"CORRELATION OF MODIFIED FEMORAL NECK SHAFT ANGLE WITH AGE AND GENDER "

DISSERTATION

**Submitted to the Integral Institute of Medical Sciences
and Research, Integral University
In partial fulfillment of the requirements for the degree of**

MASTER OF SCIENCE
IN
MEDICAL ANATOMY
DEPARTMENT OF ANATOMY

INTEGRAL INSTITUTE OF MEDICAL SCIENCES & RESEARCH, INTEGRAL UNIVERSITY, LUCKNOW

Submitted By
PRIYANKA YADAV
M.Sc. Medical Anatomy
Session 2022-23

GUIDE
DR. KAMIL KHAN
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CERTIFICATE

This is to certify that the dissertation **"Correlation of Modified Femoral Neck-Shaft Angle with Age and Gender"** is a bonafide and genuine research work of **Priyanka Yadav** necessary for award of degree of Master of Science in Medical Anatomy, Session :2022-2023, under my supervision and guidance in the Department of Anatomy, IIMS&R, Integral University, Lucknow.

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DECLARAION

I hereby declare that this dissertation **"Correlation of Modified Femoral Neck-Shaft Angle With Age and Gender"** is a bonafide and genuine research work carried out by me as per the Research Committee and Ethical Committee guidelines of IIMS&R, under the guidance of Professor Dr. Kamil Khan, Department of Anatomy, Integral Institute of Medical Science & Research, Integral University, Lucknow, U.P.

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ACKNOWLEDGEMENT

I feel indebted to my family **(My father Mr. Ram Teerath Yadav, my mother, Mrs. Sheela Yadav, Ms. Kushlawati, my brother Saurabh Yadav, Gaurav Yadav and Kanha Yadav)** for their constant support and encouragement in successfully completing my task.

PRIYANKA YADAV

LIST OF ABBREVIATIONS

FSA	Femoral Shaft Axis
MNA	Modified Neck Axis
NSA	Neck Shaft Angle
MNSA	Modified Neck Shaft Angle
Mm	Millimetre
SD	Standard Deviation
P-Value	Probability Value
Fig.	Figure

<u>CONTENTS</u>

INTRODUCTION

INTRODUCTION

The Femur is the longest and strongest bone of the human body. Morphologically, it is a typical long bone and it forms skeleton of the thigh so it is called "thigh bone".

The modified femoral neck shaft angle is defined as the angle between femoral shaft axis and modified femoral neck axis (1)

The femur has a single major centre that appears for the shaft during the eighth week of intrauterine life. And the upper end has three secondary centres that appear for the head in the first year, for the greater trochanter in the third year, and for the smaller trochanter in the thirteenth year. (2)

The femur features a proximal rounded articular head that projects medially from its short neck. The femoral neck is roughly 5 cm long and connects the head to the shaft at an average angle of 135°. This angle allows for movement at the hip joint, allowing the limb to swing clear of the pelvis. (3)

The femoral neck-shaft angle, commonly known as the caputcollum-diaphyseal (CCD) angle, is an inclination angle. Mikulicz angle is a measurement of the angle formed by the obliquely oriented neck and the vertical shaft, and it is an important anatomic measurement for evaluating hip biomechanics. (4)

The modified neck- shaft angle (mNSA), unlike the standard NSA, is rarely affected by rotation. (5)

The femoral neck shaft angle has significant implications in orthopaedic surgery. A displaced femoral neck fracture frequently results in a change in the femoral neck shaft angle. Diagnosis of congenital hip disorders such as developmental dysplasia of the hip [DDH], coxa vara and valga, and developmental problems such as slipped upper femoral epiphysis are also considered femoral neck shaft angle. (6)

The value of the neck-shaft angle varies with age, with the greatest variation occurring during the newborn period. It gets more varus with growing weight-bearing and activity level during childhood, becomes steady in mid-adolescence to maturity era, and may decline further in older age. (7)

The diagnosis and treatment of proximal end femoral fracture are dependent on an understanding of the angle of inclination. The bone markers like the upper end of the femur,

such as the head and neck of the femur, play a significant influence in determining femoral length. As a result, femoral length and stature are anthropological and forensically important. (8)

