The Position Of Glenoid Fossa In Different Patterns And Its Relation To The Functional Occlusal Plane In Local Population

[1]Rahul Panelia, [2] Preeti Bhardwaj, [3] Nitin Dungarwal, [4]Piyush Bolya, [5]Rutvik Trivedi

[1]Post-Graduate Student, Darshan Dental College and Hospital, Udaipur.

[2]Professor & Head, Darshan Dental College and Hospital, Udaipur.

[3,4]Reader, Darshan Dental College and Hospital, Udaipur

[5]Senior lecturer, Darshan Dental College and Hospital, Udaipur

ABSTRACT

Background & Objectives: Glenoid Fossa position plays an important role in the establishment of different craniofacial patterns. The purpose of this study was to verify the position of the glenoid fossa in subjects with different sagittal patterns, to assess the correlation between the position of Glenoid Fossa and different sagittal skeletal patterns and to assess the correlation between the position of the glenoid fossa and the functional occlusal plane.

Methods: A lateral cephalometric study was carried out on 200 subjects aged 18-45 years who were classified according to skeletal sagittal relationships using ANB angle into four groups (Cl. I =50, Cl. II Div.1 =50, Cl. II Div.2 = 50, Cl. III =50 subjects). Cephalometric analysis comprised both sagittal and vertical measurements for the assessment of the position of the glenoid fossa in relation to surrounding skeletal structures.

Results: The results revealed that in sagittal skeletal relation, the glenoid fossa position was more posterior in skeletal Class II Div.2 when compared with skeletal Class II Div.1, Class I and Class III; while in the vertical plane, the position of the glenoid fossa was more cranial in skeletal Class III when compared with skeletal Class I, Class II Div.1 and Class II Div.2. On the other hand, there was no correlation between the position of the glenoid fossa and the functional occlusal plane.

Interpretation & Conclusion: In conclusion, subjects with skeletal Class II Div.2 show a more posterior position of the Glenoid Fossa in relation to cranial base when compared to subjects with skeletal Class II Div.1, Class I and Class III regarding the sagittal plane and there is no valuable diagnostic information from the functional occlusal plane in relation to the position of the glenoid fossa.

Key words: Glenoid fossa; Class I malocclusion; Class II Div.1 malocclusion; Class II Div.2 malocclusion; Class III malocclusion; TMJ; Functional occlusal plane.

INTRODUCTION

The association of the mandible to the cranial base effects both sagittal and vertical facial conflicts. Glenoid fossa position plays an important role in the foundation of different craniofacial patterns. The scientific studies provides only limited data about the diagnostic importance of the position of the glenoid fossa in relation to other skeletal structures. On the contrary, many experimental and clinical contributions have demonstrated the effects of orthopaedic /orthodontic therapies on glenoid fossa position and morphology.[1]

Malocclusions are the result of various combinations of underlying dental and skeletal conflicts that involve several different components of the craniofacial region. Since the relationship of the mandible to the cranial base influences both sagittal and vertical facial disharmonies, the position of the glenoid fossa in relation to nearby skeletal structures deserves to be included in the analysis of the skeletal features of the individual patient.[2]

The scientific benefaction in this regard have indicated that the relative position of the glenoid fossa, i.e. of the attachment of the mandible to the cranium, can affect the dentoskeletal features of malocclusions, for instance, a more distal position of the fossa can cause mandibular retrusion.[3]

MATERIAL AND METHODS:

MATERIAL:

1. Pretreatment lateral cephalograms

2. X-ray viewer

3. Acetate matte tracing paper

4. 0.3 mm lead pencil

5. Compass box

SOURCE OF DATA:

The lateral cephalogram of 200 adult patients with age 18 to 45 yeards were collected from the Department of Orthodontics and Dentofacial Orthopedics, Darshan Dental College & Hospital, Loyara, Udaipur, Rajasthan. This study was undertaken after approval by the Ethical committee of Darshan Dental College & Hospital, Loyara, Udaipur, Rajasthan.

INCLUSION CRITERIA:

1. Patients with age group of 18-45 years.

2. Patients having skeletal Class I, Class II Div 1, Class II Div 2 and Class III malocclusion.

EXCLUSION CRITERIA:

1. Patients with gross facial asymmetry and any history of jaw trauma.

2. Patients with chronic oral diseases and medically compromised.

3. Patients who undergone orthodontic treatment previously.

SAMPLE COLLECTION:

Type of study – Cohort Study

Sample size   - 200

Age group   - 18-45 years   (Mean Age- 22.35 years)

METHOD

CEPHALOMETRIC ANALYSIS:

Tracing of various parameters required was done manually on matte acetate paper using 0.3 mm lead pencil.

