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Comparison of Acetabular Morphology Between Femoral Neck and Intertrochanteric Fractures

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Abstract

Objective: This study aimed to examine the correlation between acetabular morphology and fractures of the proximal femur.

Methods: In this retrospective study, we examined patients who were admitted to our hospital between 2017 and 2021 due to fractures in the neck and intertrochanteric regions of the femur. The study included 192 patients with intertrochanteric fractures (group 1) and 61 patients with femoral neck fractures (group 2). Various parameters such as age, gender, body mass index (BMI), acetabular index (AI), acetabular depth (AD), and cortical index (CI) were assessed and analyzed.

Results: Group 1 exhibited a significantly greater mean age compared to group 2 ($P = .001$). The 2 groups showed similar distributions in terms of gender and BMI. There were no significant differences observed in the AD and CI values between the groups. However, group 1 displayed a significantly higher AI compared to group 2 ($P = .01$).

Conclusion: According to our study findings, it is evident that there exists an association between proximal femoral fractures and acetabular morphology.

Keywords: Proximal femoral fractures, cortical index, acetabular morphology, acetabular depth, acetabular index

Introduction

In recent decades, there has been a notable rise in life expectancy, leading to a higher prevalence of proximal femoral fractures among the elderly population. These fractures pose a significant public health challenge, with projections indicating a global increase to 6 million hip fractures by 2050.[1] Extensive research has been conducted on the epidemiological, biomechanical, and skeletal aspects of patients affected by proximal femoral fractures.

The most common types of proximal femur fractures are neck fractures and intertrochanteric fractures. Several studies have explored the underlying factors contributing to the occurrence of these distinct fracture types. Mautalen et al (1991, 1993)[2,3] specifically examined the variations in pathophysiological mechanisms and characteristics between neck and intertrochanteric fractures.

Extensive research has focused on examining the correlation between femur morphology and various types of proximal femoral fractures.[4,5] However, to date, no studies have explored the association between acetabular morphology and proximal femoral fractures. This study aimed to fill this research gap by investigating the potential relationship between acetabular morphology and proximal femoral fractures.

Methods

A total of 253 patients who were admitted to our hospital from 2017 to 2021 were included in this study, which was conducted in compliance with the ethical guidelines set forth by the World Medical Association's Declaration of Helsinki (1975). Ethical committee approval was received from the Ethics Committee of Erzurum Regional Training and Research Hospital (Approval No: KAEK 2021/12-204, Date: June 21, 2021). Written informed consent was obtained from the patients who agreed to take part in the study.

Anteroposterior (AP) pelvic radiographs were captured with the patient in a supine position, approximately 100 cm above, aligning the symphysis pubis at the center while internally rotating both hips within a range of 15°-30°. Exclusion criteria encompassed individuals below 65 years of age, proximal femoral fractures resulting from high-energy trauma (such as traffic accidents or falls), bilateral fractures, pathological fractures, metabolic bone disease, inflammatory arthritis, developmental hip dysplasia on the fractured side, and inadequate pelvic AP radiography.

A total of 317 patients initially constituted the study population, of which 64 patients were excluded. The final sample comprised 253 patients, categorized into 2 groups: Group 1 consisted of 192 patients with intertrochanteric femur fractures, while group 2 comprised 61 patients with femoral neck fractures. Relevant data, including age, gender, acetabular index (AI), acetabular depth (AD), and cortical index (CI), were systematically recorded. Acetabular morphology was assessed using Sharp's[6] AI and AD measurements, performed by 2 orthopedic surgeons at different time points (Figure 1 and Figure 2). The average value between the 2 measurements was subsequently calculated.

Statistical Analysis

The collected data were subjected to statistical analysis using the Statistical Package for Social Sciences version 20.0 (IBM SPSS Corp.; Armonk, NY, USA), and a significance level of $P < .05$ was considered statistically significant. Descriptive statistics, including