Gender disparities in neck-shaft angle have also been observed in studies. Females have a smaller neck-shaft angle, which connects their larger pelvis and shorter femur length, however some research show females have higher values. (9)

The neck shaft angle is generally around 160° in a young kid and about 125° in an adult (coxa norma). An increase in this angle is known as coxa valga (>140°), and it can occur in the event of congenital hip dislocation. Adduction of the hip joint is limited in this situation. A decrease in this angle is known as coxa vara (120°), and it occurs in fractures of the femoral neck and slippage of the femoral epiphysis. Abduction of the hip joint is limited in this situation. (10)

The purpose of this study is to calculate the modified femoral neck shaft angle. The modified NSA (mNSA) is less susceptible to rotational effects than the traditional NSA and is repeatable due to the targeted delineation of anatomic landmarks. The Modified neck shaft angle is crucial in the anatomic description of the hip for diagnostics and surgery planning. (11)

Despite its vast size and strength, the femur is frequently broken, the kind of fracture. The type of fracture sustained is typically age- and even gender-related. The femoral neck is the most commonly fractured region of the bone because it is the narrowest and weakest part of the bone and lies at a sharp angle to the line of weight-bearing (gravity pull). It becomes increasingly fragile with age, especially in females, as a result of osteoporosis. (12)

CT scot pictures are a safer alternative to traditional CT scans since they reduce radiation exposure and can detect pathological changes in situations such as fractures, metastases, and avascular necrosis, as well as determine lower limb alignment and geometry. (13)

The primary goal of total hip arthroplasty (THA) is to restore a painless and functional hip joint. Normal anatomy and biomechanics, such as the centre of rotation, offset, and leg length, are regarded to be crucial elements in accomplishing these goals; nevertheless, there are considerable differences in the characteristics of the normal hip joint amongst patients. (14)

PURPOSE

The purpose of the study is to measure the modified femoral neck shaft angle, for more precise conclusions regarding age and gender correlation for proper diagnosis and planning of surgery.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Wilson J.D et al (2011) in university hospital of north Durham, UK studied on 30 hip measurements. The mean neck shaft angle measurement is 133.0° for observer 1st ,134.0° for observer 2nd, 130.3° for observer 3rd. PACS software using that reliability of these measurements is not overestimated. (15)

Gilligan Lan, Chandraphak Supichya. Et al. (2013) in Australian National University, Australia studied on 8000 femoras representing 100 human groups. Results from the analyses show an average NSA for modern humans of 127°. there is no sex difference, no age-related change in adults, but possibly a small lateral difference which could be due to right leg dominance. (16)

Khan Mohamad Shakil.et al. (2014) in JJM Medical college Karnataka studied on 250 femurs on the basis of neck shaft angle, femoral length and neck length of femur and found that neck shaft angle of femur was 137.1° and there is no significance difference between right and left femur measurements. (17)

Pathak Kumar Subodh et al, (2016) in pramukhswami Medical College, Gujarat conducted a study on 110 radiographs of patient (55male and 55female) of known sex, concluded that the neck shaft angle in study was 129.26° for males and 126.62° for females. The overall mean neck shaft angle in 110 radiographs was 128.60°. (18)

Boese Christoph Kolja et al, (2016) in University Hospital of Cologne, Germany conducted the 400 Pelvis computed tomography scan (800 hips) and found that mean mNSA was 147.0^0 and the 95% confidence interval was 146.7°- 147.4°. Differences of the mNSA between sexes, age groups and sides were nonsignificant. (5)

Jostmeier Janine et al, (2016) in University Hospital of Cologne, Germany conducted their study on 400 pelvic CT scan, (range 18-100 years, 200 female) at a university hospital in central Europe. Mean NSA for male adults was 129.6^0 and 131.9^0 for female in derotated

coronal reconstruction. Age and sex influenced the NSA significantly; no significant differences were found between sides. (19)

Tang Hao Zhi et al, (2017) in kaoo Teck Paut Hospital, Singapore studied on 425 hip hemiarthroplasties. The mean neck shaft angle of Chinese women was significantly greater than that of Indian women (137.48° vs 127.00°, p=.0001). They found statistically significant difference in neck shaft angle between Chinese and Indian women, and between malay and Indian women. (20)

