Section: Orthopaedics

Original Research Article

ASSESSMENT OF FEMORAL NECK-SHAFT ANGLE ON PLAIN X-RAYS AND ITS CLINICAL IMPORTANCE AS IN INDIAN POPULATION

Kata Manoj Kumar[1], Monesh K B[2], Sandeep K M[3], P. Siri Soumya[4]

[1]*Assistant Professor, Department of Orthopaedics, Rajarajeshwari medical College and Hospital,202, Mysore Rd, Kengeri Satellite Town, Kambipura, Karnataka, India.*
[2]*Associate Professor, 961-965, ESI Hospital Main Rd, Rajajinagar, Bengaluru, Karnataka, India.*
[3]*Associate Professor, Department of Orthopaedics, Rajarajeshwari medical College and Hospital,202, Mysore Rd, Kengeri Satellite Town, Kambipura, Karnataka, India.*
[4]*Junior Resident, Department of Orthopaedics, Rajarajeshwari medical College and Hospital,202, Mysore Rd, Kengeri Satellite Town, Kambipura, Karnataka, India.*

Received *: 03/04/2025*
Received in revised form *: 03/06/2025*
Accepted *: 21/06/2025*

Corresponding Author:
Dr. P. Siri Soumya,
Junior Resident, Department of Orthopaedics, Rajarajeshwari medical College and hospital,202, Mysore Rd, Kengeri Satellite Town, Kambipura, Karnataka, India.
Email: psirisoumya8@gmail.com

DOI: 10.70034/ijmedph.2025.3.327

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (3); 1782-1784

ABSTRACT

Background: Femoral neck-shaft angle is an important parameter for evaluating the biomechanics of the hip joint. It plays a pivotal role in surgeries for developmental dysplasia of the hip, neuromuscular disorders of the lower limb, proximal femoral fractures, Total Hip Arthroplasty, Perthes disease etc., It is also considered to hold an extensive bearing while designing orthopaedic implants. This study aimed to evaluate the femoral neck-shaft angle of proximal femur on plain radiographs.

Materials and Methods: Study Design is retrospective study. This cross-sectional study was done at Rajarajeswari medical college and hospital, a tertiary care institute in Bangalore. 100 pelvis with bilateral hip X-rays of patients aged between 30 to 70 who presented to the outpatient or emergency care department were used in the study. Using a goniometer the femoral neck shaft angle was measured.

Results: The mean age of the population in our study was 47.12. And the mean femoral neck shaft was 131 ° in males and 129 ° in females.

Conclusion: The present study highlights the significance of assessing the femoral neck-shaft angle (NSA) in the Indian population using plain radiographs. The mean NSA was found to be 131° in males and 129° in females, with overall values closely aligning with international reference data. Although no statistically significant gender difference was observed, the consistently lower mean angle in females reflects anatomical adaptations related to pelvic morphology. These findings are clinically relevant for diagnosing hip pathologies, planning corrective surgeries, designing population-specific orthopedic implants, and forensic sex determination. Thus, establishing normative NSA values in different populations provides an essential reference for both clinical practice and anthropological research.

Keywords: Femoral neck-shaft angle, Hip biomechanics, Orthopedic implants

INTRODUCTION

The femoral neck-shaft angle (FNSA) is one of the most frequently applied anatomical measurement for the evaluation of hip biomechanics.[1] During mobility; this angle is essential for the femoral shaft to swing clear further from the pelvis.[2] Also the neck shaft angle differs and it tends to be smaller in females because of broad pelvis leading to a greater inclination of the femoral shaft. It is usually set at in females to 140 degrees In males, when it is less than 120 °; it is coxa vara when greater than 140 ° it is coxa Valga.[3]

This angle plays a pivotal role in the diagnostic and restorative planning of patients with various hip and femur pathologies including developmental dysplasia of hip, neuromuscular disorders of the lower limb, proximal femoral fractures, total Hip arthroplasty,

Perthes disease etc.[4] Moreover; these angle values have an extensive bearing on designing orthopaedic implants; devising hip osteotomies and designing and positioning femoral stem in total hip replacement.

This study in aimed at evaluating the femoral neck shaft angle of proximal femur on plain radiographs which would provide anthropological and biochemical data implants and other orthopaedical equipment.

