ORIGINAL ARTICLE

A RADIOGRAPHIC STUDY OF NECK SHAFT ANGLE IN POPULATION OF MARDAN REGION, KHYBER PUKHTONKHWA – PAKISTAN

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ABSTRACT

Background and Objectives: Hip fracture contributes to both morbidity and mortality in elderly population. Proximal femur geometry including neck – shaft angle has been identified as a risk factor for hip fracture, which is related to mechanical strength of the femur. Geography, ethnicity, diet, heredity have effects on patterning proximal femur geometry. Neck – shaft angle can offer a guide to the clinicians for determinations of hip fracture risk and can helps in its management. Objective of present study was to assess the results of neck – shaft angle in the elderly population of Mardan region Pakistan and to compare it bilaterally in both sexes.

Methodology: The study was conducted on the pelvic radiographs of 91 participants, of either sex, aged from 50 to 70 years, in the department of radiology Mardan Medical Complex Mardan from May 2014 to October 2014. Measurement of neck – shaft angle was performed bilaterally; data was collected and analyzed statistically.

Results: In a total of 91 cases, 55 (60.4%) were male and 36 (39.6%) were female with mean age 58.24 (6.49). The mean neck – shaft angle of both sides of female population were significantly higher than male (rig-ht side p = 0.009, left side (p = 0.05). The mean left neck – shaft angle of the total population was higher than right side (p = 0.05).

Conclusions: The present study concluded that the neck – shaft angle differs with gender and with sides. Larger neck – shaft angle in elderly females of Mardan region may increase the risk of hip fracture. Further studies on other risk factors such as anthropometric parameters and bone mineral density must be conducted to collect more information on this subject, in addition to the present findings.

Keywords: Neck Shaft Angle, Proximal femur, Morphometry.

INTRODUCTION

The femur is one of the long bones being thoroughly studied anatomically and has three parts; proximal, distal end and a long shaft. The femur neck making an angle with the long axis of shaft, known as neck – shaft angle, femoral carrying angle, angle of inclination, cervico-diaphyseal angle and collo-diaphyseal angle.[1] Neck – shaft angle is important regarding its stability, control of lateral balance, walking and facilitates hip movement. It varies with age, body structure,width of pelvis, being less in adult in persons short with limbs and in women.[2] The femur act as a brace and its biomedical properties depend on width and length of the femoral length.[3] Mechanical stresses in the femoral appears to increase at three times the rate per decade of those males. These results lend support to the hypothesis that the higher fracture rate in the elderly women is due, at least in parts, to evaluated levels of mechanical stress, resulting from a combination of greater bone loss and less compensating geometric restructuring with age.[4]

Proximal femoral geometry is affected by different factors e.g. ethnicity, genetics and environmental conditions.[5] An increase (Coxavulga) or reduction (Coxavara) of neck – shaft angle can imply pathology especially hip fractures. The aged population is more prone to fracture of the femoral neck due to osteoporosis, however with an addition of the pathological neck – shaft angle, the risks of the femur neck fracture is even greater.[6]

The angulations was studied by many workers; Keats was first adopted the use of radiographs to study this angulations,[7] Cheng studied the neck – shaft angle in American skeleton through x-ray, discovered an average value of 125^{0} (8.5)[8] and Hogland did a radiographic study on Hong Kong Chinese vs. Caucasians and found the neck – shaft angle in Caucasian was more than Hong Kong Chinese.[9]

Regional variations of neck – shaft angle also exist, even within the same ethnic group. In studies by Tahir different values of mean neck – shaft angle were found in different regions of Nigeria.[10] A number of contro-

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versial studies are available on neck – shaft angle relation to hip fracture. A study was done in 2004 in Turkey on 232 hip x-rays from women with hip fracture and with no hip fracture. Besides others proximal femur parameters, it was found that neck – shaft angle was higher in cases with femur neck fractures than no fractures.[11] While another comparative study between American and Japanese the author found smaller neck shaft angle in cases with femur neck fracture, whereas a study among Swedish population shows no relation between the risks of hip fracture.[12]

Knowledge of neck – shaft angle is an important to know the race to which they belong but also helps in the diagnosis, treatment and fellow-up of hip fracture, slipped upper femoral epiphysis, developmental dysplasia of the hip. Knowledge of normal asymmetry of right and left neck – shaft angle may be great value in evaluation of patients with known or assumed pathological conditions and in correctional osteotomies in case of femoral fractures. According to Siwach; in case of total hip arthroplasty, it is mandatory that design and dimensions of the femoral components should match anatomy of the femur.[13] The implants inadequacy increases the chances of implant failure due to constitutional and biomechanical factors significantly leading to non union, malunion and avascular necrosis.[14]

Review of the literature showed a dearth of information about the proximal femur geometry and neck – shaft angle in Pakistan. Hence this study was carried out to assess the morphometry of proximal femur (neck – shaft angle) in Mardan – Pakistan in age group between 50 – 70 years.

