STUDY OF NECK SHAFT ANGLE IN PLAIN RADIOGRAPHS OF ADULT KASHMIRI POPULATION (ORIGINAL STUDY)

CONTRIBUTING AUTHORS

- **DR.MOHD.ARIF MAKDOOMI >POST-MD SENIOR RESIDENT, ANATOMY DEPARTMENT,GOVT. MEDICAL COLLEGE,SRINAGAR**
- **DR.JAVEED AHMAD KHAN ASSOCIATE PROFESSOR, ANATOMY GOVT MEDICAL COLLEGE,SRINAGAR**
- **DR.SHAHEEN SHAHDAD PROFESSOR AND EX HOD ANATOMY GOVT MEDICAL COLLEGE SRINAGAR**
- **DR.SAJAD HAMID:ASSOCIATE PROFESSOR, ANATOMY SKIMS MEDICAL COLLEGE(corresponding author)**

CORRESPONDING AUTHOR

DR.SAJAD HAMIDASSOCIATE PROFESSOR, ANATOMY SKIMS MEDICAL COLLEGE

7006359806, E MAIL:drsajadk@rediffmail.com

ABSTRACT

INTRODUCTION : The knowledge about different diameters of head and different dimensions of neck of femur is essential in orthopaedic surgery, for radiological practice in identifying pathology of bone **AIM:**Determination of mean values of femoral neck shaft angle. **METHODOLOGY:**The present study was conducted in the Department of Anatomy, GMC, Srinagar in collaboration with the Department of Radio-diagnosis and imaging GMC, Srinagar. 200 x-rays of males (100) and females (100) of pelvis with both hips anteroposterior view in the age group of 20-50 years were used in the present study.**INCLUSION CRITERIA:a)**Patients complaining of pain in hip, who had no joint pathology defined on the basis of radiological examination.**b)**Patients of age group 20-50 years.**c)**Patients without any deformity of hip joint. **EXCLUSION CRITERIA:a)**Patients having history of pathologies like Osteoarthritis, Tuberculosis, Fractures around hip joint.**b)**Patients having history of surgical intervention on proximal femur, acetabulum or pelvis.**c)**Patients who did not have the radiographs with appropriate technique.

Femoral neck shaft angle:

Long axis of shaft of femur and long axis of neck of femur were marked with the help of marker and the point of intersection of these two axes gave us the neck shaft angle. This angle was measured with the help of goniometer.

Two sided p-values were reported and $p < 0.05$ was considered statistically significant. **OBSERVATIONS :**All the 200 xrays belonged to adult (20-50 years) population. The overall mean NSA of all the 200 subjects on the right side was 128.18 + 2.92 degrees and was statistically insignificant

with p-value of 0.841. The overall mean NSA of all the 200 subjects on the left side was 127.37 + 3.40 degrees and was statistically insignificant with p-value of 0.607.

Conclusion: The results calculated provides important information about gender, age and side variations of NSA for the anatomists, radiologists and orthopaedic surgeons. Radiological knowledge of NSA will help the orthopaedicians in diagnosing and selecting various treatment modalities in fractures around the hip joint, dislocation of hip joint and also surgical procedures like implantation of prosthesis. The data thus obtained can be used as baseline for future studies in the departments of Anatomy, Radiodiagnosis and Orthopaedics.

KEY WORDS: Femur, Goniometer,Neck-Shaft angle

DOI Number: 10.48047/nq.2022.20.19.NQ99126 NeuroQuantology2022;20(19): 1376-1387

INTRODUCTION

The femur or the thigh bone is the longest and the strongest bone of the body. It has an upper end; a lower bicondylar end and a long shaft which is convex forwards .Proximally head is directed medially upwards and slightly forwards which articulates with the acetabulum to form hip joint **(1).**

The famoral neck is about 5cm long and connects the head with the shaft of femur. It is directed upwards medially and slightly forwards. The angle between the long axis of neck and the long axis of shaft of femur is called as Neck shaft angle or angle of inclination and is about 125 degrees **(2).** This angle facilitates movement at the hip joint, enabling the limb to swing clear of the pelvis.

