



PROXIMAL FEMUR MORPHOLOGY AND RADIOLOGICAL MEASUREMENT OF FEMUROACETABULAR DISTANCE

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ABSTRACT

Aim: There are some bony landmarks that are highly important in outcomes of hip surgery. In our study we aimed to find answers to 4 questions: 1) Determination of the mean values of the distance between the superior tip of the trochanter major and the superior edge of the acetabulum in males and females; 2) Determination of the femoral neck-shaft angle (NSA), meaning the inclination angle, values of the Turkish people; 3) Determination of mean values of medial femoral offset; 4) Determination of the amount of deviation of the line drawn perpendicular to the anatomical axis from the top of the trochanter major to the femoral head, in other words, where the head center is located in this line. We also aimed to compare these values in males and females and on right and left hips.

Material and Method: The study group consisted of 200 patients, 100 females and 100 males, aged between 20 and 50 years, who were admitted with the complaint of hip pain and who had no joint pathology defined as a result of physical examination and radiological examinations. The AP pelvic radiographs were evaluated bilaterally by two observers.

Results: In our study, in male patients, the distance between the superior tip of the trochanter major and superior margin of the acetabulum was 28.64 ± 6.70 mm in right hip and 28.40 ± 6.24 mm in left hip. These values were 26.01 ± 5.62 mm and 26.04 ± 5.31 mm in females, in right and left hips, respectively. Although there were not any significant differences between both sides in genders, in females the distance between the superior tip of the trochanter major and superior margin of the acetabulum was significantly shorter compared with the males. The second evaluated parameter NSA was determined as $128.19 \pm 5.08^\circ$ in males and $128.44 \pm 5.16^\circ$ in females. Femur medial offset was determined as 52.05 ± 6.53 mm and 45.08 ± 5.64 mm, in males and females, respectively. Although there was a significant difference between genders, there was not any significant difference on right or left sides regarding horizontal offset. The last parameter analyzed was the distance between the femur head center and the trochanter major crest and in males, it was 11.22 ± 5.45 mm on right hip and 8.65 ± 4.86 mm on left hip while in females it was 11.01 ± 4.96 mm on right hip and 8.43 ± 4.26 mm on left hip. The difference between right and left hips was significant in both males and females. In our analyses, the center of the head of the femur was located below the tip of the trochanter major.

Conclusion: In concomitant with the previous literature, orthopedics surgeons should be aware of the differences between genders and right and left sides to obtain the best outcomes after hip surgery.

KEYWORDS : hip, femur, trochanter major, neck-shaft angle, medial femoral offset

INTRODUCTION

In hip surgery the data about the anatomy of the proximal femur and the relationship of the proximal femur to the pelvis is very important. After both trauma and arthroplasty operations, the chief intend is the restoration of normal hip biomechanics. For that reason, to know the normal morphology is highly important for the surgeons, to repair the geometry of the proximal femur [1].

Anatomical differences and variations may also be present in proximal femur depending on the age, gender, genetic structure and races [2]. The biomechanical goals of total hip arthroplasty are to create a stable anatomical articulation with an optimized range of motion, to restore normal biomechanics for muscular efficiency, and to equalize limb lengths.

As is known, the template and implant designs used in the common hip arthroplasty surgery were performed according to the European and American populations. We do not have enough knowledge about how these implants are able to restore the normal anatomy and biomechanics of the hip in the Turkish population. However the data in Turkish population regarding the morphological parameters of proximal femur is limited [3].

There are some bony landmarks that are highly important in outcomes of hip surgery. In our study we aimed to find answers to 4 questions: 1) Determination of the mean values of the

distance between the superior tip of the trochanter major and the superior edge of the acetabulum in males and females; 2) Determination of the femoral neck-shaft angle (NSA), meaning the inclination angle, values of the Turkish people; 3) Determination of mean values of medial femoral offset; 4) Determination of the amount of deviation of the line drawn perpendicular to the anatomical axis from the top of the trochanter major to the femoral head, in other words, where the head center is located in this line. We also aimed to compare these values in males and females and on right and left hips.

MATERIAL AND METHOD

The study was approved by the ethics committee of Afyon Kocatepe University Medical Faculty. This was a retrospective study.