Cephalometric points

The bony cephalometric points included the followings : (Figure 1 A):

1. Point A (Subspinale): The deepest midline point on the premaxilla between the Anterior Nasal Spine and Prosthion

2. Point B (Supramentale): The deepest midline point on the mandible between Infradentale and Pogonion .

3. Point S (Sella): The midpoint of the hypophysial fossa .

4. Point N (Nasion): The most anterior point on the naso-frontal suture in the median plane.

5. Point T: It is the most superior point of the anterior wall of sella turcica.

6. Point Ar (Articulare): A point at the junction of the posterior border of the ramus and the inferior border of the posterior cranial base (occipital bone).

7. Point Go (Gonion): A point on the curvature of the angle of the mandible located by bisecting the angle formed by the intersection of the lines tangent to the posterior ramus and the inferior border of the mandible.

8. Point Me (Menton): The lowest point on the symphyseal shadow of the mandible seen on a lateral cephalogram.

9. Point Fs (Fossa summit): It is the point on the superior margin of the glenoid fossa where a line parallel to SBL (Stable Basicranial Line) tangent to the superior curvature of Glenoid Fossa.

10. Fs': It's the projection of point Fs on SBL.

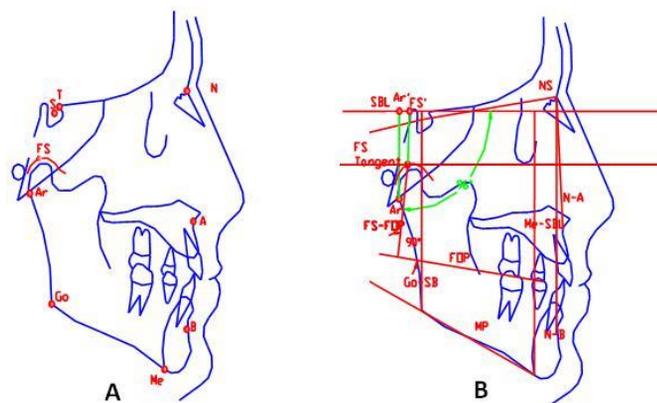11. Ar': It's the projection of point Ar on SBL.

FIGURE – 1 [Cephalometric Points and Planes]

Cephalometric Planes

The following cephalometric planes were determined (Figure 1 B):

1. N- A line: Formed by a line joining Nasion and point A.

2. N- B line: Formed by a line joining Nasion and point B.

3. Functional occlusal plane (FOP): A plane formed by bisecting the intercuspation of the first premolars anteriorly and the intercuspation of the first molars posteriorly.

4. SBL (Stable Basicranial Line): It is the line passing through point T and tangent to the lamina cribrosa of the ethmoid bone.

Cephalometric measurements

The following angles and linear measurements were recorded to the nearest degree and millimeters respectively:

A. Angular Measurements :

ANB angle: The angle between lines N-A and N-B. It represents the difference between SNA and SNB angles or it may be measured directly as the angle ANB. It is the most commonly used measurement for appraising

anteroposterior disharmony of the jaws.

B. Linear Measurements:

(a) Horizontal:

1. T-Fs': The linear distance from point T to point Fs'.

2. T-Ar': The linear distance from point T to point Ar'.

(b) Vertical:

1 Fs-Fs': The linear distance from point Fs to point Fs'.

2 Ar-Ar': The linear distance from point Ar to point Ar'.

3 Go- SBL: The perpendicular distance from SBL to point Gonion.

4 Me-SBL: The perpendicular distance from SBL to point Menton.

5 Fs-Fop: It's the perpendicular distance from point Fs to the FOP.

Classification of the skeletal malocclusion was done by use of ANB angle on lateral cephalograms as follows:

ANB angle between 1 to 3° (skeletal Class I)

- ANB >3° (skeletal Class II Div. 1 and Class II Div. 2)

- ANB <1° (skeletal Class III)

Subgrouping of Class II malocclusion was done by dental assessment into division 1 and division 2. Pretreatment cephalometric radiographs of 200 patients- 50 class I (males, females), 50 class II Div 1(males, females), 50 class II Div 2 and 50 class III (males, females) with age group of 18-45 years according to Table no. I were procured from the

The Statistical analysis included:

1. Descriptive statistics; including mean standard deviation, and statistical tables.

2. Inferential statistics including;

- ANOVA test.