Objectives
Present study aimed to assess the neck – shaft angle in the elderly population of Mardan region Pakistan and to compare it bilaterally and in both sexes.

METHODOGOLY
The study was initiated after approval of Ethical Review Committee, conducted in Mardan Medical Complex, private hospitals and clinics of Mardan during the year 2014.

Study Design
This was a prospective cross – sectional study.

Setting
The study was conducted in the departments of radiology, orthopedics in Mardan Medical Complex Mardan and in private hospitals and clinics of Mardan.

Duration
The duration of research study was six months (from May 2014 to October 2014).

Sample Size
Total of 91 patients both male and female from 50 – 70 years were included in the study.

Inclusion Criteria
All individuals between ages 50 – 70 years of age who would be undergoing pelvic digital x-rays anteroposterior view with radiologically normal x-rays were included in the study.

Exclusion Criteria
Digital radiographs of patients with osteoarthritis, metabolic diseases, renal failure, hip fractures and pathological (metastatic) hip fracture were excluded.

Plan of Study
Informed consent was obtained from each patient; history of each patient was obtained by interviewing patients. The radiograph was taken at routine object film distance of 5 cm and focal film distance of 92 cm in the antero-posterior view while the big toes touching on their medial aspects (femur in internal rotation of 15 – 30 degree).[15] The neck – shaft angle was measured bilaterally with digital calipersin degrees by the intersection of longitudinal axis of the neck with that of longitudinal axis of the shaft[16] (Fig. 1). The neck – shaft angle measurement were made under the guidance of radiologist.

Statistical Analysis
The statistical software SPSS (version 20.0) was used for descriptive statistics. Normality of quantitative data was checked by measures of Kolmogorov Smirnov tests of normality. Data was normally distributed so *t*-test was applied for comparison between two groups (male vs. females and right vs. left). A *p*-value of 0.05 or less was considered for statistical significance.

RESULTS
The study population of 91 cases included n = 55, (60.4%) of male and n = 36, (39.6%) of females, with a mean age of 58.74 (± 6.39) in male and 57.47 (± 6.6) in females. The mean age of total population was 58.24 (± 6.49) years (Table 1).

The mean right neck – shaft angle in male was

Table 1: *Age Distribution.*

	Gender	*N*	*Mean*	*Std. Deviation*
Age (in years)	Male	55	58.74	6.39
	Female	36	57.47	6.66
Total		91	58.24	6.49

N = number of study subjects, Std. Deviation = Standard deviation

134.10 (5.93), in female 137.55 (6.06) and the mean value of the total population was 137.47 (6.18). The mean left neck – shaft angle in male was 135.49 (4.99), in females 137.88 (6.5) and of the total population was 136.43 (5.77) (Table 2).

The mean neck – shaft angle of both sides of female population were significantly higher than males (right p = 0.009, left p = 0.05) (Table 2). The mean neck – shaft angle of left side of total population was higher than right side (p = 0.05) (Table 3).

Table 2: *Neck – shaft angle (in degrees) according to gender.*

		N	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*	*P-Value*
NSA Right	Male	55	120	145	134.10	5.93	0.009
	Female	36	125	155	137.55	6.06	
	Total	91	120	155	135.47	6.18	
NSA Right	Male	55	122	145	135.49	4.99	0.05
	Female	36	125	154	137.88	6.5	
	Total	91	122	154	136.43	5.77	

Where p-value 0.05 was considered statistically significant
N = number of study subjects, Std. Deviation = Standard deviation

Table 3: *Bilateral Neck – shaft angle in degrees.*

	N	*Mean*	*Std. Deviation*	*p-value*
NSA Right	91	135.47	6.18	0.05
NSA Left	91	136.43	5.77	

N = number of study subjects, Std. Deviation = Standard deviation

DISCUSSION

The neck – shaft angle has been examined by several authors and found considerable variations in this angle in disparate countries, regions. Such inter-populational variations of the neck – shaft angle has been attributed to varying activity levels, genetics and other factors like diet and lifestyle have also been implicated.[2,5,17]