Patients

The study group consisted of 200 patients who were admitted to the Afyon Kocatepe University Hospital, Orthopedics and Traumatology Outpatient Clinic with the complaint of hip pain, who had no joint pathology defined as a result of physical examination and radiological examinations. The AP pelvic radiographs of a total of 200 patients, 100 females and 100 males, aged between 20 and 50 years, were evaluated, bilaterally.

The patients younger than 20 years and older than 50 years of age, patients having osteoarthritis on hip joint, patients who

had a history of operation on hip, acetabulum or pelvic region, having hip deformity related to motor neuron 1 or 2 damage and the patients who did not have the radiographies with appropriate technique were excluded from the study.

Radiologic Evaluations

2D measurements were performed on the radiographs, retrospectively. Measurements were performed by 2 investigators on 2 separate occasions to determine intra- and inter-observer repeatability. Measurements were performed with tools available in the PACS operating system (Philips iSite PACS v3.6; Philips Healthcare, Andover, MA).

A standard pelvic radiograph was used for radiological measurements. While the antero-posterior pelvic radiograph is performed, the patient is in supine position and both lower extremities are kept at 15 degrees of internal rotation to better visualize the lateral section of the femoral head-neck joint by neutralizing the femoral antetorsion. On this graph, the film-focal distance is 1.2m, and the centralization is done at the midpoint between the line connecting the two anterosuperior iliac ridges and the upper boundary of the symphysis pubis. The graphs in which obturator foramens were symmetrical, trochanter major was lateralized, medial cortex border was significant, fossa priformis was clearly evaluated, coccyx-pubis was in the same plane in the absence of hip joint arthrosis in patients without a history of joint surgery were included in the study.

The pelvic anterior inclination was neglected due to the technique used in the measurements.

Neck-shaft angle is the angle intersected between the long axis of the femur and the long axis of the neck of the femur.

Table 1. First observer, first and second measurements of the males (results of correlation analysis and paired samples t test)

Data	Measurement number	Mean ± SD	Correlation coefficient	Pearson analysis p	Paired samples t test- p
Distance between the tip of the trochanter major and the superior edge of the acetabulum- right (mm)	1 st	28.64 ± 6.70	0.997	0.001	0.836
	2 nd	28.63 ± 6.61			
Distance between the tip of the trochanter major and the superior edge of the acetabulum- left (mm)	1 st	28.40 ± 6.24	0.998	0.001	0.134
	2 nd	28.46 ± 6.28			
Right femur shaft-neck inclination angle (°)	1 st	127.72 ± 4.88	0.999	0.001	0.566
	2 nd	127.73 ± 4.89			
Left femur shaft-neck inclination angle (°)	1 st	128.67 ± 5.25	0.999	0.001	0.707
	2 nd	128.66 ± 5.24			
Right femur medial offset (mm)	1 st	53.12 ± 6.28	0.998	0.001	0.109
	2 nd	53.05 ± 6.19			
Left femur medial offset (mm)	1 st	50.98 ± 6.64	0.999	0.001	0.566
	2 nd	51.00 ± 6.61			
Distance between the right femur head center and the trochanter major crest (mm)	1 st	11.23 ± 5.45	1.0	0.001	0.158
	2 nd	11.21 ± 5.44			
Distance between the left femur head center and the trochanter major crest (mm)	1 st	8.63 ± 4.87	0.997	0.001	0.158
	2 nd	8.57 ± 4.74			

Regarding these results: in both hips the distance between the trochanter major and acetabulum were close to each other; the femur shaft neck angles were different between the two hips but they were very close to each other; medial offset value was approximately 2 mm higher in the right hip; although the distance between the center of the femur head and the tip of the trochanter major was different in both hips, the results

Table 2. First observer, first and second measurements of the females (results of correlation analysis and paired samples t test)

Data	Measurement number	Mean ± SD	Correlation coefficient	Pearson analysis p	Paired samples t test- p
Distance between the tip of the trochanter major and the superior edge of the acetabulum- right (mm)	1 st	26.01 ± 5.62	0.998	0.001	0.798
	2 nd	26.02 ± 5.54			
Distance between the tip of the trochanter major and the superior edge of the acetabulum- left (mm)	1 st	26.04 ± 5.31	0.918	0.001	0.281
	2 nd	26.28 ± 5.57			

Medial offset, horizontal offset or simply femoral offset is the horizontal distance from the center of rotation of femoral head to a line bisecting the long axis of shaft of femur [4].

