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A Rational Factor for Overjet in Class II Division 1 Malocclusion – Growth Pattern or Bolton's Discrepancy"

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[1]*Study Design, Sample Collection, Statistical Analysis, Discussion, Results.*
[2]*Sample Collection, Statistical Analysis, Discussion.*

Abstract:
Introduction: *The increased overjet in Class II Division 1 malocclusion subjects may be due to hyperdivergent growth pattern or Bolton's tooth size discrepancy. The aim of this investigation was to find the rational factor for overjet in Class II Division 1 malocclusion as growth pattern or Bolton's discrepancy in these subjects.*
Methods: *120 untreated Class II Division 1 cases who reported to the department for orthodontic treatment were included in this study. The lateral cephalometric radiographs were evaluated for growth pattern and grouped into vertical and horizontal growers. The Bolton's ratio and overjet was measured from the study models obtained.*
Results: *A statistically significant linear positive correlation was seen between overjet with mandibular plane angle and negative with Jarabak's ratio. However, a weak correlation between overjet and Bolton's discrepancy was present in the overall sample. When the vertical growth pattern subjects were analyzed separately, statistically significant moderate correlation (r = 0.462) was present between overjet and mandibular growth pattern.*
Conclusion: *Clinician should take a note during diagnosis of subjects of Class II Division 1 with increased overjet regarding the vertical control during treatment. In such cases extrusive mechanics should not be used to avoid increasing the mandibular plane angle and thereby worsening vertical relation.*

I. Indroduction

Article: Class II malocclusions are of interest to the practicing orthodontists since they constitute a significant percentage of the cases treated by them. In individuals with normal occlusion and skeletal relationship, the amount of maxillary and mandibular growth is synchronized which results in a well-balanced and esthetically pleasing profile. However, in individuals with Class II malocclusions, there is an anteroposterior discrepancy between the maxillary and mandibular dentitions, which may or may not be accompanied with a skeletal discrepancy. Class II division 1 malocclusion is often accompanied by increase in overjet and is of a great concern for both the patients and their parents.

To achieve excellence in orthodontic finishing, proper balance should exist between the mesiodistal tooth size of the maxillary and mandibular arches to ensure proper occlusion at the completion of orthodontic treatment. Bolton's analysis, based on the ratios between the mesio-distal width of the mandibular and maxillary teeth is the most popular and best-known method for determining tooth size abnormality and is useful as a diagnostic aid in patients with severe tooth size discrepancies.(1) A better understanding of differences in growth pattern associated with different overjet magnitude and the presence of Bolton's discrepancy will definitely go a long way in treatment planning and finishing of the Class II case.

Overjet is considered the good predictor of sagittal relation in subjects with class II Division 1 malocclusion.(2) Previous studies have been done to find the relationship between overjet and in Class II division 1 subjects but most of the subjects included had a Class II molar relation with Class I skeletal base , Class II skeletal base with absence of Class II molar relation.(3,4) Investigations have reported the presence of association between overjet and hyperdivergent growth pattern and the associations of overjet with Bolton's tooth size discrepancy.(5,6) some studies found no difference in the Bolton's tooth size discrepancy in Class II malocclusion.(7,8) Whereas, the presence of maxillary tooth size excess in Class II Division 1 cases with overjet has also been reported in the literature.(9,10)

Hence, a study was conducted to determine a rational factor for overjet in Class II Division 1 malocclusion i.e., growth pattern and Bolton's discrepancy and understand the relationship of presence of overjet with Bolton's tooth size discrepancy and growth pattern in subjects having Class II Division 1 malocclusion.

II. Material And Methods

The objective of this study was to determine a rational factor for overjet in Class II Division 1 malocclusion i.e., growth pattern and Bolton's discrepancy and understand the relationship of presence of overjet with Bolton's tooth size discrepancy and growth pattern in subjects having Class II Division 1 malocclusion. Measurements calculated from the lateral cephalometric radiographs and study cast models were utilized for the statistical analysis.

