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Original Article

Anthropometry Study of Computed Tomography Scans of Hip Joints in Southwest of Iran

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Abstract

Introduction

Anthropometric investigations provide valuable data in a variety of groups. The present study aimed to compare the typical hip joint anatomical variations in the south-western population of Iran with those in other populations.

Methods

This study was carried out on 1000 normal hip joints of participants from both genders in the age group 18–80 years, who had referred to Abadan Medical College Hospitals, Abadan, Iran, during 2020-2021 to perform the anthropometric analysis. The CT scan gadget was used to obtain a scan and an axial image of the patients' hip joints. Moreover, neck shaft angle (NSA), head circumference (HC), and neck width (NW) were measured and calculated in all patients.

Results

The participants' mean age was 47 years, and the values obtained for the parameters NSA (142.4°), HC (47.7 mm), and NW (28.9 mm) in this study differed from those reported in other studies. Significant changes were also observed between the right and left sides and the gender of the proximal end of the femur in the study population.

Conclusion

When comparing the present findings with those of other studies, there are some differences between the right and left side in NSAs, which were remarkably significant in women populations. Moreover, NW on the right side of the male participants was also remarkably significant. Moreover, HC was comparable to the findings of previous investigations.

1. Introduction

The thigh bone, also known as the femur, extends from the hip to the knees and is the largest, longest, and strongest bone in the human skeleton. The proximal femur consists of the head, neck, and greater and lesser trochanters. The hip joint is formed by the rounded ball-like head articulating with the acetabulum. A small section of bone, called the neck of the femur, connects the femur head to the bone shaft. The femur can offer information about height estimation, sex determination, and regional and ethnic estimation. There is an agreement on the anatomical features, age, gender, and locomotion physiology of the femur[1-3]. The shape, biomechanical qualities, fractural type, and other characteristics of a human femur have been addressed in many studies [4]. Due to regional and racial modification in the joints and ossification, there are varied characteristics and morphology in the hip joint and proximal end of the femur in the world population.

This study aimed to analyze the anthropometric characteristics of the hip joints because of the relevance of the proximal end of the femur to the construction of the human anatomy, the quality of life, and the surgery on this joint. An anthropometric study on hip parameters can help us detect disorders and pathological changes in the joint, including osteoarthritis, avascular necrosis of the femoral neck, and femoral and trochanter fractures, thereby reaching a more immediate and more accurate diagnosis in populations [5, 6].

In the elderly, frequent and painful falls have been documented, resulting in hip joint degeneration and fractures; hence, there is an increased need for joint replacement surgery and implant insertion [7].

The anthropometric study of hip joints using plain digital radiographs helps determine bone biometrics in this population. This study reveals considerable differences between individuals' right and left hips, and these biometric values differ significantly when compared to other populations. This is, while the implant currently available in the market is not intended to fit the biomechanics of the hip. Consequently, the findings can be used to create proximal femur implants designed explicitly for individuals from the southwestern regions of Iran. In this regard, the anthropometric assessments of the hip joints are necessary for effective performance. The function and anatomical placement of normal organs may be accurately determined using computed tomography (CT) [8]. The present study examined anatomical alterations in both normal sides of the proximal end of the femur (left versus right) and estimated anthropometric characteristics using a CT scan in individuals from the southwestern regions of Iran.

2. Methods

After being approved by the Ethics Committee, this study was carried out from 2020 to 2021 at teaching hospitals in Abadan and Khorramshahr), which were affiliated to the Abadan University of Medical Sciences, Iran. Patients with normal hip morphology were included in the research (n=1000 hips from individuals in the age range of 18–80 years). The research excluded patients with hip diseases, past fractures, congenital deformities, and spine anomalies. In a supine posture with the hip in a neutral position, a 200 mA Seimens Multiphos 15R X-ray device was used to provide the CT scans of both hips from an anteroposterior perspective. The "Full screen" view was used to determine NSA, HC, and NW, and the pictures were enlarged to maximize resolution and accuracy [9].

