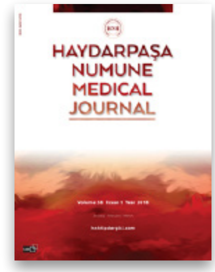
HAYDARPAŞA NUMUNE MEDICAL JOURNAL

DOI: 10.14744/hnhj.2018.92259
Haydarpasa Numune Med J 2019;59(4):363–366



hnhtipdergisi.com

ORIGINAL ARTICLE

Is there any Relationship between Proximal Femur Fracture Site and Hip Anatomy?

Sefa Giray Batıbay[1], Savaş Çamur[2]

[1]Department of Orthopedics and Traumatology, University of Health Sciences, Derince Training and Research Hospital, Kocaeli, Turkey
[2]Department of Orthopedics and Traumatology, University of Health Sciences, Umraniye Training and Research Hospital, Istanbul, Turkey

Abstract

Introduction: There are few studies reporting the relationship between hip fracture site and hip geometry and bone mineral density in the literature. The forces affecting the hip joint, the arm of the force and the angle of the load are the basis of hip biomechanical studies. The angle of the proximal femur and the morphological parameters are important for stress distribution due to the response to the burden. We think that the morphological differences of the proximal femur are related to the fracture type.

Methods: Between 2015-2018, patients who applied to the hospital with femur fracture were listed. One thousand twenty-four femur fractures were detected. Pertrochanteric, femoral neck and subtrochanteric fractures were selected on the list. Patients with appropriate pelvis X-rays were identified. Intertrochanteric distance, femoral neck length, femoral neck width, lateral offset length, neck- shaft angle and acetabulum center-edge angle were measured by one orthopedic surgeon.

Results: Significant statistical results were found between collum femoris fractures and collodiafizer angles of subtrochanteric fractures (p=0.0117). Significant statistical results were also observed between pertrochanteric fractures and subtrochanteric fractures (p=0.0439). Comparing with the subtrochanteric group and the femoral neck group' CE angles, a significant difference was found (p=0.0490). There was no statistically significant difference between pertrocanteric group and subtrochanteric group (p=0.2614).

Discussion and Conclusion: To our knowledge, this is the first morphological femur fracture study that was conducted for Turkish society in the literature. An advantage of our work is that this study can be used to design an implant.

Keywords: Hip geometry; hip fractures; hip morphology.

Proximal femur fractures have a large and important place in orthopedic surgery. According to American data, 300.000 hip fractures are reported annually. Although there are many classifications for proximal femur fractures, according to the anatomical location of the fracture, they are classified as subcapital fractures, neck fractures, intertrochanteric fractures, pertrochanteric fractures and subtrochanteric fractures [1].

There are few studies in the literature that report the relationship between the location of hip fracture, hip geometry and bone mineral density [2, 3]. Force arms and loading angles of the forces affecting the hip joint constitute the basis of hip biomechanics. The angle and morphological parameters of the proximal femur are important for the stress distribution arise from the response to the burden fallen on the hip [4].

Correspondence (İletişim): Sefa Giray Batıbay, M.D. Saglik Bilimleri Universitesi, Derince Egitim Arastirma Hastanesi, Ortopedi ve Travmatoloji Anabilim Dali, Kocaeli, Turkey
Phone (Telefon): +90 505 295 98 17 **E-mail (E-posta):** sbatibay7@yahoo.com
Submitted Date (Başvuru Tarihi): 12.06.2018 **Accepted Date (Kabul Tarihi):** 17.07.2018

We think that the morphological differences of the proximal femur are related to the fracture type. This study aims to investigate the relationship between changing morphological parameters and fracture types. Revealing the mechanism and social anthropological values will enable the development of more original and successful implant technologies.

Materials and Methods

In this study, the data of 1024 patients who applied to S.BU Umraniye Training and Research Hospital between 2015 and 2018 with femoral fractures were evaluated retrospectively. Among these patients, femoral pertrochanteric, femoral neck, and subtrochanteric fractures were found. Pelvic radiograms obtained without hip rotation where both obturator foramina were observed equally were selected. Among patients with appropriate anteroposterior pelvic radiograms, the patients in the pediatric age group, and the patients with bilateral fractures, amputated contralateral lower extremities, stress fractures and pathological fractures were excluded from this study. Fifty-six pertrochanteric (34 male, 22 female), 78 femoral neck (44 male, 34 female) and 54 subtrochanteric fractures (30 male, 24 female) were detected.