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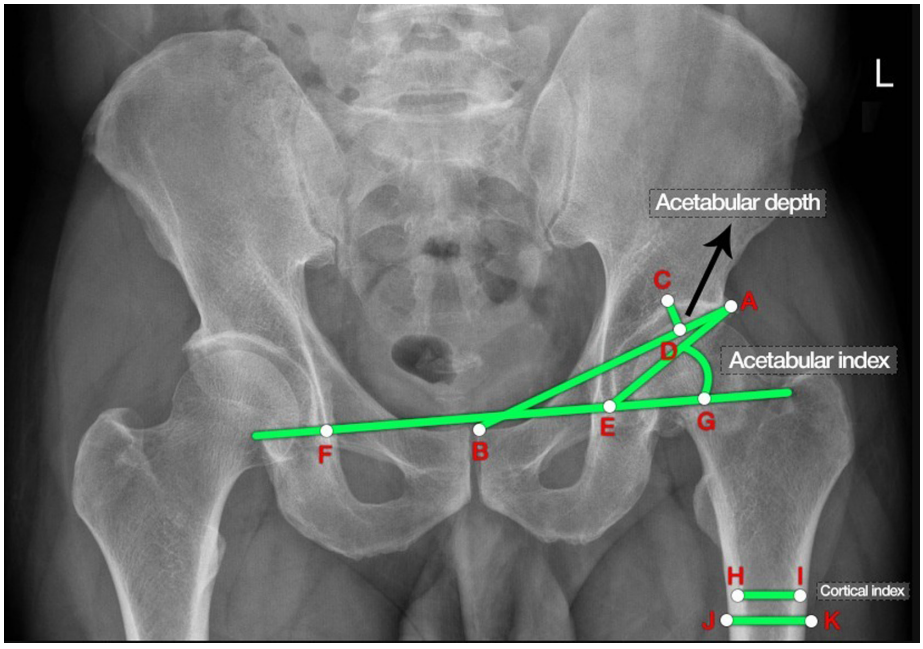

Figure 1. Acetabular morphology measurement in a patient with femoral neck fracture.

mean and standard deviation, were employed to summarize the data. The Shapiro–Wilk test was applied to assess the normality of the data distribution. To compare the groups, the Mann–Whitney *U*-test was utilized.

Results

The sample consisted of 253 patients. Group 1 consisted of 70 women (43.5%) and 91 men (56.5%) with a mean age of 75.1 (minimum = 72; maximum = 90). Group 2 consisted of 48 women (52%) and 44 men (48%) with a mean age of 78.1 (minimum = 74; maximum = 83). Groups 1 and 2 had a mean body mass index (BMI) of 20.6 ± 2.4 kg/m^2 and 21.5 ± 2.9 kg/m^2, respectively. The groups were similar in terms of gender and BMI.

Group 1 had a higher mean age than Group 2 (P = .001) (Table 1). Group 1 had a median AI, AD, and CI of 37.1, 12.3, and 0.42, respectively. Group 2 had a median AI, AD, and CI of 32.8, 12.5, and 0.47, respectively. There was no significant difference in

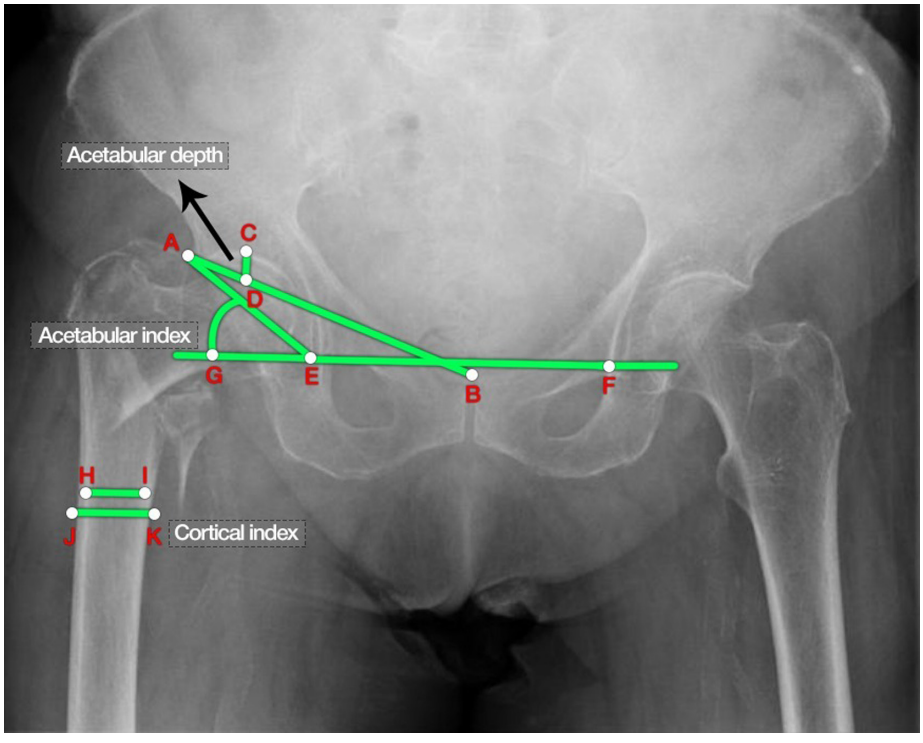

Figure 2. Acetabular morphology measurement in a patient with intertrochanteric fracture.