The knowledge about different diameters of head and different dimensions of neck of femur is essential in orthopaedic surgery, for radiological practice in identifying pathology of bone (3).

Knowing the normal morphology of hip joint and proximal femur is highly important for the orthopaedicians to repair the geometry of the proximal femur after both trauma and hip arthroplasty. The chief intent being the restoration of normal hip biomechanics **(4).** One of the major problems arising after total hip arthroplasty is limb length discrepancy. Use of templates and radiographs in preoperative planning may minimize this problem and preoperative and intraoperative templating were suggested for this purpose **(5,6,7).**

AIMS AND OBJECTIVES:

Determination of mean values of femoral neck shaft angle.

MATERIALS AND METHODS:

The present study was conducted in the Department of Anatomy, Government Medical College, Srinagar in collaboration with the Department of Radio-diagnosis and imaging Government Medical College, Srinagar. 200 x-rays of males (100) and females (100) of pelvis with both hips anteroposterior view in the age group of 20-50 years were used in the present study. The radiographs belonged to patients who had presented with pain hip or lower back. Only those radiographs were included in the present study which did not show any pathological condition. The radiographs were obtained from the Department of Radiodiagnosis and Imaging, Government Medical College, Srinagar.

Instruments used:

- Goniometer.
- Measuring scale.
- Markers.
- Divider.

Photograph 1: Showing instruments used.

INCLUSION CRITERIA:

- Patients complaining of pain in hip, who had no joint pathology defined on the basis of radiological examination.
- Patients of age group 20-50 years.
- Patients without any deformity of hip joint.

EXCLUSION CRITERIA:

- Patients having history of pathologies like Osteoarthritis, Tuberculosis, Fractures around hip joint.
- Patients having history of surgical intervention on proximal femur, acetabulum or pelvis.
- Patients who did not have the radiographs with appropriate technique.

Methods:-

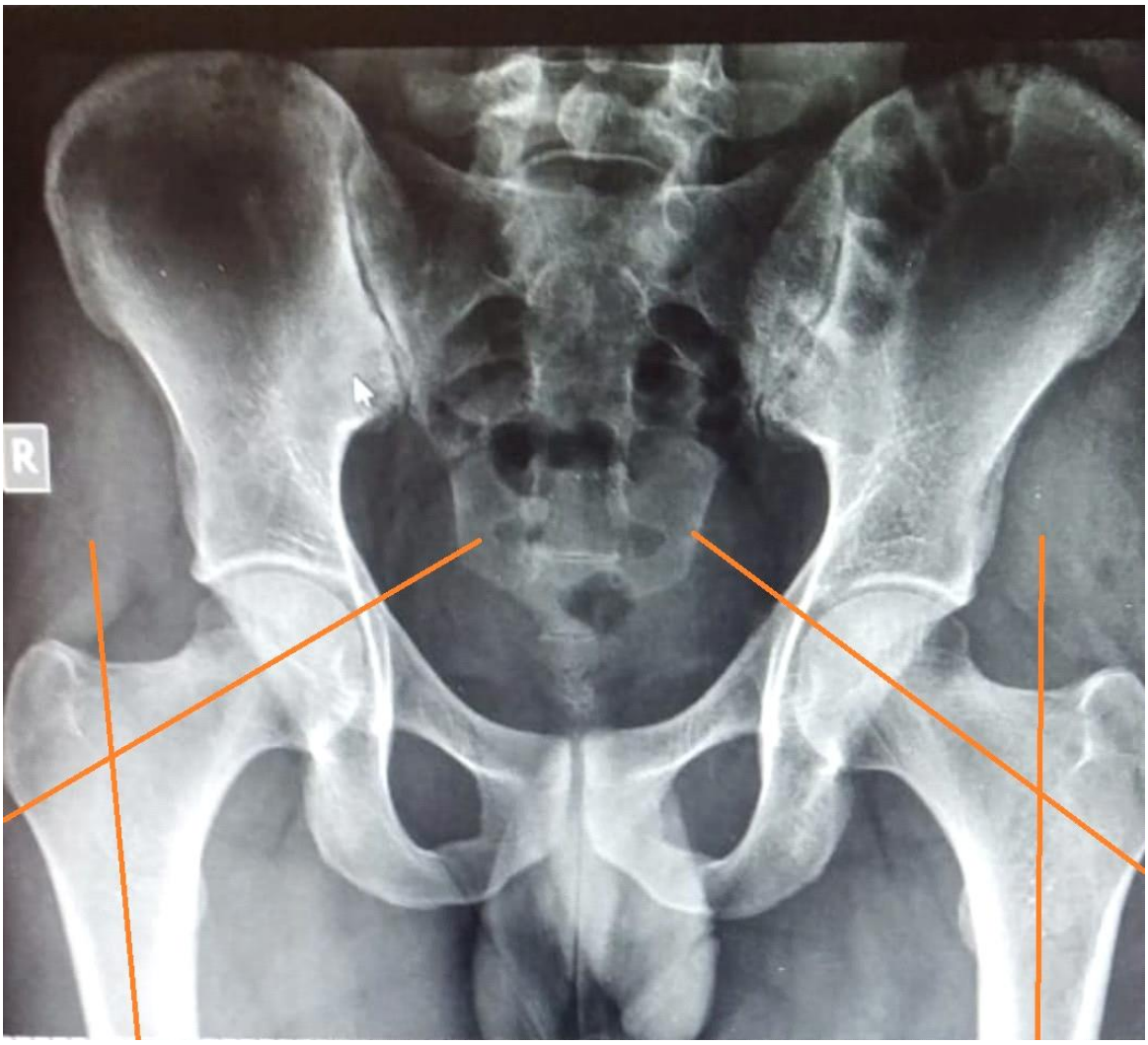
Radiological measurements used in the present study were obtained from the standard pelvic radiographs. The anteroposterior view of radiographs were used, while the patient was in supine position and both the lower limbs internally rotated at 15 degrees. The film focal distance of these radiographs was 1.2 metres. The mid-point between the two anterior superior iliac spines and upper boundary of symphysis pubis was used for centralization.

