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Gender Determination from Mandible Using Lateral Cephalogram- A Short Study

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Abstract

Background: The mandible is seen as an important tool for radiological identification because of several growth parameters that can be exploited using cephalometric analysis, ease of imaging, and no overlying bony structures. These parameters can be handy in gender determination in extreme situations like mass disasters, remains of dead exhumed and murderous mutilations, missing or severely burnt individuals, etc.

Material and Methodology: The study was conducted on randomized 80 lateral cephalograms Obtained from the Department of Oral Medicine and Radiology. Three linear measurements of mandibular growth were; mandibular body length, mandibular length and mandibular height. Gonial angle was measured as the angle formed by the ramus line (RL) and mandibular line (ML). The values obtained were statistically analyzed by Student’s t-test using Statistical Package for Social Sciences (SPSS),IBM Version 24.0.

Results: After obtaining all the measurements, unpaired‘t-test’ was performed. The Gonial angle, Height of ramus, Mandibular length, showed statistically significant gender

difference.Where as mandibular body length showed statisticallynonsignificant in gender determination

Conclusion: The linear and angular parameters used in the study, when combined together, might prove to be of importance in studying the growth pattern of mandible in males and females for gender determination.

Keywords: Mandible, Linear Measurements ,Sexual Dimorphism, Lateral Cephalogram.

Introduction

Recognition of gender is an important aspect of identification of an individual and is an important part of the medicolegal practice, where forensic odontology has an important role[1].Apart from pelvis, mandible exhibits great amount of sexual dimorphism in the human body. The mandible is used as an important tool for radiologicalidentification due to several growth parameters thatcan be recorded by using cephalometric analysis, easeof imaging, and no overlying bony structures. Thisparameters can be used in gender assessmentin extreme conditions like mass disasters, remains ofdead exhumed and murderous mutilations, missing orseverely burnt individuals, etc[2]. The equipment required for lateral cephalometry is readily available and the technique is cost effective, easy to perform offers quick results. So lateral cephalogram is a reliable tool which can be routinely used for forensic and anthropological purposes[3]. With this background the present study was focusing to identification of gender by gonial angle and measuring three linear measurements of mandibular growth.

Materials And Methods

Aim and objective

To assess the mandibular growth parameters such as Total mandibular body length, mandibular length, mandibular height and gonial angle using lateral cephalogram in the study population for determination of the gender of an individual.

Inclusion and exclusion criteria

The criteria for sample selection demanded an ANB angle between 0 and 4. Radiographs with Class 1skelatal base are included and radiographs with skeletal class II or III skeletal base were excluded (because of exaggerated growth). patients with missing teeth or withsyndromes, cleft lip or palate, or other craniofacial pathology, were also excluded.

Study design

The study was conducted on randomized 80 lateral cephalogramobtained from the Department of Oral Medicine and Radiology data base .The study used the following cephalometric landmarks; condylon (Co), gonion (Go),and gnathion (Gn). Three linear measurements of mandibular growth were; mandibular body length (distance between Go and Gn Fig-1)mandibular length (distance between Co and Gn Fig-2)and mandibular height (distance between Co and Go Fig-3) as per a study conducted by Rai *et al.*[4] These measurements were done using mouse driven cursor.Gonial angle was measured as the angle formed by the ramus line (RL) and mandibular line (ML), where RL is a tangent to the posterior border of mandible and ML is the lower border of the mandible through the Gn as per a study conducted by Upadhyay*et* al[5].[Figure -4].

