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MORPHOMETRIC MEASUREMENTS OF THE HEAD OF FEMUR AND ITS CLINICAL IMPLICATIONS

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Abstract

Background: Osteoarthritis frequently affects the hip joint, one of the human body's most weight-bearing joints. The most common joint condition and the tenth biggest cause of disability in the world is osteoarthritis[1,2,3]. Whole hip replacement, in which the head of the femur and the cartilage of the acetabulum are both removed and replaced by metal sockets, is the treatment for hip osteoarthritis. When designing the prosthesis, the varied head of femur measurements become important.

Aims and objectives: Determine the different characteristics of the femur head.

MATERIALS AND METHODS: The current study was carried out at the Government Medical College of Srinagar's Department of Anatomy. There were 110 dry femurs removed in all, of which 63 were on the right side and 47 on the left. The vertical and the transverse heights of the head were measured and the maximum head circumference of the head was measured using a vernier caliper and an inch tape.

Results: The results showed that the mean vertical diameter was 40.75mm and the mean transverse diameter was 38.71 mm, and the mean circumference of the head was seen to be 141.11 mm.

Conclusion: To ensure effective hip replacement, these factors can be utilized to design prostheses and plates for hip joint reconstructive procedures for the Indian population.

Keywords:

Anatomy, Othopaedics, Arthroplasty

INTRODUCTION

Osteoarthritis is the most prevalent joint disease. It has been ranked as the 10th leading cause of disability worldwide[1] with a prevalence of 22% to 39% in India. [2,3,4]

Because it is multiaxial and highly dynamic, osteoarthritis most frequently affects the hip joint[5]. Early-onset osteoarthritis has recently been linked to femoroacetabular impingement. Because the head of the femur and the acetabulum of the hip bone articulate to form the hip joint, femoroacetabular impingement has been seen to have two components. The femur's nonspherical head or an extensive acetabular covering may be the cause[6,7].Hence, the size of the femoral head plays a significant role in the early diagnosis of osteoarthritis[8,9]

Total hip replacement surgery, in which the cartilage in the acetabulum and the head of the femur are both replaced with metal sockets, is used to treat osteoarthritis[10]. The anatomical structure of the femur may be influenced by racial origin, age, gender, and environmental circumstances, therefore understanding its morphology is crucial for the production of implants. Most of the prosthesis and implants available in the market, are designed in north America or Europe according to the western population [11,12]. Thus, there may be a mismatch of the dimensions of commercially available hip prosthesis and that required by the Indian population. The use of such mismatched implants for joint fixation may result in a number of issues, including load distribution issues, pain, and loosening[13]. Thus, it is necessary to produce population-specific data for the proximal end of the femur in order to design implants and prostheses that are appropriate for the Indian population.

The aim of the present study was to find out the dimensions of the upper head of femur that could be helpful to orthopaedic surgeons and radiologists.

MATERIALS AND METHODS:

110 dried adult femora of unknown sex were obtained from the Department of Anatomy at the Government Medical College of Srinagar for use in the current study. Of 110 femora, 47 had a left side and 63 a right side. Femurs that were broken, malformed, fractured, or incomplete were not included in this study.

The collected data was represented as mean±SD then analysed with MS Excel 2007 software. An independent t test was used to calculate the differences in parameters of right and left femur. Pvalue <0.05 was considered statistically significant.

The following parameters of femoral head were taken with the help of vernier calliper (accurate to 0.001mm):

Vertical diameter of head

The most superior and inferior points on the head's articular border were measured in a vertical plane (fig. 1).

Figure 1: Measurement of the vertical diameter of head of Femur

Transverse diameter of head

The maximum distance between the femoral head and the articular margin in the transverse plane was used to quantify the transcverse diameter (fig. 2).

Figure 2: Measurement of transverse diameter of the head of Femur

Circumference of the head of Femur

By wrapping a flexible measuring tape around the head's circumference along its articular margin, it was measured (fig. 3).

Figure 3: Measurement of the head of Femur

RESULTS:

Following results were obtained while conducting this study;

Side	Number	Mean±SD(mm)	Range(mm)	P-Value
Right	63	40.79±3.47	34-49	0.90
Left	47	40.71±3.48	34-49	
Total	110	40.75±3.46	34-49	

Table 1: Statistical measurement of vertical diameter of Head of femur (right, left and total)

Side	Number	Mean±SD(mm)	Range(mm)	P-Value
Right	63	39.31±4.15	30-49	0.07
Left	47	37.89±4.0	28-46	
Total	110	38.71±4.13	28-49	

Table 2: Statistical measurement of transverse diameter of Head of femur (right, left and total)

Side	Number	Mean±SD(mm)	Range(mm)	p-Value
Right	63	140.58±11.25	115-165	0.55
Left	47	141.82±10.37	110-160	
Total	110	141.11±10.85	110-165	

Table 3: Statistical measurement of circumference of Head of femur (right, left and total)

An Independent t-test done to compare the parameters of right and left side was found to be statistically insignificant as the p-value obtained was more than 0.05.

DISCUSSION

Many studies on the adult femur have been conducted in various nations, and these findings support the idea that distinct femur proportions vary depending on the locale. Forensic experts, implant and prosthesis producers, and orthopaedic surgeons can all benefit greatly from our findings.

The average vertical diameter in our study was 40.79±3.46, which is comparable to the findings of A.K. Dwivedi et al. [17] and SK Sanjeev et al. [21], but lower than those of Katchy et al. [15], Saima Rashid et al. [18] , and Gupta M et al. [22] and higher than those of Rajendran et al [20].

In our research, the mean transverse diameter of the head of the femur was found to be 38.71±4.13, which is comparable to T.J. Pillai et al. [16] , but lower than the values obtained by Unnanuntana A et al [21].

Our study revealed that the average circumference of the head of the femur was 141.11±10.85, which is comparable to the findings of Rajendran et al. [20] but greater than the findings of AK Dwivedi et al. [17] , Saima Rashid et al. [18], and SK Sanjeev et al [22].

Authors	Population	Mean vertical diameter of head of femur±SD(mm)	Mean transverse diameter of head of femur±SD(mm)	Mean circumference of head of femur±SD(mm)
Unnanuntana A et al[14].,(2010)	Americans and Caucasians	_	52.09±4.43	_
Katchy et al[15].,(2021)	Nigerian	44.64±3.13	44.55±3.37	_
T. J Pillai et al[16].,(2014)	South Indian	42.24±3.53	37.86±3.06	_
A.K Dwivedi et al[17].,(2019)	Maharashtra	40.53±3.51	40.44±3.47	126.69±10.55
Saima Rashid et al[18].,(2019)	North Indian	43.34±3.59	42.51±3.44	137.9±11.1
G Vinay et al[19].,(2020)	Telangana	_	40.90±3.50	_
Rajendran et al[20].,(2020)	South Indian	39.90±3.42	_	141.3±10.4
SK Sanjeev et al[21].,(2021)	Bihar	40.97±3.46	41.74±2.76	133.25±11.57
Gupta M et al[22].,(2022)	Uttar Pradesh	41.59±3.25	_	_

Table 4: Comparison of the various head parameters between different populations

Conclusion

The knowledge of the various parameters of the head of femur gains importance in desigining and manufacturing of implants, as the head shows variation according to the age, ethinic origin, gender and environmental factors. For better customised implants and prosthesis a detailed knowledge about the various parameters of head of femur of the Indian population is important.

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