A shivashankarappa et al, (2017) in JJM medical college, Karnataka studied on 457 (243 right and 214 left). the neck shaft angle of femur was 138.3°± 5.67°. there is no significant difference right and left femur measurements. (21)

R Amith et al, (2017) in K.S. Hegde Medical Academy, Nitte University Karnataka studied on 171 dry adult femora (92 right and 79 left). The mean NSA was 121.2°± 6.2. No significant side defference were noted. (22)

Wei Qiang et al, (2020) in Xi'an University of posts and Telecommunications, china. Studied on 80 standard AP radiographs. Analysis of the Neck shaft angle mean from manual measurements is 128.98° and automatic evaluations mean is 129.51°. They found the Femoral neck angle and Femoral shaft angle are fitted so that the NSA can be automatically evaluated. (23)

Huda Najamul et al, (2020) in Teerthanker Mahaveer Medical College & Research Centre, Moradabad, India. They conducted study on total 200 adults. They were equally distributed under four cohorts according to age and gender. They concluded that gender- based variation exists in the population with the higher value of NSA in male as compared to female in any age group. The age difference is also present, but is not significant. (24)

Zaghlouletal Ahmed et al, (2020) in Mansoura University, Egypt they conducted study on 200 hips in 100 normal children and adolescents. In These Study they assessed the effect of body weight, height and BMI on the femoral NSA. They noticed that there was nonsignificant decrease in NSA with increase in height but, there was significant decrease in angle with increase in weight and BMI. (25)

Fischer Cornelius S et al, (2020) in University Medicene Greifswald studied on 6452 measured hip right and left side and the mean neck shaft angle was 127° while men had a lower neck shaft angle than women. The reference range was 114°-140°. (26)

Janjua Nasir Sarmad et al, (2020) in Pakistan atomic energy commission general hospital, Islamabad studied on 200 patients (400 femoral necks) in which were 114 male and 86 females. The mean neck shaft angle on right for male was found to be 130.90° and mean NSA on left was 131.01°. the mean NSA for females on right was 129.94° and for left was 130.48°. They found out that these are different in male, female but this difference was not found statistically significant. (27)

Lyidobi C Emmanuel et al (2020) in National orthopaedic Hospital, Enugu, Nigeria studied on 827 AP pelvis x- rays done we examined the 75 patients (30 males and 45 females). The mean FNSA was 131.04± 3.86. the FNSA of adults in this study is difference from the western textbook value of 125°. (28)

Altubasi Ibrahim et al (2020) in The University of Jordan studied on 50 pelvis CT scot images. The mean vale of all angle measurements was 131.3°. intra- class correlation coefficients were 0.726 and 0.63 for inter and intra-rater measurements. this study for measuring the neck-shaft angle showed good reliability and small measurement error. (29)

Akinmokun O.I. et al (2021) in University of Lagos, Nigeria studied on 56 adult dry femoral bones. 36% of the femoral neck shaft angle were between 130° and 134°, while 19% had FNSA between 125° and 129°. (30)

Shetty Ullasa Dr et al, (2021) in A.J Institute of Medical Sciences and Research Centre Mangalore studied on 300 bones. Average NSA was 127° stated that the mean value of the femoral neck angle in the female 125.1° and male 125.2° being almost same in the both sexes. There is no significant difference between NSA of two sides. (31)

Haddad Bassem et al, (2022) in the university of Jordan, Aman studied on 400 pair femoral neck (200 male and 200 female). In the upright radiograph, the overall mean neck shaft angle was 131.21°. there was no significant difference between right and left femur NSA among the patients. On both sides, male NSA was higher than female NSA. (32)

Chaudhary Nand Prabha et al, (2023) in J.N Medical college, Belagavi, Karnataka studied on 100 adult dry human femora of unknown age and sex (50 right and 50 left side). The NSA ranged from 115° to 140° with the mean of 127.21°. in the right femur, it ranged from 115° to 137° with the mean of 126.78°, and in the left femur it ranged from 119° to 140° with the mean of 127.64°. there was no comparative difference between the value of right and left sides. (33)

AIMS AND OBJECTIVE

AIM – To find out the relationship between modified Neck-shaft angle with age and gender.

Objectives-

- ➢ To determine the Femoral shaft axis.
- ➢ To determine modified femoral neck axis.
- ➢ To Measure modified Femoral neck shaft angle.

