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MORPHOMETRIC STUDY OF FEMORAL NECKSHAFT ANGLE AND ITS APPLIED ASPECTS

Anatomy

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ABSTRACT

Background and Aims: Fractures involving the neck and trochanter of the femur are very common. Internal fixation with implants for these fractures is important for rehabilitation and early mobilization of the patients. Depending upon the dimensions of the upper end of the femur, the implants are designed. Currently most of the orthopaedic surgeons need notifications in the dimensions of the implants that suit the Indian standards.This study is designed to find out whether there is any significant difference between right and left femur for the purpose of modelling orthopaedic implants as the femoral fractures are very important health burden in India.

Materials and methods: This study done with 90 dry adult femur bones of both sides from the department of anatomy at Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamil Nadu. By using a coloured thread, axis of the neck of femur was determined. The thread divides the anterior surface of the neck into two equal halves. In the mid sagittal plane over the anterior surface, the axis of the shaft was marked using same thread.Then the angle between the neck and shaft is measured using the goniometer. The measurement was subjected to statistical analysis to evaluate the significance.

Result: We observed that the mean neck shaft angle of the left side was 126.15±4.22 degrees and the mean value of the right side was 127.20±2.43 degrees.

KEYWORDS

neck shaft angle, femora, implants.

INTRODUCTION:

Femur is the thigh bone which is the longest and strongest bone of the body. It provides skeletal support for the thigh. It consists of a proximal end, a shaft and a distal end. The proximal end of femur consists of a head, a neck and on the upper part of the shaft there are two large projections known as greater trochanter and lesser trochanter.Femur has a spherical shaped head that articulates with the acetabulum of the pelvic bone. On its medial surface, it has a non- articular pit called fovea which gives attachment to the round ligament of the head of the femur.Femoral neck is a cylindrical strut of bone which connects the head to the shaft of the femur. Approximately at an angle of 125 degrees the neck projects superomedially from the shaft and also it projects slightly forwards. The greater and lesser trochanters provides attachments to the muscles that move the hip joint.[2] The neck of femur is 5cms long and connects the head and the shaft at an angle. This is known as the angle of inclination or the neck-shaft angle (NSA)or collo-diaphysealangle (CDA) or cervicodiaphyseal angle of the femur. In most of the cases, the collo-diaphysial angle on the right side is lesser than that of the left side and there was no significant differencebetween the two sexes.[3]

To measure the dimensions of the femur, various methods are used by researchers. The femur dimensions on cadaveric bones are measured mechanically, but in patients, various methods such as ultrasound, roentgenography, computerised tomography (CT) and magnetic resonance imaging (MRI) are used. Number of studies in femur dimensions varies according to the methods adopted and according to the populations.[4]

On the basis of measurements performed in Causasians, the implants are used for the treatment of proximal femur fractures including the 135degrees cervico- diaphyseal angle. At birth the cervico- diaphyseal angle measures about an average of 160degrees and is greater but along with the skeletal growth the angle decreases and in adults the cervico- diaphyseal angle measures about an average of 135 degrees. So for the manufacture of implants used in the orthopaedic surgery, the reference value of about 135 degrees is used.[5]

For pre-operative assessment of the size of the implants, combined use of computerised tomography and radiography is recommended, especially in the cemented arthroplasty where it is essential for an optimal biological fixation.[6]Anthropometry gives various techniques and scientific methods for taking number of measurements in the different races and geographical regions.[7]The individuals in the central Indian population have medium femora when compared to the other available data.[8] In India, very few studies have been done on morphometry of the femur and these studies reveal that in Indian population the results of western studies are not applicable because the measurements of the femora differ in both populations.[9]Proximal femur morphology is a necessary parameter for designing and implant development in the total hip replacement. Use of inappropriately designed implants and their size affects the outcome of the surgery with some complications such as micromotion, loosening and stress shielding. Implants are mostly manufactured and designed in North America and European region which are designed, based on morphology of their population.[10]

MATERIALS AND METHODS:

Source of data: The present study was carried out in the department of Anatomy from June 2014 to August 2015 on 90 dry femurs consists of 45 right and 45 left femurs from the department of Anatomy, SreeMookambika Institute of Medical Sciences, Kulasekharam.This study was approved by Institutional Research Committee and Institutional Human Ethics Committee.