The sex determination is almost accurate if the entire skeleton is studied in detail. In the medico-legal cases mostly the isolated long bones and their fragments are studied to determine the sex of the deceased. The determination of sex from unidentified human skeletal remains is a challenge for Anthropologists and forensic investigators, Skull and pelvis are usually studied for sex determination. The femur remains the most reliable skeletal region in establishing sex. It is the largest, heaviest, and strongest bone of the human body

So, it takes more time to decay in comparison to the other bones, hence it is a better specimen for sex determination of a human being. The sex differences seen between the males and the females by the Anthropometric study of the bones of the body including soft tissues, explained by Stanfield's Postulation in Evolutionary Biology (1977), which states that the genotypic variations are inversely proportional to the stabilizing selection which explains the morphological difference of adult males and females.

Sexual dimorphism of the femur has been very well studied in different populations with diverse and interesting results. Much work has been done earlier by various workers like Parson 1914), Pons 1955), Lofgren (1956), Krogman (1986). Hence the long bones are taken for morphological analysis with statistical value to determine sex.

The oblique femoral alignment approximates the feet together under the line of the body weight in standing and walking. It is involved in forward movements also. The peculiar waddling gait of a female attracts most of the anatomists to measure and compare the NSA angle of femur, Femur is more oblique in women due to relatively short femur and wide pelvis. This angle is known by many names, including neck-shaft angle (NSA), collodiaphyseal angle (CDA), diaphysio-femoral neck angle, angle of the neck of femur, angle of inclination, cervicodiaphyseal angle and collum diaphyseal angle

This angle is necessary to enable the femoral shaft to swing clear of the pelvis during mobility. The slope of the femoral neck is in line with the forward and upward propulsive thrust of normal progression. The NSA is important in the control of lateral balance during mobility. The angle of the NSA varies and it is noticed to be smaller infemale (due to wider pelvis leading to greater inclination of the femoral shaft on the neck).

MATERIALS AND METHODS

This was a retrospective study which involved measuring the NSAs from radiographs of adult patients who had presented to rajarajeshwari medical college and hospital.The radiographs selected were the anterior-posterior (AP) view of the pelvis showing both hip joints and upper femur. The X-rays were taken using standard protocols for AP pelvic X-rays; 15–30° internal rotation of the hips in the supine position with a film-focus distance of 100 cm, with the beam centred on the symphysis pubis. The radiographs used were those whose studies were carried out between years 2022 and 2023. The radiographs selected were those with no visible pathology and were reported as normal by the radiologist.

The measurements were done with the aid of viewing box and single handheld 360° goniometer. The measurements were done by two researchers at different times, blinded to each other's findings and the average value was recorded as the final value. Before the commencement of the measurement, the two researchers discussed and had ten pelvic radiographs to test run their measurements. The NSA measured is the angle made by the intersection of the longitudinal axis of the neck with that of the longitudinal axis of the femoral shaft. The longitudinal axis of the neck was obtained by joining two midpoints of the diameters of the neck and the head of the femur while the longitudinal axis of the shaft of the femur was drawn by joining the midpoints of two points on the proximal shaft of the femur below the lesser trochanter. The angle formed by the intersection of the two axes was read off as the femoral NSA with the handheld goniometer. The same goniometer was used for all the measurements. The mean value of the left and the right femoral NSAs were recorded.

Figure 1

RESULTS

Observations were made in 100 patients at rajarajeshwari medical college and Hospital, Bangalore. From each femur above mentioned data

were recorded and the details were obtained about the mean, Standard Deviation, percentage, P-value as per the following tables.

In [Table 1] total 100 x rays were taken, out of which forty-five were males and fifty five were females.

Out of The forty-five male constituted twenty-three from the right side and twenty-two from the left side. Similarly, out of fifty five female have thirty from the right side and twenty five from the left side. The neck shaft angle of males range from 116 ° to 145 ° with a mean of 131.57 ± 5.66 on laterality,the mean values for the right and left sides (male)were 131.91± 6.14 and 131.15± 5.07

The values of NSA for females range from 120 ° to 148 °. the mean value for female NSA was 129.97 ±6.33 .the mean value on the right side was 130.66±7.16 where as mean value of left side was 129.40± 5.31

Overall, the mean value for both sexes was 130.77 ± 6.03 from NSA values that ranged from 116 ° to 148 ° on the right side and 120 ° 143 ° on the left side.