MATERIAL AND METHODS

MATERIAL AND METHODS

This is cross sectional study and it was conducted in the Department of Anatomy in the collaboration with Department of Radiodiagnosis, IIMS&R Integral University, Lucknow. The study group was comprised of 100 CT images (54 Females and 46 males) of pelvis in scout view of patient. The study was approved by Institutional Ethics Committee. The CT images were taken from random selection of patient from Department of Radiodiagnosis. Coronal pictures of Scot view from pelvis used to calculate the modified neck shaft angle using the imaging software's measuring tools. The femoral shaft axis, modified femoral neck axis, modified neck shaft angle of right femur and modified neck shaft angle of left femur. All the measurements were done using CT images with the help of Simens 128 slice CT machine and software syngoCT VA48A.

INCLUSION CRITERIA–

- All the CT images of patient above the age of 18 years.
- Upper end of femur is visible.

EXCLUSION CRITERIA–

- Pathology of hip joint,
- History of surgery around hip joint

MEASUREMENTS

Femoral shaft axis (FSA)-

Line drawn from upper most extension of greater trochanter, crossing the centre of two circles that is upper circle is positioned at the outer margins of the sub-trochanteric femur, the centre of this circle is placed by the lower boundary of the lesser trochanter whereas, the lower one is placed above the end of the scan. (Fig.1)

The modified femoral neck axis (mFNA)-

The modified femoral neck axis is a line connecting the center of femoral head and center of rotation. It is an intersecting point between FSA and horizontal line (at the apex of lesser trochanter to the FSA). Thus, Modified Femoral NSA (mNSA) is defined as the angle between the FSA and the modified FNA (mFNA). (Fig.1)
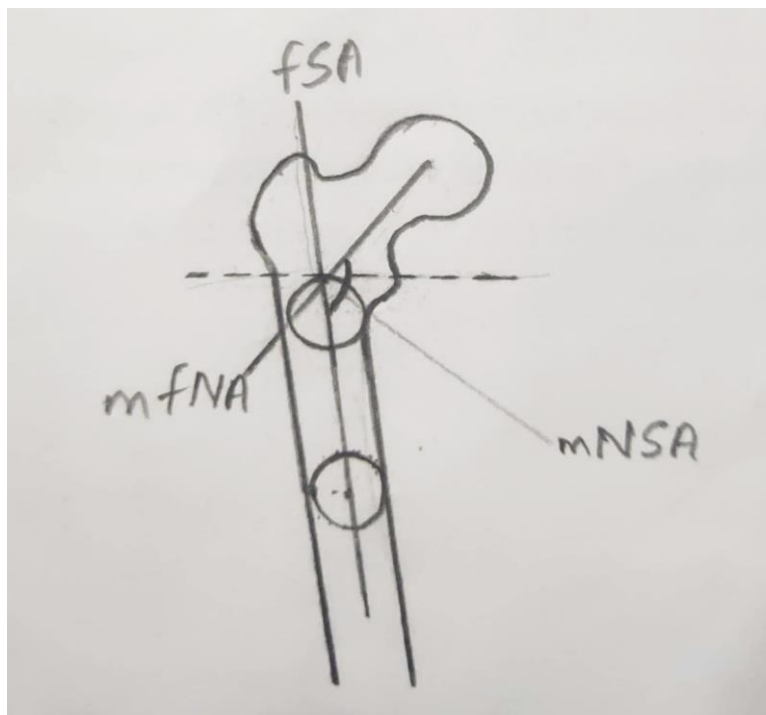

Fig .1. The modified neck shaft angle of femur

STATISTICAL ANALYSIS

The data was entered into MS- Excel spreadsheet and were analysed by using software statistical package for social sciences (SPSS) – 22 trial version test of significance (independent t-test) were applied. $P<0.05$ was considered statistically significant.