The sample size was derived from a pilot study (proportion of 20% vertical growth pattern and 65% horizontal growth pattern keeping the power of study - 90%, alpha error- 0.05) was calculated to be 56 with equal distribution of 28 in each vertical and horizontal growth pattern. Total 120 untreated Class II division 1 subjects, who visited the Department of Orthodontics of Nair Hospital Dental College in Mumbai, India, were studied. The subjects included in the study had Angle's Class II Division 1 malocclusion with skeletal Class II base with ANB angle more than 4.5°; no previous orthodontic treatment; all permanent teeth; no restorations or tooth deformity and overjet of more than 4 mm. Informed consent were obtained from all the patients according to the recommendations of the ethics committee at Nair Hospital Dental College and the guidelines for the main dissertation Under Maharashtra University Of Health Sciences, Nashik, Maharashtra, India.

Lateral cephalometric radiograph of each subject were traced for sagittal relation (Steiner's ANB angle) and skeletal facial morphology (SN-Go.Gn angle and Jarabak's ratio). There was a stratification of the sample done at the time of statistical analysis and 58 samples were selected and divided into 2 groups with a sample of 29 in each group based on SN-Go.Gn angle, Group 1 consisted of subjects with horizontal growth pattern (SN-Go.Gn angle less than 25°); Group 2 consisted of subjects with vertical growth pattern (SN-Go.Gn angle more than 36°).

Overjet was measured from the study casts taken from each subjects as distance from labial surface of mandibular central incisor to labial surface of most prominent maxillary incisor using digital Vernier Caliper held parallel to the occlusal plane. The readings were measured at 0.01 mm and the same examiner made all the measurements. Due to error in calculation of the mesiodistal size from labial aspect due to the presence of crowding, a constant measurement point was considered on the study models and the measurements were taken from incisal or occlusal aspect rather than labial. The same examiner calculated the method error by retracing 20 lateral cephalographs and remeasuring the values on the study models.

The method error was calculated using the Dahlberg formula,

$$ME = \sqrt{\frac{\Sigma d^2}{2n}}$$

Where, d is the difference between two registrations of pair and, n is the number of duplicate registrations. The method error of angular measurement was 0.453° and linear measurement was 0.019mm.

Bolton's ratio was calculated using the formula,

Overall Ratio - $\frac{\text{Sum of Mandibular mesiodistal width of 12 teeth}}{\text{Sum of Maxillary mesiodistal width of 12 teeth}} = 91.3\%$

Anterior Ratio – $\frac{\text{Sum of Mandibular mesiodistal width of 6 Anterior teeth}}{\text{Sum of Maxillary mesiodistal width of 6 Anterior teeth}} = 77.2\%$

The results obtained were subjected for statistical analysis to calculate the correlation with significance $p<0.05$ and $p<0.01$. The strength of the relationship was measured with Pearson's correlation coefficient. The mean and standard deviation for each variable were calculated using statistical package for social sciences (SPSS), version 16.0 for windows.

III. Results

The total sample size was 120 untreated Class II Division 1 malocclusion subjects (Table 1) with all the permanent teeth present.

Table 2 and Table 3 shows statistically significant correlation ($p< 0.01$) between overjet with growth pattern i.e. mandibular plane ($r = 0.288$) and Jarabak ratio ($p< 0.05$) ($r = -0.215$).

Table 4 shows no significant correlation between overjet with Bolton's anterior and a statistically significant correlation between overjet and Bolton's overall ratio ($r = 0.191$) ($p<0.05$).

Stratification of the sample was done at the time of statistical analysis into two groups. This was done to prevent the group of subjects having normal growth pattern which are analyzed in the overall sample (n=120) to be included in the two Groups.

Group 1(horizontal growth pattern): Table 5, 6, and 7 did not show any statistically significant correlation ($p< 0.05$) between overjet with the mandibular plane angle, Jarabak ratio and Bolton's ratio.

