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Morphometric Examination of the Proximal Femur in the Hip Joint

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Abstract

It is located between the femur, hip and knee. It is the heaviest, longest and strongest bone in the body. As the age progresses, osteoporosis develops and proximal femur fractures can be seen. Today, hip fractures are among the most common cases. Surgical interventions for the region are quite common. In our study, measurements were made on dry bone with a calliper and proximal femur morphometry was examined in eight parameters. The mean head of femoris diameter was found to be 42.75±6.14 mm in the right femurs and 43.83±4.03 mm in the left femurs. Intertrochanteric line length was measured as 56.78±5.22 mm in the right femurs and 57.65±9.97 mm in the left femurs. The results are similar to the literature. In other studies, it was observed that some parameters related to the proximal femur were not standardized. We think that our study will have an important contribution in standardizing the values obtained in dry bone studies. In addition, head to femoris diameter and neck of femoris length are important parameters in surgical interventions to be performed on the proximal femur. In particular, the length of the neck of femoris is directly related to the design, size and type of the femoral arthroplasty apparatus in surgical intervention in the region. In this respect, we believe that it will contribute to the literature.

Key words: *Femur, Dry bone, Morphometry*

Introduction

The thigh bone is the longest and thickest bone of the human body and is located in the thigh region. Its length is approximately 1/4 of the body length. In the proximal part of the thigh bone, there are structures such as head of femur, neck of femur, greater trochanter, and lesser trochanter. Neck of femur connects the head of femur to body of femur. The angle

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between the neck of femur and body of femur is 125^0-135^0 in adults (1). The hip joint is a spheroidal joint formed by the head of femur and the acetabulum. This joint makes abduction, adduction, flexion, extension, rotation movements and the circumduction movement, which is a combination of these movements. Head of femur is covered with hyaline cartilage, and the further away from the centre, the thinner the cartilage. In the middle of the head of femur, there is a pit called fovea for ligament of head. Ligament of head of femur attaches here (2). As the age progresses, osteoporosis develops and simple traumas cause hip fractures (3). Therefore, hip fractures are among the most common health problems today. Especially the elderly are at risk of falling due to age-related changes such as visual impairment, gait abnormalities, degenerative joint disease and cognitive disorders (4). In our country, it is expected that the incidence of hip fractures has increased in the last 20 years and that around 64 thousand hip fracture cases will be seen annually in 2040 (5). Dry bone studies are carried out in the literature (6-8). Also, dry bone studies and MR imaging studies are performed together in comparison (9-11).

In this study, detailed and precise measurements were made on the anatomical structures described above on the femur bone and the results were recorded. Anatomical knowledge of the femur will help orthopaedists perform surgery in this region. Therefore, we have shown many morphometric measurements related to femur in our article.

Methods

For this study, dry bones were used in Anatomy Department of Erciyes University. This study was carried out dry femur bones of 30 (15 left, 15 right) by using digital calliper with sensitivity of 0.01 mm. There was no age determination and gender discrimination on the bones. Data from both sides were measured symmetrically and those with fractures, pathology and erosion of femur bones were not included.

Measurements were made on the structures in the proximal part of the thigh bone with a digital calliper. The width, length and depth of the fovea for ligament of head in the head of femur were measured. In addition, length and width neck of femur were measured (Figure 1, 2 and 3).

Variables measured in the thigh bone

1. Length of the fovea for ligament of head
2. Width of the fovea for ligament of head
3. Depth of the fovea for ligament of head
4. Diameter of the Head of femur
5. Length of the neck of femur
6. Width of the neck of femur
7. Axis length of the neck of femur
8. Length of the intertrochanteric line

Figure 1: Length of the intertrochanteric line.

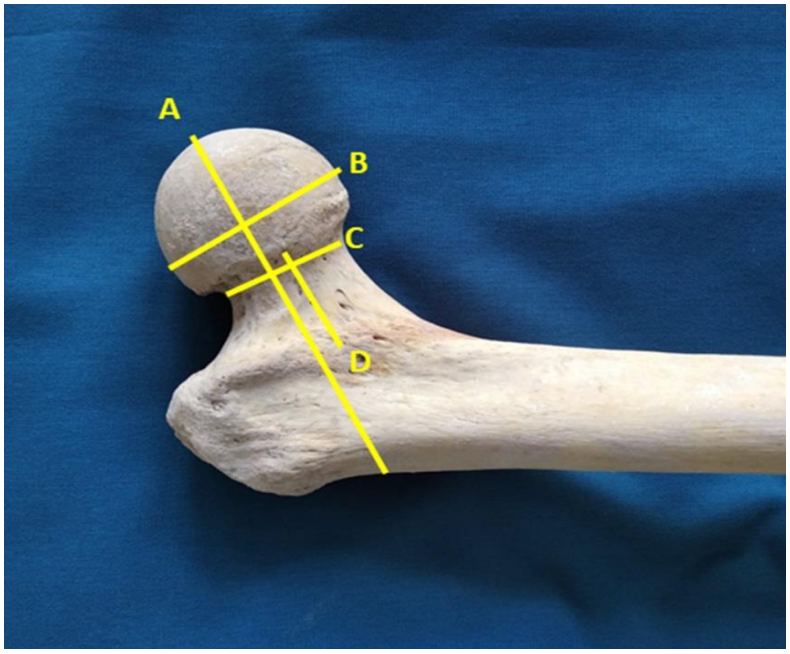

Figure 2: A. Axis length of the neck of femur **B.** Diameter of the head of femur **C.** Width of the neck of femur **D.** Length of the neck of femur.