In the radiographs, presence of the pelvic tilt, abduction or adduction of the lower extremity, superposition of the trochanter major medial cortex, hip joint arthrosis and the disappearance of the femoral head sphericity were considered the criterion for exclusion and these radiographs were not evaluated.

Statistical Analysis

The vertical distance measurements between the trochanter major and the acetabular superior, the femoral shaft-neck inclination angle, the proximal femur medial offset, the trochanter major crest and the femoral head center were investigated statistically. T test was used to evaluate the obtained data (paired t test for intra-observer evaluation, student t test in inter-observer evaluations). Intra-observer and inter-observer consistency were evaluated. The strength of correlation was assessed with the Pearson correlation coefficient (r). All analyzes were performed using SPSS version 15.0 for Windows (SPSS Inc., Chicago, USA). p<0.05 was regarded as statistically significant.

RESULTS

In our study, the images that were taken in digital format of our hospital were recorded in dicom (dcm) format and then the data was evaluated by the aid of Radiant Dicom Viewer 1.1.8. (32 Byte) program measured by 2 observers for 2 times.

The data obtained was analyzed both separately and together on both hips, in males and females and summarized in Tables 1-6.

were close to each other but it was slightly higher in the right hip. The center of the head of the femur was located below the tip of the trochanter major.

There was not any significant difference between two measurements at any points.

Right femur shaft-neck inclination angle (°)	1 st	127.62±4.92	1.0	0.001	0.158
	2 nd	127.64±4.90			
Left femur shaft-neck inclination angle (°)	1 st	129.26±5.29	0.999	0.001	0.045
	2 nd	129.30±5.29			
Right femur medial offset (mm)	1 st	46.32±5.73	0.999	0.001	0.320
	2 nd	46.30±5.71			
Left femur medial offset (mm)	1 st	43.85±5.28	1.0	0.001	0.320
	2 nd	43.86±5.29			
Distance between the right femur head center and the trochanter major crest (mm)	1 st	11.05±4.90	0.999	0.001	0.083
	2 nd	11.02±4.90			
Distance between the left femur head center and the trochanter major crest (mm)	1 st	8.41±4.26	0.998	0.001	0.707
	2 nd	8.40±4.27			

Regarding these results: in both hips the distance between the trochanter major and acetabulum were close to each other; the femur shaft neck angles were different between the two hips but they were very close to each other, which was approximately 2 degree higher; medial offset value was approximately 2.5 mm higher in the right hip; although the distance between the center of the femur head and the tip of

the trochanter major was different in both hips, the results were close to each other but it was slightly higher in the right hip. The center of the head of the femur was located below the tip of the trochanter major.

There was not any significant difference between two measurements at any points.

Table 3. Second observer, first and second measurements of the males (results of correlation analysis and paired samples t test)

Data	Measurement number	Mean ± SD	Correlation coefficient	Pearson analysis p	Paired samples t test- p
Distance between the tip of the trochanter major and the superior edge of the acetabulum- right (mm)	1 st	28.62±6.70	1.0	0.001	0.083
	2 nd	28.65±6.70			
Distance between the tip of the trochanter major and the superior edge of the acetabulum- left (mm)	1 st	28.37±6.25	1.0	0.001	0.158
	2 nd	28.39±6.23			
Right femur shaft-neck inclination angle (°)	1 st	127.75±4.90	0.996	0.001	0.470
	2 nd	127.78±4.83			
Left femur shaft-neck inclination angle (°)	1 st	128.69±5.27	0.994	0.001	0.593
	2 nd	128.72±5.27			
Right femur medial offset (mm)	1 st	53.10±6.28	1.0	0.001	0.566
	2 nd	53.09±6.28			
Left femur medial offset (mm)	1 st	50.96±6.64	1.0	0.001	0.083
	2 nd	50.99±6.60			
Distance between the right femur head center and the trochanter major crest (mm)	1 st	11.22±5.45	1.0	0.001	0.320
	2 nd	11.23±5.45			
Distance between the left femur head center and the trochanter major crest (mm)	1 st	8.66±4.86	0.998	0.001	0.320
	2 nd	8.63±4.87			

Regarding these results: in both hips the distance between the trochanter major and acetabulum were close to each other; the femur shaft neck angles were different between the two hips but they were very close to each other; medial offset value was approximately 2 mm higher in the right hip; although the distance between the center of the femur head and the tip of the trochanter major was different in both hips, the results

were close to each other but it was slightly higher in the right hip. The center of the head of the femur was located below the tip of the trochanter major.