- Student t - test.

3. Pearson's Correlation coefficient.

The level of significance was established as $P \leq 0.05$ for statistical tests.

DISCUSSION

As the relationship of the mandible to the cranial base influences both sagittal and vertical facial disharmonies, glenoid fossa position is likely to play an important role in the establishment of different craniofacial patterns. The literature provides only limited data about the diagnostic significance of the position of the temporomandibular joint in relation to other skeletal structures Hopkin et al (1968)[2]; Droel and Isaacson (1972)[3]; Kantomaa (1989)[1]. Pancherz (1979)[4.] On the contrary, many experimental and clinical contributions have demonstrated the effects of orthopaedic/orthodontic therapies on glenoid fossa position and morphology Stockli and Willert (1971)[5]; Elgoyhen et al (1972)[6];; Agronin and Kokich (1987)[7], Woodside et al (1987)[8]; Paulsen et al (1995)[9]. In particular, Pancherz (1979)[4]

GROUPS	MALOCCLUSION	AGE/SEX	NUMBER
Group 1	Skeletal class I malocclusion(ANB 1°-3°)	18-45 years (males, female)	50
Group 2	Skeletal class II malocclusion(ANB >3°)	18-45 years(males, females)	50
Group 3	Skeletal class II Div 2 malocclusion(ANB >3°)	18-45 years(males, females)	50
Group 4	Skeletal class III malocclusion(ANB <1°)	18-45 years(males, females)	50

records of Department of Orthodontics and Dentofacial Orthopaedics, Darshan Dental College, Loyara, Udaipur.

STATISTICAL ANALYSIS

After the collection of data, the obtained data was checked, verified and edited. All the data of the sample are subjected to computerized statistical analysis using IBM SPSS 16.0 computer program.

described the forward displacement of the articular portion of the temporal bone following Herbst therapy of Class II malocclusion.

- T – Fs' and T – Ar'

Our study showed that mean value T – Fs' and T – Ar' is higher in Class II Div. 2 than Class II Div.1 ,Class I and Class III (p = < 0.001) .The results suggest that position of glenoid fossa is more posterior in Class II Div.2 than Div.1 , Class I and Class

III. These results come in accordance with Droel and Isaacson (1972)[3] although they used a different reference point (point S) for the assessment of the sagittal position of the glenoid fossa. In the present study, point T was used instead of point S. Point T was chosen in order to avoid uncontrolled variability of the reference structures due to the remodeling of the floor and of the posterior wall of sella turcica along with growth (Melsen, 1974)[12]. Moreover, Baccetti *et al* (1997)[10] and Arkan *et al* (2010)[11] used the same reference point and the results in this study agreed with them. They found sagittal position of glenoid fossa is more posterior in class II than Class I and Class III.

- Fs- Fs'

Our study showed that mean value Fs – Fs' is higher in Class II Div. 2 than Class II Div.1 ,Class I and Class III (p = < 0.001) &   Ar – Ar' is higher in Class II Div 1 than Class II Div 1, Class I and Class III. (p = < 0.001). The variations in the position of point articulare in relation to the basicranial structures and to both nasal spines were in the same direction as the variations in the position of point Fs. However, the position of point Ar showed significant differences mainly between extreme vertical facial types. This could be due to the fact that point Ar does not belong to the temporal bone as it is constructed at the intersection between the inferior surface of the cranial base and the posterior surfaces of the mandibular condyles (Riolo *et al* 1974[15]). In contrast with a previous investigation done by Droel and Isaacson (1972)[3], by Baccetti *et al* (1997)[10] ,Arkan *et al* (2010)[11] in fact, the present study analysed not only groups of subjects with extreme facial disharmonies, but also groups of subjects with normal facial relationships with sagittal skeletal parameters.

- Me - SBL

 Our study showed that Me-SBL (distance correlates the point menton to the base of skull) revealed that the mean value of this variable was higher in class III than class I , class II Div 2 and class II Div 1 with a significant difference (p = < 0.001)   between the classes as indicated by ANOVA test. Baccetti *et al.* (1997)[10] found that this variable was nearly similar in different sagittal skeletal classes with a non-significant difference; the difference in the results may be attributed to the difference in the age groups as they took their sample with an age ranged between 7 and 12 years and still the mandible had the potential for growth, while in the present study adult sample was selected to exclude the growth effect. This result may be attributed to that CL.III subjects may have increased anterior facial height due to backward mandibular

rotation or presence of dental and/or skeletal open bite. The study done by Arkan *et al*[11] showed similar results to our study.