Intertrochanteric distance, femoral neck length, femoral neck width, lateral offset length, neck-shaft angle and acetabulum center-edge angle were measured by a single orthopedic surgeon. ExtremePacs (2017, Beytepe, Ankara) digital measurement system was used for the measurements.

While performing measurements, the neck width was measured from the narrowest part of the femoral neck. In the acetabular center edge angle (CE) measurement, the outermost point of the acetabulum was taken as a criterion. The distance between the intertrochanteric line and the center point of the femoral head was measured when calculating the femoral neck length. The distance between the femoral head and trochanter tip was recorded as lateral offset measurement (Figs. 1–3).

For statistical analysis, SPSS 22.0 software package (IBM Corporation, Armonk, NY) was used. For parametric variables, independent t-test, and for non-parametric variables, Mann-Whitney U test was used. Statistical significance was set at $p<0.05$.

Results

The mean values for femoral neck angle measurements in the pertrochanteric, femoral neck, and subtrochanteric fracture groups were 133.5, 132.8, and 136.5 degrees, respectively. A statistically significant difference was found

Figure 1. Measurement of intertrochanteric distance and lateral offset length.

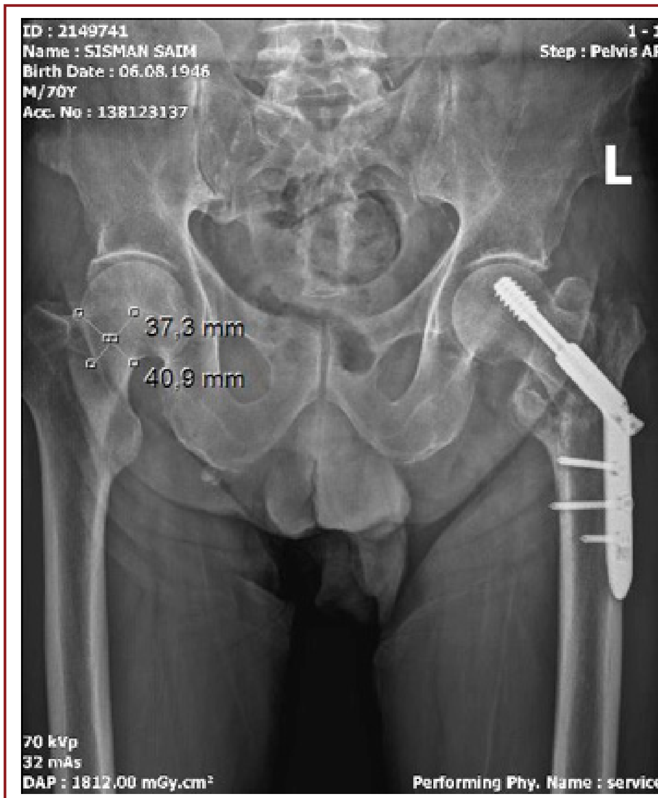


Figure 2. Measurement of width and length of femoral neck.

