7% من المرضى. كان متوسط الوقت من الدخول إلى الجراحة 7.62 (±7.915) يومًا، وتلقّى 66% من المرضى العلاج الجراحي حيث كان ارجاع الكسر مُرضيا في 83.9% من الحالات التي عُولجت جراحيًا.

الخلاصة: كسور عظم الحُق هي إصابات غير شائعة، حيث أنّ حوادث المرور هي السبب الأكثر شيوعًا للإصابة. كان كسر الجدار الخلفي هو النمط الأكثر شيوعًا و معظم المرضى من الذكور. نتائج هذه الدراسة متوافقة مع النتائج المنشورة في المراجع الطبية. ومع ذلك، فإننا نوصي بدراسات مستقبلية لقياس نتائج علاج كسور عظم الحُق.

Objectives: To review the epidemiology of acetabular fractures in Jordan and to provide a base to advance high-level clinical research in the future.

Methods: A total of 141 acetabular fractures admitted to King Hussein Medical City, Amman, Jordan, from July 2018 to December 2022 were reviewed retrospectively. Fractures were classified according to Judet and Letournel and were analyzed regarding age, gender, the cause of injury, fracture classification, mode of treatment, and associated nerve and other body part injuries.

Results: Males represented 84.4% of patients. The mean age was 42.52 (±17.655) years, and the age group from 20 to 39 represented 54.6% of patients. Road traffic accidents caused 56.7% of injuries, and 53.9% had other accompanying injuries. Posterior wall fractures were the most common (37.6%) patterns, and femoral head dislocation was reported in 28.4%. Posttraumatic and iatrogenic sciatic nerve injuries were reported in 7% of patients. The mean time from admission to surgery was 7.62 (±7.915) days; 66% of patients received surgical treatment, and 83.9% had a satisfactory reduction.

Conclusion: Acetabular fractures are uncommon injuries, with road traffic accidents being the most common cause of injury. Posterior wall fracture was the most frequent pattern; most patients were males. Our results are comparable to the literature. However, we recommend future studies to measure the outcome of acetabular fracture management.

Keywords: acetabulum, fracture, epidemiology, Jordan

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Acetabular fractures are uncommon injuries. However, it has bimodal distribution where young patients sustained high-energy injuries, and road traffic accidents (RTA) are cited as the most common cause of injury. The other peak occurs in elderly patients who sustained low-energy fragility fractures.[1-3] Acetabular fractures are a significant cause of morbidity and mortality and pose a challenge in orthopedic injuries because they require special expertise to treat.[4]

The acetabular fractures are affected by many factors, such as the vector of injury force, the position of the femoral head, and bone quality, leading to different fracture patterns explained by Judet and Letournel.[5] Non-displaced fractures are treated conservatively, while displaced acetabular fractures require open anatomical reduction and rigid internal fixation to reduce the development of posttraumatic osteoarthritis.

It has been shown that the quality of the reduction of the articular surface is associated with improved clinical results and a decrease in the development of arthritis.[6,7] Letournel described arthritis rates of 5.4% in anatomically reduced patterns but jumping to 30.7% when the reduction is imperfect.[5]

Many epidemiological studies on acetabular fractures have been published overseas; however, in Jordan, such studies are limited; therefore, we conduct this study to understand its epidemiology to provide a base to advance high-level clinical research.

Methods. This study reviewed the clinical and radiological records of all acetabular fractures admitted to the Royal Rehabilitation Center (RRC) at King Hussein Medical City (KHMC), Amman, Jordan, between July 2018 and December 2022. The KHMC is a medical compound affiliated with Jordanian Royal Medical Services, which has an extensive network of hospitals in different regions throughout Jordan. RRC is a tertiary hospital specializing in orthopedic and plastic surgery, covering military-insured individuals and their families and cases referred from all healthcare hospitals in Jordan.

This study includes all acetabular fractures admitted primarily or referred from other military hospitals across Jordan. Patients readmitted for reoperation and infection were excluded. Sociodemographic data were extracted from patients' records, and their radiographs were reviewed using Picture Archiving and Communication System (PACS) to analyze fracture locations and patterns.

Fractures were analyzed regarding age, gender, the cause of injury, fracture classification, mode of treatment, and associated nerve and other body part injuries. Age groups are ≤19 years, 20 -39 years, 40-64 years, and ≥ 65 years. Fractures were classified according to Judet and Letournel, which classify acetabular fractures into five primaries and five associated patterns. In surgically treated fractures, the satisfactory reduction was considered if postoperative displacement was less than 2 mm.