Group 2 (Vertical growth pattern): Table 8, 9 shows the statistically significant correlation ($p< 0.05$) between overjet with growth pattern i.e. mandibular plane ($r = 0.462$) and Jarabak's ratio ($r = -0.372$).

Table 10, did not show any significant correlation between overjet and Bolton's ratio.

IV. Discussion

The present study included 120 untreated Class II Division 1 patients who reported to the Department of Orthodontics for consult regarding orthodontic treatment. Lateral cephalometric radiographs were traced with the following parameters SNA, SN-Go.Gn, Jarabak ratio as point S and N are easily located on lateral cephalometric radiograph and located in midsaggital plane, they are moved minimum when the head tilts or deviates from its true position. The line Go.Gn was considered, as we preferred a line, which more nearly represents the mass of the body of the mandible rather than its lower border. (11) Bolton's anterior tooth size discrepancy is an important determinant of proper overjet and overbite,(1) hence, the value of Bolton's anterior and overall ratio with the overjet was taken to be a factor for evaluation in the present study.

The results of this study found a statistically significant negative correlation between Jarabak's ratio and overjet (Table 2) suggesting an increase in growth pattern as the overjet in Class II Division 1 patients increased. A statistically significant positive correlation (Table 1) was also present between overjet and mandibular plane angle suggestive of increase in mandibular plane angle with increase in overjet values. This tendency of increase in the growth pattern In Class II Division 1 subjects was also in agreement with previous investigations. (3,6) Whereas studies who had found an absence of a relationship did not consider Class II Division 1 malocclusion as separate group and included all the malocclusions together and measurements of overjet traced were based on lateral cephalometric radiographs.(12)

The results of the present study showed a significantly positive correlation ($p<0.05$) between the Bolton's overall (Table 3) and overjet i.e. as the overjet increased there was an increase in the Bolton's overall ratio. The Bolton's anterior ratio (Table 4) did not show any correlation.

The second part of the study was to analyze the samples stratified at the time of statistical analysis. The results of the study for Group 1 subjects showed no statistically significant correlation (Table 7,8) of overjet with Bolton's ratio, mandibular plane angle and Jarabak's ratio in subjects with horizontal growth pattern. A comparison between growth pattern (based on values of Jarabak's ratio and mandibular plane) with the overjet also found no significant correlation (Table 5,6) between overjet with mandibular plane angle and Jarabak's ratio in subjects having horizontal growth pattern.

In the Group 2 subjects with vertical growth pattern, a statistically significant positive moderate correlation ($r = 0.462$) between mandibular Plane (SN-Go.Gn) with the overjet; and statistically significant negative moderate correlation Jarabak ratio ($r = -0.372$) with overjet was seen. The study found no significant correlation between overjet and Bolton's overall and anterior ratio having vertical growth pattern. The results suggest that increased overjet seen in Class II Division I subjects with vertical growth pattern group is related with increase in the mandibular plane angle and decrease in Jarabak's ratio rather than Bolton's tooth size discrepancy.

V. Conclusion

The present study can be concluded as follows:

1. When subjects with horizontal growth patterns were studied separately, no significant correlation was seen between overjet with mandibular plane angle (SN-Go.Gn), Jarabak's ratio and Bolton's ratio.
2. A statistically significant moderate correlation between overjet with mandibular plane angle (SN-Go.Gn) and Jarabak ratio is seen in subjects with vertical growth pattern suggesting an increase in overjet is related to increase in mandibular plane angle (SN-Go.Gn) and decrease in Jarabak's ratio.

The present study showed a linear correlation of overjet with mandibular plane angle (SN-Go.Gn) and Jarabak ratio suggesting that in Class II Division 1 malocclusion subjects with vertical growth pattern, an increase in overjet is related to an increase in mandibular plane angle (SN-Go.Gn) and decrease in Jarabak ratio and not due to Bolton's discrepancy. Hence, during diagnosis of subjects of Class II Division 1 malocclusion having vertical growth pattern with increased overjet the clinician should be careful regarding the vertical control during treatment. In such cases of increasing overjet extrusive mechanics should not be used ignorer to avoid increasing the mandibular plane angle and thereby worsening of the vertical relation and soft tissue convex profile.

