ORIGINAL RESEARCH

Morphometric Analysis Of The Upper End Of The Femur

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Abstract
Introduction: The biomechanical engineers take a revolutionary step towards altering the implant designs to suit our needs. Hence, morphometricevaluation of the femur bone on both sides playsan important role in reducing complications during the procedureof Hemiarthroplasty.
Objectives: To evaluate the morphometric analysis of the upper end of the femur and alsofind out whether there are any significant differences between the right and left femur.
Materials and method: 90 dry femurs were collected from the Department of Anatomy, NC Medical College and Hospital, Panipat. Measurements were obtained using a Goniometer, Coloured thread and sliding caliper.
Results: In this study, the mean value of Neck shaft angle, Head transverse diameter, Neck transverse diameter, Head vertical diameter, Neck vertical diameter and proximal breadth on the right and left femora have no statistically significant differences.
Conclusion: It is commonly accepted that the statistical analysis of the Morphometry of the femur among various populations reveals a large amount of variation due to the fact that the morphometric measurements of the femur are from different countries.
Keywords: Morphometry of femur, Upper end of Femur, Hemiarthroplasty

Introduction

The femoral neck is a cylindrical bone strut connecting the head to the shaft of the femur. Approximately at an angle of 1250 the neck projects superomedially from the shaft and also it projects slightly forwards. The greater and lesser trochanters provide attachments to the muscles that move the hip joint. (1) Approximately the neck of the femur is 5 cm long and connects the head and the shaft at an angle. This is known as the angle of inclination, the neck-shaft angle, collo diaphyseal angle (CDA), or the cervico diaphyseal angle of the femur. In most of the cases, the collo diaphyseal angle on the right side is lesser than that of the left side and there were no significant differences seen in gender.(2) Researchers use various methods to measure the dimensions of the femur. The femur dimensions on cadaveric bones are measured mechanically, but in patients, various methods such as ultrasound, roentgenography, computerized tomography (CT),and magnetic resonance imaging (MRI) are used. Several studies on femur dimensions vary according to the methods adopted and according to the populations.(3) In India, very few studies have been done on morphometry of the femur and these studies reveal that in the Indian population, the results of Western studies are not applicable because the measurements of the femora differ in both populations.(4) There is an increase in the incidence of injuries such as fractures of the neck of femur. Treatment of those fractures uses implants which are based on the measurements of upper end of femur. This study was carried out to evaluate the morphometry of the femur, to find the difference between the right and the left side for designing implants used in the treatment of fracture of femur.

Material and Method

The present study was carried out in the Department of Anatomy from June 2014 to August 2015 on 90 dry

femora (45 right femurs and 45 left femora) from the Department of Anatomy, N C Medical College and Hospital, Panipat. A Descriptive study consists of 90 dry bones (47 right femora and 43 left femora). Bones of both sides of either sex were included in the study. Any femur that showed a significant malformation and abnormality that could affect its shape and structure was excluded from the study. The recorded parameters i.e. Angle between neck and shaft of femur in degrees, Head transverse diameter (mm), Neck transverse diameter (mm), Head vertical diameter (mm), Neck vertical diameter (mm), Proximal breadth (mm) parameters were studied. With the help of a Goniometer, Coloured thread and sliding caliper were used for parameter measurement record.

Statistical analysis
The data was collected and entered into a master chart. The statistical contents like arithmetic mean and standard deviation were found. In order to test various hypotheses to see the difference between the measurements of both sides, the mean was tested by using the 't-test. All the statistical calculations were done through SPSS version. P- value less than 0.005 is considered statistically significant.

Result
The femoral measurements were studied on 90 bones (47 right and 43 left femora) from the Department of Anatomy, NC Medical College and Hospital, Panipat. The measurements of the bones on the right side and the left side were subjected to statistical analysis to evaluate the significance Table 1: Shows the distribution of bones. By literature reference, the sample size was calculated, and a total of 90 bones were studied. In this study, the bones are distributed into 47 on the right side and 43 on the left side to identify the difference between the femur of the right and left sides.

Table No. 1. Distribution Of Bones

Femur Bone	Number
Right bone	47
Left bone	43
Total	90

Table No.2 Distribution of measurement of right and Left Femur

Parameters	Right Femur Mean (±) SD	Left femur Mean (±) SD	P<value
Neck shaft angle	127.5±4.31	127.1±4.29	0.16
Neck Transverse diameter	18.11 ±2.0	18.0±1.95	0.13
Transverse diameter of the head	34.11±3.0	34.0±2.90	0.31
Vertical diameter of Head	32.17±2.53	32.10±1.90	0.11
Vertical diameter of the neck	25.7±3.20	24.5±3.18	0.09
Proximal Breadth (PD)	80.0±7.21	79.0±7.12	0.46
Femur length (in cm)	42.94± 2.76	42.70±3.02	0.80