The Royal Medical Services Human Research Ethics Committee granted ethical approval (Approval No. 13/2022), and the study was conducted according to the principles of the Helsinki Declaration.

Statistical analysis. Continuously measured variables were described using the mean and standard deviation, while categorically measured variables were described using frequency and percentages. To assess the correlations between categorically measured variables, the chi-squared test of independence was used. To assess statistical mean differences in metric variables across levels of more than 2 categorical measured variables, the One-way ANOVA test was used. The data was analyzed using SPSS Statistics for Windows, version 21 (IBM Corp., Armonk, N.Y., USA). The level of alpha significance was set at 0.050.

Results. The mean age of 141 admitted patients with acetabular fractures was 42.52 (±17.655) years. Males represented the majority of the sample, with a percentage of 84.4%. Most patients (85.1%) were aged 20-64. Road traffic accidents was responsible for 56.7% of injuries, followed by a fall (42.6%). The associated hip dislocation was detected in 28.4%. More than half of the patients (53.9%) had concomitant other body injuries. Sciatic nerve injuries were detected in 7% of the patients; half were secondary to the injury itself, and the other half were iatrogenic in surgically treated individuals. Two-thirds of fractures were treated surgically, the mean time from admission to surgery was 7.62 (±7.915) days, and one-third received conservative treatment. However, 2 patients were treated with a primary hip replacement, see Table 1.

Table 2 demonstrates the frequency of each fracture type; posterior wall fractures were the most common (37.6%) patterns, followed by the anterior column (14.2%), and both columns (12.8%).

On comparing different patterns of acetabular fracture with variables, there was no significant correlation with age, gender, extremity, associated sciatic nerve injury, and other body part injuries. However, a significant correlation was found with the fracture patterns and injury mechanism, associated hip dislocation, and received treatment, Table 3.

Table 1 - Acetabular fracture distribution (N=141).

Characteristics	n	%
Age		
≤19	3	2.1
20-39	77	54.6
40-64	43	30.5
≥65	18	12.8
Gender		
Male	119	84.4
Female	22	15.6
Extremity		
Right	67	47.5
Left	71	50.4
Bilateral	3	2.1
Mechanism of injury		
RTA	80	56.7
Falling down	60	42.6
Gun shot	1	0.7
Hip dislocation		
Yes	40	28.4
No	101	71.6
Sciatic nerve		
No	131	92.9
Pre-traumatic	5	3.5
Iatrogenic	5	3.5
Associated injuries		
Isolated injury	65	46.1
Other body part injuries	76	53.9
Treatment modality		
ORIF	93	66.0
Conservative	46	32.6
Total hip arthroplasty	2	1.4
Quality of reduction, n=93		
Satisfactory	78	83.9
Unsatisfactory	15	16.1

ORIF: open reduction and internal fixation

Table 2 - Acetabular fracture patterns frequency (N=141).

Acetabular fracture patterns	n	%
Posterior wall	53	37.6
Anterior column	20	14.2
Associated both column	18	12.8
Transverse + Posterior wall	13	9.2
Anterior wall	11	7.8
Posterior column + posterior wall	11	7.8
Transverse	9	6.4
T-type	3	2.1
Posterior column	2	1.4
Anterior column + Posterior hemitransverse	1	0.7

Road traffic accidents were more likely to cause posterior wall, posterior column, and transverse fractures. While falls were more likely to cause anterior wall, anterior column, and associated both columns fractures, see Figure 1. Hip dislocation mostly occurs with posterior wall and posterior column fractures. However, posterior wall and column, anterior column, T type, and transverse fractures were more likely to receive surgical fixation, while anterior wall fractures were more likely to receive conservative treatment.

Discussion. Epidemiological fracture studies are lacking in Jordan; thus, this study reviewed all acetabular fractures in a tertiary hospital in Amman, the capital of Jordan. King Hussein Medical City (KHMC) is a referral center for all Jordan district military and other healthcare hospitals. Therefore, studies from such centers are representative of Jordan.

Almigdad et al[8] reviewed all admitted fractures to KHMC over 3.5 years, out of 3387 fractures; pelvic fractures represented 4.6% of all fractures. However, no specific details on acetabular fractures. Accordingly, this study aims to improve our understanding of the patterns, etiologies, and management of acetabular fractures.