Study design: Descriptive study.
Materials used: Goniometer, Coloured thread.

Method of analysis: Analysis was done using Pearson correlation. Pearson correlation is applied to test the difference between the neck shaft angle of right and left femur. Bar diagrams are used to represent the data, P value ≤ 0.05 is considered statistically significant.

RESULT:

Table.01.Neck shaft angle of left and right side

Neck shaft angle (NSA) of femur	Left side		Right side		t value	p value
	Mean	S.D (+)	Mean	S.D (+)		
	126.15	4.22	127.20	2.43	-1.44	0.152

Table.01 shows the difference between the neck shaft angle of femur on right and left side. In the present study, we observed that the mean neck shaft angle of the left side was 126.15±4.22 degrees and the mean value of the right side was 127.20±2.43 degrees(Table.01/ Figure.01). The difference in the mean neck shaft angle on right and left side was found to be statistically insignificant (p value: 0.152).

DISCUSSION:

In the past few decades, researchers from worldwide have used various methods to measure the neck shaft angle of femur. They have measured mechanically on the cadaveric bone as well as in patients by roentgenography, ultrasound, computerised tomography and magnetic resonance imaging. Earlier studies revealed that the measurements vary in population and the methods adopted.

The present studywas carried out to evaluate the morphometry of neck shaft angle of femur and to find out the difference between the right and the left side for designing orthopaedic implants used in the treatment of fracture neck of femur.Treatment of those fractures uses implants which are based on the measurements of upper end of femur.

Neck shaft angle:

In the present study, the mean value of neck shaft angle on left side was 126.16±4.22 degrees and on the right side 127.20±2.43 degrees. The difference in the mean neck shaft angle between right and left side was found to be statistically insignificant (pvalue: 0.152). The average value of neck shaft angle on left side was 126.15 degrees and on right side 127.20 degrees.

Ravichandran.D et al[1]were studied the proximal femoral geometry and concluded that the average neck shaft angle was 126.55 degrees, which is almost similar to the values obtained in the present study.

Kate studied on 1000 femora and found the average neck shaft angle was 128.4 degrees. Issac.B et al found the average neck shaft angle as 127.5 degrees. Toogood et al in their study on proximal femoral anatomy in the normal human population have reported the average angle as 129.23 degrees. The present studyresults are almost similar to that of Kate,Issac and Toogood et al. Saikia.K.C et al has reported the average neck shaft angle in North Eastern population as 139.5 degrees. Nallathamby.R et al worked on 100 dry femora in South Indian population and found the average neck shaft angle to be 134.6 degrees. The present study findings differ largely from that of Saikia.K.C and Nallathambhy.R et al.

CONCLUSION:

The present study findings showed that statistically there is no significant difference between the neck shaft angle of femur on the right and the left side.It is commonly accepted that the statistical analysis of morphometry of femur among various populations reveals a large amount of variation due to the fact that the morphometric measurements of femur from different countries are likely to be affected by variations in climate, hereditary, diet and other geographical factors related to life style.

List of abbrevations:

CDA-Collodiaphyseal angle.
NSA- Neck shaft angle.
FA- femoral anteversion.
BMI-Body mass index.
FNL- Femoral neck length.
DHS- Dynamic hip screw.
PFN- Proximal femoral nails.
SD- Standard deviation.

Competing interests:

Nil

Authors contributions:

Dr.RathijaSreekumar is the principal investigator in this study.

Dr.N.Mugunthan &Dr.K.Girijakumari are the supervisor and made substantial contributions to conception, design of the study, analysis and interpretation of data.

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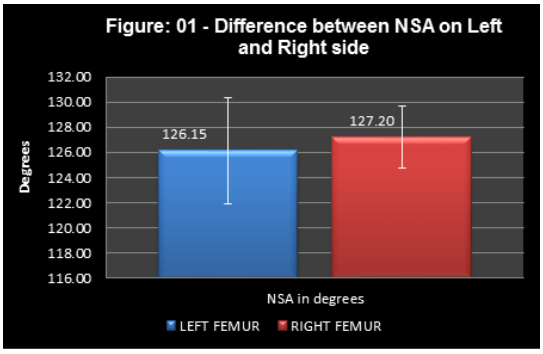

Figure: 01 represents the difference between neck shaft angle of femur of left and right side.

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