In present study it was found that the mean neck – shaft angle in females was 137°, which was significantly higher than male (p = 0.009) for right and (p = 0.05) for left neck– shaft angle and was consistent with a studies by Yoshioka, Tardieu, and Massaki, in which mean neck – shaft angle in females was higher than male.[18,19,20] In a comparative study, Anderson, et al, found sexual dimorphism in femoral neck – shaft angle; the mean neck – shaft angle in females was higher in 58.8% of the 17 samples, suggesting lower activity levels of females relative to male.[21]

In retrospective study of 100 patients by Chiuck et al, found mean age of 56 years, mean neck – shaft angle 136 (5.6) of females (n = 54) were higher than male (n = 46 NSA = 135.9 (5.8).[22]

An increase of neck – shaft angle can imply pathology, the older population is more prone to fracture of the neck of the femur due to osteoporosis, and with the addition of pathological neck – shaft angle, and the risk of the neck fracture is even greater.[6]

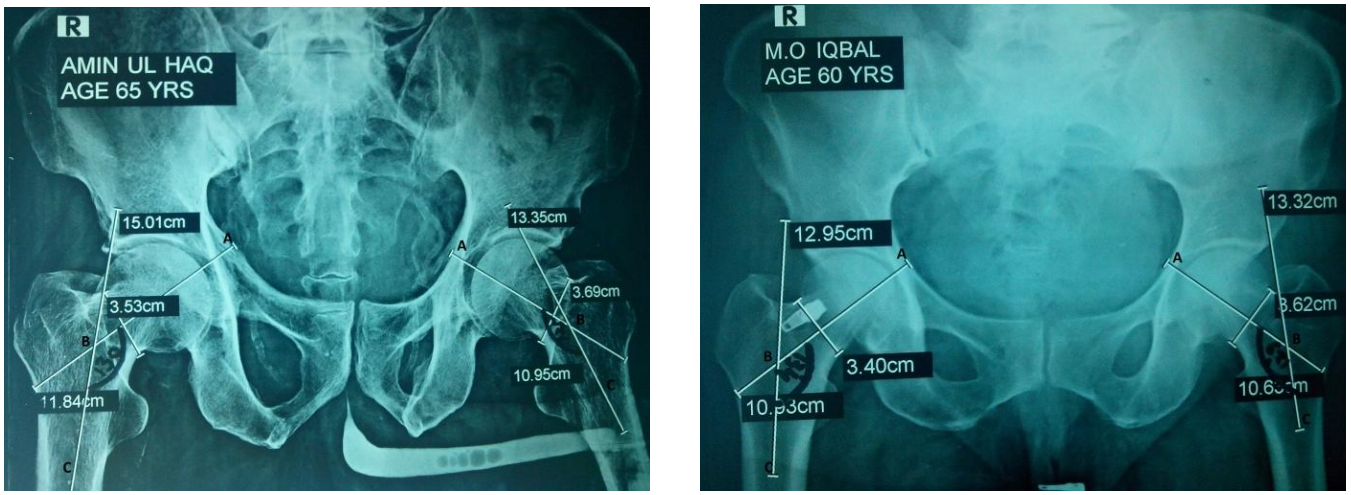

Fig. 1: Geometrical parameters of proximal femur.
Antero-posterior radiograph of hip joint showing neck – shaft angle ABC – the angle between the femur neck and shaft.

Population differences in the geometry of the proximal femur have also been used to explain differences in the incidence of fractures of the neck of the femur in different populations. Nakamura et al, and Yoshikawa et al, compared proximal femoral morphometric characteristics in Japanese and white American women.[18] They found that Japanese women had smaller neck – shaft angles than American women. This, along with other differences in femoral morphometry, could be used to explain the differences in hip fracture risk between the two populations. Japanese have a lower incidence of hip fracture despite having lower femoral neck mass. A wider neck – shaft angle was detected in a cross – sectional study of 547 post-menopausal women over 69 years of age with cervical hip fractures according to Gnudi et al; (88 cervical, 93 trochanteric fractures and 366 control).[23]

The neck – shaft angle of the left side was significantly higher than right (p = 0.05). According to Samaha, et al, there is a system of the proximal femur in normal conditions with the predominance of the left proximal epiphysis in providing moving and support function, the right proximal femur metaphysic is less adjusted to movement and severe strain. Present study was consistent with studies of Anderson, Hoaglund and Trinkaus in which all authors have noted variably greater degrees of left leg robusticity in individuals.[9,19,21]

The study ***concludes*** that there is significantly larger femur neck – shaft angle in elderly female population in Mardan region Pakistan. This finding of a tendency towards coxavulga in old age may be one of the contributing factors in the increased hip fracture in this age group. However further studies on other risk factors for hip fractures such as anthopometric parameters and bone mineral density must be conducted to find out the clinical significance of the present study findings.