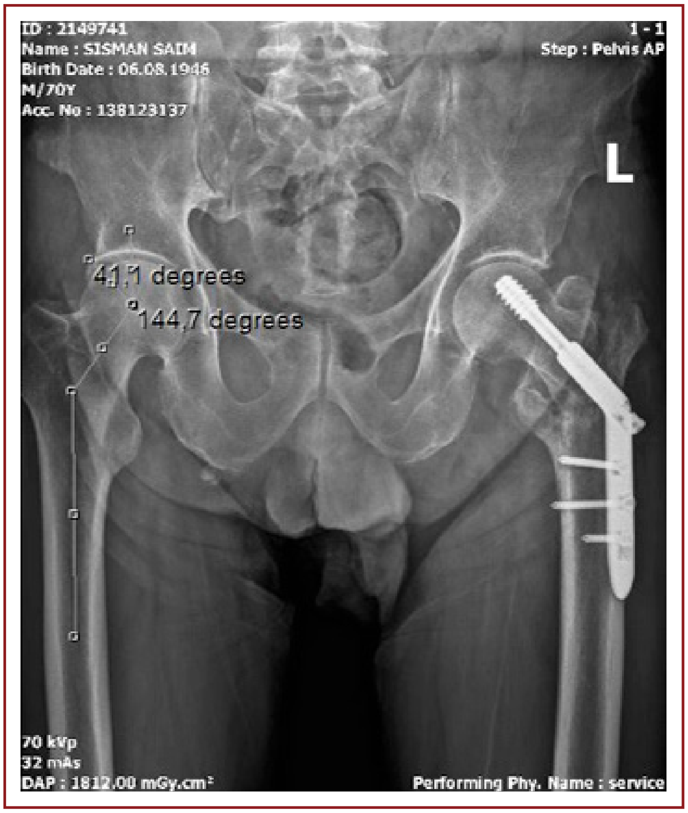


Figure 3. Measurement of femoral neck -shaft and CE Angles.

between the collo-diaphyseal angles of the femoral neck and subtrochanteric fractures (p=0.0117). Significant statistical results were observed between pertrochanteric and subtrochanteric fractures (p=0.0439). However, any significant results were not observed when the femoral neck and pertrochanteric fractures were compared (p=0.6815).

The mean ages at the admission of the patients with pertrochanteric, femoral neck and subtrochanteric fractures were 76.1, 60.1 and 62.3 years, respectively. When the age distribution of femoral neck pertrochanteric fractures was examined, it was observed that the patients who had pertrochanteric fractures were older (p=0.0001). There was no statistically significant difference between subtrochanteric and femoral neck fracture groups concerning age distribution (p=0.7232). However, there was a significant age difference between these groups, and pertrochanteric group (p=0.0139).

Mean CE angles of the subtrochanteric, femoral neck and pertrochanteric groups were 42.4, 37.6, and 39.2 degrees, respectively. Any statistically significant difference could not be found as for CE angles between the femoral neck and pertrochanteric groups (p=0.3694), and also between pertrochanteric, and subtrochanteric groups (p=0.2614). However, a significant difference was determined between subtrochanteric and femoral neck groups as for CE angles. When the pertrochanteric and subtrochanteric groups were compared, any significant results were not determined as for CE angles (p=0.0490).

The mean values for intertrochanteric distance in the pertrochanteric, femoral neck and subtrochanteric groups were 65.4 mm, 68.9 mm, and 66.9 mm, respectively. Any statistically significant differences were not found between pertrochanteric and femoral neck (p=0.0618), subtrochanteric and femoral neck (p=0.3165) and also between subtrochanteric and pertrochanteric groups (p=0.5480).

The mean values of lateral offset length in subtrochanteric, femoral neck and pertrochanteric groups were 54.1 mm, 54.9 mm, and 54.6 mm, respectively. Any significant results were not found between the groups concerning lateral offset measurements.

The mean values for femoral neck width in the pertrochanteric, femoral neck and subtrochanteric groups were 36.5 mm, 38.3 mm, and 37.9 mm, respectively. Any statistically significant difference was not determined between the pertrochanteric and femoral neck groups (p=0.0714). Any statistically significant difference was not found between the femoral and subtrochanteric fracture (p=0.6939) and also between the pertrochanteric and subtrochanteric fracture groups (p=0.2650).

Mean values for femoral neck length in pertrochanteric, femoral neck and subtrochanteric fracture groups were 41.7 mm, 42.9 mm and 41.8 mm, respectively. There was no statistically significant difference between the groups.

Discussion

Yamauchi et al. studied morphological parameters between intertrochanteric and femoral neck fractures in the Japanese population. They indicated that neck- shaft angle was higher in femoral neck fractures.

In our study, we observed that the lowest femoral neck angle among the fracture types was in the neck fracture group. Although we think that there may be different morphological features inherent to societies, we can relate this finding that the Japanese population has an advanced life expectancy. The mean age of the femoral neck fracture group in Yamauchi's study was 79 years, while in our study group, it was 60.1 years. This finding suggests that some orthopedic features may be specific to peculiar societies [5].

In a study performed by Pulkkinen et al. [3], the authors evaluated BMD, medial calcar width and neck-shaft angle as predictors of hip fractures. They stated that low neck-shaft angle is a risk for trochanteric fracture. In our study, a low neck- shaft angle was more frequently associated with neck fractures. In his study, Rafferty examined the relationship between bone morphology and bone mineral density and detected that with the increase in the neck- shaft angle, the superior neck cortex thickens further, and inferior cortex becomes thinner. This finding, which is observed as a result of mechanical loading, can be considered as data showing the relationship between fracture type and bone morphology [4].