OBSERVATIONS AND RESULTS

OBSERVATIONS AND RESULTS

Table 1: Description of variables

Age	Mean = 43.77 years
	Std. Deviation = 16.63
Sex	Female N (%) = 54 (54.0)
	Male N (%) = 46 (46.0)
Right Modified NSA	Mean = 146.60°
	Std. Deviation = 7.70
Left Modified NSA	Mean = 145.71°
	Std. Deviation = 7.73

Table 2: Test of Normality for age, sex, right, and left modified NSA

Variables	Kolmogorov-Smirnov statistic	p-value
Right Modified NSA	0.096*	0.023
Female	0.095	0.200
Male	0.148*	0.013
Left Modified NSA	0.082	0.093
Female	0.094	0.200
Male	0.106	0.200
Age	0.130*	0.000

Table 2 represents the KS test of normality for right and left modified NSA by sex as well as for age, right, and left modified NSA. The results conclude that in right modified NSA, male population is not normally distributed (p < 0.05). Further, age, right and left modified NSA are not normally distributed (p < 0.05). This suggests that by a grouping variable sex, we will perform Mann-Whitney U test for right modified NSA whereas Independent Sample t-test for left modified NSA. Moreover, the Spearman's rho correlation will be applied to age, right, and left modified NSA.

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Table 3: Comparison of right and left modified NSA by sex

Modified NSA	Sex		p-value
	Female Mean (SD)	Male Mean (SD)	
Right	145.72° (8.39)	147.63° (6.74)	0.283
Left	145.13° (8.75)	146.39° (6.35)	0.407

Table 3 results interpret that both left (M_f = 145.13°, M_m = 146.39°; $p > 0.05$) and right (M_f = 145.72°, M_m = 147.63°; $p > 0.05$) modified NSA is not significantly distributed across sex.
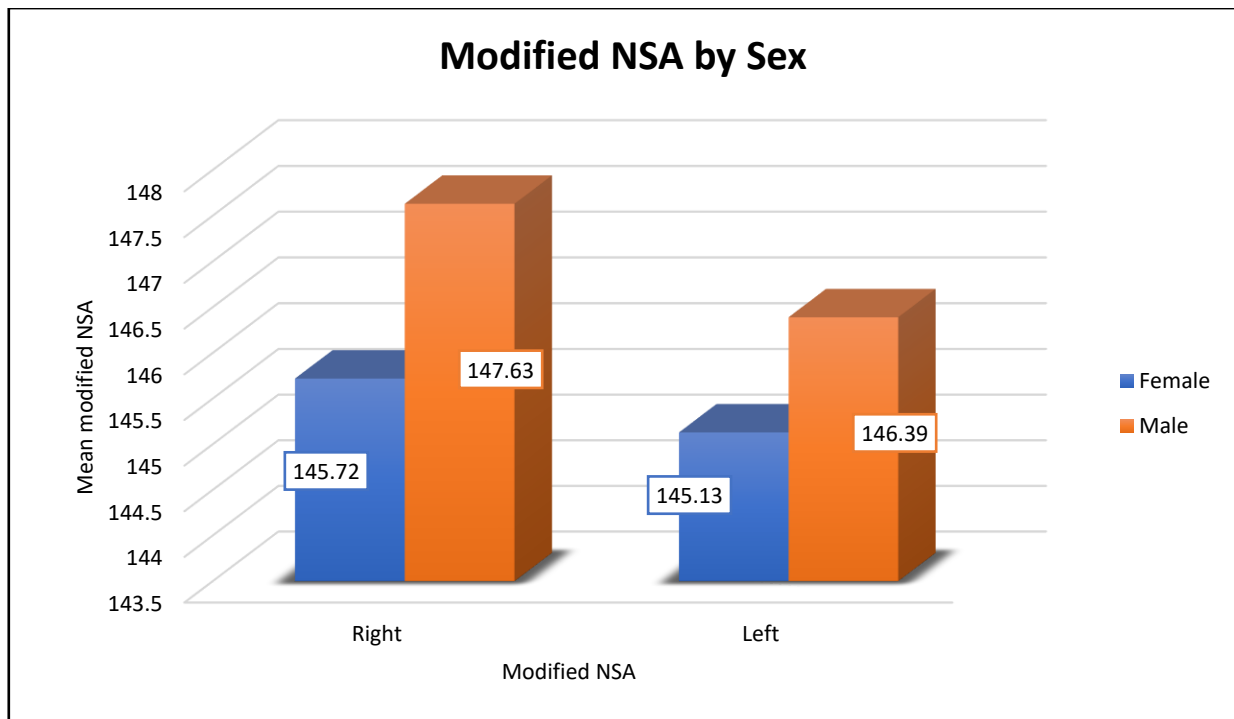