Table 1. Demographic Characteristics

	Group 1	Group 2	*P*
Age (years)	78.1 ± 9.10	75.1 ± 9.60	.001
Woman/man	70/91	48/44	.18
Body mass index (kg/m^2)	20.6 ± 2.4 kg/m^2	21.5 ± 2.9 kg/m^2	.27

Table 2. Radiological Measurements

	Group 1	Group 2	*P*
AI	37.1	32.8	.001
AD	12.3	12.5	.62
CI	0.42	0.47	.22

AI, acetabular index; AD, acetabular depth; CI, cortical index.

AD and CI between the groups. However, group 1 had a significantly higher AI than group 2 ($P = .001$) (Table 2).

Discussion

The objective of this study was to examine the association between acetabular morphology and proximal femur fractures. Our findings revealed that patients in group 1 with intertrochanteric fractures exhibited higher AI values compared to patients in group 2 with neck fractures. However, no significant statistical difference was observed between the groups regarding AD and CI.

Proximal femoral fracture poses significant challenges to public health, leading to increased mortality, morbidity, and healthcare expenditures. Gaining insights into the underlying causes of these fractures is crucial for effective prevention strategies. Extensive research has been conducted to identify the predictors of proximal femoral fractures. This study specifically examines the association between acetabular morphology and proximal femoral fractures, contributing valuable knowledge to the existing body of literature.

Previous research has consistently demonstrated that patients with intertrochanteric fractures tend to be older compared to those with neck fractures.[7] In our study, we found a similar trend among female participants, where women with intertrochanteric fractures were older than those with neck fractures. However, we did not observe a significant age difference between men with intertrochanteric fractures and neck fractures. The age disparity between group 1 and group 2 was primarily driven by the age variations among female participants with intertrochanteric fractures and neck fractures. Additionally, we observed that group 1 had a lower BMI than group 2, aligning with existing literature findings.[7] Nonetheless, there is still ongoing debate regarding the impact of age and BMI on proximal femur fractures, and a consensus has not yet been reached.

Group 1 exhibited a higher AI compared to group 2, which aligns with the limited available information in the literature. Tokyay et al[8] propose that an elevated AI could potentially lead to an increased separation between the body's center of gravity and the rotation center of the femoral head. Consequently, this may result in a shorter abductor arm length, potentially increasing the load exerted on the trochanteric region.

The strength of bone is primarily attributed to cortical bone rather than cancellous bone. However, cortical bone tends to undergo thinning as individuals age, with a decline in thickness of approximately 14% per decade among adults aged 50 and above.[9] In a study by Feola et al (2015),[10] it was observed that individuals with lower CI values faced a higher risk of hip fractures. In our study, similar to the findings of Maeda et al,[11] no significant difference in CI was detected between the groups. Intertrochanteric fractures, occurring in the intertrochanteric region of the femur, exhibit reduced cortical thickness. Consequently, when pressure is applied to the hip, the medial-inferior femoral neck bears the stress, while the tension zone is formed in the outer upper quadrant of the femoral neck.[12]

Studies have indicated that AD is associated with acetabular dysplasia and osteoarthritis.[13] However, our study did not reveal a significant correlation between acetabular depth and proximal femur fractures. This finding is consistent with the observations made by Tokyay et al,[8] who also did not identify a relationship between proximal femur fractures and AD. Nevertheless, further investigation is needed to better understand the potential connection between acetabular depth and proximal femur fractures.

The existing research on the association between acetabular morphology and proximal femur fractures is limited. While Tokyay et al[8] conducted acetabular morphological measurements on intact hips, it is important to consider that significant morphological changes can occur in the hips due to various etiological factors, such as usage, occupation, and previous trauma. In our study, we aimed to address this issue by conducting measurements specifically on the affected hip. Furthermore, a notable strength of our study is the inclusion of a power analysis prior to conducting the research.

Our study had several limitations that need to be acknowledged. First, the retrospective nature of the study introduced the potential for selection and information bias, which should be taken into consideration when interpreting the results. Second, the data obtained from radiological images that were captured by different technicians using varying machines may have introduced variability in the measurements. Lastly, we did not incorporate additional data on the mechanism of injury, medical history, risk factors for osteoporosis, or other underlying bone pathologies, which could have provided further insights into the relationship between acetabular morphology and proximal femur fractures.

Conclusion

The findings of the acetabular index suggest a potential association between proximal femoral fractures and acetabular morphology. However, further research is needed to delve deeper into the relationship between proximal femoral fractures and acetabular morphology and to expand our understanding in this area.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Erzurum Regional Training and Research Hospital (Approval No: KAEK 2021/12-204, Date: June 21, 2021).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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