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Contributing Skeletal and Dental Components to Deep Overbite in Class II Division 1 Malocclusion: An *In Vitro* Study Model and Cephalometric Analysis

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Abstract

Introduction: Malocclusions in sagittal dimensions are often associated with malocclusions in vertical dimensions i.e.; deep overbite which may be either dental or skeletal in nature, however a correct understanding of contributing factors towards the deep overbite is important in planning and execution of an appropriate treatment plan.

Aims and Objectives: The aim of this study was to evaluate the various contributing factors towards the deep overbite in Class II division 1 malocclusion subjects and to analyze the significantly contributing factors and correlation between these factors.

Material and Methods: Lateral cephalometric radiographs and study models of 60 patients with Class II division 1 malocclusion along with deep overbite were selected and various skeletal and dental components were measured on the lateral cephalometric radiographs and study models of these patients respectively. These measurements were statistically analyzed. Mean, Standard deviation, P value was calculated and correlations between these factors were evaluated. A P value of <0.001, was considered as statistically significant.

Results: Descriptive statistical analysis was carried out and among the skeletal components gonial angle (P=0.0018) was the highly contributing factor towards deepbite with mandibular plane to frankfurt mandibular plane angle (P=0.0017) second highly contributing factor and among the dental components exaggerated curve of spee (P=0.0013) was the highly contributing factor while as other skeletal and dental components included in this study were least shared components to the deepbite malocclusion.

Conclusion: Deep bite malocclusion has definite skeletal and dental components, among the skeletal components gonial angle, mandibular to frankfurt plane angle and among dental components exaggerated curve of spee were the significantly contributing factors towards deepbite while as other factors included in this study were least shared.

Keywords: Deep overbite; Class II div 1 malocclusion; Dental and Skeletal measurements

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Introduction

Malocclusion can occur in sagittal, vertical and transverse dimensions, however malocclusions in sagittal dimensions are often associated with vertical problems i.e.; deep overbite which may be skeletal or dental in nature. A deep overbite is the most common and frequent malocclusion present and routinely faced in an orthodontic clinical practice [1]. Some severe deepbite cases in which overbite is ≥ 5 mm are present in nearly about 20% and 13% of children's and adults respectively, which represent about 95.2% of occlusal problems in vertical dimension [2]. A deepbite malocclusion encompasses a myriad of underlying hidden skeletal or dental discrepancies. So accordingly, a deepbite malocclusion should not be considered and approached as a separate type of malocclusion; instead, it should be considered as a clinical manifestation of an underlying skeletal or dental disharmony in vertical dimension. Earlier studies which were carried out to address the deep overbite focused on detecting all the changes that were occurring in the dentoalveolar morphology and accompanying the changes in overbite [3,4]. Other studies focused to evaluate the effect of increased age on the change in bite depth in vertical dimension [5] and to relate the increase in bite depth to other malocclusions [6]. A classification of deepbite into dental and skeletal deepbite was based on certain causative factors, still the various components of a deepbite malocclusion and

Table 1: Cephalometric findings.

Measurement	Definition
Dental	
Maxillary anterior alveolar and basal height (Mx-AABH, mm)	Distance between the midpoint of the alveolar meatus of the maxillary central incisor and the intersection point between the palatal plane and the long axis of the maxillary central incisor
Maxillary posterior alveolar and basal height (Mx-PABH, mm)	Perpendicular distance between the midpoint of the alveolar meatus of the maxillary first molar and the palatal plane
Inclination of the upper incisors (U1/SN,°)	Angle formed between the extension of the long axis of the maxillary incisor and the sella-nasion plane
Mandibular anterior alveolar and basal height (Md-AABH, mm)	Distance between the midpoint of the alveolar meatus of the mandibular central incisor and the intersection point between the mandibular plane and the long axis of the mandibular central incisor
Mandibular posterior alveolar and basal height (Md-PABH, mm.)	Perpendicular distance between the midpoint of the alveolar meatus of the mandibular first molar and the mandibular plane
Inclination of the mandibular incisors (L1/MP,°)	Angle formed between the extension of the long axis of the mandibular incisor and mandibular plane
Skeletal	
Mandibular plane angle (MndP-FH,°)	Angle formed between the mandibular plane and the Frankfort horizontal plane
Gonial angle (Ar-Go-Me,°)	Angle formed at the gonial area between the posterior border of the ramus and a corpus line
Maxillary plane angle (SN-MxP,°)	Angle formed between the maxillary plane and the sella-nasion plane
Ramus/FH (°)	A new skeletal measurement made between a tangent to the posterior border of the mandibular ramus and the Frankfort horizontal plane