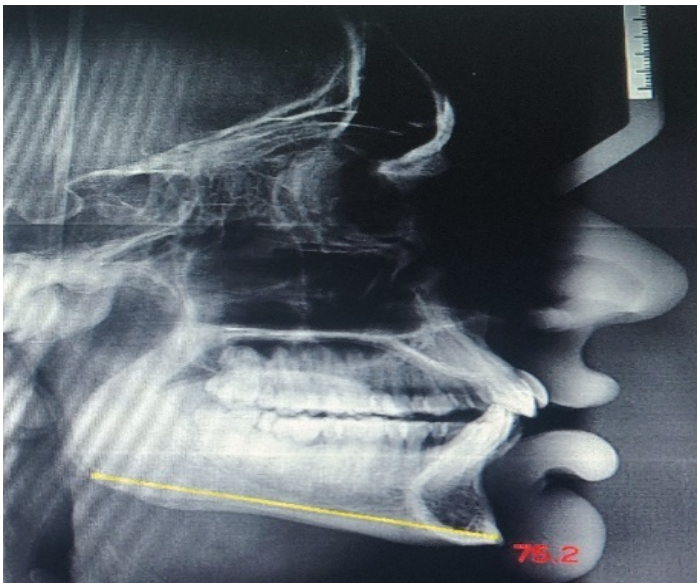


Fig.1: Mandibular body length

Fig. 2: Mandibular length

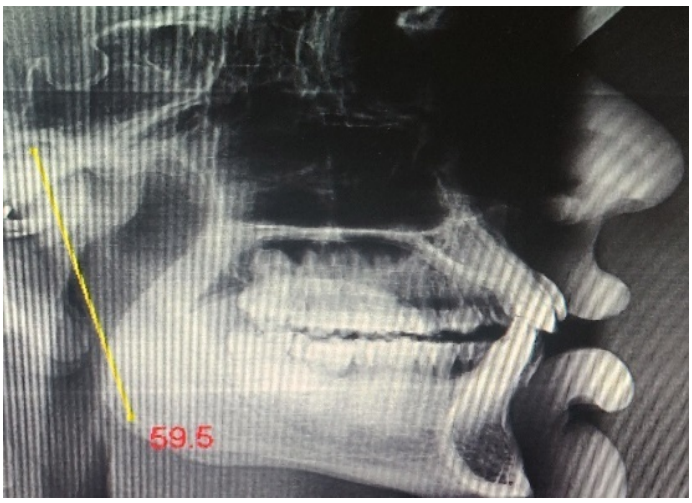


Fig.3: Mandibular height

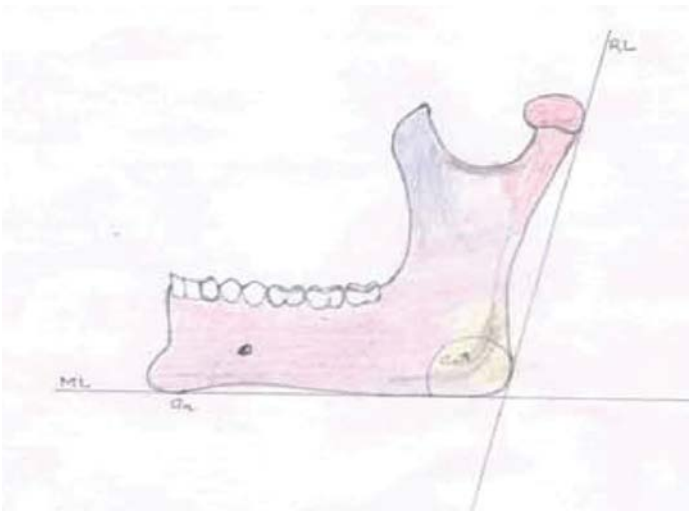


Fig. 4: Measurement of gonial angle

Statistics

All the measurements were done on a computer monitor using a mouse driven cursorand mathematical protractor. The values obtained were statistically analyzed by Student's *t*-test using IBM SPSS, Version 24.0(IBM SPSS Inc USA).

Results

The study constituted of 80 participants out of which 40 were females and 40 were males. The age range was 10–35 years.

Table 1 describes the distribution of samples and mean values of various linear measurements and gonial angle among males and females.