Several studies have shown that traffic accidents are the most common cause of acetabular fractures.[9,10] However, the incidence and severity of acetabular fractures are reduced with the introduction of seat belts.[11,12] In our study, RTA caused 56.7% of injuries, which is higher than a regional study from Qatar,[13] it accounted for 49.5% of causes, but close to a study from Singapore[14] where RTA was responsible for approximately 53.8%. Falls accounted for 42.6%. However, grouping the falls mechanism into one category makes it difficult to identify the exact mechanism of the injury and establish future preventive measures accordingly.

The mean age for patients in our study was equivalent to other studies while there was a lower proportion of women compared to the international studies contributed to the fact that most fractures caused by RTA and males are more involved with RTA.[9,13,14] While the female proportion is higher than the regional studies from Qatar, which is attributed to the fact that the majority of the workforce in Qatar from men.[13]

Fractures of the posterior wall were the most common fractures; the high frequency of the posterior wall is explained by the high frequency of RTA, resulting in dashboard injuries. Our results are comparable to those published in the literature.[9,15]

Acetabular fractures are usually associated with other body part injuries secondary to the high-energy injury mechanism; in our study, it was 53.9%. However, this is lower than reported in the literature, which exceeds 75% of patients.[9,13,14] Our study lacks a description of injury mechanisms and categorizes them into broad categories due to insufficient proper documentation.

Table 2 - Bivariate comparison between acetabular fracture patterns and others variables.

	AC	AC+PH	AW	B	PC	PCPW	PW	T type	T	T+PW	Test statistic	*P*-value
Mean Age (SD)	**42.80 (20.107)**	**47.00**	**48.64 (22.151)**	**53.56 (21.086)**	**52.00 (1.414)**	**46.18 (19.073)**	**37.09 (13.483)**	**33.33 (14.572)**	**43.22 (14.754)**	**40.54 (16.860)**	**F=1.808**	**0.072**
Age categories												
≤19	0 (0)	0 (0.0)	2 (18.2)	1 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (.00)	0 (0.0)		
20-39	14 (70.0)	0 (0.0)	2 (18.2)	4 (22.2)	0 (0.0)	6 (54.5)	37 (69.8)	2 (66.7)	4 (44.4)	8 (61.5)	χ^2=47.641	0.008
40-64	2 (10.0)	1 (100)	4 (36.4)	7 (38.9)	2 (100)	4 (36.4)	13 (24.5)	1 (33.3)	5 (55.6)	4 (30.8)		
≥65	4 (20.0)	0(0.0)	3 (27.3)	6 (33.3)	0 (0.0)	1 (9.1)	3 (5.7)	0 (0.0)	0 (0.0)	1 (7.7)		
Gender												
Female	3 (15.0)	0(0.0)	6 (54.5)	4 (22.2)	0 (0.0)	1 (9.1)	6 (11.3)	1 (33.3)	0 (0.0)	1 (7.7)	χ^2=15.969	0.068
Male	17 (85.0)	1 (100)	5 (45.5)	14 (77.8)	2 (100)	10 (90.9)	47 (88.7)	2 (66.7)	9 (100)	12 (92.3)		
Extremity												
Bilateral	2 (10.0)	0(0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0(0.0)	0 (0.0)	1 (11.1)	0 (0.0)		
Left	10 (50.0)	1 (100)	3 (27.3)	9 (50.0)	1 (50.0)	4 (36.4)	29 (54.7)	2 (66.7)	5 (55.6)	7 (53.8)	χ^2=15.829	0.604
Right	8 (40.0)	0 (0.0)	8 (72.7)	9 (50.0)	1 (50.0)	7 (63.6)	24 (45.3)	1 (33.3)	3 (33.3)	6 (46.2)		
Treatment modality												
ORIF	13 (65.0)	1 (100)	0 (0.0)	1 (66.7)	2 (100)	9 (81.8)	34 (64.2)	3 (100)	9 (100)	10(76.9)		
Conservative	7 (35.0)	0(0.0)	11 (100)	6 (33.3)	0 (0.0)	2 (18.2)	17 (32.1)	0 (0.0)	0 (0.0)	3(23.1)	χ^2=42.234	0.001
THA	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (3.8)	0 (0.0)	0 (0.0)	0 (0.0)		
Mechanism of injury												
Falling down	14 (70.0)	1(100)	9 (81.8)	10 (55.6)	2(100)	4 (36.4)	11(20.8)	1(33.3)	4 (44.4)	4 (30.8)		
Gun Shot	1 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	χ^2=37.315	0.005
RTA	5 (25.0)	0 (0.0)	2 (18.2)	8(44.4)	0 (0.0)	7 (63.6)	42 (79.2)	2(66.7)	5 (55.6)	9 (69.2)		
Hip dislocation												
Yes	3 (15.0)	0 0.0)	0 (0.0)	1 (5.6)	1 (50.0)	1 (9.1)	26 (49.1)	1(33.3)	1 (11.1)	6 (46.2)	χ^2=32.581	0.000
Sciatic Nerve												
Pre-traumatic	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	5 (9.4)	0 (0.0)	0 (0.0)	0 (0.0)		
Iatrogenic	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.6)	0 (0.0)	1 (9.1)	2 (3.8)	0 (0.0)	0 (0.0)	1 (7.7)	χ^2=14.834	0.673
Associated Injuries												
Multiple	12 (60.0)	1 (100)	6 (54.5)	9 (50.0)	1 (50.0)	3 (27.3)	29 (54.7)	2 66.7)	5 (55.6)	8 (61.5)	χ^2=5.404	0.798