- Go - SBL

Our study showed that Go-SBL (distance correlates the point gonion to the base of skull) revealed that the mean value of this variable was higher in class III than class I , class II Div 2 and class II Div 1 with a significant difference (p = < 0.001) between the classes as indicated by ANOVA test. This result may be attributed to due to mandibular rotations or presence of dental and/or skeletal open bite. The study done by Arkan *et al*[11], Baccetti[10] showed were in contrast to our study as they found similar results but non significant difference among different classes. This result may be attributed to due to mandibular rotations or presence of dental and/or skeletal open bite. The study done by Arkan *et al*[11], Baccetti[10] showed were in contrast to our study as they found similar results but non significant difference among different classes.

- Fs - FOP

Our study showed that Fs - FOP (distance correlates the fossa summit to functional occlusal plane) revealed that the mean value of this variable was higher in class III than class I , class II Div 1 and class II Div 2 with a non significant difference (p = 0.06). The study done by Arkan *et al*[11] showed similar results to our study. The study done by Braun et al. (2000)[16] showed significant difference in this distance between class II and III in male group only. This difference in results may be attributed to different landmarks used and to the effect of dentoalveolar compensation.
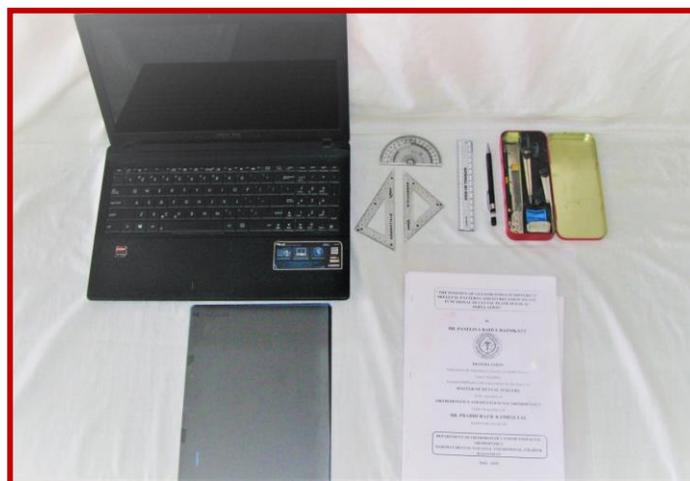

Figure 2 . Armamentarium used in the present study are as follows: - Pre-treatment Lateral Cephalogram of the subjects, Acetate Tracing Paper, Compass, Calipers, Laptop, Scale, 0.3 mm lead pencil, Eraser,
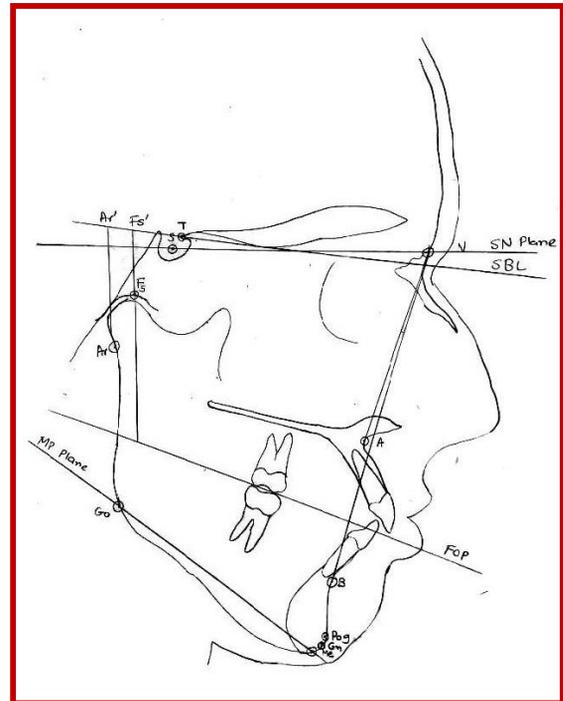
Pen

FIGURE – 3 [Natural Head Position]

