A Comparative Evaluation of Condylar Position in Class II Division 2 Malocclusion between Pre- and Post-alignment and Leveling Phase

Raghav P[1], Singh S[2], Khera A[3], Kumar A[4], Sagar A[5]

[1]Professor and Head, Department of Orthodontics and Dentofacial Orthopaedics, Subharti Dental College Meerut, drpradeepraghav@gmail.com
[2]Private Practitioner, Meerut, drshishir2k@yahoo.com
[3]Reader, Department of Orthodontics and Dentofacial Orthopaedics, Subharti Dental College, Meerut, dr_amitkhera@rediffmail.com
[4]Lecturer, Department of Orthodontics and Dentofacial Orthopedics, Subharti Dental College, Meerut
[5]MDS, Private Practitioner, New Delhi, dramitsager@gmail.com

ABSTRACT

Objective: To compare the position of condyle in Skeletal Class II Division 2 patients between pre- and post-alignment and leveling phase and to formulate a list of variables which may help in predicting the favorable prognosis in treatment planning of this malocclusion.

Materials and Methods: Serial Lateral cephalograms of 25 subjects of Skeletal class II, Division 2 malocclusion were taken in natural head position. Software Nemoceph Nx-2009 was used to make all the tracings and measurements. All subjects were treated by non-extraction orthodontic therapy, were analyzed at two point of times i.e., pre-treatment and post-leveling and alignment. Fifteen landmarks were identified, angular and linear measurements were analyzed (17 skeletal and 5 dental) in both vertical and horizontal plane.

Results: Glenoid Fossa/Condyle, showed a statistically significant forward movement from the vertical plane, a statistically significant difference was seen, in all the four linear variables, i.e., overbite, ANS-Me, S-Go and Co-Go. In the angular measurements, statistically significant difference was observed in interincisal angle, I-Pal Plane and LI-M and Plane. In 36% of the subjects, post-alignment and leveling phase mandible was found to be more anteriorly repositioned in the glenoid fossa.

Conclusions: 1) There was a definite unlocking of the mandible in 36% of the subjects. 2) There was a statistically significant increase in the horizontal anterior reposition of the mandible in the glenoid fossa.

Keywords: Class II div 2 Malocclusion

INTRODUCTION

E.H. Angle[1] first described Class II Division 2 malocclusion in 1907. Since then, there have been many studies describing the characterization of this specific malocclusion and yet there is still no conclusive evidence as to the cause of the malocclusion.[2-6]

In addition, these malocclusions are one of the least prevalent malocclusions represented in populations today.[7,8] The clinical management of Class II Division 2 malocclusion still remains a seldom-investigated mystery that continues to present diagnostic, treatment and retention problems for the orthodontist. Although there is little evidence, it is a common belief in the orthodontic literature that "unlocking" the mandible in Class II Division 2 malocclusions allows growth of the mandible to be expressed in a more anterior direction, which will aid in the correction of the disto-occlusion.[9,10]

In assessing growth, longitudinal research designs are the gold standard. Many cephalometric studies[2,11,12] have been conducted characterizing the malocclusion, but few have longitudinally evaluated the effects of orthodontic treatment and growth of mandible in the treated Class II Division 2 patients.[13]

Based on this premise, this study was designed:

• To check whether unlocking the bite after alignment and levelling in Class II Division 2 malocclusions would promote anterior repositioning of the mandible.

• To evaluate the change in position of condyle and glenoid fossa in Class II Division 2 cases before treatment (T1) and after leveling and alignment (T2)

MATERIALS AND METHODS

Subjects were selected from the OPD reporting in the Department of Orthodontics and Dentofacial Orthopedics, Subharti Dental College with the following inclusion criteria:

• Deep bite.

• Skeletal class II pattern with ANB more than 5 degrees.

• A classical class II Division 2 incisor pattern (i.e. Maxillary central incisors retroclination).

• *Age range:* 17–24 yrs

• Western Uttar-Pradesh ethnicity.