Table 1: The values of neck shaft angles for both Genders.

Parameters	Least value	Maximal value	Mean value	Mean value (left)	Mean value (right)
Male	116 °	145 °	131.5±5.66 °	131.1±5.07 °	131.9±6.14 °
Female	120 °	148 °	129.4±6.33 °	129.4±5.31 °	130.6±7.16 °

DISCUSSION

Femoral neck-shaft angle measurement is very significant as it has a greater importance in diagnosing numerous disease conditions like Paget's disease; femoral fracture etc. This is the foremost reason why it is of high clinical relevance to surgeons. Assessment of neck-shaft angle in our community gives an insight into several related disease conditions and also contributes in the manufacturing of several orthopaedic implants specific for our population. Various methods for measurement such as MRI, CT dry bone measurements etc can be used but among them radiology is the most preferred because of its easy availability and practicality. Thus it is a potent tool to measure the femoral neck-shaft angle. In our study when we measured the neck-shaft angle of our population; the mean neck-shaft angle in males turned out to be 131 ° and in females it was 129 °. The results seemed nearly indistinguishable compared to other studies.

This study reveals higher mean NSAs for males then females, although statistically insignificant. this is as found by other workers.[5-8]

Moreover in our study; we also noted that the NSA is lesser in females compared to males. The slight dissimilarities of NSA are influenced due to many factors like gender, race, ethnicity, lifestyle changes side as well as the method of assessment. In the early diagnosis and treatment of several orthopaedic conditions like epiphysiolysis capitis femoris, arthritis of hip etc. the femoral neck shaft angle has been extremely helpful in designing orthopaedic implants in the recent years lead to innovative and modernised manufacture of implants.

CONCLUSION

The present study highlights the significance of assessing the femoral neck-shaft angle (NSA) in the Indian population using plain radiographs. The mean NSA was found to be 131° in males and 129° in females, with overall values closely aligning with international reference data. Although no statistically significant gender difference was observed, the consistently lower mean angle in females reflects anatomical adaptations related to pelvic morphology. These findings are clinically relevant for diagnosing hip pathologies, planning corrective surgeries, designing population-specific orthopedic implants, and forensic sex determination. Thus, establishing normative NSA values in different populations provides an essential reference for both clinical practice and anthropological research.

REFERENCES

1. Boese CK; Frink M; Jostmeier J; Hanede s; Dargel J; Eysel P; Lechler P. The modified femoral neck-shaft angle: age-and sex-dependent reference values and reliability analysis.BioMed Research International.2016 Dec 14;2016.
2. Adekoya-Cole TO; Akinmokun Ol; Soyebi KO; Oguche OE. Femoral neck shaft angles a radiological anthropometry study. Nigerian Postgraduate Medical Journal 2016 jan.
3. Iyidobi EC; Obande BO; Eyichukwu GO;Nwadinigwe CU; Ekwunife RT; Ede O;Lasebikan OA. Assessment of the Femoral Neck-shaft Angles of Adults in Nigeria Establishing an Age and Gender Stratified Reference Values. Asian Journal of Orthopaedic Research. 2020 Mar 10.
4. Pathak SK; Maheshwari P;Ughareja P;Gadi D; Prashant RM;Gour SK.Evaluation of femoral neck shaft angle on plain radiographs and its clinical implications Oct 2 Int J Res Orthop. 2016
5. Igbigbi PS. Collo-diaphysial angle of the femur in East African subjects. Clin Anat 2003.
6. Otsianyi WK, Naipanoi AP, Koech A. The femoral collodiaphyseal angle amongst selected Kenyan ethnic groups. J Morphol Sci 2011.
7. Tahir A, Hassan AW, Umar IM. A study of the collodiaphyseal angle of the femur in the North-Eastern sub-region of Nigeria. Niger J Med 2001.
8. Nwoha PU. The collodiaphyseal angle of the femur in adult Nigerians. Afr J Med Med Sci 1991.