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Original Research Article

Study of Neck Shaft Angle of Femur in Dry Bones of Cadavers

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Conflict of interest: Nil

Abstract:

Background: The femur's Neck shaft angle (NSA) plays a crucial role in determining biomechanical properties and susceptibility to fractures. Knowledge of NSA is essential in understanding and treating pathological conditions of the hip joint. Despite its clinical importance, there remains a dearth of comprehensive data regarding the range and distribution of NSA values in cadaveric specimens.

Aims: This study aims to measure the NSA of femur bones in dry cadavers, compare them with the previous studies, and discuss their clinical importance.

Materials and Methods: Sixty (60) dry femur bones from cadavers were meticulously examined between 31 August 2020 and 30 August 2023. Approval from the concerned ethical committee was taken before starting the study. The NSA (defined as the angle made by the long axis of the shaft and the long axis of the neck of the femur) was measured by drawing the long axes of the femoral shaft and neck of the femur on the white sheet using a pencil, scale, and sketch pen and the NSA was measured using a goniometer (Figure-3). The Statistical analysis was done to determine the mean, standard deviation, and range of NSA values within the sample population. The results of the present study were compared with the previous studies on this topic.

Results: The mean neck shaft angle (NSA) observed in 60 dry femur bones of cadavers was 130.5 degrees, with a standard deviation of 6.2 degrees. The range of NSA values varied from 120.3 degrees to 140.8 degrees within the study population.

Conclusion: This study provides valuable insights into the neck shaft angle (NSA) of femur bones in dry cadavers, shedding light on anatomical variations. The observed range of NSA values underscores the importance of individualized surgical approaches in orthopedic procedures involving the femur.

Keywords: Neck shaft angle (NSA), Goniometer, Femur, Cadavers, Orthopedic surgery, Anatomical variations.

Introduction

The neck shaft angle (NSA) of the femur is a critical anatomical parameter influencing biomechanical properties and surgical outcomes in orthopedic practice [1]. Defined as the angle made by the long axis of the shaft and the long axis of the neck of the femur, NSA plays a pivotal role in load distribution and joint stability, particularly in weight-bearing activities [2]. Deviations from the normal NSA can predispose individuals to various musculoskeletal conditions, including femoral neck fractures and hip osteoarthritis [3].

Despite its clinical significance, there exists a paucity of comprehensive data regarding the distribution and variability of NSA values, particularly in cadaveric specimens. Previous studies have highlighted the importance of understanding the normal range of NSA values in different populations to optimize surgical interventions and implant designs [4]. Additionally, age-related changes in NSA have been documented, emphasizing the need for age-specific considerations in clinical practice [5].

This study aims to contribute to the existing literature by investigating the NSA of femur bones in dry cadavers over three years at Bhagwan Mahaveer Institute of Medical Sciences, Pawapuri.

By elucidating the range and distribution of NSA values in this population, the findings of this study will provide valuable insights for orthopedic surgeons, biomechanical engineers, and forensic anthropologists alike.

Materials and Methods:

Study Design: This study employed a retrospective observational design to investigate the neck shaft angle (NSA) of femur bones in dry cadavers over three years.

Specimen Selection: A total of 60 dry femur bones from cadavers were included in the study. These

specimens were obtained from the anatomical laboratory at Bhagwan Mahaveer Institute of Medical Sciences, Pawapuri. Bihar. The inclusion criteria comprised femur bones with intact neck and shaft regions, free from any visible pathological or traumatic alterations. (Figure 1,2)

Figure1: Dry Femur bones of cadavers

Figure 2: Neck Shaft Angle (NSA) of Femur

(NSA is the angle between the long axis of the neck of the Femur (shown by a and b; where 'a' is the point at the center of the head of the Femur and 'b' is the center of the narrowest part of the neck).

and the long axis of the shaft of Femur (shown by 'c' 'd' 'e' where 'c' is the center of upper end of the shaft, 'd' is the center of the middle part of shaft and 'e' is the center of lower end of the shaft of Femur).

Data Collection:

Each femur bone was meticulously examined to ensure the absence of soft tissue remnants or gross anatomical abnormalities. The NSA was measured using a goniometer shown in Figure 3, following standardized techniques described in the literature (6) and measurements were recorded to the nearest degree.

