Original Article

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A Study of Certain Femoral Metrics in South Indian Population and its Clinical Importance

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Abstract

Background: An osteological study of femur provides useful data to understand various diseases of femur and serves as a guide for the treatment of various pathological conditions of it.

Aim: The purpose of this study is to determine the various parameters of femur among south Indian population and to compare them with the data available worldwide.

Materials and Methods: A total of 158 adult femora were used to measure femoral total length, femoral anterior neck length and femoral neck shaft angle at Government Mohan Kumaramangalam Medical College, Salem and Government Stanley Medical College, Chennai.

Results: The length of the femur range from 35.5 cm to 50 cm with mean of 41.66 cm. The anterior neck length range from 2 cm to 4cm with mean of 3.09 cm. The neck shaft angle range from 120° to 145° with mean of 134.15°.

Conclusion: The present study hence provides valuable parameters which would help the forensic anthropologists, orthopedicians, and prosthetics to deliver excellent performance in their respective specialties.

Key words: Anterior neck length, Femoral length, Femur, Neck shaft angle, Parameters

INTRODUCTION

The femur is the largest and strongest bone in the body and the structure of its proximal portion allows the leg to move in three dimensions relative to the torso, thus serving as a linchpin of human mobility. Moreover, age related and pediatric disorders at this skeletal site are common and confer strong risk factors for current and future disability. In Orthopedic practice, operations on femur are the most common. Variations in hip morphology are also of critical interest to surgical planning where the ability to take hip morphology into account on a patient specific basis is crucial for success in choosing designs of implants and other structures used for hip replacements and augmentations of hip stability.[1]

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Different authors have suggested that difference in parameters of bone exists among different races and have tried to figure out the relationship of these variations to increased development of hip osteoarthritis, femoral neck fracture and slipped capital femoral epiphysis.[2-5]

The purpose of this study is to determine the various parameters of femur among south Indian population and to compare them with the data available worldwide.

MATERIALS AND METHODS

A total of 158 dry femora were collected randomly not knowing the sex and age of bone and studied at Government Mohan Kumaramangalam Medical College, Salem and Government Stanley Medical College, Chennai. Damaged, incomplete and unossified bones were excluded. All the bones intact and fully ossified belonging to the adult persons were collected for study. 158 femora were studied for following measurements:

1. The femoral length: With the help of osteometric board
2. The femoral anterior neck length: With the help of sliding caliper

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3. The femoral neck shaft angle: With the help of goniometer.

The femoral length is the total length of the bone measured with the osteometric board. Anterior length of neck is the distance between the base of head and intertrochanteric line at the junction of the front of neck with the shaft. The neck shaft angle is the angle made by the axis of the neck with the axis of the shaft. The axis of the neck and axis of the shaft were measured respectively as the line joining the two center points on the anterior surface of neck and the line joining the two center points on anterior surface of shaft.

RESULTS

The results of the present study were the mean length of femur was 41.66 cm, left femur was 41.88 cm and right femur was 41.29 cm, the anterior neck length of the femur was 3.09 cm, left femur was 3.16 cm and right femur was 2.98 cm. The neck shaft angle of femur was 134.15°, left femur was 135.02°, and right femur was 132.66° (Table 1).

DISCUSSION

Femur Length

In our study, the average length of femur was 41.66 cm, right femur was 41.29 cm, and left femur was 41.88 cm. The femur length in different populations is tabulated (Table 2).

The difference in mean femoral length in between populations may possibly be a result of factors affecting bone morphology such as genetic constitution, diet, nutrition status, environment, and physical activity.

Our results are in agreement with Bhosale and Zambare.[8] In their study the mean length of left male femur was 45.23 cm that of left female was 42.04, the mean length of right male femur was 45.08 cm that of right female was 41.64 cm.

Table 1: Results of femoral length, anterior neck length and neck shaft angle

Parameters	Number	Mean	Range	SD
Femur length in cm				
Total	158	41.66	35.5-50	3.03
Left	100	41.88	36-48.5	2.82
Right	58	41.29	35.5-50	3.39
Anterior neck length in cms				
Total	158	3.09	2-4	0.49
Left	100	3.16	2-4	0.46
Right	58	2.98	2-4	0.53
Neck shaft angle in degree				
Total	158	134.15	120-145	5.52
Left	100	135.02	120-145	5.36
Right	58	132.66	123-145	5.56

SD: Standard deviation

Our values are similar to the study of Zuylan and Murshid[6] (in their study left femur length was 42.84 cm, right femur length was 41.68 cm).

Anterior Neck Length

The neck of the femur in humans is a very important structural and functional specialization for man's erect posture.

The anterior neck length of femur in different populations is tabulated (Table 3).