References

1. Bolton WA. The clinical application of a tooth-size analysis. Am J Orthod. 1962 Jul;48(7):504–29.
2. Zupancic S, Pohar M, Farcnik F, Ovsenik M. Overjet as a predictor of sagittal skeletal relationships. Eur J Orthod. 2008 Jun;30(3):269–73.
3. Al-Khateeb EAA, Al-Khateeb SN. Anteroposterior and vertical components of class II division 1 and division 2 malocclusion. Angle Orthod. 2009 Sep;79(5):859–66.
4. Hassan AH. Cephalometric characteristics of Class II division 1 malocclusion in a Saudi population living in the western region. Saudi Dent J. 2011 Jan;23(1):23–7.

5. Lopatiene K, Dumbravaite A. Relationship between tooth size discrepancies and malocclusion. Stomatol Issued Public Inst Odontol Stud Al. 2009;11(4):119–24.
6. Saltaji H, Flores-Mir C, Major PW, Youssef M. The relationship between vertical facial morphology and overjet in untreated Class II subjects. Angle Orthod. 2012 May;82(3):432–40.
7. Basaran G, Selek M, Hamamcı O, Akkuş Z. Intermaxillary Bolton Tooth Size Discrepancies Among Different Malocclusion Groups. Angle Orthod. 2006 Jan 1;76(1):26–30.
8. Fattahi HR, Pakshir HR, Hedayati Z. Comparison of tooth size discrepancies among different malocclusion groups. Eur J Orthod. 2006 Oct 1;28(5):491–5.
9. Strujić M, Anić-Milošević S, Meštrović S, Šlaj M. Tooth size discrepancy in orthodontic patients among different malocclusion groups. Eur J Orthod. 2009 Jan 1;31: 584-9.
10. Lopatiene K, Dumbravaite A. Relationship between tooth size discrepancies and malocclusion. Stomatol Issued Public Inst Odontol Stud Al. 2009;11(4):119–24.
11. Steiner CC. Cephalometrics for you and me. Am J Orthod. 1953 Oct;39(10):729–55.
12. Kshitij Gupta UKN. Effect of Overjet on the Maxillary and Mandibular Morphology: A Cephalometric Study. J Indian Orthod Soc. 2013; 47:452–60.