Table 2: Mean values and SD of the parameters are tabulated as follows-
1. Shows the difference between the neck shaft angle of the femur on the right side and the left side. It has been observed that the mean neck shaft angle the 127.5±4.31 (right side), and 127.1±4.29 (left side). The difference in the mean neck-shaft angle on the right side and left side was found to be statistically insignificant (p-value: >0.05).
2. The difference between the head transverse diameter of the femur on the right and the left sides. Here, the mean value and the standard deviation on the left side were 34.0±3.89 and on the right side, it was 34.11±2.49 respectively. As the p-value is >0.05, there was no significant difference.
3. Femur bones show the difference between the Neck transverse diameter on the left side was 18.0±1.95as compared to the right side was 18.11 ±2.0 respectively. The difference in the mean neck transverse diameter on the right and left sides was found to be statistically insignificant (p-value: >0.05).
4. The values of head vertical diameter on the right side were higher than on the left side but statistically, no significant difference was found, as the p-value was >0.05. The mean value of head vertical diameter on the right side showed

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32.17±2.53 and 32.12±2.00 on left side as shown in Table no. 2

5. These results show that the mean and the standard deviation of neck vertical diameter on the left side was 25.7±3.20 and on the right side it was 24.5±3.19. The values obtained in the study were found to be insignificant the p-value was >0.05.

6. The mean proximal breadth on the left side was found to be 79.0±5.74 and 80.0±7.21 on the right side, the difference between them was found statistically insignificant (p -value:0.46)

Discussion

There is an increase in the incidence of injuries such as fracture of neck of femur. Treatment of those fractures uses implants which are based on the measurements of upper end of femur. In our study, the mean value of neck shaft angle the 127.5±4.31 (right side), and 127.1±4.29 (left side). The difference in the mean neck shaft angle on right and the left side was found to be statistically insignificant (p-value: 0.15). Ravichandran.D et al (2011) (5) studied proximal femoral geometry and concluded that the average neck shaft angle was 126.550 , which is almost similar to the values obtained in our study. Not many Indian studies are available with respect to the proximal femur dimensions. Nallathamby.R et al (2013) (2) worked on 100 dry femora in South Indian population and found the average neck shaft angle to be 134.60 . Desousa. E. B et al (6) studied the proximal extremity of femur and found that the average head transverse diameter on right side was 31.1±2.7 and on the left side it was 30.8±3.0. , similar findings with our study. But Ziylan. Tet al (7) quoted that in Anatolion population, the average HTD was 44.7±4.1 theon right side and 44.3±3.3 on the left side. The results reported by Ziylan. T et al were contrasting to the values obtained in our study. The average Neck transverse diameter on the left side was 18.0±1.95 as compared to the right side was 18.11± 2.0 respectively .Ziylan. T et al (7) studied an analysis of Anatolian femur and reported that the values of neck transverse diameter othen right side was 26.3±3.1 and on the left side it was 25.5±2.7. The difference between head's vertical diameter on the femora of the right and left sides. The values of head vertical diameter on the right side were higher than left side but statistically, no significant differences were found, as the p-value was 0.122. Nidugala.H et al (8) did a study on the morphometry of the femur in the South Indian population and revealed that the head vertical diameter on the right side was 39.85±3.55 and on the left side was 41.75±3.48. So, the result obtained by Nidugala.H et al differs greatly when compared to our study. The mean proximal breadth on the left side was found to be 79.0±5.74 and 80.0±7.21 on the right side. The difference in proximal breadth of the right side and the left side was found to be statistically insignificant (p-value:0.46). Nidugala.H et al studied the metric assessment on the femur in the South Indian population and concluded that the proximal breadth the on right side was 76.74±5.73 and that on the left side was 79.78±6.71. The values obtained in this study were almost similar to our study.These femur parameters were proceeded also in Asian countries as in Malay population (9), Chinese population (10) and in Pakistani population (11). These studies also favour the fact of regional difference in the parameters of proximal femur. Hence, there are a few limitations of the study that data not specified Gender and Age. Moreover, study done on dry bones as well as sample size also less. So, could not be taken into account.

Conclusion

The study revealed that there is no statistically significant difference found in the measurements on the right and the left femora. In this study, the mean value of Neck shaft angle, Head transverse diameter, Neck transverse diameter, Head vertical diameter, Neck vertical diameter, and proximal breadth on the right and left femora have no statistically significant differences. It is commonly accepted that the statistical analysis of the Morphometry of the femur among various populations reveals a large amount of variation due to the fact that the morphometric measurements of the femur from different countries are likely to be affected by variations in climate, hereditary, diet and other geographical factors related to lifestyle.

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