Table 2: Dental cast findings.

Measurement	Definition
Palatal height index	Palatal height/Posterior arch width ×100%
Intercanine width	The distance between cusp tips of the right and left maxillary permanent canines
Intermolar width	The distance between the mesiobuccal cusp tips of the right and left maxillary molar
Curve of Spee	Line formed between the deepest point on the mandibular buccal segment and a horizontal line formed between the most overerupted mandibular incisor and the most overerupted molar
Length of the clinical crown of the maxillary central incisors	Line formed between the midpoint of the cervical margin of the tooth and the midpoint of the incisal edge
Length of the clinical crown of the mandibular central incisors	Line formed between the midpoint of the cervical margin of the tooth and the midpoint of the incisal edge

the significance of their contributions to the problem have not been thoroughly investigated and studied well [3].

In dental deepbite, a deep curve of Spee [7,8] and buccal root torque of the maxillary incisors [9] both of which were increased were found to be correlated with deepbite malocclusions. The overeruption of maxillary and mandibular incisors along with the excessive development of anterior dentoalveolar heights [3] and the undereruption of the maxillary and mandibular posterior dental segments 10 were also shown to have positive correlations with deepbite malocclusions. When we carry out the extraction of the mandibular incisors, it can lead to collapse of the dental arch with resultant deepening of the bite.

When a deepbite is skeletal in nature, it could result from a discrepancy of the maxilla, the mandible, in the vertical position or their cant [10,11]. Few studies have been carried out, that have dealt with the components of skeletal deepbite; it was shown that the growth of mandible in the vertical direction has a more pronounced effect than the rotational component [12,13] and that the mandibular skeletal changes are two times and 2.5 times more important than the mandibular dental changes and maxillary skeletal and dental changes respectively in producing the changes in overbite [13].

In this study, we evaluated the different skeletal and dental components of the deepbite malocclusion and determine their actual role and significant contribution towards the development of deepbite in subjects with Class II division 1 malocclusion.

Material and Methods

Lateral cephalometric radiographs and study models of 60 patients with Class II division 1 malocclusion along with deep overbite were selected from patient records at the department of orthodontics, Government Dental College and Hospital Srinagar, J&K. The subjects were aged from 14 to 30 years, and their selection was based on following criteria: (1) Class II division 1 malocclusion with deep overbite more than 5 mm, (2) second molars in fully erupted position, (3) no previous history of orthodontic treatment, (4) without any craniofacial syndrome, and (5) no congenitally missing or extracted permanent teeth.

Skeletal cephalometric measurements (Table 1 and Figure 1, 2) were used in this study [7]. A recent skeletal measurement was introduced and used in this analysis i.e.; ramus/Frankfort horizontal, was made between a tangent to the posterior border of the mandibular ramus and the Frankfort horizontal plane. The purpose of measuring this angle in subjects with Class II division 1 malocclusion with deepbite sample was to test whether the ramal growth and the angulation of the mandibular ramus have any significant role in etiology of deepbite malocclusions.

Dental cast measurements were done on the study models [8,14,15] of these patients as shown in (Table 2 and Figure 3, 4).