Radiographs having following features were included in the study:

- Symmetrical obturator foramen.
- Lateralization of greater trochanter.
- Clearity of pyriform fossaa.
- Pubis and coccyx in the same plane.
- Absence of hip joint arthrosis.

Femoral neck shaft angle:

Long axis of shaft of femur and long axis of neck of femur were marked with the help of marker and the point of intersection of these two axes gave us the neck shaft angle. This angle was measured with the help of goniometer.



Photograph 2: Showing the femoral neck shaft angle.

Statistical Methods:

Data was entered in a Microsoft excel spread sheet. Categorical variables were summarized as

percentages. Continuous variables were summarized as mean and standard deviation. To test the hypothesis of no difference in measurements between males and females, unpaired t-test was used. Measurements were compared across age groups by using one-way ANOVA. Paired t-test was used to compare the difference in measurements between right and left sides. Analysis was done using SPSS version 23. Two sided p-values were reported and $p < 0.05$ was considered statistically significant.

OBSERVATIONS AND RESULTS

Observation:

In our present study the radiographs were taken in digital format. The data was analysed both separately and compared with other side in both hips in both the sexes and summarized in the tables separately.

Age (years)	Frequency	Percent
<= 30.0	54	27.0
31.0 - 40.0	69	34.5
41.0+	77	38.5
Total	200	100.0

MEAN = 37.3 YEARS , SD=8.47

Table 1: Showing age distribution of study population.

The above table shows age distribution of study population. All the 200 xrays belonged to adult (20-50 years) population. Of the age less than or equal to 30 years, there were 54 xrays contributing 27 percent of the total xrays. Similarly, age group 31-40 years, there were 69 xrays, making 34.5 percent of total xrays. Age group 41-50 years, there were 77 xrays, making 38.5 percent of the total xrays. The mean age of study under population was 37.3 years + 8.7 years.

		angle_rt	angle_lt
N	Valid	20	200
	Missing	0	0
Mean		0	127.37
Std. Deviation		128.18	3.40
Minimum		2.92	120.0
Maximum		121.0	135.0

Table 2: Showing distribution of overall dimensions of neck shaft angle in study population.

