

Correlation of Femoral Neck Shaft Angle with Selected Proximal Femoral Parameters Among Adult Bangladeshi People

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Abstract

Background: Understanding of Anatomy of proximal end of femur is a prerequisite for a complete discover of the mechanics of hip joint. The present study is designed to establish the association between femoral neck shaft angle (FNSA) along with femoral neck length (FNL), femoral neck width (FNW) and inter trochanteric width (ITW) of both genders and also on right and left sides for the reason of scheming, bioengineering and manufacturing of orthopedic implants of adult Bangladeshi people.

Materials & Methods: It was a cross sectional observational study and was conducted in the Department of Anatomy, Chittagong Medical College from July 2020 to June 2021 among 200 (119 male, 81 female) adult Bangladeshi people of Chattogram district. Participants recruited from Radiology Department of Chittagong Medical College Hospital (CMCH) as per enrolment criteria. After taking demographic data of all participants plain pelvic x-ray A/P view were taken and reported by an expert radiologist of CMCH. Only normal radiographs were included in the study. All measurements such as FNSA, FNL, FNW, ITW of femur were taken from both sides of the x-rays. Data were analyzed by SPSS version–25.

Results: In this study, the association between FNSA of right and left sides along with FNL, FNW, ITW of both sides and in both sexes were not statistically significant.

Conclusion: The result of the present study gives some standard data in order to recognize the orthopedic surgeons to treat different disorders of the femur and hip joint.

Key words: Femoral neck shaft angle, femoral neck length, femoral neck width, intertrochanteric width.

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Introduction

Femur is extensively studied in the discipline of orthopaedics, comparative anatomy, forensic medicine and human biomechanics. Orthopaedics experimentation requires morphological analysis of femur for joint studies in order to design intramedullary fixators & to determine the axes of orthopedic surgery.¹

In spite of many examinations, the pathophysiology of primary hip osteoarthritis has still not been distinctly determined. The virulent factors that cause joint degeneration can be categorized into two groups such as biological & mechanokinetic. The components that causes such type of malformation includes hormonal changes such as female estrogen, vascular malfunction leading to cyst formation in the bones, overburden the joint cartilage, inherent susceptibility & morphological peculiarity

in the joint components that are not appeared through radiological examination.²

Femur fractures are mainly subdivided into intertrochanteric & femur neck fractures. Based on clinical data, almost 20% of surgeries done by orthopedic surgeons are because of femur fractures and almost 50% of femur fractures are femur neck fractures. It has been predict that with increased life expectancy, the number of femur neck fractures would jump up from 6.26 million in 2050.³⁻⁶

The femur neck is situated along the long axis of bone shaft forming an angle which is called femoral neck-shaft angle (FNSA).^{7,8} Severe pressure during physical movements occurs at the neck of the femur.⁹ The expertise of FNSA is important in the detection and management of upper femoral fractures. Based on documentation the configuration of proximal femur is affected by various factors such as ethnicity, hereditary & ecological circumstances.¹⁰ The knowledge about the proximal femoral geometry is significant in planning preoperative procedures of surgical operation or fracture fixations. The fact is also helpful in designing suitable implants with a more accurate angle of the femoral neck. The use of implants that are smaller or larger than that of the

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size of the femur can lead to improper tension in the soft tissue that causes more stress on joints.¹¹

As mentioned, femoral fractures put heavy socio-economic burdens in both developing & developed countries. As a result assessment of FNSA is crucial in construction and bioengineering of orthopedic implants that might change life span of implants and less strain in fixing the fractures of proximal femur.^{12,13} Therefore, the current research is focused to evaluate the value of FNSA and find out the correlation of FNSA with FNL, FNW & ITW on both sides and in both genders for the purpose of adequate planning, preparation, and pre-operative selection of prosthesis for orthopedic implants and also stocking of prosthetic implants in hospitals of Bangladesh.

Materials and Methods

This cross sectional observational study was conducted in the Department of Anatomy, Chittagong Medical College, Chattogram during the period from July 2020 to June 2021. Ethical clearance for doing the proposed study was obtained from the Ethical Review Board (E.R.B) of Chittagong Medical College. After getting consent from Chittagong medical college hospital authority as well as Radiology Department of CMCH informed written consent was taken from the patients who were attending in CMCH Radiology Department and want to involve in this study willingly. Total 200 adult Bangladeshi participants except tribal population were selected as per enrolment criteria. Among them 119 were male & rest are female. The participant's age ranged between 20-75 years. Respondents with age greater than or equal to 20, no visible pathology in radiograph, bilaterally symmetrical acetabulum were included in the study. On the other hand, participants with age less than 20 years, having poor image quality, fracture or deformity in the proximal femur, previous hip surgery or implant were excluded. All measurements were taken from both sides of the body. The participants were asked to wear light cloths, put off shoes and belt. Then plain pelvic radiograph A/P view was taken by using the standardized protocol that was 15-30 degrees of internal rotation of the hips in the supine position with a film-focus distance of 100 cm and the beam centered on the symphysis pubis^{14,15} and then reported by an expert radiologist of CMCH. Only normal radiographs were included in the study. All dimensions of every individual were measured by the same observer with the help of same view box, measuring steel plate and protractor¹⁵ to avoid any

technical error. The following parameters were recorded.