Graph 1: Descriptive characteristics of the study participants

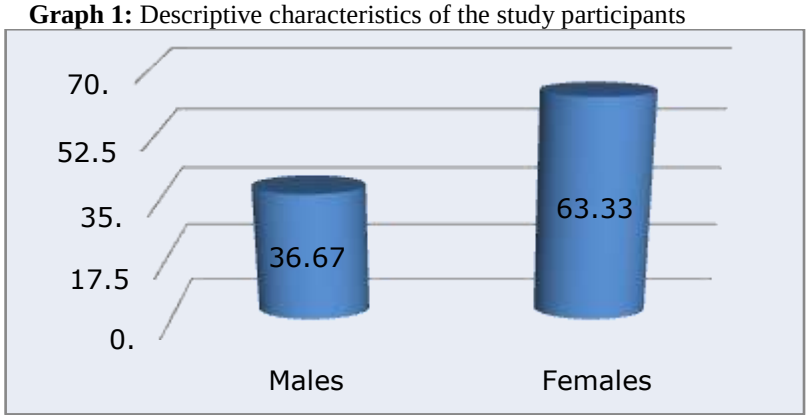
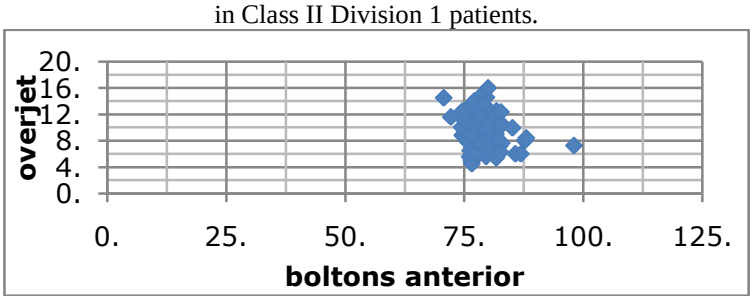
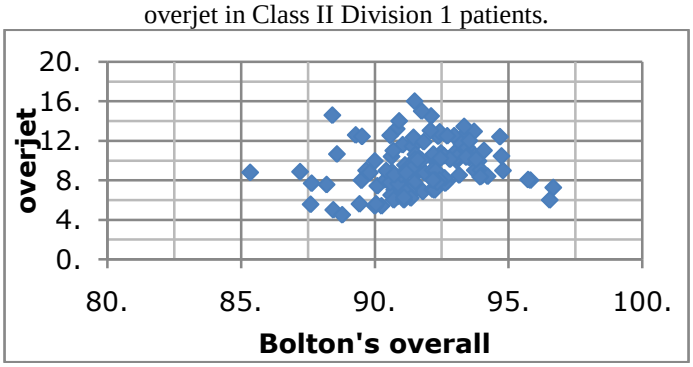


Table 1 show the gender based descriptive statistics (percentage of participants) of 120 patients who visited department of orthodontics, and were included in the study who met the inclusion criteria.

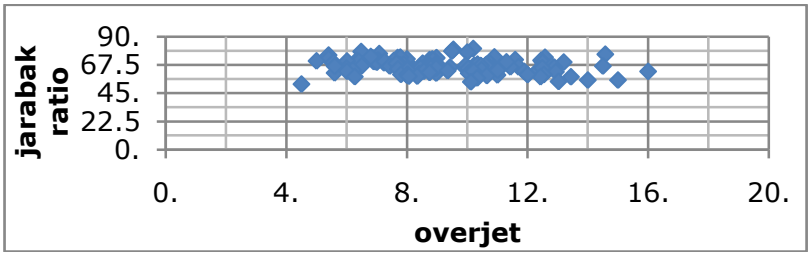
Graph no.2 (A): Scatter plot representation of Correlation between Bolton's anterior discrepancy with overjet in Class II Division 1 patients.



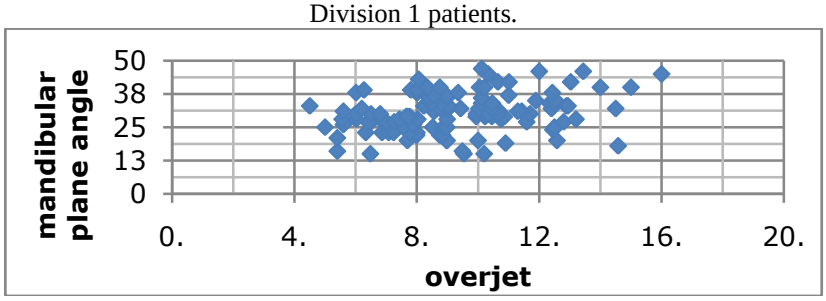
Graph no.2 (B): Scatter plot representation showing Correlation between Bolton's overall discrepancy with overjet in Class II Division 1 patients.