• No congenital facial defects.

• No history of previous orthodontic treatment or facial surgery.

The serial lateral head radiographs of the subjects were divided into two groups—pre-treatment and post-alignment and leveling phase of the fixed mechanotherapy treatment. Digital lateral cephalograms of 25 selected patients were taken in NHP (natural head position) at T1 (before initiation of treatment) and T2 (after alignment and leveling). Software Nemoceph Nx-2009 (Nemotec Corporation, Madrid, Spain) was used for cephalometric analysis. The average treatment time taken to achieve the complete leveling and alignment was 5 months.

Table 1 and Figure 1 shows all the cephalometric Landmarks used in this study as given by Athanasios E Athanasiou.[16] The same operator evaluated all the cephalograms. The point Condylion (Co) and Articular Eminence (Ae) were recorded

Table 1

Cephalometric landmarks

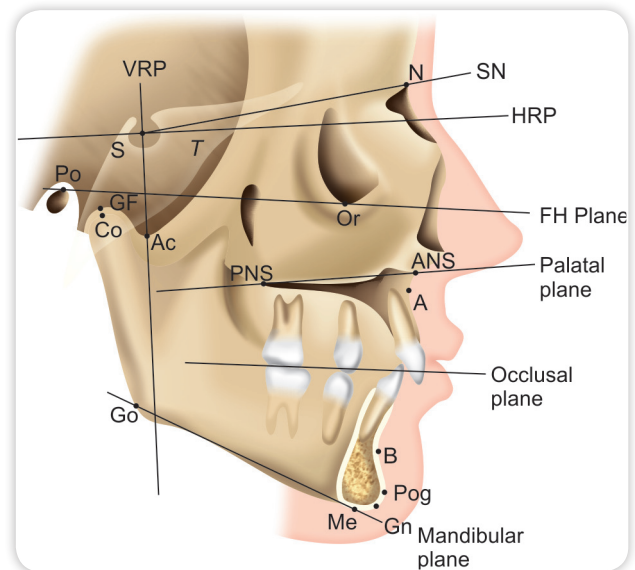| Cephalometric variables	
Sagittal plane	1.Wits, 2.Overjet, 3.Co-Pog
Vertical plane	1. Overbite, 2. ANS-Me, 3. PNS-Go, 4. Co-Go
Angular	1. SNA, 2. SNB, 3. ANB, 4. Interincisal Angle, 5. HRP-Occ Pl, 6. HRP-Mand Pl, 7. HRP-Pal Pl, 8. Upper Incisor-Pal Pl, 9. Lower Incisor-Mand Pl
Glenoid Fossa/ Condyle	1. VRP-Co, 2.VRP-GF, 3. VRP-Ae, 4. HRP-Co, 5.HRP-GF, 6. HRP-Ae.

Figure 1 Cephalometric planes used (*Abbreviations:* Horizontal Reference Plane-HRP, Vertical Reference Plane-VRP, Frankfurt Horizontal Plane, Palatal Plane, Occlusal Plane, Mandibular Plane)
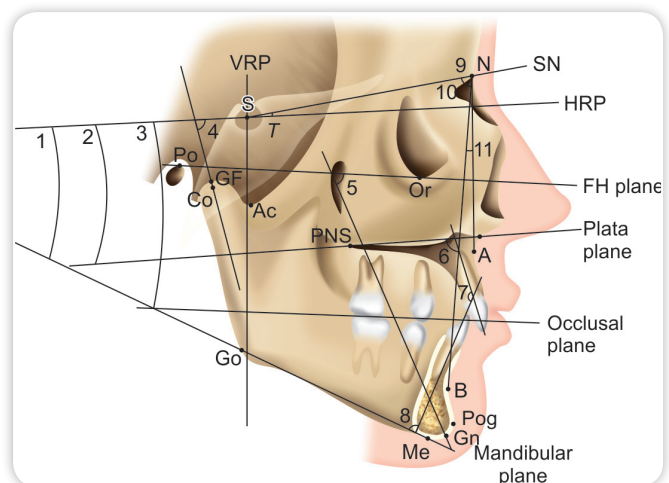