Table 2 shows the mean difference of age among the males and females of 1.245 (p value .316) which showed that statically non-significant, and mean difference of MBL of 4.84296(p value.088)which showed that statically non-significant ,and mean difference of ML of 6.34587(p value .018) which showed that statically significant, and mean difference of MH of 5.52189(p value .036) which showed that statically significant and mean difference of ML of 6.34587(p value .018) which showed that statically significantand mean difference of Gonial angle of -0.6198(p value .046) which showed that statically significant.

Bar diagram 1 shows that mean MBL among males and females.

Bar diagram 2 shows that mean ML among males and females.

Bar diagram 3 shows that mean MH among males and females.

Bar diagram 4 shows that mean Gonial angle among males and females.

Discussion

In the present study, linear and angular parameters of mandibular growth were analyzed on cephalometric radiographs and were used to study the mandibular growth rate between males and females groups and the linear and angular measurements were compared between males and females .It has been observed that the mandible grows in aposterior superior direction resulting in at anteriorinferior displacement and that mandibular sagittalgrowth is due to anterior resorption in the ramus.

Height of mandibule: In the present study the mean value of the height of ramus of mandible was found to be 51.3 in males and 48.49 in females. The standard deviation for height of ramus in male was 7.42784 and in female was 3.97204 The values in the female mandibles was lesser compared to that obtained in males. Study conducted by Rai R et al showed mean mandibular ramus height was greater in males (53.9 cm) than in females (51.8 mm) and there was a statistically significant correlation in the height of ramus between the male and female mandibles [6].Study conducted by Al-Shamout R et al concluded that males have higher values of the height of ramus compared to female counterparts and statistically significant gender differences were recorded in the height of ramus[7].In accordance with studies done by Rai R et al and Al-Shamout R et al our study showed statistical significant difference between male and female mandible height with a p value of 0.036.

Gonial angle: In the present study the mean value of gonial angle was found to be 122˚ in male and 125.2˚ in females. The standard deviation in male was 7˚and female was 6˚. The values of female mandibles were higher than that of males. Study conducted by Vinay G et al found that mandibular angle of male mandible varies from 111° – 136° with an average of 121° ± 6° and that of female mandible varies from 97° – 137° with an average of 122° ± 7°. The gender differences in mean values of Mandibular angle of male and female is not statistically significant for mandible[8].Jayakaran F et al in their series of 207 mandible found that the mean of mandibular angle for male mandible was 121.43˚ and for female 124.19˚. Standard deviation was 6.99 in males and 6.90 in females[9].Ranganath V et al found that the mean for mandibular angle in males was 110.68˚ and for females mean was 114.53˚. Standard deviation for male was 15.50 and for female 6.95[10]Ayoub F et al observed no significant difference in mandibular angle in sex determination in the young Lebanese population (83 young individuals - 40 males and 43 females) aged between 17 and 26 years[11].In present study there was a statistical significant difference between male and female mandible with p value of .046.

Mandibular length: In the present study the mean value of the mandibular length was found to be 108.6mm in males and 105.2 mm in females. Standard deviation for mandibular angle in male was 7.5 and in female was 5.02. Jayakaran F et al in their series of 207 mandible found that the mean of mandibular length for male mandible was 7.44 cm and for female was 7.06 cm. Standard deviation was 0.41 in males and 0.47 in females[9].Ranganath V et al in their study on 111 mandibles showed that the mean of mandibular angle in males was 6.78 cm and for females 6.63 cm. Standard deviation for male was 0.94 and for female was 0.76.**7** Ongkana N et al data on 102 mandibles showed that the mean value of mandibular length for male

mandible was 8.94 cm and for female was 8.53 cm. Standard deviation for male was 0.60 and for females was 0.55[9].Vinay G et al in their study found the mean value of the mandibular length 7.54 cm in males and 7.25 cm in females. Standard deviation for mandibular angle in male was 0.43 and in female was 0.51. The demarking point of mandibular length for male was 8.81 and for female was 6.22. Limiting point for mandibular length was 7.36, by which 66.02% of male and 53.01% of female were correctly sexed. The t-value of mandibular length was 4.83. The sex differences in mean values of Mandibular length of male and female was statistically significant ($p<0.0001$) for mandible bone[12].In accordance with studies done by.Jayakaran F et al, Ranganath V et al,Ongkana N et al and Vinay G et al our study showed statistical significant difference between male and female mandible length with a p value of 0.018.