The above table shows the overall dimensions of neck shaft angle in studied population (200 xrays). The mean of neck shaft angle (rt.) was found to be 128.18º+ 2.92º. The mean of neck shaft angle (lt.) was found to be 127.37º+ 3.40º.

	sex	N	Mean	Std. Deviation	Std. Error Mean	p – Value
NSA_rt	Female	100	127.94	3.05	0.30	0.237
	Male	100	128.43	2.78	0.27	0.237
NSA_lt	Female	100	127.22	3.38	0.33	0.535
	Male	100	127.52	3.43	0.34	0.535

Table 3: Showing association of NSA with gender.

The above table shows the neck shaft angle in the right and left femurs of both the sexes each consisting of 100 males and 100 females. The mean neck shaft angle in the males on the right side is 128.43º, with the standard deviation of + 2.78º and standard error mean of 0.27. On left side, it is 127.52º with standard deviation of + 3.43º and standard error mean of 0.34. So in males, the neck shaft angle on right side is higher as compared to that of left side. In females, slight difference in the neck shaft angle on right and left sides was observed with the mean value of 127.94ºon the right side and the standard deviation of + 3.05ºand standard error mean of 0.30. On the left side, the mean value observed was 127.22ºwith standard deviation of + 3.38ºand standard error mean of 0.33.

The association of females and males in NSA on right side was insignificant with p-value of 0.237 and on the left side, the association of females and males in NSA was also insignificant with p-value of 0.535.

NSA		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	p - Value
						Lower Bound	Upper Bound			
NSA_rt	<= 30.0	54	128.37	3.03	0.41	127.54	129.19	121.0	134.0	
	31.0 - 40	69	128.05	2.61	0.31	127.42	128.68	124.0	133.0	
	41.0+	77	128.16	3.13	0.35	127.45	128.87	121.0	134.0	0.841
	Total	200	128.18	2.92	0.20	127.77	128.59	121.0	134.0	
NSA_lt	<= 30.0	54	127.68	3.65	0.49	126.68	128.68	120.0	135.0	
	31.0 - 40	69	127.43	3.29	0.39	126.64	128.22	121.0	134.0	
	41.0+	77	127.09	3.34	0.38	126.33	127.85	120.0	135.0	0.607
	Total	200	127.37	3.40	0.24	126.89	127.84	120.0	135.0	

Table 4: Showing the association of NSA with age.

The above table shows association of neck shaft angle with age:

The mean NSA on right side in age group 20-30 years in 54 subjects was 128.37 + 3.03 degrees with

95% confidence interval (127.54-129.19 degrees) and on the left side it was 127.68 + 3.65 degrees with 95% confidence interval (126.68-128.68 degrees).

The mean NSA on right side in age group 31-40 years in 69 subjects was 128.05 + 2.61 degrees with 95% confidence interval (127.42-128.68 degrees) and on the left side it was 127.43 + 3.29 degrees with 95% confidence interval (126.64-128.22 degrees).

The mean NSA on right side in age group 41-50 years in 77 subjects was 128.16 + 3.13 degrees with 95% confidence interval (127.45-128.87 degrees) and on the left side it was 127.09 + 3.34 degrees with 95% confidence interval (126.33-127.85 degrees).

The overall mean NSA of all the 200 subjects on the right side was 128.18 + 2.92 degrees and was statistically insignificant with p-value of 0.841. The overall mean NSA of all the 200 subjects on the left side was 127.37 + 3.40 degrees and was statistically insignificant with p-value of 0.607.

		Mean	N	Std. Deviation	Std. Error Mean	Mean difference* 95% of confidence interval	p - Value
Pair 1							
	angle_rt	128.18	200	2.92	0.20		
	angle_lt	127.37	200	3.40	0.24	0.82(0.32-1.31)	<0.001

Table 5: Showing paired sample statistics comparison of two sides in all 200 subjects.

Above table shows the comparison of NSA in bilateral hips in all 200 subjects in both genders. The values of NSA on two sides shows a p-value of 0.001 which is significant.