Figure 2 Cephalometric angles used 1.HRP-Mand Plane, 2.HRP-Pal Plane, 3.HRP-Occlusal Plane, 4.Condylar Inclination, 5.Y-axis, 6.UI-Pal Plane, 7.Interincisal angle, 8.LI-Mand Plane, 9.SNA, 10.SNB, 11. ANB)

and changes in the horizontal and vertical dimensions were evaluated, as described by *Buschang and Santos-Pinto.*[14] Horizontal and Vertical changes of Co and Ae were evaluated using Cartesian coordinates.[15] Horizontal and vertical reference planes (HRP and VRP respectively) were used in lateral cephalograms. HRP used wasdrawn -7° from SN plane and VRP was drawn perpendicular on Figure 2.[12]

Table 1.Cephalometric Landmarks used in this study as given by Athanasios E Athanasiou[16], were: Point A:

Subspinale; Point B: *Supramentale;* Sella (*S*); Nasion (*N*); ANS (*anterior nasal spine*); PNS (*posterior nasal spine*); Gn (*gnathion*); Me (*menton*); Go (*gonion);* Po (*porion*); Or (*orbitale*); CO (*condylion*); FMN (*fronto nasal suture*); Gf (*glenoid fossa*); Ae (*articular eminence*).

STATISTICAL ANALYSIS

The data obtained was subjected to statistical analysis using Microsoft Excel 2010 software, Paired 't' test was used for evaluation of mean values ± SD were calculated and difference values of T1 and T2 films were evaluated by paired 'T' test. A total of 50 cephalometric radiographs were retraced four weeks after the entire sample was originally traced. A combined error of landmark identification, tracing was determined. The mean measurement error was less than 0.5° for all angular measurements, whereas the error for linear measurements was less than 0.5 mm for all measurements except HRP to Co, which was less than 1.25 mm.

RESULTS

The cephalograms were traced and evaluated, as described by *Buschang and Santos-Pinp.*[12] Horizontal and vertical changes of Co and Ae were evaluated using Cartesian coordinate system.[13]

The observed/obtained values were tabulated and subjected to statistical analysis (Table 2).

In order to find whether a significant difference exists between the pre-treatment and post-treatment group, paired 'T' test was applied.

Table 2, reveals a statistically significant difference (p<0.05) between T1 and T2 group in overjet (P<0.005), overbite (p<0.005), ANS-Me (p<0.03), S-Go (p<0.02), and Co-Go (p<0.03). In the angular measurements, statistically significant difference was seen in, SNA (p<0.01), ANB (p<0.01), interincisal angle (p<0.001), and a highly significant difference was observed in, UI-Pal Plane (p<0.002), and LI-M and Plane (p<0.005).

In the glenoid Fossa/Condylar changes, a statistically significant difference was observed in the VRP-Co (p<0.005) and VRF-GF (p<0.002) and a statistically significant change was observed in condylar inclination (p<0.02) with a mean increase of 6.6º.

DISCUSSION

Angle proceeds to describe that the disto-occlusion and recession of the lower jaw and chin results in a facial deformity that is caused by the distal positioning of the mandible and lack of vertical growth below the nose.[1] In addition, the upper incisors tipping down and inward and the lingual tipping of the lower incisors is the result of the molars not erupting to the normal vertical height.

Taylor[9] was one of the first to discuss the idea of "releasing" the distally held mandible in Class II Division 2 malocclusions and claimed that there was forced retrusion of mandible in a posterior position by the retroclined maxillary central incisors. Therefore, he recommended early treatment of this malocclusion.

Three possible treatment modalities for Class II Division 2 malocclusions were presented by Ricketts et al.[16,17] These include (1) Distalizing the upper arch, (2) Advancing the lower arch, or (3) A combination of the both. The authors believed that it was important to "unlock" the deep bite by advancing the upper incisors, which would resemble a Class II Division 1 malocclusion that could be treated with more dental changes instead of skeletal changes.