The mean femur neck length in the present study was 3.09 cm, right femur neck length was 2.98 cm and left femur neck length was 3.16 cm, our values agree with Ravichandran *et al.* study,[13] in their study the mean femur neck length was 3.18 cm.

Our study is similar to that of de Sousa *et al.*,[12] in their study right femur neck length was 3.01 cm, left femur neck length was 3.05 cm.

Table 2: Femur length in different population

Authors	Population	Subdivision	Femur length in cm
Zuylan *et al.*[6]	Anatolian	Left	42.84
		Right	41.68
Pandya *et al.*[7]	Indian	Left	
		Male	45.33
		Female	42.04
		Right	
		Male	45.18
		Female	41.74
Bhosale and Zambare[8]	Indian	Left	
		Male	45.23
		Female	42.04
		Right	
		Male	45.08
		Female	41.64
Gujar *et al.*[9]	Indian	Left	43.65
		Right	43.99
Khan and Saheb[10]	South Indian	Left	44.58
		Right	44.66
This study (2015)	South Indian	Left	41.88
		Right	41.29

Table 3: Anterior neck length of femur in different populations

Authors	Population	Subdivision	Anterior neck length in cm
Siwach and Dahiya[11]	Indian		3.72
de Sousa *et al.*[12]	Brazil	Left	3.05
		Right	3.01
Ravichandran *et al.*[13]	Indian		3.18
Gujar *et al.*[9]	Indian	Left	3.42
		Right	3.45
Khan and Saheb[10]	South Indian	Left	3.64
		Right	3.61
This study (2015)	South Indian	Left	3.16
		Right	2.98

Neck Shaft Angle

The neck shaft angle varies with age, stature and width of pelvis. When this angle >135°, condition is known as coxavalga. When angle <120°, it is known as coxa vara. The angle of femoral neck is reduced with aging. In early infancy the neck shaft angle is about 150°, in childhood 140°, in adult about 125°, and in elderly about 120°.

The neck shaft angle was studied in different population and races such as Norwegian, Mexican, Brazilian, and Indian (Table 4).

The average neck shaft angle found in this study was 134.15° which was similar to the study of Khan and Saheb,[10] de Sousa *et al.*,[12] Huaglund and Low[14] and Gujar *et al.*[9] our values are higher than the study of Pujari *et al.*,[18] Isaac *et al.*[17] and Siwach and Dahiya[11] in Indian population.

These observations have profound implications. According to Siwach and Dahiya[11] and Noble *et al.*,[19] in case of total hip arthroplasty, it is mandatory that the design and dimensions of femoral components should match the anatomy of femur. Siwach and Dahiya had noted a geometrical discrepancy between western implants and our Indian femora.[11]

According to Reddy *et al.*, a strong correlation has been established between the occurrence of thigh pain and inadequate fit and fixation of the implant. It has been noted that there is an increase in the clinical outcome score, which was directly proportional to the degree of implant bone fit. In using implants which have been designed for our western counterparts, the chance of implant mismatch is much greater. This in turn may lead to increase in the rate of aseptic loosening, greater implant subsidence, and increased incidence of anterior thigh pain, more number of intraoperative complications and shorter lifespan of the implant.[20]

The implant device and prosthesis designed for western skeleton are large in size, there angles, orientations and thread length also mismatch the femora. Implants that are designed by taking in to account anthropometric and bio mechanic data will help in designing patient specific implants thereby minimizing the complications.[21]

Numerous studies have also shown that there is increase in the rate of intraoperative complication in the event of using mismatched implants especially over size implants.[22]

From this study, it is evident that the regional variations in the parameters measured do exist when the data of two different countries are considered but within a country there is not much variation. The present study is to generate a database for femur to help in designing for future implant.

Table 4: Neck shaft angle of femur in different populations

Authors	Population	Subdivision	Neck shaft angle in degree
Hoaglund and Low[14]	England		136
	China		135
Reikerås *et al.*[15]	Norwegian		127.7
Garcia and Uribe[16]	Mexico		130
Isaac *et al.*[17]	South Indian		126.7
Siwach and Dahiya[11]	Indian		123.5
de Sousa *et al.*[12]	Brazil	Left	131.8
		Right	132.1
Ravichandran *et al.*[13]	Indian		126.55
Gujar *et al.*[9]	Indian	Left	136.6
		Right	136
Khan and Saheb[10]	South Indian	Left	136.9
		Right	137.3
Pujari *et al.*[18]	Indian		127.5
This study (2015)	South Indian	Left	135.02
		Right	132.66

CONCLUSION

The results of the present study show that the Indian dimensions of the femur are different from the western standards. Therefore, this study will enlighten the biomechanical engineers to take a revolutionary step towards altering the implant designs to suit our Indian needs. The limitation of this study has been a small sample size hence a study with a larger sample size is warranted. Gender and age of the bones have not been taken into account in the present study warranting inclusion of these parameters in future.

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