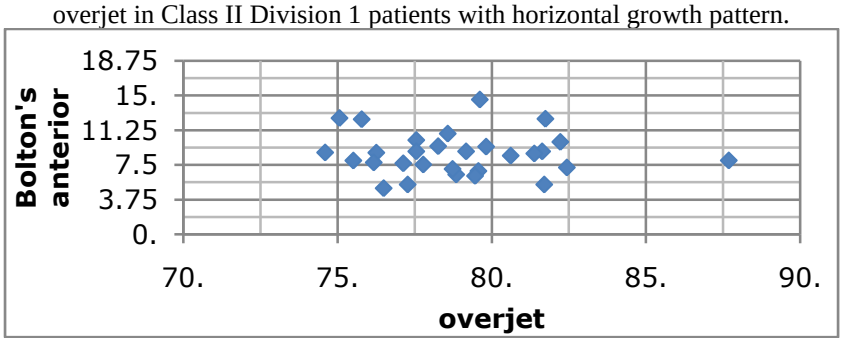
Graph no.3: Scatter plot representation showing Correlation between Jarabak's ratio with overjet in Class II Division 1 patients.



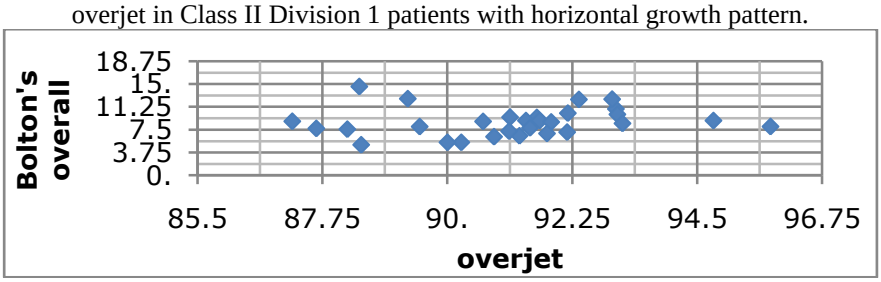
Graph no.4: Scatter plot representation showing Correlation between Mandibular Plane with overjet in Class II Division 1 patients.



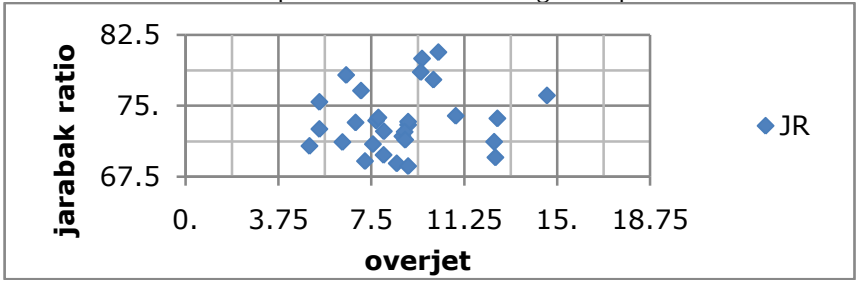
Graph no.5 (A): Scatter plot representation showing Correlation between Bolton's anterior discrepancy with overjet in Class II Division 1 patients with horizontal growth pattern.



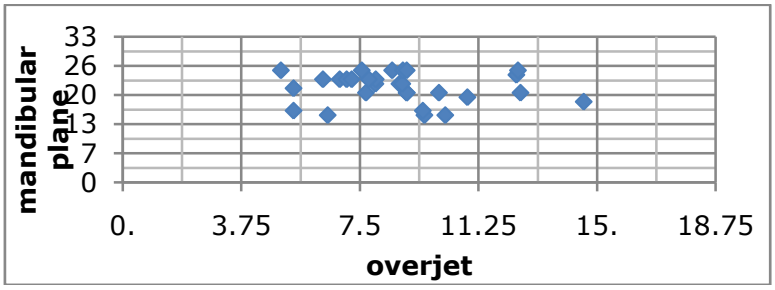
Graph no.5 (B): Scatter plot representation showing Correlation between Bolton's overall discrepancy with overjet in Class II Division 1 patients with horizontal growth pattern.