Figure 3: A. Width of the fovea for ligament of head **B.** Length of the fovea for ligament of head.

Statistical analysis

The data of our study were transferred to computer by using SPSS (Statistical Package for Social Sciences) 22.0 program and descriptive statistical method was used. Shapiro Wilk normality test was applied. It was seen that the data were distributed normally. Independent Samples T-test was applied for binary comparison. The data were present as the mean of normalized data plus the standard deviation (SD) of the mean. A p value of <0.05 was considered as statistically significant.

Results

Length of the fovea for ligament of head was calculated as 10.93±1.77 mm on the right side and 11.41±2.02 mm on the left side. Width of the fovea for ligament of head was calculated as 12.73±1.94 mm on the right side and 12.55±2.68 mm on the left side. Diameter of the head of femur was 42.75±6.14 mm in the right thigh bone and 43.83±4.03 mm in the left thigh bone. Length of the intertrochanteric line was measured as 56.78±5.22 mm in the right thigh bone and 57.65±9.97 mm in the left thigh bone. In our study, no statistically significant difference was found between the right and left sides in the measurements made in the proximal part of the thigh bones.

Table 1: Results of measurements made in the proximal part of the thigh bone. (p<0.05 was considered significant).

Variables	N	Mean ± standard deviation (mm)	*p*
Length of the right fovea for ligament of head	15	10.93 ± 1.77	0.492
Length of the left fovea for ligament of head	15	11.41 ± 2.02	
Width of the right fovea for ligament of head	15	12.73 ± 1.94	0.838
Width of the left fovea for ligament of head	15	12.55 ± 2.68	
Depth of the right fovea for ligament of head	15	2.93 ± 0.95	0.442
Depth ofthe left fovea for ligament of head	15	2.67 ± 0.93	
Diameter of the right head of femur	15	42.75 ± 6.14	0.571
Diameter of the left head of femur	15	43.83 ± 4.03	
Length of the right neck of femur	15	24.64 ± 4.95	0.114
Length of the left neck of femur	15	27.39 ± 4.24	
Width of the right neck of femur	15	29.88 ± 6.71	0.298
Width of the left neck of femur	15	31.99 ± 3.78	
Axis Length of the right neck of femur	15	87.83 ± 8.38	0.775
Axis Length of the left neck of femur	15	87.62 ± 6.51	
Length of the right intertrochanteric line	15	56.78 ± 5.22	0.769
Length of the left intertrochanteric line	15	57.65 ± 9.97	

Discussion

It is important for physicians to know the morphology of the proximal part of the thigh bone in surgical interventions for the hip joint by orthopaedic surgeons. It has been reported in many literature studies that well-known morphological features of the proximal part of the thigh bone is important in determining risk factors for pathological conditions and designing prosthetic applications (12).

Morphologically, head of femur measurements have been studied in communities living in different geographical regions (13, 14). In our study, the diameter of the head of femur was measured as 42.75±6.14 mm in the right thigh bone and 43.83±4.03 mm in the left thigh bone. Iyem reported the mean diameter of the head of femur as 44.8±4.0 mm in their study. In the radiological measurements made by the same people,

the mean diameter of the head of femur was found to be 51.9±3.2 mm in men and 48.0±4.0 mm in women (15).

Risk factors for femoral fractures include the amount of bone mineral density, advanced age, gender, high body mass index, and head of femur large diameter.

Iyem (15) found the width of the neck of femur to be 32.7±4.0 mm in their study, Minakshi et al. found the width of the neck of femur to be 24.15 mm on the right and 23.86 mm on the left in the measurement they performed on 91 dry bones (16). In our study, the mean width of the neck of femur was found to be 29.88±6.71 mm on the right and 31.99±3.78 mm on the left. The mean diameter of the femoral head was 42.11 mm on the left and 42.51 mm on the right. In our study, the mean diameter of the femoral head was 42.75±6.14 mm on the right and 43.83±4.03 mm on the left. Our studies are similar.

Sproul et al. reported the mean diameter of the femur as 49.8 mm in their dry bone study (17).

In the radiological study performed by Hoaglund et al., the mean width of the neck of femur was found to be 33 mm, and the result was found to be close to the result of our study (18).

Isaac et al. they found the mean length of the neck of femur to be 28.4 mm in the measurement they performed on 171 dry femoral bones (19). In our study, the length of the neck of right femur was calculated as 24.64±4.95 mm and the length of the neck of left femur was calculated as 27.39±4.24 mm. Isaac et al. found the average length of the intertrochanteric line to be 57.9±6.7 mm (19). In our study, the length of the right intertrochanteric line was 56.78±5.22 mm, and length of the left intertrochanteric line was 57.65±9.97 mm.

Conclusion

In our study, the proximal part of the femur was morphologically examined on dry bone samples. In other studies, it was observed that some parameters related to the proximal part of the femur were not standard. We think that our study will significantly contribute to the standardization of the values obtained in dry bone studies. In addition, head of femur diameter and neck of femur length are important parameters in surgical procedures to be performed on the proximal femur. In particular, length of the neck of femur is directly related to the design, size and type of the femoral arthroplasty apparatus in surgical intervention in the proximal region of the thigh. In this respect, we believe that it will contribute to the literature.

Conflict of Interest

The authors declare that no conflict of interest exists.

Acknowledgement

All researches contributed equally to the study.

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