Mandibular body length: In the present study the mean value of the mandibular body length was found to be 76.1mm in males and 73.3mm in females. Standard deviation for mandibular body length in males 6.4 and in females was 5.0 which does not showedstatistically significant.

Conclusions

Human skeletal examination plays an important role in Anthropology and Medicolegal works to identify the individual, sometimes if a part of bone is also available, sex and age can be determined based upon different morphological and metrical parameters. The present study utilizes the 4 different metrical parameters like Gonial angle, Height of mandible, Mandibular length and mandibular body length The application of these parameters along with morphological features could be an useful tool for sex determination of mandibles. This is the first time where 4 different linear measurements has been taken for gender differentiation and out of those measurements except mandibular body length all the other parameters showed significant gender differentiation .

Independent Sample T-Test

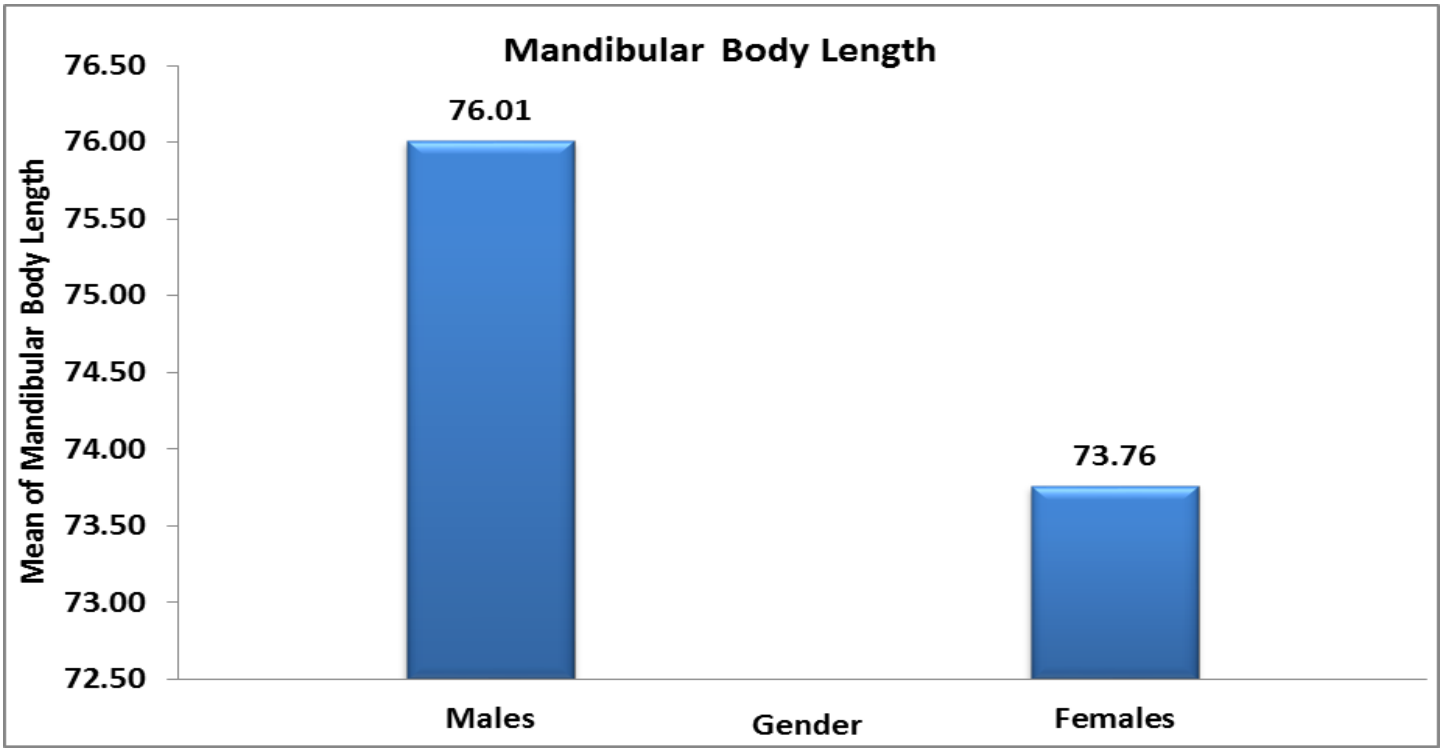
Table 1: Group Statistics

Gender		N	Mean	Std. Deviation	Std. Error Mean
Age	Male	40	20.28	6.481	1.025
	Female	40	21.55	4.679	.740
Mandibular body Length (mbl)	Male	40	76.0125	6.46181	1.02170
	Female	40	73.7625	5.09739	.80597
Mandibular Length (ML)	Male	40	108.6975	7.55671	1.19482
	Female	40	105.2150	5.02504	.79453
Mandibular Height (MH)	Male	40	51.3500	7.42784	1.17444
	Female	40	48.4925	3.97204	.62804
Gonial Angle (GA)	Male	40	122.0000	7.07107	1.11803
	Female	40	125.1250	6.68403	1.05684

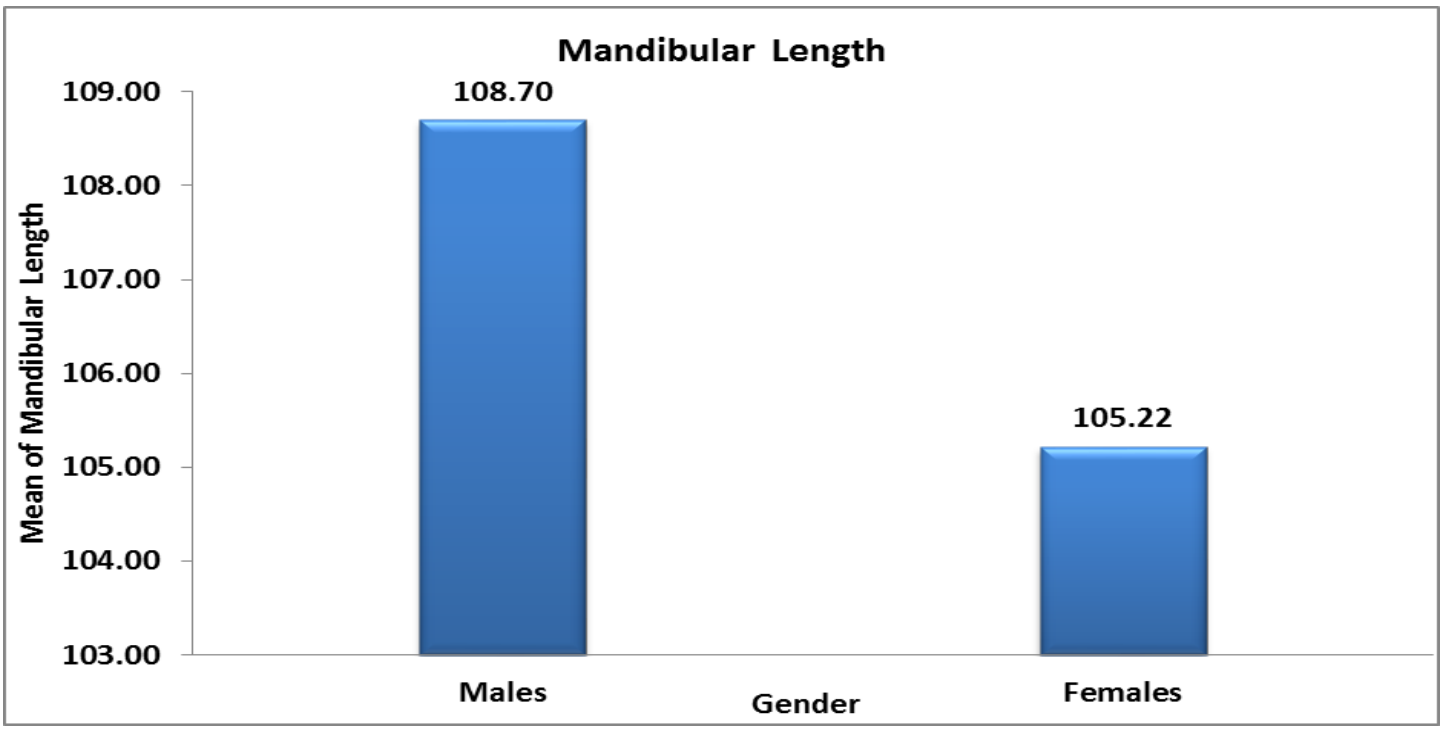
Table 2: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	P Value	Mean Difference	Std. Error Difference	Lower	Upper
AGE	Equal variances assumed	4.735	.033	-1.009	78	.316	-1.275	1.264	-3.791	1.241
	Equal variances not assumed			-1.009	70.973	.316 NOT SIG	-1.275	1.264	-3.795	1.245
MBL	Equal variances assumed	2.540	.115	1.729	78	.088 NOT SIG	2.250	1.30133	-.34075	4.84075
	Equal variances not assumed			1.729	73.989	.088	2.250	1.30133	-.34296	4.84296
ML	Equal variances assumed	10.887	.001	2.427	78	.018	3.483	1.43488	.62588	6.33912
	Equal variances not assumed			2.427	67.850	.018 SIG	3.483	1.43488	.61913	6.34587
MH	Equal variances assumed	15.372	.000	2.146	78	.035	2.857	1.33182	.20605	5.50895
	Equal variances not assumed			2.146	59.619	.036 SIG	2.857	1.33182	.19311	5.52189
GA	Equal variances assumed	.075	.785	-2.031	78	.046 SIG	-3.12500	1.53848	-6.18787	-.06213
	Equal variances not assumed			-2.031	77.754	.046	-3.12500	1.53848	-6.18802	-.06198

