Original Article Nepal Orthopaedic Association Journal (NOAJ)

Proximal Femoral Morphometry of Adult Nepalese Presenting to a Tertiary Healthcare Centre

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ABSTRACT

INTRODUCTION: A variation in morphometric parameters of the proximal femur has been observed among different population. The management of many of the hip pathologies involve the restoration of normal or near normal anatomy of the hip via corrective surgeries and application of prosthetic devices.Our current knowledge regarding the morphology of human skeleton however is primarily based on the studies performed in the population of the developed countries which is different from ours with respect to geography, race, nutrition, lifestyle etc.A study of proximal femoral morphometry in our own population wouldtherefore provide valuable information with wide range of utility.

METHODS: A prospective observational study was carried out in 142 patients aged 18 years and above presenting to ER and Orthopedic OPD of Tribhuvan University Teaching Hospital (TUTH) in 2013. The participants underwent AP radiographs of pelvis with bilateral hips in standard technique. The measurements were then taken in digital copy of X-ray from one of the hips.

RESULTS: The average values of proximal femoral morphometric parameters were found to be as follows: Hip Axis Length (HAL): 115.8± 8.92mm, Neck Axis Length (NAL): 103 ± 7.55mm, Head Width (HW): 49.5 ± 3.56mm, Neck Width (NW) : 32.3± 3.15mm, Trochanteric Width (TW): 58.9 ± 4.48mm and Neck Shaft Angle (NSA) : 125 ± 3.27°. Significant differences were found in HAL, NAL, HW, NW and TW between male and female participants; however, there was no significant difference in NSA between the two categories. Nearly 88.5% of the people had NSA between 120 to 130 degrees.

CONCLUSION: The proximal femoral morphometric parameters of adult Nepaleseis unique. NSA in particular is lower than 130 degrees in majority.

KEY WORDS: Femoral, Geometry, Morphomety, Nepalese

ABSTRACT

INTRODUCTION

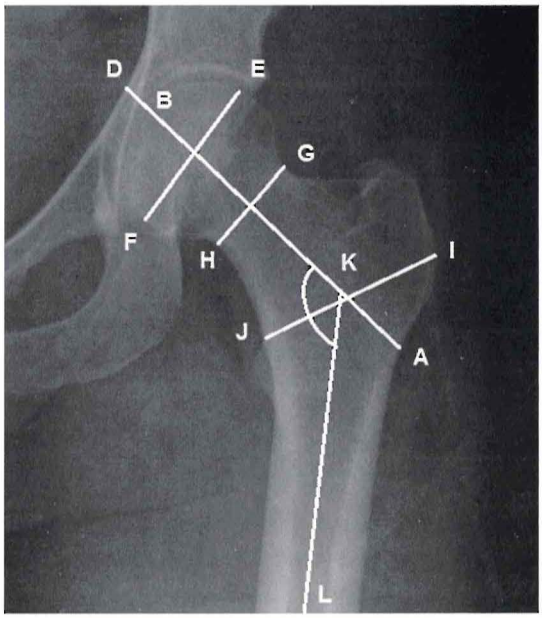
Hip joint is a multiaxial ball and socket type of synovial joint formed by the articulation of head of femur and the acetabulum of pelvis.[1] It involves unique biomechanics, an understanding of which is crucial in the treatment of many pathologic conditions. There are metric differences in the skeletal components in males and females within a population[2] and among different population respective to their genetic composition and various environmental factors

such as geography, diet and lifestyle.[3] The management of many of the hip pathologies involves the restoration of normal or near normal anatomy of the hip via corrective surgery and application of prosthetic devices and implants. Moreover, certain variations in the parameters of proximal femur such as a longer hip axis length are associated with increased risk of fracture.[4] A study of proximal femoral morphometry in the Nepalese population would therefore provide valuable information to orthopedic surgeons, anatomists, forensic scientists, anthropologists and implant developers.