There was not any significant difference between two measurements at any points.

Table 4. Second observer, first and second measurements of the females (results of correlation analysis and paired samples t test)

Data	Measurement number	Mean ± SD	Correlation coefficient	Pearson analysis p	Paired samples t test- p
Distance between the tip of the trochanter major and the superior edge of the acetabulum- right (mm)	1 st	25.99±5.66	0.978	0.001	0.448
	2 nd	26.08±5.46			
Distance between the tip of the trochanter major and the superior edge of the acetabulum- left (mm)	1 st	26.01±5.37	1.0	0.001	0.158
	2 nd	26.03±5.37			
Right femur shaft-neck inclination angle (°)	1 st	127.73±4.91	0.996	0.001	0.515
	2 nd	127.70±4.86			
Left femur shaft-neck inclination angle (°)	1 st	129.35±5.27	0.995	0.001	0.338
	2 nd	129.30±5.28			
Right femur medial offset (mm)	1 st	46.31±5.64	0.998	0.001	0.408
	2 nd	46.34±5.65			
Left femur medial offset (mm)	1 st	43.78±5.25	0.998	0.001	0.057
	2 nd	43.84±5.20			
Distance between the right femur head center and the trochanter major crest (mm)	1 st	10.98±5.03	0.991	0.001	0.566
	2 nd	11.02±4.89			

Distance between the left femur head center and the trochanter major crest (mm)	1 st	8.45±4.25	0.999	0.001	0.181
	2 nd	8.48±4.23			

Regarding these results: in both hips the distance between the trochanter major and acetabulum were close to each other; the femur shaft neck angles were different between the two hips but they were very close to each other; medial offset value was approximately 2.5 mm higher in the right hip; although the distance between the center of the femur head and the tip

of the trochanter major was different in both hips, the results were close to each other but it was slightly higher (approximately 2 mm) in the right hip. The center of the head of the femur was located below the tip of the trochanter major. There was not any significant difference between two measurements at any points.

Table 5. Comparison of the first measurement results of the first and second observers on males and females

		MALE (n:100)		FEMALE (n:100)		p ¹
		Mean ± SD	Student t test- p	Mean ± SD	Student t test- p	
Distance between the tip of the trochanter major and the superior edge of the acetabulum- right (mm)	1 st observer	28.64±6.70	0.983	26.01±5.62	0.980	0.001
	2 nd observer	28.62±6.70		25.99±5.66		0.001
Distance between the tip of the trochanter major and the superior edge of the acetabulum- left (mm)	1 st observer	28.40±6.24	0.973	26.04±5.31	0.968	0.001
	2 nd observer	28.37±6.25		26.01±5.37		0.001
P2		0.941		0.984		
Right femur shaft-neck inclination angle (°)	1 st observer	127.72±4.88	0.965	127.62±4.92	0.875	0.884
	2 nd observer	127.75±4.90		127.73±4.91		0.967
Left femur shaft-neck inclination angle (°)	1 st observer	128.67±5.25	0.979	129.26±5.29	0.904	0.642
	2 nd observer	128.69±5.27		129.35±5.27		0.668
P2		0.764		0.468		
Right femur medial offset (mm)	1 st observer	53.12±6.28	0.982	46.32±5.73	0.990	0.001
	2 nd observer	53.10±6.28		46.31±5.64		0.001
Left femur medial offset (mm)	1 st observer	50.98±6.64	0.983	43.85±5.28	0.925	0.001
	2 nd observer	50.96±6.64		43.78±5.25		0.001
P2		0.214		0.268		
Distance between the right femur head center and the trochanter major crest (mm)	1 st observer	11.23±5.45	0.990	11.05±4.90	0.921	0.886
	2 nd observer	11.22±5.45		10.98±5.03		0.792
Distance between the left femur head center and the trochanter major crest (mm)	1 st observer	8.63±4.87	0.965	8.41±4.26	0.947	0.856
	2 nd observer	8.66±4.86		8.45±4.25		0.788
P2		0.001		0.001		

p¹: Student t test p- comparing males and females
 p2: Student t test p- comparing the results of right and left sides

was approximately 2.2 mm higher in males and approximately 2.5 mm higher in females in the right hip; although the distance between the center of the femur head and the tip of the trochanter major was different in both hips, the results were close to each other but it was slightly higher (approximately 2.6 mm in males and approximately 2.5 mm in females) in the right hip. The center of the head of the femur was located below the tip of the trochanter major.