2.1 Angle between the neck and the shaft

The angle is formed by the long axis of the femur intersecting the long axis of the femur neck. The femoral shaft axis is a line traced from the mediolateral surface of the femoral shaft at the middle of the medullary canal via two equidistant spots. The neck axis is formed by connecting the two spots on the superior and inferior surfaces of the femoral neck, which are equidistant (Figure 1. a).

2.2. HD

The diameter of a perfect circle drawn above the perfectly spherical femoral head was measured (Figure 1.b).

2.3. NW

At the narrowest point of the femoral neck, a perpendicular line to the neck axis was measured (Figure 1.c). The anthropometric parameters of hip joint on a schematic image were also determined (Figure 1.d). The mean and 95% confidence interval of the dependent variables in both tights were calculated, and their differences were measured using a paired sample t-test. Stata software version 14 was used to perform the required analyses.

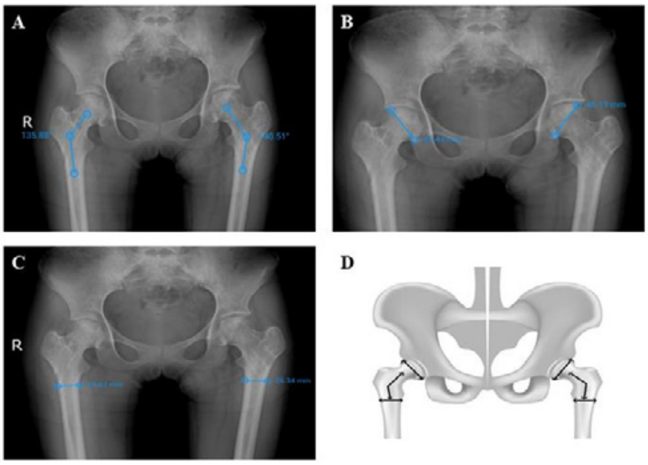

Figure 1. Size of Neck-shaft angle (a), Femoral head circumference (b), and Neck width (c) in CT images of hip joint in adult patients. Anthropometric parameters of hip joint on a schematic image (d).

3. Results

3.1. NSA

The participants' mean age was 47 years old, and the mean values of the NSA in this study were 142.4° on the right side and 140.4° on the left side.

The mean values of NSA by gender were 142.6° on the right and 139.4° on the left in females, and 142.8° on the right and 141.6° on the left in males. The statistical analysis was performed, and the significance level of the right side was significantly larger than that of the left side ($p<.05$) ($p = .03$).

Significant differences were also observed among women ($p=.000$); however, no significant difference was observed among men ($p>.05$) (Table 1).

3.2. Femoral HC

The mean values of HC were 47.7 mm on the right side and 47.9 mm on the left side. The mean values of HC by gender were 45.4 mm on the right and 45.3 mm on the left in females, and 50.2 mm on the right, and 50.7 mm on the left in males. There was no statistically significant difference between the two sides ($p>.05$) ($p=.9$). There was no significant difference between the two genders ($p>.05$) (Table 1).

3.3. NW

The mean values of the NW were 28.9 mm

Table 1. Hip joint parameter analysis

Variable	Mean	Mean		95% CI	P-Value	
		Male	Female		Male	Female
NSA	142.4	142.8	142.6	140.3	Not.sig	Sig.
NSAL	140.4	141.6	139.4	139.7	Not.sig	Not.sig
HC	47.7	50.2	45.4	47.8	Not.sig	Not.sig
HCL	47.9	50.7	45.3	47.9	Not.sig	Not.sig
NW	28.9	30.1	27.9	28.6	Sig	Not.sig
NWL	29.5	29.6	29.4	28.4	Not.sig	Not.sig
AGE	47.06	43.5	50.31	44.99		

*(L stands for the left side. Sig.= significant)

on the right side and 29.5 mm on the left side. The mean values of NW by gender were 27.9 mm on the right side and 29.4 mm on the left side in females, and 30.1 mm on the right and 29.6 mm on the left in males. There was no statistically significant difference between the two sides ($p>.05$) ($p=.6$). Moreover, in males, the mean value of this variable is significantly more considerable on the right than on the left ($p=.01$) (Table 1).