Paired Samples Statistics according to gender

Sex		Mean	N	Std. Deviation	Std. Error Mean	Mean difference* 95% of confidence interval	p - Value
	angle_rt	127.94	100	3.05	0.30	0.72(0.31 – 1.41)	0.041
	angle_lt	127.22	100	3.38	0.33		

Table 6: Showing paired sample statistics according to gender in females.

In case of females, the mean NSA on the right side of 100 subjects was 127.94 + 3.05 degrees while on the left side it was 127.22 + 3.38 degrees. The mean difference of 95% confidence interval was 0.72 and this association of right and left sides was statistically significant with p-value of 0.041.

Paired Samples Statistics according to gender

Table 7: Showing paired sample statistics according to gender in males.

In case of males, the mean NSA on the right side of 100 subjects was 128.43 + 2.78 degrees while on the left side it was 127.52 + 3.43 degrees. The mean difference of 95% confidence interval was 0.91 and this association of right and left sides was statistically significant with p-value of 0.015.

Paired Samples Statistics according to age

	Mean	N	Std. Deviation	Std. Error Mean	Mean difference* 95% of confidence interval	p – Value
angle_rt	128.37	54	3.03	0.41		
angle_lt	127.68	54	3.65	0.49	0.69(0.22-1.59)	0.137

Table 8: Showing paired sample statistics according to age between 20-30 years.

The above table depicts the paired sample statistics in the age group 20-30 years of the subjects under study:

The mean NSA on the right side in the age group 20-30 years in 54 subjects was 128.37 + 3.03 degrees with the mean difference 95% of confidence interval 0.69 and on the left side it was 127.68 + 3.65 degrees with the mean difference of confidence interval of 0.69. This association of right and left sides was statistically insignificant in this age group with the p-value of 0.137.

	Mean	N	Std. Deviation	Std. Error Mean	Mean difference* 95% of confidence interval	p – Value
angle_rt	128.05	69	2.61	0.31		
angle_lt	127.43	69	3.29	0.39	0.62(0.25-1.49)	0.159

Table 9: Showing paired sample statistics according to age between 31-40 years.

The above table depicts the paired sample statistics in the age group 31-40 years of the subjects under study:

The mean NSA on the right side in the age group 31-40 years in 69 subjects was 128.05 + 2.61 degrees with the mean difference 95% of confidence interval 0.62 and on the left side it was 127.43 + 3.29 degrees with the mean difference of confidence interval of 0.62. This association of right and left sides

was statistically insignificant in this age group with the p-value of 0.159.

Paired Samples Statistics according to age

	Mean	N	Std. Deviation	Std. Error Mean	Mean difference* 95% of confidence interval	p – Value
angle_rt	128.16	77	3.13	0.35		
angle_lt	127.09	77	3.34	0.38	1.08(0.24-1.91)	0.012

Table 10: Showing paired sample statistics according to age between 41-50 years.

The above table depicts the paired sample statistics in the age group 41-50 years of the subjects under study:

The mean NSA on the right side in the age group 41-50 years in 77 subjects was 128.16 + 3.13 degrees with the mean difference 95% of confidence interval 1.08 and on the left side it was 127.09 + 3.34 degrees with the mean difference of confidence interval of 1.08. This association of right and left sides was statistically significant in this age group with the p-value of 0.012.

Discussion

In our present study, 200 subjects (100 males and 100 females) in age group of 20-50 years were selected. Measurements were done separately on the radiographs on both sides of each gender. Mean value was calculated, comparison was done between the measurements of neck shaft angle on two sides in each gender and each side was also compared with the neck shaft angle of the corresponding side in the other sex. In the study, mean neck shaft angle on the right side in males was found to be 128.43+ 2.78 degrees and on the left side it was 127.52+ 3.43 degrees. Thus, we observed a difference of 0.91 degrees in the mean values of neck shaft angle on the two sides in males. In females, the mean neck shaft angle values on the right side was found to be 127.94+3.05 degrees and on the left side it was 127.22+ 3.38 degrees.Thus, we observed a difference of 0.72 degrees in the mean values of neck shaft angle on the two sides in females. However, the mean neck shaft angle on right side in males was higher than those in females. The mean neck shaft angle on the left side of the two sexes was close to each other.