Femoral neck-shaft angle (FNSA): The FNSA is the angle made by the intersection of the longitudinal axis of the femoral neck with that of longitudinal axis of femoral shaft. The longitudinal axis of the neck was obtained by joining two midpoints; One at the center of the head and another at the constricted part of neck region while the longitudinal axis of the shaft of the femur was drawn by joining the midpoints on the proximal shaft of the femur below the lesser trochanter. The angle is formed by the intersection of the two axes (figure 1).¹⁴

Femoral neck length (FNL): FNL was measured by drawing a line as distance between the lateral margin of the femoral head and the superior base of the trochanteric region with the help of measuring steel plate (figure-1).¹⁶

Femoral neck width (FNW): FNW was measured by drawing a line which is the midpoint distance between the superior cortex and the inferior cortex of the femoral neck with the help of measuring steel plate (figure-1).¹⁶

Inter-trochanteric width (ITW): ITW was measured by drawing a line by cross-section from immediately above the lesser trochanter to the most lateral aspect of the greater trochanter with the help of measuring steel plate (figure1).¹⁶

After collection, all data placed into a record sheet and compiled in Microsoft Xcel sheet to generate a master sheet and then they were reserved into SPSS (statistical package for social science) version 25 software for processing and analysis. P-value was considered significant if it was <0.05.

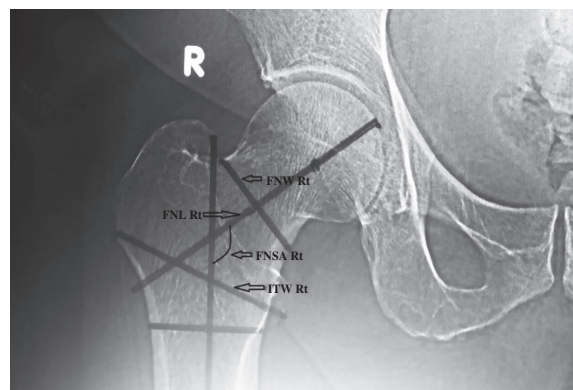


Fig.-1: Measurement of FNSA, ITW, FNW and FNL (Right).

Results

Table I
Measurement of FNSA, FNL, FNW, ITW of both right and left sides (N=200)

Variable	Male (right) (n=119) Mean $\pm$ SD (Range)	Female (right) (n=81) Mean $\pm$ SD (Range)	Male (left) (n=119) Mean $\pm$ SD (Range)	Female (left) (n=81) Mean $\pm$ SD (Range)
FNSA	126.11 $\pm$ 2.48	125.21 $\pm$ 3.36	125.12 $\pm$ 3.84	124.31 $\pm$ 2.86
(in degree)	(124.84-135.26)	(123.32-132.24)	(123.55-129.47)	(122.78-128.75)
FNL	35.630 $\pm$ 2.872	35.371 $\pm$ 3.74	34.157 $\pm$ 2.82	34.084 $\pm$ 3.59
(in mm)	(31.25-38.57)	(30.82-36.47)	(30.45-36.89)	(29.82-37.57)
FNW	32.739 $\pm$ 3.81	30.469 $\pm$ 3.62	31.363 $\pm$ 3.71	29.062 $\pm$ 3.39
(in mm)	(30.52-36.81)	(28.25-35.35)	(28.52-34.46)	(27.37-34.25)
ITW	6.950 $\pm$ 0.42	6.662 $\pm$ 0.38	6.830 $\pm$ 0.44	6.557 $\pm$ 0.39
(in cm)	(5.55-7.65)	(5.25-6.65)	(5.11-6.85)	(5.15-6.75)

N= Total sample size, n = sample size in each group

Table II
Correlation coefficients of parameters such as (NSL, NW, and ITW) with FNSA among male and female on right side (N=200)

Correlation with FNSA Variable	Male (n=119) (right side)			Female (n=81) (right side)		
	Correlation coefficient (r)	Coefficient of determination (r ²)	P value	Correlation coefficient (r)	Coefficient of determination (r ²)	P value
FNL	+0.061	0.004	0.513 ^{ns}	+0.067	0.004	0.552 ^{ns}
FNW	+0.098	0.010	0.289 ^{ns}	-0.156	0.024	0.164 ^{ns}
ITW	-0.166	0.028	0.072 ^{ns}	-0.100	0.010	0.374 ^{ns}

Correlation with FNSA with FNL, FNW and ITW on right side among male and female are done by Pearson correlation coefficient test. N = Total sample size, n = sample size in each group, ^{ns} = Not significant at P>0.05

