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Original Research Article

Morphometric Data Assessment of Proximal Femur in Indian Population

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Abstract

Background: The prosthesis for proximal femur used in India is manufactured by the western countries whose morphometry does not fit our people leading to complications. Hence, this study is to provide the morphometric data of proximal femur for Indian population and to clear the drawbacks in the information about proximal femur in our people and customize the implant design to suit the Indian people and thereby reduce the complications.

Material & Methods: The material used for the study contained 5° human femora of unknown sex obtained from different the Department of Anatomy, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India. The instruments used are metal sliding caliper and osteometric board. The maximum length of femur and anterioposterior diameter of upper, middle and lower shaft of femur was measured.

Results: The study was undertaken in 50 human femurs for measuring epicondylar breadth, Neck shaft angle, transverse and vertical diameter of head.The average mean transverse diameter of head was 35.7 ± 3.07 mm, mean right transverse diameter of head was 38.0 ± 3.10 mm and left it was 37.8 ± 3.15 mm. The average mean vertical diameter of head was 41.5 ± 3.56 mm, mean right vertical diameter of head was 40.4 ± 3.07 mm and left it was 41.45 ± 3.90 mm, Neck shaft angle ranges from a minimum of 105° to maximum 134° with a mean value of 125.5°**.**

Conclusion: This study showed that our values were comparatively smaller than the western people and varied with regional ethnicity. This study will encourage our biomechanical engineers to bring in a revolution in the designing and manufacturing of implants with correct morphometric data to befit our Indian population and lead to improved surgical outcome with minimal surgical complications.

Keywords: Proximal femur, Neck shaft angle, Inter-trochanteric distance, anterior neck length.

Introduction

Prevalence of hip osteoarthritis, fracture neck femur and other hip joint ailments are increasing day by day. Arthroplasty is the definite treatment for these patients. The femur forms the skeleton of the thigh, carries body weight, supports the movements of leg and provides attachment to the muscles [1]. Morphology of bones is very much affected by race, sex, environmental factors and lifestyle. A

population-based study by Nurzenski et al., showed that lifestyle factors also influence geometric indices of bone strength in the proximal femur [2]. FHO and VO are significant tools for range of motion and abductor muscle strength after total hip arthroplasty [3]. Commercially available hip prostheses are made based on European data [4,5]. So, the undersize and oversize hip prosthesis in THA (Total Hip Arthroplasty) can affect these functions. Goal of the surgical intervention is mostly to achieve anatomical reduction with a stable fracture fixation which helps bone reunion and allows early mobilization. A better contour fit bone and plate is crucial to establish a stronger bone plate construction [6]. Morphometric study of the proximal femur was performed in different population and communities [7].

Anatomical study of femur bone serves helpful data to understand different aspect of clinical disease conditions including common site of fractures, changes in osteoporosis, associated congenital anomalies as well as medico legal cases. The neck of femur in humans is an important functional modification of femur after man took up his erect posture. The angle of inclination has been studied by many workers.

According to Noble P.C [8] and Siwach [9] in Total Hip Arthroplasty, it is mandatory that design and dimensions of Femoral component match the anatomy of femur. Siwach has noted a gross geometrical difference between these western implants and Indian Femora.

Material & Methods:

The material used for the study contained 5° human femora of unknown sex obtained from different the Department of Anatomy, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India.The instruments used are metal sliding caliper and osteometric board. The maximum length of femur and anterioposterior diameter of upper, middle and lower shaft of femur were measured.

Vertical diameter of head: It measures the straight distance between the highest and deepest points of the head, for this sliding caliper is used.

Epicondylar breadth: It measures the distance between the most projected points on the epicondyles, for this Osteometric board is used.

Neck shaft angle: It is angle made by axis of shaft with the axis of the upper anterior column. Axis of column is determined by means of a thread which divides the anterior surface of the column in two equal halves. Axis of the shaft is determined by a thread which extends in the mid sagittal plane over the anterior surface of the bone from the upper end of the oblique line of the condyles. In case of strongly developed torsion, it may be difficult to fix a thread on the entire surface, so take only the axis of the upper shaft into consideration for such cases; the materials used are thread and mud clay.