Silva VJ et al, 2003(8) while conducting morphometric study in 66 femurs (33 right and 33 left) and found no significant difference in the neck shaft angle values on the two sides which is contradictory to our study.

Atkinson H D et al 2010,(9) used 100 consecutive caucasian patients (61 males and 39 females) to study the differences in hip morphology between the genders in patients undergoing hip resurfacing, in the study they compared the neck shaft angle. The males had mean neck shaft angle of 129 degrees (range 119-138) and the females had a mean neck shaft angle of 128 degree (range 121-138). The present study is consistent with our study with

respect to gender.

Our study findings were consistent with a study conducted by Kour P et al 2013(10) who found the average NSA in males on right side to be 121.63+ 2.41 degrees and on left side it was 121.33+ 2.36 degrees while in females the mean NSA on right side was found to be 121.16+ 2.50 degrees while on left side it was found to be 120.94+ 2.51 degrees.

Ma H etal, 2014(11) in a Chinese study analysed neck shaft angle with computed tomography, and found no significant difference in the neck shaft angle on the two sides in males which is contradictory to our present study but the same parameter in females on the two sides was close to each other which is contradictory with our present study. Moreover, the neck shaft angle values when compared in the two sexes were also close to each other which is consistent with our present study.

Christopher KB et al, 2016(12) while measuring femoral Neck shaft angle on plain radiographs observed that the mean Neck shaft angle of healthy adults was 128.8º(98-180º) and in patients of Osteoarthritis it was 131.5. For rotation corrected the mean NSA was 128.5 and for non rotation corrected it was 129.5º.

Yet in another study conducted by Pathak SK et al 2016(13) showing the mean values of NSA for males to be 129.26 degrees and in females the mean value of NSA to be 126.62 degrees, thus is in concinnity with our study.

Adekoya-cole TO et al, 2016(14) studied femoral neck shaft angle in 264 hip joints of 132 subjects, 68 males and 64 females in adult Nigerian population. The average neck shaft angle for an adult Nigerian was 130.77+ 6.03 degrees with mean neck shaft angle of 131.28+ 6.56 on the right side and 130.22+ 5.18 for the left side. In males mean neck shaft angle was 131.57+ 5.66 degrees, whereas the mean value for the adult female was 129.97+ 6.33. The above findings were consistent with our study as in our study also the mean value of male NSA was more than that of females and also the values on right side are higher as compared to left. Another radiological study conducted by Parashar R et al 2017 (15) for femoral NSA found the mean NSA on right side was 130.22 degrees and on left side was 129.81 degrees which was consistent with our study with respect to side variation.Shrestha R et al 2018 (16) in their radiological study of NSA in Napalese population found that in males average right NSA was 132.96+ 6.05 degrees and left NSA was 131.54+ 13.66 degrees while in females the average right NSA was 134+ 6.57 degrees and on left side 132.98+ 6.23 degrees. The above findings according to gender was not consistent with our study but right left variation corroborated with our study.

Yin et al, 2018(17) observed that neck shaft angle was higher on right side in males which is consistent with our present study but in females also it was higher on the right side which is consistent to our present study.

Ates A et al, 2019(18) while doing radiological measurement of neck shaft angle in 200 subjects (100 males and 100 females) observed that the mean neck shaft angle in males was 128.19+ 5.08 degrees and in females it was 128.4+ 5.18 degrees. No significant difference in the mean value of neck shaft angle in the

males on two sides was observed which is contradictory to our present study. However, the values on the two sides in female subjects and also the mean values of neck shaft angle in both the sexes were close to each other which is inconsistent with our present study.

Conclusion:

The results calculated provides important information about gender, age and side variations of NSA for the anatomists, radiologists and orthopaedic surgeons. Radiological knowledge of NSA will help the orthopaedicians in diagnosing and selecting various treatment modalities in fractures around the hip joint, dislocation of hip joint and also surgical procedures like implantation of prosthesis.