Regarding these results: in both hips the distance between the trochanter major and acetabulum were close to each other; the femur shaft neck angles were different between the two hips but they were very close to each other; medial offset value

Table 6: Comparison of the first measurement results of the first and second observers bilaterally on males and females

		MALE (n:200)		FEMALE (n:200)		p ¹
		Mean± SD	Student t test p	Mean± SD	Student t test p	
Distance between the tip of the trochanter major and the superior edge of the acetabulum- (mm)	1 st observer	28.52±6.46	0.969	26.02±5.46	0.964	0.001
	2 nd observer	28.49±6.46		26.00±5.50		0.001
Femur shaft-neck inclination angle (°)	1 st observer	128.19±5.08	0.961	128.44±5.16	0.846	0.782
	2 nd observer	128.22±5.10		128.54±5.15		0.874
Femur medial offset (mm)	1 st observer	52.05±6.53	0.976	45.08±5.64	0.943	0.001
	2 nd observer	52.03±6.54		45.04±5.58		0.001
Distance between the femur head center and the trochanter major crest (mm)	1 st observer	9.93±5.32	0.985	9.73±4.77	0.975	0.882
	2 nd observer	9.94±5.31		9.71±4.82		0.943

p¹: Student t test p- comparing males and females

measurement between the trochanter major and the acetabulum in the limb length evaluation. In our study, in male patients, the distance between the superior tip of the trochanter major and superior margin of the acetabulum was 28.64 ± 6.70 mm in right hip and 28.40 ± 6.24 mm in left hip. These values were 26.01 ± 5.62 mm and 26.04 ± 5.31 mm in females, in right and left hips, respectively. The second evaluated parameter was femur shaft-neck angle and it was determined as 128.19 ± 5.08° in males and 128.44 ± 5.16° in females. Femur medial offset was determined as 52.05 ± 6.53

DISCUSSION

In the Turkish population in Afyonkarahisar region, in young adult patients aged between 20-50 years, with the complaints of hip pain or reflected pain, the radiographic findings were evaluated in the digital environment. Four different anatomical measurements were performed in our study. One of the aims of our study was to test the reliability of the distance

mm and 45.08 ± 5.64 mm, in males and females, respectively. The last parameter analyzed was the distance between the femur head center and the trochanter major crest and this distance was determined as 9.93 ± 5.32 mm in males and 9.73 ± 4.77 mm in females. In our analyses, the center of the head of the femur was located below the tip of the trochanter major.

A surgeon performing hip arthroplasty has to be a master regarding the anatomy and morphometric knowledge of the hip joint. We believe that, our study gives valuable information about the proximal femur geometry of the Turkish population. The data obtained for two times by two independent observers were highly correlated with each other; meaning that the results obtained by radiographs which are easily available are also highly reliable and repeatable.

Limb-length discrepancy is one of the major problems after total hip arthroplasty, which may be minimized with preoperative planning using templates and radiographs. For this purpose many measurements were suggested for preoperative and intraoperative templating [5-7]. The distance between the tip of the trochanter major and the superior edge of the acetabulum is one of these landmarks that may be used in minimizing limb-length discrepancy; since trochanter major is a traditional landmark for intraoperative leg-length assessment [8,9]. In our study, in male patients, the distance between the superior tip of the trochanter major and superior margin of the acetabulum was 28.64 ± 6.70 mm in right hip and 28.40 ± 6.24 mm in left hip. These values were 26.01 ± 5.62 mm and 26.04 ± 5.31 mm in females, in right and left hips, respectively. Although there were not any significant differences between both sides in genders, in females the distance between the superior tip of the trochanter major and superior margin of the acetabulum was significantly shorter compared with the males.