Erickson and Hunter[10] showed that the mandible grew significantly more in the anterior direction when compared to untreated controls. Although the type of treatment did not make a significant difference, treatment alone enhanced the growth of the mandible in the cases studied. In this study, they observed that among the treated subjects, 12% grew more horizontally and 41% grew more vertically.

In the present study, out of the total samples, a statistically significant difference was seen in the *horizontal distance* from Vertical Reference Plane to Condylion and Vertical Reference Plane to Glenoid Fossa in 44% (n=11) of patients. And in 56% (n=14) of patients no mandibular movement was seen, which is in similarity with the study of *Erickson and Hunter.*[10] They further showed that there was forward repositioning of the mandible by 0.5 mm/yr in 27% of the treated cases.

Primarily the condylar changes may be because of probable surface remodeling due to relieving of condylar stress. Since in a Class II Division 2 malocclusion the mandible is in forced retruded position due to markedly retroclined central incisors, as the maxillary central incisors are aligned the mandible repositions in forward direction leading to condylar adaptive surface remodeling at posterior border of condyle. In the present study, 32% (n=8) of the treated cases the direction of mandibular growth became more vertical, possibly due to opening of the bite. This also correlated with study done by *Erickson and Hunter*[10] and Gong[18] in which 35% showed the movement of mandible in vertical direction.

Possible reason for forward movement in some cases while not in others may be the path of mandibular closure.

Table 2
Mean and standard deviation, for the different variables in pre-treatment and post-alignment scores with paired t-test

S. no.	Different variables	Pretreatment Mean ± S.D.	Postalignment Mean ± S.D.	Difference (Post-Pre) (+) or (-)	P < 0.05 Significant
1.	Wits	6.18 ± 3.06	5.81 ± 2.61	-0.37	0.63
2.	Overjet	1 ± 1.18	7.63 ± 2.61	6.63	0.005*
3.	Co-Pog	112.8 ± 11.7	117.3 ± 7.28	4.5	0.11
4.	Overbite	8.63 ± 2.94	4.27 ± 3.06	-4.36	0.005*
5.	ANS-Me	61.82 ± 6.67	65.09 ± 5.48	3.27	0.03*
6.	S-Go	78.55 ± 7.56	82.86 ± 6.19	4.31	0.02*
7.	Co-Go	58.91 ± 6.45	63.27 ± 4.48	4.36	0.03*
8.	SNA	81.64 ± 3.13	80.45 ± 2.97	-1.19	0.01*
9.	SNB	75 ± 4.21	75.27 ± 3.92	0.27	0.61
10.	ANB	6.54 ± 2.29	5.18 ± 1.94	-1.36	0.01*
11.	Interincisal angle	157.6 ± 15.83	123.1 ± 15.84	-34.5	0.001*
12.	HRP-Occ Pl	8.5 ± 3.17	7.22 ± 3.93	-1.28	0.28
13.	HRP-Mand Pl	22 ± 4.58	22.90 ± 3.93	0.90	0.05
14.	HRP-Pal Pl	3 ± 3.76	4.40 ± 5.06	1.4	0.25
15.	UI-Pal Pl	90.77 ± 7.64	117.09 ± 6.87	26.32	0.002*
16.	LI-Mand Pl	92.09 ± 5.73	101.4 ± 11.39	9.31	0.005*
17.	Y-axis	56.27 ± 3.79	56.55 ± 3.80	0.28	0.69
18.	VRP-Co	14.36 ± 2.24	12.96 ± 2.02	-1.4	0.005*
19.	VRP-GF	14.63 ± 2.07	12.81 ± 2.72	-1.82	0.002*
20.	VRP-Ae	4.68 ± 2.32	3.5 ± 1.94	-1.18	0.10
21.	HRP-Co	20 ± 1.94	18.90 ± 2.90	-1.1	0.30
22.	HRP-GF	18.36 ± 1.59	17.22 ± 2.67	-1.14	0.19
23.	HRP-Ae	25.68 ± 2.22	25.81 ± 2.77	0.13	0.75
24.	Age	16.45 ± 3.93	17 ± 3.97	0.55	-
25.	Condylar inclination	80 ± 6.24	86.45 ± 8.22	6.45	0.02*

*Shows a significant difference at 5% level of significance, (+)=Increase, (-)=Decrease

Those cases having functional retrusion showed mild forward movement while others having normal or forward path of closure showed no movement.