In the study of Yamauchi et al. [5], the mean CE angles of the neck fracture and intertrochanteric fracture groups were 33.7, and 38 degrees, respectively. In our study we found that subtrochanteric group had higher CE angle than neck fracture group. The reason for this is that the subtrochanteric group is older than the neck fracture group. Nevertheless, it can be considered that the coverage levels provide the transfer of postfall steress from a different area concerning the distribution of the load and the compression angle that may develop. Biomechanical studies related to this subject are needed.

Some authors stated that there was no relationship between femoral neck width and fracture type in their studies [2, 7], while some others stated that it is related to the type of the fracture [9, 10]. In our study, we found that femoral neck width and length are not associated with fracture type.

In the study of Yamauchi et al., [5] femoral intertrochanteric distance, lateral offset length, femoral neck length and width were not related to fracture type. We found that these measurements were not statistically significant concerning fracture type.

The shortcomings of our study are the retrospective nature of this study, lack of information about fracture mechanism, and realization of the measurements by one person. In addition, as another limitation of our study, the BMD values of the patients were not known. Although a correlation was found between BMD and age, in consideration of the studies reporting the relationship between the fracture mechanism and BMD, we can say that this is a limiting factor for our study [3, 4, 6].

Although there is already little relevant data in the literature, an advantage of our study is that our measurements can be used to design implants in the future. Nowadays, morphological differences between societies are popular concerning orthopedics. Thus, this study is important in that it yields information about measurements of hip circumferences relevant in the Turkish society [11].

Ethics Committee Approval: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: S.G.B.; Design: S.G.B.; Data Collection or Processing: S.G.B., S.C.; Analysis or Interpretation: S.C.; Literature Search: S.G.B.; Writing: S.G.B.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Suckel AA, Dietz K, Wuelker N, Helwig P. Evaluation of complications of three different types of proximal extra-articular femur fractures: differences in complications, age, sex and surviving rates. Int Orthop 2007;31:689–95. [CrossRef]
2. Faulkner KG, Cummings SR, Black D, Palermo L, Glüer CC, Genant HK. Simple measurement of femoral geometry predicts hip fracture: the study of osteoporotic fractures. J Bone Miner Res 1993;8:1211–7. [CrossRef]
3. Pulkkinen P, Partanen J, Jalovaara P, Jamsa T. Combination of bone mineral density and upper femur geometry improves the prediction of hip fracture. Osteoporos Int 2004;15:274–80
4. Rafferty KL. Structural design of the femoral neck in primates. J Hum Evol 1998;34:361–83. [CrossRef]
5. Greenspan SL, Myers ER, Maitland LA, Kido TH, Krasnow MB, Hayes WC. Trochanteric bone mineral density is associated with type of hip fracture in the elderly. J Bone Miner Res 1994;9:1889–94 [CrossRef]
6. Yamauchi K, Naofumi M, Sumida H, Fukuta S, Hori H. Comparison of morphological features in the femur between femoral neck fractures and femoral intertrochanteric fractures. Surg Radiol Anat 2016;38:775–80. [CrossRef]
7. Gnudi S, Ripamonti C, Lisi L, Fini M, Giardino R, Giavaresi G. Proximal femur geometry to detect and distinguish femoral neck fractures from trochanteric fractures in postmenopausal women. Osteoporos Int 2002;13:69–73. [CrossRef]
8. Partanen J, Jamsa T, Jalovaara P. Influence of the upper femur and pelvic geometry on the risk and type of hip fractures. J Bone Miner Res 2001;16:1540–6. [CrossRef]
9. Gómez Alonso C, Díaz Curiel M, Hawkins Carranza F, Pérez Cano R, Díez Pérez A; Multicenter Project for Research in Osteoporosis. Femoral Bone Mineral Density, Neck-Shaft Angle and Mean Femoral Neck Width as Predictors of Hip Fracture in Men and Women. Osteoporos Int 2000;11:714–20. [CrossRef]
10. Michelotti J, Clark J. Femoral neck length and hip fracture risk. J Bone Miner Res 1999;14:1714–20. [CrossRef]
11. Pietak A, Ma S, Beck CW, Stringer MD. Fundamental ratios and logarithmic periodicity in human limb bones. J Anat 2013;222:526–37. [CrossRef]