The second parameter investigated in this study was the femur shaft-neck inclination angle (NSA). This angle is important in improving the results of hip arthroplasty since misplacement of femoral shaft may disturb the hip joint motions and NSA is also defined as an independent predictor of hip fracture risk in postmenopausal women [10,11]. We did not determine any significant differences between genders or sides (right or left hip) in this study regarding the femur shaft-neck inclination angle. Yin et al [12] reported that NSA was significantly higher on the right side of the body than the left side and it was correlated with age, weight, and body mass index. In a Chinese study, NSA was analyzed with computed tomography and similar with our results, there were not any significant differences between genders or right and left sides of the body [13]. Sengodan et al [14] investigated the anthropometric measurements of the hip joint in south Indian population and reported that the mean NSA was 136.7° in males and 134.18° in females and the difference between genders was statistically significant. Moreover, the mean NSA was 134.60° on the right side and it was 136.26° on the left side and the difference between right and left sides was also statistically significant. In another recent study, Roy et al [15] investigated the morphologic features of the proximal femur with anterior-posterior radiograph and reported that there were not any significant differences between genders on right and left sides of hip regarding the NSA in 120 Indian patients. They reported the average NSA in males and females as 131° and 130.37° , respectively. We believe that, in all populations, the mean values of landmarks in proximal femur should clearly be defined, including NSA in order to improve the outcomes of hip arthroplasty.

The third parameter analyzed was the femur medial (horizontal) offset. It has also been reported that, after hip arthroplasty, femoral horizontal offset restoration was associated with the increased range of motion and decreased

post-operative complication rates [16]. In this study, we reported that the mean femur medial offset values were 52.05 ± 6.53 mm and 45.08 ± 5.64 mm, in males and females, respectively. Although there was a significant difference between genders, there was not any significant difference on right or left sides regarding horizontal offset. In a study of Unnanuntana A et al [17] on 200 cadaveric femora analyzed with digital photographs, the mean horizontal offset values were reported as 42.66 ± 5.67 mm in males and 39.67 ± 6.02 in females and the difference between genders was statistically significant. Sengodan et al [14] reported the mean values of horizontal offset as 39.84 mm in males and 35.40 mm in females and the difference between genders was statistically significant. However, Roy et al [15] also reported the larger horizontal offset values in males compared with females (3.86 ± 0.47 vs 3.5 ± 0.55 on left side and 3.85 ± 0.47 vs 3.6 ± 0.67 on right side) but the differences between genders were not statistically significant. Moreover, during evaluation of the femoral offset with plain radiographs, it should also be kept in mind that, the hip rotation may influence the results [18]. However, in our study, since the patients with any gross hip pathology were excluded, this effect tried to be abolished.

The last parameter evaluated was the distance between the femur head center and the trochanter major crest. We did not determine any significant difference between males and females regarding the distance between the femur head center and the trochanter major crest; but this distance was significantly shorter on left hip. In males, this distance was 11.22 ± 5.45 mm on right hip and 8.65 ± 4.86 mm on left hip while in females it was 11.01 ± 4.96 mm on right hip and 8.43 ± 4.26 mm on left hip. The difference between right and left hips was significant in both males and females. In our study, the center of the head of the femur was located below the tip of the trochanter major in all measurements. Panichkul et al [19] investigated the anatomical landmarks used as a reference for restoration of the femoral head center in hip arthroplasty patients and reported that the level of tip of the greater trochanter was found higher than the femoral head center in 75% of patients.

There are some limitations of this study that should be mentioned. First, the number of patients included was not much but since the patients were analyzed bilaterally, the number of hips analyzed was not low. Secondly, we did not encounter the height, weight or body mass index of the patients which may also affect the morphological appearance of hip joint. And lastly we performed the study based on plain radiographs which is both a limitation and strength of the study. Although plain radiography is definitely the most cost effective and easily available method with less radiation in evaluation of hip joint, computed tomography is known to be more accurate than the plain radiographs [20].

In conclusion, we analyzed some morphological parameters of the hip joint by two observers, with two measurements each and we reported valuable data regarding the bony landmarks highly important for the outcomes of hip surgery in Turkish population. Moreover we also determined that, in females the distance between the superior tip of the trochanter major and superior margin of the acetabulum was significantly shorter compared with the males; there was not any significant difference between genders regarding NSA, femur medial offset was significantly shorter in females, and lastly, distance between the femur head center and the trochanter major crest was significantly shorter on left side compared with the right side. In concomitant with the previous literature, orthopedics surgeons should be aware of the differences between genders and right and left sides to obtain the best outcomes after hip surgery.

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