4. Discussion

Anthropometric investigations can provide information on various bone and joint characteristics and their variances among different groups. The CT scan approach facilitates assessing the anatomic condition, bone shape, and bone density. The capacity of a multi-slice CT scanning system to simulate 3D appears to be particularly effective in anthropometric investigations.

In our previous studies, we reported anthropometric data on bone anatomy using the computed tomography (CT) scan [9-11].

The CT scan technology was used to measure different characteristics of the hip joint in individuals living in individuals from the southwestern regions of Iran to compare these parameters quantitatively with other populations. Furthermore, a quantitative comparison was made between genders on both sides of the body.

Iran consists of various populations with different genetic, morphological, and cultural characteristics, which are likely to impart variable bone anatomy. Knowing these anatomical differences is essential to understand the etiology of disease and achieve acceptable surgical outcomes. The Iranian population is also anatomically different from the Western and Indian populations [12].

In the present study, the mean values of NSA were 142.4° on the right side and 140.4° on the left side, which is larger than the values reported in Jalali Kondori et al.'s study for the Tehran population [13].

The NSA value reported for the southern Indian population was larger than those reported for individuals in New Delhi. However, the NSA values in the present study and those reported for southern India by Sengodan et al. were smaller than those reported by Saikia et al. for patients from northeastern India [9, 14, 15].

In a typical adult, the femoral neck makes a 135° ±7° angle with the shaft, and the functional relevance of this angle is that the displacement of the femoral shaft away from the pelvis promotes the hip joint's motion freedom [16].

The conventional femoral prosthesis in arthroplasty has a neck stem angle of 131° [17], much smaller than the mean NSA value reported in the present study (142.4°). Such a difference in anatomical morphometric between natural bone and artificial implants may potentially interfere with normal hip biomechanics, leading to suboptimal post-surgery prognosis [16].

In this study, the anthropometric characteristics connected to the hip joint in the research group are similar to those in other populations. In contrast, NSA in this study was a few degrees smaller compared to other populations. Furthermore, females were more affected by the specified angle than males.

There have been many reports on NSA in previous studies (e.g., mean NSA of 132.8° [18] and 135° in adults [19]). The NSA value was 142.4° in adult men participating in the present study, which was somewhat larger than those reported for other groups. According to the present findings, women's NSA is 2 degrees smaller than men's.

The mean values of HC in this study were 47.7 mm on the right side and 47.9 mm on the left side, which is in line with studies on the Western population. Among the southwestern population of Iran, the femoral HC was similar compared to Swiss population [10] and Caucasian populations and had further significant differences with the

Indian population [20].

The femoral HC values reported in other studies were also compared to the present study [21]. A similar study in line with our study conducted in South Indian population showed that parameters measured by CT scan are more accurate than X-ray images.

In this study, the mean values of NW were 28.9 mm on the right side and 29.5 mm on the left side, which were larger than those reported for the Indian population [9]. CT scan images of the hip joint are more accurate for anthropometric analysis. When treating the fracture near the neck of the femur, three cancellous screws are usually required. The cancellous screw has a diameter of 6.5 mm; and regarding this NW value, three screws are sufficient to fix the fracture [9] and perfect to mend the fracture.

Understanding the anthropometric characteristics of major bones and joints, such as the hip joint, might greatly contributes to identifying skeletal diseases [14].

5. Conclusion

Using plain digital radiographs for anthropometric examination of hip joints is beneficial to establish bone biometrics in a local population. This study revealed remarkable variances between a person's right and left hips and showed that these biometric values differed significantly when compared to other populations. This is, while the implant currently available in the market is not intended to fit the biomechanics of the hip. Consequently, the findings can be used to design proximal femur implants tailored to the study population's needs.

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Conflicts of interests

The authors have no conflicts of financial or non-financial interest to disclose.

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All authors contributed to the research conception and design. E. F., M. K., and S. K. performed data preparation, data collection, and analysis. S. K. wrote the first draft of the manuscript, and all authors commented on the previous versions of the manuscript. All authors read and approved the final manuscript.

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