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ANNUXURES

INFORMATION SHEET
"A RADIOGRAPHIC STUDY OF NECK – SHAFT ANGLE IN AGE OF 50 – 70 YEARS IN MARDAN REGION PAKISTAN"

Researcher: Dr. Wajid Akbar
M. Phil Scholar
Study Location: Mardan Medical Complex, Mardan

I would like you to take part in a research study, before you decide you need to understand why this research is being done and what it involve for you. Please take a time to read this information carefully. Talk to others about the study if you wish. Please ask me if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Purpose of Study
This study is designed to understand the role of proximal femur geometry (neck – shaft angle) in hip fracture risk. This information will be used in diagnosing and treatment of hip fracture. The long term aim is that this information will be contributed in prevention of hip fractures.

Why Have I been Invited?
Your participation will involve a history taking, pelvic X-ray.

Do, I Have to Take Part?
It is up to you to decide. It is entirely optional and deciding not to participate or to withdraw from the study will not affect your healthcare in anyway.

What will Happen if I Agree to Take Part?
- ✓ A pelvic x-ray will be taken, to measure proximal femur geometry (neck – shaft angle).
- ✓ The study will not change your current healthcare, the results of the study will be analysed but will not influence the treatment you receive.

Will My Taking Part in the Study be Kept Confidential?
All the information that is collected about you for the study will be kept confidential. Any results from the study that are published will be completely anonymous and will have all personal information removed, so that you cannot be identified in anyway. All information will be held securely in strict accordance with hospital policy and will only be accessed by authorized personnel.

What will Happen to the Results of the Study?
It is intended that the results will be use as a part of research. You will not be identifiable in any report or publication. You can request a summary of the results if you would like them once the study has been published.

Who has Reviewed the Study to Ensure it is Correctly Conducted?
The research has been reviewed by the Research and Development Committee here at Khyber Medical University, to ensure that the project is performed with due care and attention to the responsibilities of Researchers in healthcare.

Thank You for your participation and cooperation.

Dr. Wajid Akbar
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Research Case Study Number:

Informed Consent Form

"A RADIOGRAPHIC STUDY OF NECK – SHAFT ANGLE IN AGE OF 50-70 YEARS IN MARDAN REGION PAKISTAN"

Researcher: Dr. Wajid Akbar
Study Location: Mardan Medical Complex, Mardan

X-ray pelvis and measuring proximal femur geometrical parameters will be done, to assess the relation of hip fracture risks to proximal femur geometry and BMD in age of 50 – 70 years Mardan Medical Complex Mardan. Ultrasound densitometry of heel will be done to know bone mineral density and/or curetted bone from fracture site will be taken for biopsy.

I.....s/o w/o D/o.....understand that my pelvic x-ray is advised by ..... is examining for research study , measuring proximal femur geometrical parameters is also part of the study, all these investigations will benefit me and other people of my nation.

Please Initial box

1. I confirm that I have read and understand the information sheet for the above study. I have had the time and opportunity to consider the Information, ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. ☐
3. I have been informed of the fact that there will be no risk to me. ☐
4. Having been assured of total anonymity, I consent to the collected data being used for analysis, as a part of research study and publication. ☐
5. I understand that the result obtained from above mentioned investigations will be kept confidential and conveyed to me privately if I would ask for it. ☐
6. I have been cleared that I will not pay to them, data is used for research purpose I hereby confirmed that I have read and understand what ever has been stated above and I have no objection. ☐
6. Knowing all the facts, I agree to take part in the above study. ☐

Date: _____

Subject 'Signature: _____ Witness's Signature: _____

Subject 'Name:_____ Witness's Name: _____

Title suggestions:

1. A study of femoral neck – shaft angle in age of 50 – 70 years in Mardan region Pakistan.
2. A study of femoral neck – shaft angle in elderly population Mardan region Pakistan.
3. A study of femoral neck – shaft angle in Mardan – Pakistan on radiographs.
4. A radiographic study of femoral carrying angle in elderly Mardan – Pakistan population.