The data thus obtained can be used as baseline for future studies in the departments of Anatomy, Radiodiagnosis and Orthopaedics.

References

1. Chaurasia BD Human Anatomy Hip Joint Volume II; Lower Limb, Abdomen and Pelvis; 8th edition 2020, reprint 2021; CBS publishers and distributors Pvt. Ltd. Page No. 15

2.**Singh V.** Textbook of Anatomy; Femur Volume II Abdomen and lower limb; 3rd edition 2018. Reed Elsevier India Private Limited; Page No. 303.

3. Chowdhury MS, Naushaba H, Mahbubul Mawla Chowdhury AHM, Khan LF, Ara JG. Morphometric study of full ossified head and neck of human left femur. J Dhaka Natl Med Coll Hos 2012; 18(2):9-13

4.Tipton SC, Sutherland JK, Schwarzkopf R. The assessment of limb length discrepancy before total hip arthroplasty. J Arthroplasty. 2016 ssApr;31(4):888-92.

5.Deorio JK. Intraoperative evaluation of limb length in hip arthroplasty using a single anteroposterior radiograph. Hip Int. 2005 oct-dec; 15(4): 199-205.

6.Desai AS, Dramis A, Board TN. Leg length discrepancy after total hip arthroplasty: a review of literature. Curr Rev Musculoskeletal Med. 2013 Dec;6(4):36-41

7.**Kayani B, Pietrzak J, Hossain FS, Konan S, Haddad FS.** Prevention of limb length discrepancy in total hip arthroplasty. Br J Hosp med (Lond). 2017 jul 2; 78(7): 385-390.

8.Silva VJ, Oda JY, Santana DMG. Anatomical aspects of the proximal femur of adults Brazilians. Int J Morphol 2003;21(4):303-08.

9.**Atkinson HD, Johal KS, Willis-Owen C, Zadow S, Oakeshott RD.** Differences in hip morphology between sexes in patients undergoing hip resurfacing. J Orthop Surg. Res: 2010 Oct 15; 5:76

10.**Kour P, Mathew S, George U.** A study of neck shaft angle in the north-west Indian population on Radiographs. International Journal of basic and applied medical sciences. Volume 3 (3) September-December, PP 9-15.

11.**Ma H, Han Y, Yang Q, Gong Y, Hao S, Li Y, Liu J**. Three dimensional computed tomography reconstruction measurements of acetabulum in Chinese adults. Anat Rec (Hoboken). 2014 Apr;297(4):643-9.

12.Christopher KoljaBoesa, Jens Dargel, Philipp Lechler. "The femoral neck shaft angle

on plane radiographs: a systemic review". Skeletal radiology (2016) 45,19-28.

13.Pathak SK, Maheshwari P, Ughareja P, Gadi D, Raj PM, Gour SK. Evaluation of femoral neck shaft angle on plain radiographs and its clinical implications. International Journal of Research in Orthopaedics. 2016 dec; 2(4):383-386.

14.Adekoya-cole TO, Akinmokun OI, Soyebi KO, Oguche OE. Femoral neck shaft angle: A radiological anthropometric study. Niger postgrad med J 2016; 23:17-20.

15.Parashar R, Sharma A, Gupta UK. Correlation of neck shaft angle with age. A radiographic study. Int. J Res Med. 2017;6(2) 93-96.

16. Shrestha R, Gupta HK, Hamal RR, Pnadit R. Radiographic anatomy of neck shaft angle of femur in Nepalese people: Correlation with its clinical implications. Kathmandu, Univ Med J. 2018;62(2):124-8.

17.Yin Y, Zhang R, Jin L, Li S, Hou Z, Zhang Y. The hip morphology changes with aging in asianpolulation. Biomed Res Int. 2018 sep 27; 2018: 1507979.

18.Ates A, Aydin E, Maralcan G, Proximal femur morphology and radiological measurement of femuroacetabular distance, Global Journal for Research Analysis Volume-8, issue-6, june 2019 Print issn No. 2277-8160

eISSN 1303-5150