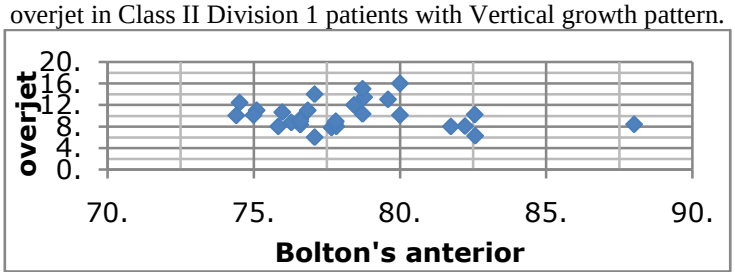
Graph no.6 : Scatter plot representation showing Correlation between Jarabak's ratio with overjet in Class II Division 1 patients with horizontal growth pattern.



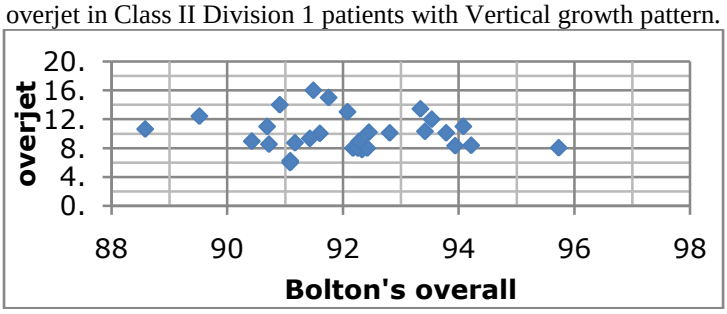
Graph no. 7: Scatter plot representation showing Correlation between Mandibular Plane with overjet in Class II Division 1 patients with horizontal growth pattern.



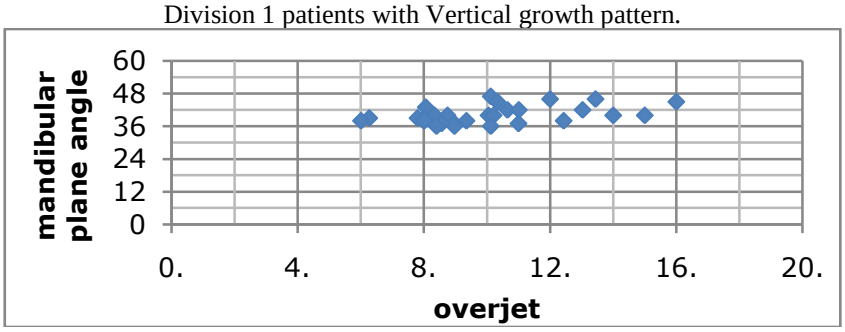
Graph no.8 (A): Scatter plot representation showing Correlation between Bolton's anterior discrepancy with overjet in Class II Division 1 patients with Vertical growth pattern.



Graph no 8 (B): Scatter plot representation showing Correlation between Bolton's overall discrepancy with overjet in Class II Division 1 patients with Vertical growth pattern.



Graph no.9: Scatter plot representation showing Correlation between Mandibular Plane with overjet in Class II Division 1 patients with Vertical growth pattern.



Graph no. 10: Scatter plot representation showing Correlation between Jarabak's ratio with overjet in Class II Division 1 patients with Vertical growth pattern.

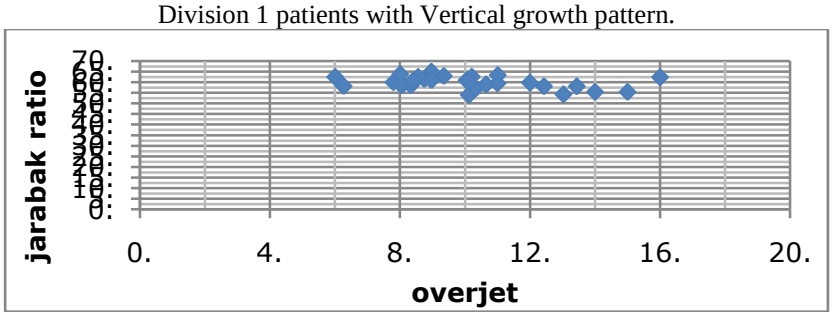


Table no.1: Descriptive characteristics of the study participants

	Number (%)
Males	44 (36.67)
Females	76 (63.33)
Total	120 (100)

Table no.2: Correlation between Mandibular Plane with overjet in Class II Division 1 patients in 120 samples.