Fig NO. 1 Modified neck shaft angle right and left side by sex

Table 4: Correlation between age and right modified NSA; and left modified NSA

Modified NSA	Age	p-value
Right	0.235*	0.018
Left	0.217*	0.030

The results of table 4 can be interpreted as age is positively but weakly correlated with both the right modified NSA (coefficient = 0.235, $p < 0.05$) and left modified NSA (coefficient = 0.217, $p < 0.05$).
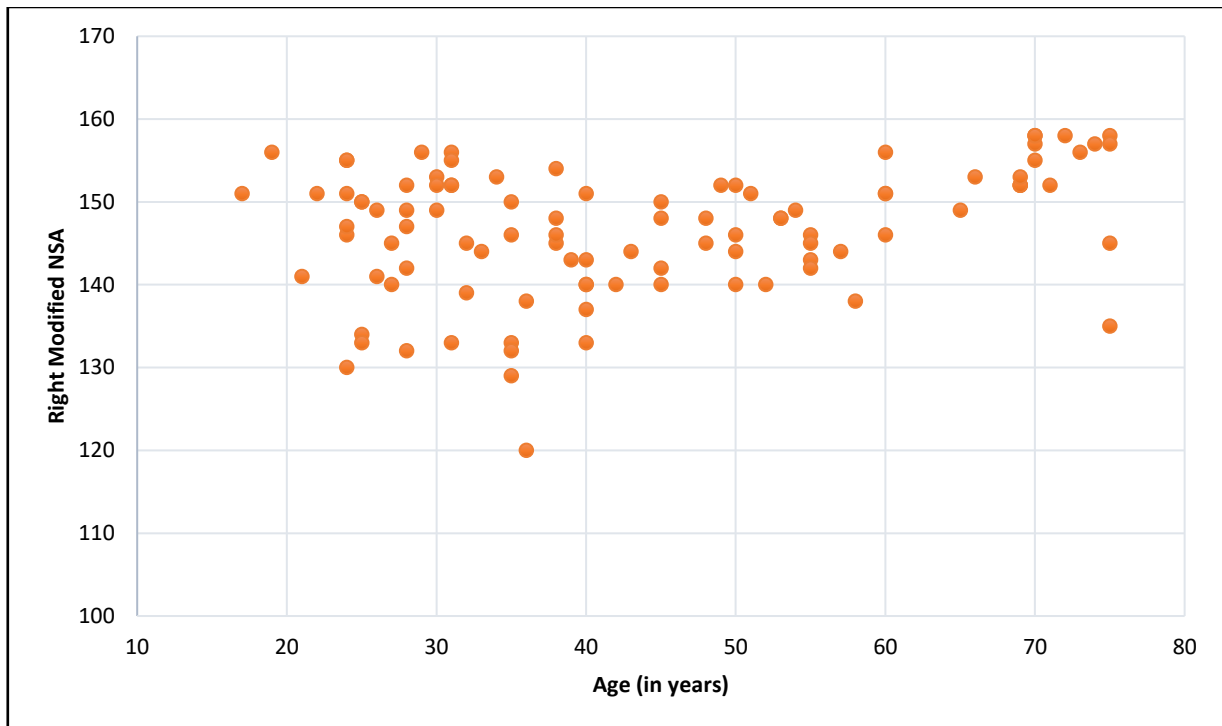