METHODS AND MATERIALS

A prospective observational study was conducted in 142 patients aged 18 years and above who had presented to the ER and OPD of Tribhuvan University Teaching Hospital (TUTH) in 2013. Ethical approval was obtained from the Institutional Review Board. Patients who had indication to undergo an X-ray pelvis with bilateral hips AP view as part of their management were included in the study. Informed written consent was taken. History and Physical findings were recorded including height and weight of the patients. The patients then underwent X-ray pelvis with bilateral hips AP view in standard technique i.e. in recumbent position with a film focus distance of 100 cm, with central beam projecting midway between the level of the ASIS and the symphysis pubis. Both the hips were maintained in 15 - 20 degrees of internal rotation and the heels kept 20 cm apart. This optimum position brings the neck of femur parallel to the cassette. They were screened for any exclusion criteria which were presence of malignancy, systemic bone disease, coxarthroses, history of surgery for bony disorders in lower limb, history of growth disorders, bony injury and evidence of proximal femoral pathology of any other kind. The measurements were taken on digital copy of the radiographs using standard software (AGFA NX Version 2.0) available in the Department of Radiology of TUTH.

Figure 1:



Six parameters were included in the study

Figure 1. Landmarks for morphometric parameters

1. Hip axis length (HAL i.e. A-D): length of the femoral neck axis from the base of the lateral part of the greater trochanter to the inner pelvic brim.[5]
2. Neck axis length (NAL i.e. A-B): length of the femoral neck axis from the base of the lateral part of the greater trochanter to medial border of femoral head.[5]
3. Head width (HW i.e. E-F): broadest diameter of the femoral head.[5]
4. Neck width (NW i.e. G-H): narrowest cross section of the femoral neck.[5]
5. Trochanteric width (TW i.e. I-J): cross section of trochanteric region medially from immediately above the lesser trochanter to the most lateral aspect of the greater trochanter.[5]
6. Neck shaft angle (NSAi.e.between AD and KL): angle between femoral neck axis and the axis of shaft of femur.[5]

The data was analyzed with the use of SPSS version 20.0 software.

RESULTS

The average age of the participants was 40.12 years with standard deviation of 14.81 years (Range 18 years -78 years). There was female predominance among the participants with54.9% being females and 45.1% being males. The mean height of the participants was 1.56±0.10m, the mean weight was 55.08±11.17kg and the mean BMI was 22.35±3.66.

Mean and standard deviation calculated for each of the six morphometric parameterswere HAL: 115.8± 8.92mm, NAL: 103 ± 7.55mm, HW: 49.5 ± 3.56mm, NW: 32.3± 3.15mm, TW: 58.9 ± 4.48mm and NSA: 125 ± 3.27°. Significant differences were found in HAL, NAL, HW, NW and TW between male and female participants; however, there was no significant difference in NSA between the two categories. (Table 1)

Table 1. Variation of femoral morphometric parameters according to gender (N=142)

Measure-ments	Male		Female		T	p value
	Mean	SD	Mean	SD		
HAL	122.51	7.47	110.44	5.80	10.83	<0.001
NAL	108.38	6.60	98.68	5.07	9.64	<0.001
HW	51.95	3.14	47.50	2.46	9.43	<0.001
NW	34.07	3.08	30.95	2.44	6.72	<0.001
TW	61.47	4.33	56.94	3.48	6.90	<0.001
NSA (degrees)	124.62	3.38	125.37	3.15	-1.37	0.172

(Independent sample t test)

Neck shaft angle of the participants was studied in five groups (Figure 2). Maximum no. of participants fell in the group with NSA between 125° - 129.9° (66 patients) followed by the group 120° - 124.9° (60 patients). Approximately 90% cases were between 120° to 129.9°. There were seven patients with NSA of less than 120° and nine patients with NSA of 130°-135°. None of the participants had neck shaft angle greater than 135°.