Mandibular Plane (mean ± SD)	Overjet (mean ± SD)	Pearson's correlation value (r)	P value
30.47 ± 7.22	9.35 ± 2.38	0.288	0.001*

** $p<0.01$ is statistically significant

Table no.3: Correlation between Jarabak's ratio with overjet in Class II Division 1 patients in 120 samples.

Jarabak's ratio (mean ± SD)	Overjet (mean ± SD)	Pearson's correlation value (r)	P value
66.37 ± 5.72	9.35 ± 2.38	- 0.215	0.019*

*$p<0.05$ is statistically significant

Table no.4: Correlation between Bolton's anterior and Bolton's overall discrepancy with overjet in Class II Division 1 patients in 120 samples.

	Mean ± SD	Overjet (Mean ± SD)	Pearson's correlation value (r)	P value
Bolton's anterior (mean ± SD)	78.85 ± 3.39	9.35 ± 2.38	- 0.176	0.054
Bolton's overall (mean ± SD)	91.74 ± 1.85	9.35 ± 2.38	0.191	0.036*

*$p<0.05$ is statistically significant

Table no.5: Correlation between Bolton's anterior and Bolton's overall discrepancy with overjet in Class II Division 1 patients with horizontal growth pattern (n -29).

	Mean ± SD	Overjet (mean ± SD)	Pearson's correlation value , (r)	P value
Bolton's anterior discrepancy (mean ± SD)	78.91 ± 2.81	8.72 ± 2.29	- 0.062	0.751
Bolton's overall discrepancy (mean ± SD)	91.14 ± 2.02	8.72 ± 2.29	0.122	0.530

*$p<0.05$ is statistically significant

Table no.6: Correlation between Jarabak's ratio with overjet in Class II Division 1 patients with horizontal growth pattern (n -29).

Jarabak's ratio (mean ± SD)	Overjet (mean ± SD)	Pearson's correlation value , (r)	P value
73.39 ± 3.31	8.72 ± 2.29	0.130	0.502

*p<0.05 is statistically significant

Table no.7 Correlation between Mandibular Plane with overjet in Class II Division 1 patients with horizontal growth pattern (n -29).

Mandibular Plane (mean ± SD)	Overjet (mean ± SD)	Pearson's correlation value , (r)	P value
21.13 ± 3.31	8.72 ± 2.29	-0.119	0.539

*p<0.05 is statistically significant

Table no.8: Correlation between Mandibular Plane with overjet in Class II Division 1 patients with Vertical growth pattern (n -29).

Mandibular Plane (mean ± SD)	Overjet (mean ± SD)	Pearson's correlation value , ®	P value
40.13 ± 3.21	10.09 ± 2.47	0.462	0.012*

**p<0.05 is statistically significant

Table no.9: Correlation between Jarabak's ratio with overjet in Class II Division 1 patients with Vertical growth pattern (n -29).

Jarabak's ratio (mean ± SD)	Overjet (mean ± SD)	Pearson's correlation value , (r)	P value
59.83 ± 2.81	10.09 ± 2.47	-0.372	0.047*

*p<0.05 is statistically significant

Table no.10: Correlation between Bolton's anterior and Bolton's overall discrepancy with overjet in Class II Division 1 patients with Vertical growth pattern (n -29).

	Mean ± SD	Overjet (mean ± SD)	Pearson's correlation value , (r)	P value
Bolton's anterior discrepancy (mean ± SD	78.28 ± 2.96	10.09 ± 2.47	- 0.125	0.517
Bolton's overall discrepancy (mean ± SD)	92.11± 1.52	10.09 ± 2.47	-0.118	0.542

*p<0.05 is statistically significan