Transverse diameter of head: It measures the straight distance between the most laterally projected points on the equatorial plane taken at right angle to the vertical diameter, sliding calliper is used for this measurement.

Results:

The study was undertaken in 50 human femurs for measuring epicondylar breadth, Neck shaft angle, transverse and vertical diameter of head. The results were the average mean epicondylar breadth was 74.6 ± 6.3 mm, mean right epicondylar breadth was 72.5 ± 4.86 mm and left it was 74.75 ± 7.2 mm. The average mean neck shaft angle was 123.6 ± 6.2 mm, mean right neck shaft angle was 123.6 ± 5.5 mm and left it was 127.6 ± 7.40mm. The average mean transverse diameter of head was 35.7 ± 3.07 mm, mean right transverse diameter of head was 38.0 ± 3.10 mm and left it was 37.8 ± 3.15 mm. The average

mean vertical diameter of head was 41.5 ± 3.56 mm, mean right vertical diameter of head was 40.4 ± 3.07 mm and left it was 41.45 ± 3.90 mm, Neck shaft angle ranges from a minimum of 105° to maximum 134° with a mean value of 125.5

Discussion:

Over 80,000 artificial hip joint replacement are done annually worldwide [10]. There are regional differences in the stature of human beings so prosthesis should be designed according to specific population. Reddy et al., highlighted that a mismatch between femoral bone and stem may definitely result in micromotion which can lead to thigh pain, osteolysis and aseptic loosening [11]. If the implant is too large the femur can fracture so the tendency is to undersize for safety but highly undersized implant may fail to bond with bone [12].

Mahaisavariya B et al., combined the CT imaging with the reverse engineering technique to obtain and analyse the three dimensional inner and outer geometry of the proximal cadaveric femur [7]. Deshmukh TR et al., studied the geometry of femur in the Vidarbha (central) region of India by using the mathematical approach [13].

Rawal et al observed a difference of 16.8% in the femoral head offset between Indian and Swiss populations, which can affect soft tissue tension and range of motion [14]. Maheshwari et al also reported that when compared with the Western data, the femoral neck anteversion values were 3-12 degrees lower and the combined anteversion values were 3-5 degrees lower in Indian adults. The acetabulum anteversion values were comparable but were skewed towards the higher side [15].

In study of Parson [16] bicondylar with was <72mm in female and >78mm in male. In present study Neck- shaft angle ranges from minimum of 1°6° to maximum of 135° with a mean value of 125.3°. Neck-shaft angle earlier reported by TanerZuylan[17] has given report as an average 125° and shame author stated that the results of neck shaft angle of left femur were generally shown to have greater value, but they were not significantly greater than the corresponding dimensions of right femur. Issac B et al.[18]stated that any estimated defective angle can be help for forensic identification of an individual with pathological changes leading to abnormal gait.

Mrunal and Pritha [19] in their morphometric study of neck of adult femora has measured the neck length on anterior and posterior aspects as 34.96mm and 33.42mm respectively which was similar to the present study.

Mishra's [20] study on femoral head diameter in Nepalese was 44.26mm which was higher than the present study implicating the variations among Asians too. He compared his value with western population who had an average of 46.1mm which is greater than Asians stressing up the need for designing of implants with our own morphometry.

Ravi [21] in his study has given femoral length - 447.1+/-28.94, neck length – 36.3+/-5.4mm, neck shaft angle as 136.80 and concluded that there is no significance between right and left femur measurements.

Suja Robert [22] in her morphometric study has shown femur length as 41.9+/-3.4cm and intertrochanteric distance as 5. 81cm.The inter-trochanteric distance in the present study was 6.13 cm which correlated with the above study.

Conclusion:

This study showed that our values were comparatively smaller than the western people and varied with regional ethnicity. This study will encourage our biomechanical engineers to bring in a revolution in the designing and manufacturing of implants with correct morphometric data to befit our Indian

population and lead to improved surgical outcome with minimal surgical complications.

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