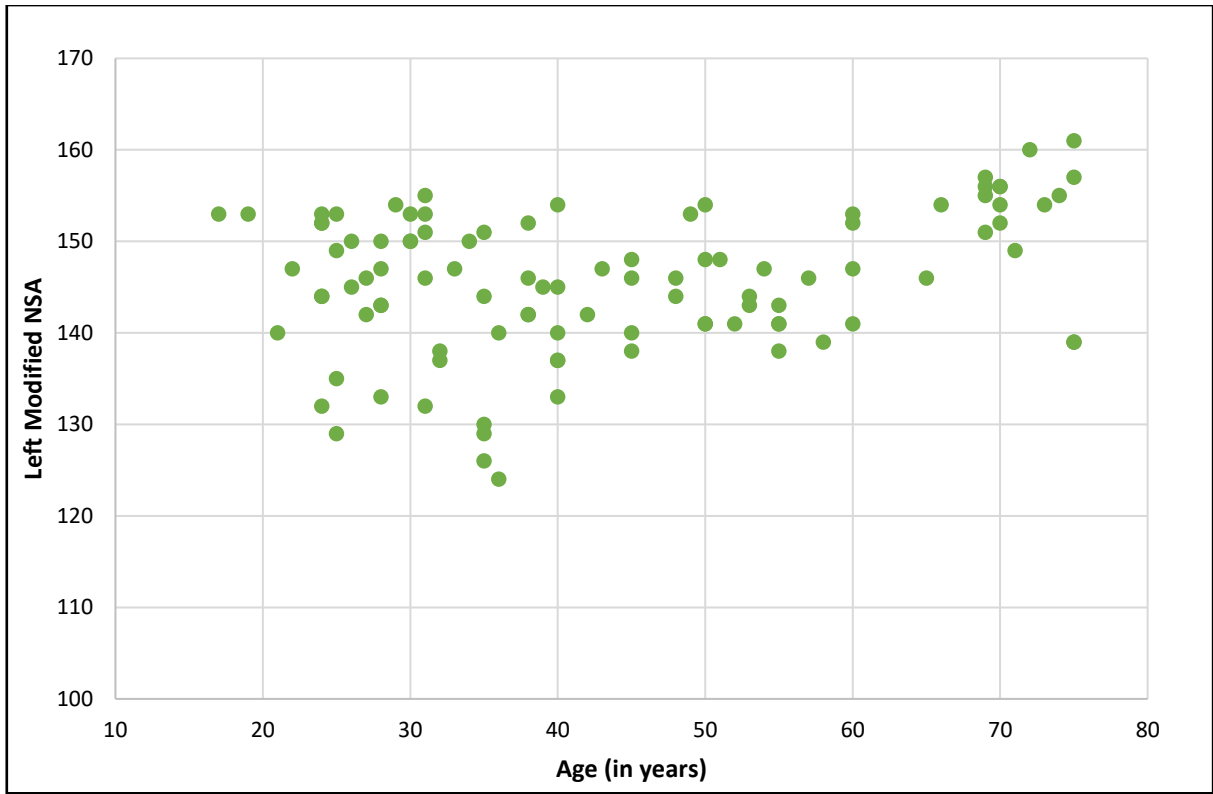Fig No.2 Scattered plot of Right modified neck shaft angle by age.

Fig No.3 Scattered plot of Left modified neck shaft angle by age.

RESULTS

Mean value of both gender were found to be 43.77 years and with the standard deviation 16.63, between 54(54.0) percent of female and 46(46.0) percent 0f male. The mean value of Right modified NSA were found to be 146.60° with Std. deviation 7.70. and mean value of left modified NSA were found to be 145.71° with S.td deviation 7.73. The differences of the modified NSA between right and left were statistically nonsignificant. (Table-1)

The KS test of right modified NSA were found 0.096* and p value 0.023. In female the KS test for right side were found 0.095 in which p value 0.200 and KS test of male for right side were found 0.148* in which p value o.013.

The KS test of left modified NSA were found 0.082 and p value 0.093. the KS test in female of left side were found o.094 in which p value 0.200 and the KS test of male in left side were found 0.106 in which p value 0.200 the KS test for age were found 0.130* with p value 0.000. the KS test were not statistically significant (p value=0.000) in age group for both gender. The KS test for right mNSA (p value=0.23) and left mNSA (p value=0.093) were less statistically significant. (Table-2)

Comparison of right and left modified NSA by sex as following the value of mean and Std deviation for mNSA in right side of female were found $145.72^{0}(8.39)$ and right side of male were found 147.63° (6.74). p value for right side in both gender were 0.283.

The value of mean and Std. deviation for mNSA in left side of female were found 145.13° (8.75) and left side of male were found 146.39° (6.35). p value for left side in both gender were 0.407. hence, the modified NSA is not significantly distributed across sex. (Table-3)

Correlation between age and right mNSA, and left mNSA as following the right mNSA were found (coefficient = 0.235, $p < 0.05$) and left mNSA (coefficient = 0.217, $p < 0.05$). The results of Table 4 can be interpreted as age is positively but weakly correlated with both the right modified NSA and left modified NSA.