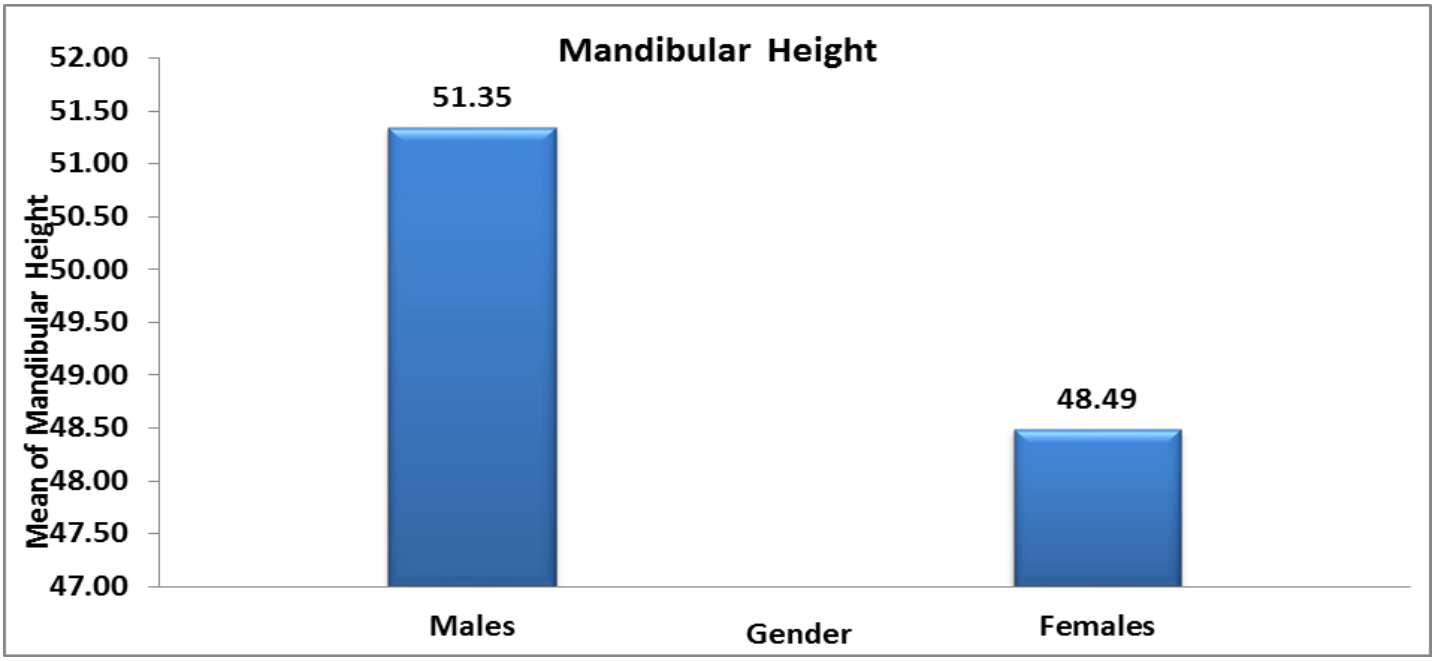
Bar Diagram 1



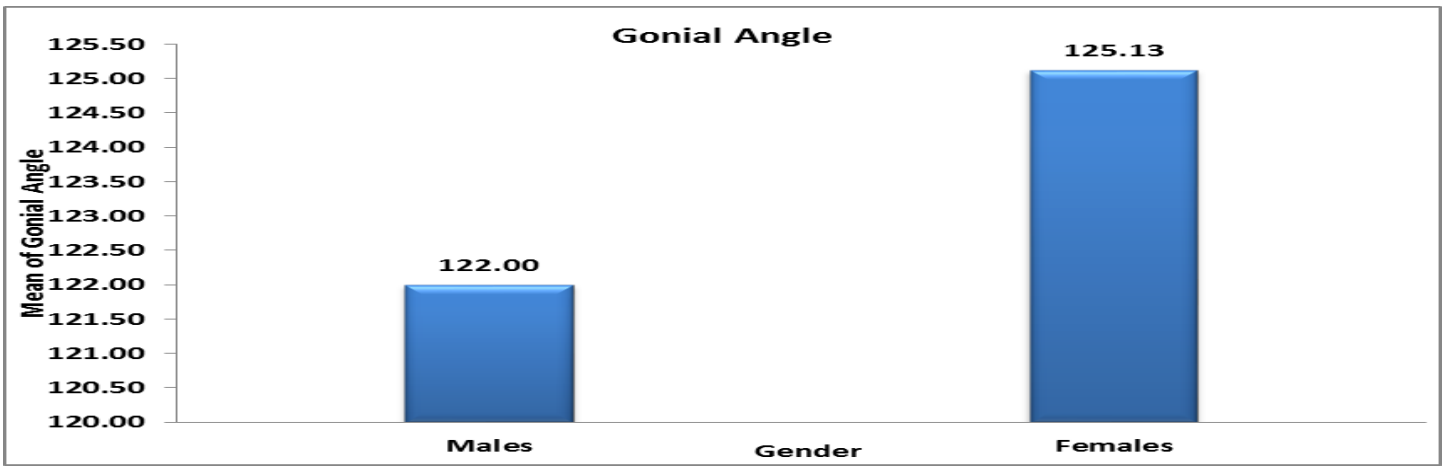
Bar Diagram 2



Bar Diagram 3



Bar Diagram 4



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