AC: anterior column, AC+PH: anterior column + posterior hemitransverse, AW: anterior wall, B: associated both column, PC: posterior column, PC+PW: posterior column + posterior wall, PW: posterior wall, T: Transverse, T+PW: transverse + tosterior wall, THA: total hip arthroplasty, RTA: road traffic accident, ORIF: open reduction and internal fixation

Therefore, this obscures a detailed analysis of injury mechanisms and formulation of preventive measures.

Acetabular fractures are associated with femoral head dislocation in less than a third of cases, particularly with a posterior wall fracture.[16] In our study, 28.4% of fractures were associated with a femoral head dislocation. In motor vehicle collisions, injury patterns vary depending on the side of the impact. Frontal collisions can cause knee, thigh, and hip injuries. However, the position of the femur, whether adducted or abducted, affects the force vector and determines the pattern of the acetabular fracture and associated hip dislocation.[17,18] Acetabular fractures with associated hip dislocation have poorer long-term functional outcomes with higher complication rates and late total hip arthroplasty (THA) conversion than acetabular fractures without dislocation.[16]

Stavrakakis et al[19] carried out a meta-analysis of the incidence and outcomes of sciatic nerve injury after acetabular fractures; they reported that the incidence of posttraumatic sciatic nerve palsy was 5.1% and that of iatrogenic palsy was 1.4%. Due to the unsatisfactory outcomes of sciatic nerve grafting, they suggested a "wait and see" approach in cases of a contused but anatomically intact sciatic nerve. The incidence of sciatic nerve palsy in our study was 3.5% due to trauma and 3.5% due to iatrogenic cause. A higher Abbreviated Injury Scale, posterior column fracture, and posterior hip dislocation were associated with an inferior prognosis for sciatic nerve palsy.[20]

Two-thirds of our patients received surgical fixation. Posterior wall and column fractures, anterior column, T-type, and transverse fractures were more likely to be fixed surgically, while anterior wall fractures were more likely to be treated conservatively. The reduction was satisfactory if the postoperative displacement was less than 2 mm and was seen in 83.9% of surgically treated fractures. The most important parameters affecting