Table III
Correlation coefficients of some selected parameters (FNW, FNL, ITW) and FNSA among male and female on left side (N=200)

Correlation with FNSA Variable	Male (n=119) (left side)			Female (n=81) (left side)		
	Correlation coefficient (r)	Coefficient of determination (r ²)	P value	Correlation coefficient (r)	Coefficient of determination (r ²)	P value
FNL	+0.127	0.016	0.170 ^{ns}	+0.089	0.008	0.430 ^{ns}
FNW	+0.060	0.004	0.518 ^{ns}	-0.207	0.043	0.064 ^{ns}
ITW	-0.204	0.042	0.056 ^{ns}	-0.108	0.012	0.339 ^{ns}

Correlation with FNSA with FNL, FNW and ITW on left side among male and female are done by Pearson correlation coefficient test. N = Total sample size, n = sample size in each group, ^{ns} = Not significant at P>0.05

Discussion

Correlation of femoral NSA with FNL in relation to sex and side. The present study revealed non-significant positive correlation of both sided femoral NSA with FNL in both sexes. Sayed et al revealed that the mean NSA in male and female femur of both sides showed non-significant positive correlation with FNL. The values of right side of both male and female femurs were ($r=0.03$; $p=0.78$ and $r=0.20$; $p=0.22$) and left side was ($r=0.08$; $p=0.50$ and $r=0.16$; $p=0.31$) respectively.¹⁷ Nagarathnamma stated that there was significant positive relationship between femoral neck shaft angle and femoral neck length on right side ($r=0.53$; $p<0.05$ and $r=0.43$; $p<0.05$) as well as on left side in both sexes ($r=0.22$; $p<0.05$) in radiographs.¹⁸ Irdesel and Ari found that there was non-significant positive correlation of femoral neck length with NSA on both sides only in case of female.¹⁹ All the studies have shown similarity along with this present study. Sultan et al revealed non-significant negative correlation on left sided femoral neck length and femoral NSA in case of male ($r=-0.1652$; $p=0.1039$) as well as female ($r=-0.1297$; $p=0.3594$ on rt. side and $r=0.0606$; $p=0.6692$ on lt. side)²⁰ which is dissimilar with the present study.

Correlation of femoral NSA with FNW in relation to side and sex

Correlation analysis of femoral neck width with femoral neck-shaft angle in the present study showed that in case of male non-significant positive correlation of femoral neck-shaft angle of both sides with femoral neck width on right ($r=0.098$; $r^2=0.010$; $p=0.289$ and $r=0.060$; $r^2=0.004$; $p=0.518$) but in case of female non-significant negative correlation of both sided femoral neck-shaft angle and femoral neck width ($r=-0.156$; $r^2=0.024$; $p=0.164$ and $r=-0.207$; $r^2=0.043$; $p=0.064$). Sultan et al found non-significant positive correlation between right sided femoral neck width and right femoral NSA ($r=0.0782$; $p=0.4437$) in case of male but in case of female there was non-significant negative correlation between femoral neck-shaft angle femoral neck width on right side ($r=-0.1093$; $p=0.44$) and also on the left side ($r=-0.685$; $p=0.62$).²⁰ Sayed et al revealed non-significant positive correlation of femoral neck shaft angle on right side and right femoral neck

width ($r=0.08$; $p=0.46$) in case of male but non-significant negative correlation along with left sided NSA with left femoral neck length ($r=-0.02$; $p=0.85$) and in case of female non-significant negative correlation in both sides ($r=-0.20$, $p=0.22$ on right side & $r=-0.11$, $p=0.512$ on left side).¹⁷ Nagarathnamma showed that there was non-significant positive correlation between femoral neck width and femoral neck shaft angle in both sides and in both genders in radiographs ($r=0.21$, $p=0.20$).¹⁸ The results of all the studies have shown similarity with this present study.

Correlation of femoral NSA with ITW in relation to side and sex

This present study showed non-significant negative correlation of femoral neck-shaft angle of right and left side with inter trochanteric width ($r=-0.166$; $r^2=0.028$; $p=0.072$) and ($r=-0.204$; $r^2=0.042$; $p=0.056$) in case of male but no significant negative correlation between right femoral NSA and right inter trochanteric width ($r=-0.100$; $r^2=0.010$; $p=0.374$) and left femoral NSA and left inter trochanteric width ($r=-0.108$; $r^2=0.012$; $p=0.339$) in case of female. Irdesel and Ari in their study stated that, there are significant positive correlation among intertrochanteric width and the femoral neck-shaft angle ($p=0.02$) on both sides in case of female.¹⁹ This finding does not correlate with the findings of present study.

Conclusion:

The result of the present study showed no significant correlation between FNSA along with FNL, FNW & ITW. The result should be used in terms of prosthesis selection throughout different regions of Bangladesh where the implants came from different ethnicity model and prosthesis companies also can design a suitable model according to the result of the study. We also suggest that more studies should be carried out in this territory where tribes must be included.

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