There was a decrease in SNA angular measurement (1.19º, p<0.01*). *Parker and Cleal*[19,20] also observed that in class II Division 2 after leveling and alignment SNA exhibited a mean increase of 1.84º with p<0.0001. An increase in SNB was also seen (0.27º, p<0.61) which correlated with the study of *Binda et al*[12] with mean change in SNB was 0.5º. There was a resultant decrease in ANB (1.36º, p<0.01*) which confirmed with the study of *Parker et al,*[19] *Cleall*[20] and *Binda et al*.[12] This is most likely due to the remodeling of point A that occurs when the upper incisors are flared.

There were significant changes in all the dental measurements. UI-Pal Pl was observed to be increased by 25º from pre-treatment to post-treatment, the interincisal angle decreased by 34º, which were confirmed treatment changes in the literature.[18,19,11,10] The upper and lower incisors flared anteriorly with treatment which resulted in a decrease in the interincisal angle, which is related with the literature.[18,19,20,21,11,10] Statistically significant improvement i.e. increase was observed in overjet in post-treatment patients after achieving correct incisor inclination. The bite gradually opened post leveling and alignment, due to the extrusion of posterior teeth during the treatment[19] and the difference was statistically significant.

The lower anterior facial height was also found to be increased by an average of 3.42 mm in the post-treatment patients, which was statistically significant (P<0.03). This was probably due to the extrusion of posterior teeth during the treatment.[19]

However, in this study, it was seen that the subjects (n=11) in which the mandible moved forward had the maximum linear distance from VRP-Co and VRP-GF which was more than 14 mm approximately and patients (n=14) in which the mandible did not move had the linear distance less than 13 mm (Tables 3 and 4).

Increased VRP-Co and VRP-GF probably indicates that those subjects having forced retrusion only showed forward repositioning of mandible. Therefore, the linear distance (VRP-Co and VRP-GF) may serve as a prognostic parameter for forward mandibular repositioning.

Another parameter in this study was condylar inclination which showed a statistically significant difference (p<0.02), which was increased by an average of 6.45° which again may had been due to condylar remodeling following the post alignment phase in subjects showing positive results (forward mandibular relocation).

Therefore, condylar inclination may be also an important prognostic variable that may be utilized for assessing for mandibular relocation especially in successfully treated patients.

Further research is recommended on a larger sample for a longitudinal study i.e., during treatment and postretention to come to a definitive conclusion in this field.

Table 3
The patients (n = 11), with condylar movement, their mean values at T1 and T2

Patients showing movement (n=11)	Variable	Mean value (mm)
Pre-treatment	VRP-Co VRP-GF	14.36 14.63
Post-treatment	VRP-Co VRP-GF	11.81 11.27

Table 4
The patients (n=14), with no condylar movement, their mean values at T1 and T2

Patients not showing movement (n=14)	Variable	Mean value (mm)
Pre-treatment	VRP-Co VRP-GF	12.17 12.53
Post-treatment	VRP-Co VRP-GF	12.71 13.03

CONCLUSION

Only 44% of the subjects (n=11, 5 females and 6 males) showed mandible repositioning either in the vertical or horizontal direction. While 56% of the patients (n = 14, 6 males and 8 females) did not show any movement.

Only those subjects having functional retrusion (backward path of mandibular closure) showed mild forward mandibular movement while others having normal path of closure showed no movement.