DISCUSSION

DISCUSSION

This study was conducted on 100 CT images and the mean modified NSA of right femur and modified NSA of left femur. In this study, the mean age of all 100 patients was 43.77 years (above 18, SD 16.63 years) whereas in 2016 study conducted by Boese CK et. al. described mean age of all 400 patients was 54.32 years (18-100, SD 22.05 years).

The mean modified NSA on right side was 146.60° and on left side was 145.71°. while R Amith et. al. (2017) observed mean value of NSA, 120.9° in right side and 121.5° in left side. Whereas AC oduntan Thomas e.t al. (2022) measured the mean value NSA of on the right side was 130.66° and the mean value on left side was 129.40°. However Fischer S Cornelius et. al. (2020) obtained mean value of NSA on right and left side was 127°. While Zaghloul Ahmed et. al. (2020) observed the mean value of NSA on right side was 133.04° and the mean value of left side was 133.42°. Whereas A Shivashankarappa et. al. (2017) obtained the mean value of NSA on right side was 136.2° and mean value of NSA on left side was 140.1°.

The P value of right modified NSA in male and female was (P=0.283). and the P value of left modified NSA in male and female was (P=0.407). while Lyidobi C. Emmanuel et. al. (2020) measured the P value of right and left was (P=0.62). Whereas R Amith et. al. (2017) observed the P value right and left was (P=0.87).

CONCLUSION

CONCLUSION

In male, the modified neck shaft angle of femur is more as compared to female in any age group.

The difference of the modified neck shaft angle of femur between right and left side is very less that is statistically nonsignificant.

The modified neck shaft angle is positively with age but weakly correlated with both right and left modified neck shaft angle.

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इंटीग्रल इंस्टिट्यूट ऑफ़ मेडिकल साइंस एंड रिसर्च
इंटीग्रल यूनिवर्सिटी लखनऊ -226026
सूचित सहमति पत्र

अनुसंधान/अध्ययन विषय...
रोगी का नाम/ पता ....
....दूरभाष नं..
जन्मतिथि/उम्र..
अध्ययनकर्ता का नाम ....
अध्ययनकर्ता के हस्ताक्षर/दिनांक...

1. मैं प्रियंका यादव एमएससी मेडिकल एनाटॉमी आई.आई.एम.एस एंड आर, लखनऊ में तृतीय वर्ष की छात्रा हूं I मेरा अध्ययन विषय ''कोरिलेसन ऑफ़ मोडीफाईड फिमोरल नेक शाफ़्ट एंगल विद ऐज एंड जेंडर'' है I

2. इस शोध/ अध्ययन और परीक्षण के लिए ,मैं यह नमूना सीटी स्कैन फिल्म के आंकलन के लिए लूंगी I

3. सीटी स्कैन फिल्म केवल मूल्यांकन के अधीन है और किसी अन्य उद्देश्य के लिए नहीं है I

4. आपकी पहचान तथा अन्य सूचनाएं किसी तीसरे पक्ष से साझा नही की जाएगी या प्रकाशित नही किया जायेगा I

5. अध्ययन में सम्मिलित होने के लिए समस्त सावधानी बरतते हुए सीटी स्कैन मशीन द्वारा किया जायेगा I

6. इस अध्ययन का आपके उपचार से कोई लेना –देना नहीं है और न ही यदि आप भाग लेने से इंकार करते हैं तो इससे इसमें बाधा नहीं आएगी I

7. अध्ययन का आपके वर्तमान उपचार से कोई लेना- देना नहीं है, लेकिन यह रोग प्रक्रिया के ज्ञान और समझ में सुधार कर सकता है और यह ज्ञान भविष्य में सहायक हो भी सकता है और नही भी I

8. मैंने इस सहमति पत्र को पढ़ लिया है/ पढ़ कर सुना दिया है I उपरोक्त सभी विवरणों को जानने के बाद, क्या आप हमारे अध्ययन में भाग लेना चाहेंगे ? हाँ/ नहीं I

9. सहमति –मैं केवल उपरोक्त अध्ययन के लिए अपने सीटी स्कैन फिल्म के नमूनों को सूचित और लिखित सहमति देता/देती हूं I

रोगी के अंगूठे का निशान /हस्ताक्षर/दिनांक...

RE-2022-146709-plag-report