Figure 4. Traced Pre treatment Lateral

Table 1					
Variable	Class I (Mean±SD)	Class II Div 1 (Mean±SD)	Class II Div 2 (Mean±SD)	Class III (Mean±SD)	*p* value
T - Fs'	17.20±1.61	19.40±1.71	20.00±1.82	16.40±1.64	**<0.001***
T - Ar'	20.40±1.45	22.60±1.51	23.00±1.64	19.80±1.37	**<0.001***
Fs - Fs'	19.60±2.42	22.40±2.45	23.80±2.26	18.80±2.42	**<0.001***
Ar - Ar'	33.60±2.49	38.40±1.93	35.60±2.49	33.00±2.50	**<0.001***
Me - SBL	119.60±2.72	109.20±2.02	116.80±3.92	125.40±1.64	**<0.001***
Go - SBL	89.20±2.78	85.00±2.75	86.00±2.90	91.40±3.27	**<0.001***
Fs - FOP	41.20±5.52	40.60±5.45	39.00±5.14	42.20±5.65	0.06

Comparison of Variables between All Skeletal Malocclusions **n : 200**
* indicates statistically significant difference at *p* ≤ 0.05 n- Sample Size

CONCLUSION

The present investigation identified significant elements regarding glenoid fossa position in different skeletal patterns.

- Class II Division 2 skeletal relation is associated with a more posterior position of the glenoid fossa when compared to Class II Division 1, Class I and Class III skeletal relation.

- Subjects presenting with skeletal Class III show a more cranial position of the glenoid fossa in relation to the cranial base when compared to Class I, Class II Division 1 and Class II Division 2 relationships regarding the vertical plane due to mandibular rotations.

- This study did not reveal a strong relationship between the glenoid fossa position and the functional occlusal plane.

BIBLIOGRAPHY

1. Kantoma T. The relationship between mandibular configuration and the shape of the glenoid fossa in the human. Eur J Orthod 1989; 11(1): 77-81.

2. Hopkin GB, Houston WJ, James GA. The cranial base as an etiological factor in malocclusion. Angle Orthod 1968; 38(3): 250-5.

3. Droel R, Isaacson RJ. Some relationships between the glenoid fossa position and various skeletal discrepancies. Am J Orthod 1972; 61(1): 64-78.

4. Pancherz H. Treatment of class II malocclusion by jumping the bite with the Herbst appliance: A cephalometric investigation. Am J Orthod 1979; 76(4): 423-41

5. Stockli PW, Willert HG. Tissue reactions in the temporomandibular joint resulting from anterior displacement of the mandible in the monkey. Am J Orthod. 1971; 60(2):142-55.

6. Elgoyhen JC, Moyers RE, McNamara JA, Riplo ML. Craniofacial adaptation to protrusive function in young rhesus monkeys. Am J Orthod 1972; 62(5): 469-80.

7. Agronin KJ, Kokich VJ. Displacement of glenoid fossa: a cephalometric evaluation of growth during treatment. Am J Orthod Dentofac Orthoped 1987; 91(1): 42-8

8. Woodside DJ, Metaxas A, Altuna G. The influence of functional appliance therapy on glenoid fossa remodeling. Am J Orthod Dentofac Orthod 1987; 92(3): 181-98

9. Paulsen HU, Karle A, Bakke M, Herskind A. CT scanning and radiographic analysis of temporomandibular joints and cephalometric analysis in a case of Herbst treatment in late puberty. The Eur J Orthod 1995 17(3):165-75.

10. Tiziano Baccetti, Antonino Antonini , Lorenzo Franchi ,Marco Tonti and Isabella Toaro. Glenoid Fossa Position in Different Facial Types: a Cephalometric Study. British Journal of Orthodontics 1997; 24(55-59)

11. Arkan Muslim and Fakhri Ali. The position of glenoid fossa in different skeletal patterns and its relation to the functional occlusal plane. J Bagh Coll Dentistry 2010;22(2):81-86

12. Melsen, B. (1974) The cranial base, Acta Odontologica Scandinavica, 32, Supplement 62.

13. Giuntini DE, Toffol LD, Franchi L, Baccetti T. Glenoid fossa position in Class II malocclusion associated with mandibular retrusion. Angle Orthod 2008; 78(5): 808-12.

14. Innocenti C, Giuntini V, Defraia E, and Baccetti T. Glenoid fossa position in Class III malocclusion associated with mandibular protrusion. Am J Orthod Dentofac Orthop 2009; 135(4):438-41.