Subjects in which the mandible moved forward had the greater linear distance of VRP-Co and VRP-GF as compared to those subjects having no change in mandibular position. Therefore, the increased linear distance (VRP-Co and VRP-GF) may serve as a prognostic parameter to determine that there is functional retrusion of mandible in class II div 2 subjects.

The condylar inclination was also statistically significant (p<0.023), with mean increase in these patients by 6.4°.

Address for Correspondence
Raghav P
Department of Orthodontics and Dentofacial Orthopaedics
Subharti Dental College
Meerut
e-mail: drpradeepraghav@gmail.com

REFERENCES

1. Angle A. Treatment of malocclusion of the Teeth. 7th edn. Philadelphia: SS White Dent. Mfg. Co.; 1907.
2. Godiawala RN, Joshi MR. Cephalometric comparision of Class II Division 2 malocclusion. Angle Orthod.1974;44:262-8.
3. Brezniak N, Arad A, Heller M, Wasserstein A. Pathognomonic cephalometric characteristics of Angle Class II Division 2 malocclusion. Angle Orthod. 2002;72(3):251-7.
4. Wallis S. Integration of certain variants of the facial skeleton in Cl II, Division 2 malocclusion. Angle Orthod.1963;33:60-7.
5. Maj G, Lucchese FP. The mandible in Class II, Division 2. Angle Orthod. 1982;52(4):288-92.
6. Hitchcock HP. The cephalometric distinction of class II, division 2 malocclusion. Am J Orthod. 1976;69(4):447-54.
7. Sandhu SS, Bansal N, Sandhu N. Incidence of malocclusion in India – A Review. J oral Health comm Dent. 2012;6(1):21-4.
8. Trehan M, ChughVK, Sharma S. Prevalence of malocclusion in Jaipur, India. IJCPD. 2009;2(1):23-35.
9. Taylor A. Release mechanisms in the treatment of Class II, Division 2 malocclusions. Aust Dent J. 1966;11:27-37.
10. Erickson LP, Hunter WS. Class II, division 2 treatment and mandibular growth. Angle Orthod. 1985;55(3):215-24.
11. Hedges R. A cephalometric evaluation of Class II Division 2. Angle Orthod. 1958;28:191-7.
12. Binda SKR, Kuijpers-Jagtman AM, Maertens JKM, van 't Hof MA. A long term cephalometric evaluation of trteayted class II division 2 malocclusion. European Journal of Orthod. 1994;16:301-8.

13. Peter HB. Buschang and Ary Santos-Pinto. Condylar growth and glenoid fossa displacement during childhood and adolescence. Am J Orthod.1998;113:437-42.

14. Cartesian Coordinates System. *Wikipedia.en./Wikipedia.org/wiki/Cartesian_coordinates_system* 2013.

15. Athanasiou AE. Orthodontic cephalometry. 1995 Times Mirror International Publishers Limited.

16. Rickets RM. Various conditions of the TMJ as revealed by cephalometric laminagraphy 1952. Angle Orthod. 98-115.

17. Ricketts R, Bench R, Gugino C, Hilgers J, Schulhof R. Bioprogressive therapy. In: Bioprogressive therapy. Denver: Rocky Mt. Orthod; 1979. pp. 183-99.

18. Gong FF, Tao L, Cao HJ. A clinical study of the changes of condylar position in class division 2 deep-bite patients after orthodontic treatment. Chinese Journal of Stomatology. 2003; 5:334-7.

19. Parker CD, Nanda RS, Currier GF. Skeletal and dental changes associated with the treatment of deep bite malocclusion. Am J Orthod Dentof Orthop.1995;107:382-93.

20. Cleall JF, BeGole EA. Diagnosis and treatment of class II Division 2 malocclusion. Angle Orthod. 1982;52:38-60.

21. Verma RK, Jena AK, Singh SP, Utereja AK, Saradana D. Innovative approach to class II Division 2 malocclusion. Clinical Dentistry. 2014;(3):43-7.