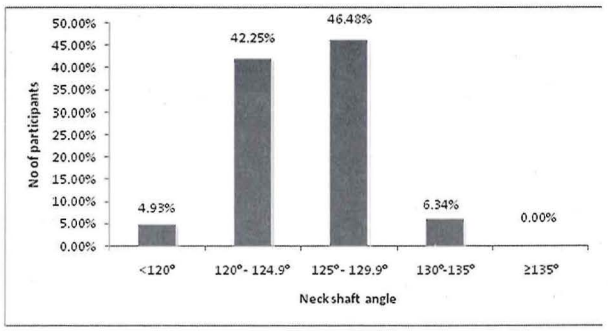


Figure 2. Distribution of patients according to Neck Shaft Angle.

DISCUSSION

Differences have been observed in the morphometry of the proximal femur among different population in many studies.

Compared to studies done in India by Rawal et al[6] and Isaac et al[7], mean values of femoral head diameter and neck diameter in Indian population were slightly lower than that of our mean while the mean value of NSA was similar to our findings. Similarly, in a study done in Brazil by Pires et al[8] and in a study conducted in UK by Patton et al[9] and Tuck et al[10] the mean values of morphometric parameters were higher compared to our study population. Comparing our results with a study conducted in Malayan population by Baharuddin et al[11] and another study conducted in Finnish women by Pulkkinenet al[12] the mean values of most morphometric parameters were higher than that of our study population except NSA which was lower than our mean. In a study performed in Turkish women by Irdesel et al[5], HAL and NAL were found to be lower compared to our study population , however HW, TW, NW and NSA were found to be higher. Compared to our study population a study performed in Japanese women by Sugano et al[13] showed lower mean values for the morphometric parameters of proximal femur.

Most differences have been considered to be due to genetic and environmental factors including race, sex and lifestyle.[2,3,5,6] Therefore,

Dimension	Nepalese (Average in mm)			Indian [6,7]	Brazil-ian[8]	Malayan[9]		British[11,15]		Turkish Women[5]	Finnish Women (Pulk-kinenet al.)	Japanese women[16]
	Present study											
	Male	Female	Mean (N=142)			Male	Female	Male	Fe-male			
Hip axis length(mm)	122.51	110.44	115.88					140.5	127.5	108	104	
Neck axis length(mm)	108.38	98.68	103.05		113.4	91.08	81.78	120.9	111.7	101.4	90	
Femoral head diam-eter (mm)	51.95	47.50	49.50	45.4		43.62	38.85	60.2	53.9	52.1	43	44.1
Femoral neck diam-eter (mm)	34.07	30.95	32.36	30.2	36.6	28.88	18.46	42.1	37.4	35.4	29	
Trochan-teric width (mm)	61.47	56.94	58.98							84.2	52	
Neck shaft angle	124.62°	125.37°	125.03 °	124.4°	129.2°	132.33°	129.87°	130°	128°	131.52 °	128°	122.6°

differences observed between Nepalese population in the present study and studies conducted in other populations can be attributed to the genetic makeup of different races and varying environmental influences.

In this study HAL, NAL, HW, NW and TW were significantly higher in males compared to females. This finding is also supported by the previous studies done in UK by Patton et al.[9] Similar findings were observed in studies done in Nigeria and Thailand by Asala et al[14] and Saengnipanthkulet al[15] respectively.

Neck shaft angle of proximal femur in the present study was not significantly different in both sexes. This finding is supported by a study conducted in Singapore by Elbuken et al[16] among 18,943 individuals between 20-108 years of age using DEXA scan to measure NSA of proximal femur. The study revealed small differences in neck-shaft angle between males and females which was not significant at 95% level of confidence. The mean value for females and males were 129. 142° (95% CI 129.032–129.252) and 129.630° (95% CI 129.157–130.104), respectively.

CONCLUSION AND RECOMMENDATION

The proximal femoral geometry of our population is unique. Nearly 88.5% of the people have NSA between 120 to 130 degrees. Significant differences were found in HAL, NAL, HW, NW and TW between male and female participants; however, no significant difference in NSA was observed according to gender. A multicentric large scale study needs to be carried out to validate the key findings of this study.

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