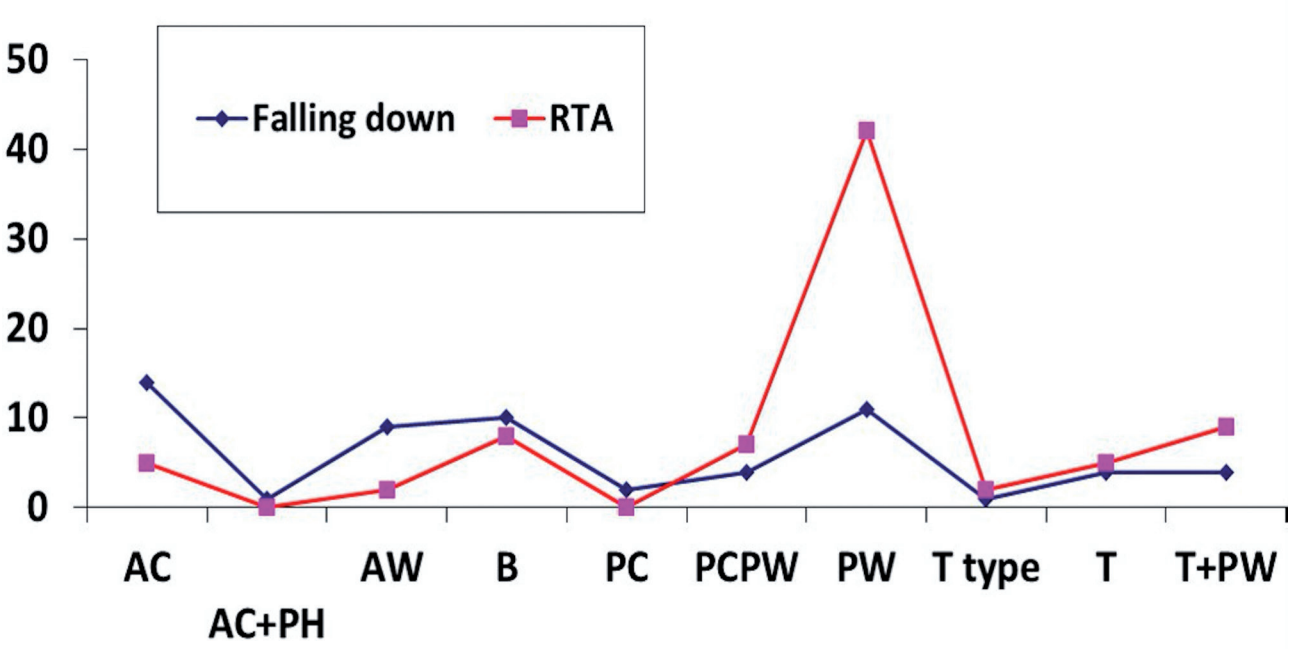

Figure 1 - Comparison of fracture patterns with rroad traffic accident (RTA) and falls. Key: AC: anterior column, AC+PH: anterior column + posterior hemitransverse, AW: anterior wall, B: associated bothcolumn, PC: posterior column, PC+ PW: posterior column + posterior wall, PW: posterior wall, T: transverse, T+PW: pransverse + posterior wall

the prognosis of acetabular fractures are the type of fracture, the operating time, and the reduction quality. However, the length of time between trauma and surgery indirectly affects outcomes. Avascular necrosis, heterotopic ossification, and arthritis can negatively affect long-term outcomes.[21]

Waiting more than ten days from injury to surgery leads to reduction difficulties, while delays of more than three weeks lead to reduction and stabilization problems due to bone resorption.[22] The waiting time from injury to surgery in our study was 7.62 (±7.915) days. However, the longer delay time was secondary to the patient's comorbidities and late referral from other hospitals. However, we did not measure outcomes in our study. Therefore, we could not compare the impact of delay time and other parameters on the prognosis. Early surgeries are associated with a smaller incision, less soft tissue dissection, and more satisfactory clinical and radiological outcomes.[23]

Primary THA is recommended for elderly patients with significant osteopenia and comminution, as well as those with preexisting hip arthritis. Arthroplasty can be performed early in combination with fracture fixation with an anti-protrusion cage and bone grafting for acetabular fractures; or it can be delayed after the fracture healing. Nevertheless, patients older than 60 have approximately a 30% late conversion rate to THA after acetabular fractures. However, secondary THA after acetabular fixation is a challenging technique due to adhesions and frequent misalignment of the acetabulum; THA is associated with a higher risk of infection, a tendency to develop para-articular ossification and a higher risk of premature component loosening than the standard procedure.[24-27]

Study limitations. Our data were extracted from a single center and may have limited the generalizability of our results. The retrospective design and the lack of details on the mechanism of injury due to inadequate documentation. Also, the exclusion of patients who died from injuries. The lack of a surgical approach and the outcomes of the treatments and complications are limitations of this study.

In conclusion, there are insufficient studies on the epidemiology, injury pattern, and treatment of acetabular fractures in Jordan, and even regional studies are scarce. In our study, road traffic accidents were the most prevalent cause of acetabular fractures, and a posterior wall fracture was the most common fracture pattern. More than half of the cases are associated with injuries to other regions of the body, and both traumatic and iatrogenic sciatic nerve palsy account for 3.5% of the cases. This study does not contain any outcome data.

Therefore, we recommend future studies to measure the outcome and to improve the documentation in the archive system.

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