15. Riolo MR, Moyers RE, McNamara JA, Hunter WS. An Atlas of Craniofacial Growth: Cephalometric Standards from the University School Growth Study Monograph No 2, Craniofacial Growth Series, Center for Human Growth and Development, University of Michigan, Ann Arbor, 1974; p 17

16. Braun S, Kim K, Tomazic T, Legan HL. The relationship of the glenoid fossa to the functional occlusal plane. Am J Orthod Dentofac Orthop 2000; 118(6):658-61.

Variable	Class II Div 1 (Mean±SD)	Class III (Mean±SD)	*p* value
T - Fs'	19.40±1.71	16.40±1.64	**<0.001***
T - Ar'	22.60±1.51	19.80±1.37	**<0.001***
Fs - Fs'	22.40±2.45	18.80±2.42	**<0.001***
Ar - Ar'	38.40±1.93	33.00±2.50	**<0.001***
Me - SBL	109.20±2.02	125.40±1.64	**<0.001***
Go - SBL	85.00±2.75	91.40±3.27	**<0.001***
Fs - FOP	40.60±5.45	42.20±5.65	0.08
Intergroup (Class II Div 1 & Class III) Comparison of Cephalometric Variables n : 200 (50,50), * indicates statistically significant difference at p ≤ 0.05			

Variable	Class I (Mean±SD)	Class II Div 2 (Mean±SD)	p value
T - Fs'	17.20±1.61	20.00±1.82	**<0.001***
T - Ar'	20.40±1.45	23.00±1.64	**<0.001***
Fs - Fs'	19.60±2.42	23.80±2.26	**<0.001***
Ar - Ar'	33.60±2.49	35.60±2.49	**<0.001***
Me - SBL	119.60±2.72	116.80±3.92	**<0.001***
Go - SBL	89.20±2.78	86.00±2.90	**<0.001***
Fs - FOP	41.20±5.52	39.00±5.14	0.08

Intergroup (Class I & Class II Div 2) Comparison of Cephalometric Variables n : 200 (50,50) * indicates statistically significant difference at p ≤ 0.05

Variable	Class I (Mean±SD)	Class II Div 1 (Mean±SD)	p value
T - Fs'	17.20±1.61	19.40±1.71	**<0.001***
T - Ar'	20.40±1.45	22.60±1.51	**<0.001***
Fs - Fs'	19.60±2.42	22.40±2.45	**<0.001***
Ar - Ar'	33.60±2.49	38.40±1.93	**<0.001***
Me - SBL	119.60±2.72	109.20±2.02	**<0.001***
Go - SBL	89.20±2.78	85.00±2.75	**<0.001***
Fs - FOP	41.20±5.52	40.60±5.45	0.18

Intergroup (Class I & Class II Div 1) Comparison of Cephalometric Variables n : 200 (50,50)
* indicates statistically significant difference at p ≤ 0.05

Variable	Class II Div 2 (Mean±SD)	Class III (Mean±SD)	P value
T - Fs'	20.00±1.82	16.40±1.64	<0.001*
T - Ar'	23.00±1.64	19.80±1.37	<0.001*
Fs - Fs'	23.80±2.26	18.80±2.42	<0.001*
Ar - Ar'	35.60±2.49	33.00±2.50	<0.001*
Me - SBL	116.80±3.92	125.40±1.64	<0.001*
Go - SBL	86.00±2.90	91.40±3.27	<0.001*
Fs - FOP	39.00±5.14	42.20±5.65	0.03*

Intergroup (Class II Div 2 & Class III) Comparison of Cephalometric Variables n : 200 (50,50), * indicates statistically significant difference at p ≤ 0.05

Variable	Class II Div 1 (Mean±SD)	Class II +Div 2 (Mean±SD)	p value
T - Fs'	19.40±1.71	20.00±1.82	0.08
T - Ar'	22.60±1.51	23.00±1.64	0.18
Fs - Fs'	22.40±2.45	23.80±2.26	**<0.001***
Ar - Ar'	38.40±1.93	35.60±2.49	**<0.001***
Me - SBL	109.20±2.02	116.80±3.92	**<0.001***
Go - SBL	85.00±2.75	86.00±2.90	0.08
Fs - FOP	40.60±5.45	39.00±5.14	0.09

Intergroup (Class II Div 1 & Class II Div 2) Comparison of Cephalometric Variables n : 200 (50,50), * indicates statistically significant difference at p ≤ 0.05