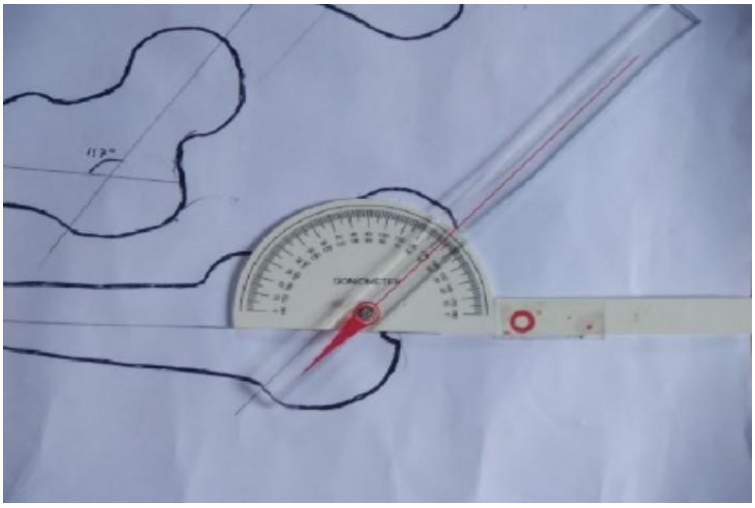

Figure 3: Showing the method of measuring NSA using a goniometer

Results: Table 1 provides the summary of the neck shaft angle (NSA) measurements obtained from 60 dry femur bones of cadavers. The mean NSA value was calculated to be 130.5 degrees, with a standard deviation of 6.2 degrees, indicating the variability of NSA within the study population.

Table 1: Summary of Neck Shaft Angle Measurements

Statistical Parameter	Value
Total number of Femur examined(N)	**60**
Range(Degree)	**121-138**
Mean NSA(Degree)	**130.5**
Standard Deviation	**6.2**

Statistical Analysis: Descriptive statistics, including mean, standard deviation, and range, were calculated to summarize the distribution of NSA values within the study population.

Discussion:

The neck shaft angle (NSA) of the femur is a crucial anatomical parameter that influences biomechanical properties and surgical outcomes in orthopedic practice. The clinical significance of NSA extends beyond orthopedic surgery to forensic anthropology, where knowledge of femoral anatomy aids in age estimation and identification of skeletal remains [5]. There is a significant increase in mean neck-shaft angles across populations with an increasingly sedentary existence and with mechanization [6]. Table 2 compares various studies examining the NSA with the present study.

Table 2: Comparison of various studies on the Neck-Shaft Angle (NSA) of the Femur with the present study

Author	Year	Sample size	Population	Method	Neck shaft Angle of the femur	Standard deviation
Rc Siwach [11]	2003	150	Rohtak	Dry femur	123.5	4.3
Rc siwach[13]	2003	150	Rohtak	Dry femur + X-ray	123	4.3
K C saikia [9]	2008	92	Guhati	CT	139.5	7.5
T R Deshmukh[7]	2010	77	Vidarbha	X-ray	131.5	-
Sinha et. al.[6]	2017	60	North Bihar	Dry femur	130.82	4.86

Lakshmi et. al.[12]	2016	100	Rajasthan	Dry femur	124.95	6.09
Rawal et. al.[13]	2012	298	India	CT	124.42	5.49
Thipse et al[18]	2014	2000	India	X-ray	136.8	-
Mukherjee et. al.[10]	2020	281	West Bengal	Dry femur	124.12	6.231
Present study	2023	60	Bihar	Dry femur	130.5	6.2

The present study revealed a mean NSA of 130.5 degrees, with a standard deviation of 6.2 degrees, within the study population. This range of NSA values is consistent with previous studies by Sinha et al., [7] and Deshmukh et al., [8] assessing NSA in cadaveric specimens who reported mean NSA of 130.8 and 131.5 respectively. However, the results of Thipse J D et al. [9] and K C Saikia [10] were considerably higher (136.8 degrees and 139.5 degrees respectively) than the present study. Mukherjee et al. [11] and Siwach et al [12] and Luxmi et al [13] reported a lower value of NSA (123 degrees and 124.12,124.95 degrees respectively) compared to the present study. The observed variability underscores the importance of individualized surgical approaches and implant designs to accommodate anatomical variations among patients.

Limitations: Limitations of our study include the use of dry cadaveric specimens, which may not fully represent the in vivo anatomy and biomechanics of the femur. Additionally, the sample size of the current study was limited to 60 specimens, which may restrict the generalizability of our findings to broader populations. Future studies incorporating larger sample sizes and in vivo imaging modalities are warranted to further elucidate the extent of variations in NSA.

Conclusion

This study provides valuable insights into the neck shaft angle of femur bones in cadaveric specimens, highlighting the variability of NSA values. Our findings underscore the importance of considering anatomical variations in orthopedic practice and forensic anthropology, informing clinical decision-making and forensic investigations.

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