Statistical analysis

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version

20.0 (SPSS Inc., Chicago, Illinois, USA). Statistical software SPSS (version 20.0) and Microsoft Excel were used to carry out the statistical analysis of data. Descriptive statistical analysis was first done and data were expressed as Mean ± SD. Student's independent t-test was employed for each dental and skeletal component of deepbite malocclusion, with the percentage of contribution of each component towards the development of deep overbite was analyzed.

Results

The means, standard deviations, and percentages of contribution of the dental and skeletal components of deep overbite after statistical analysis measurements are given in Table 3.

Discussion

Malocclusion in the vertical dimension i.e.; deep overbite overlies many hidden dental and skeletal components. A proper understanding of the contributing factors towards the deep overbite malocclusion whether it is skeletal or dental in nature, helps in providing clues to

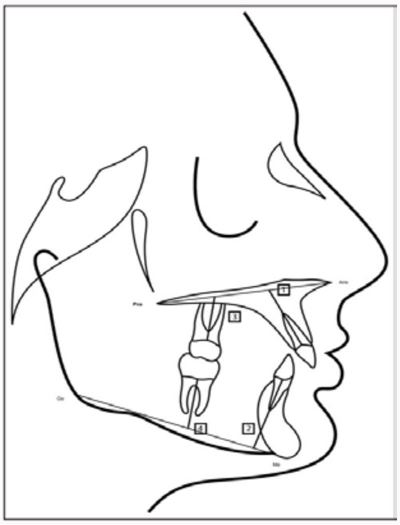

Figure 1: Dental cephalometric measurements (1, Mx-AABH; 2, Md-AABH; 3, Mx-PABH; 4, Md-PABH).

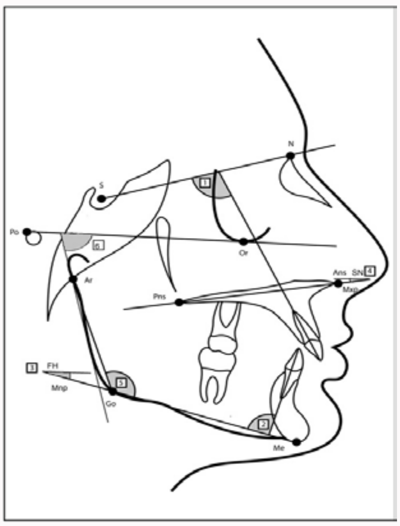

Figure 2: Dental cephalometric measurements (1, U1/SN; 2, L1/MP) and skeletal cephalometric measurements (3, FH/Mnp; 4, Mxp-SN; 5, gonial angle [Ar-Go-Me]; 6, ramus/Frankfort horizontal).

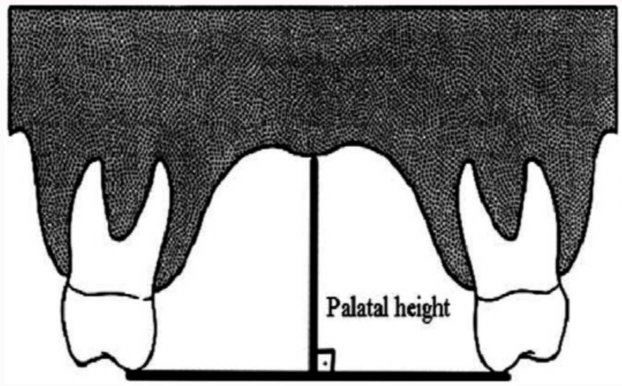

Figure 3: Palatal height index.

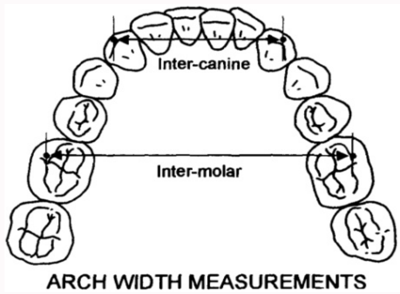

Figure 4: Intercanine and intermolar width.

the orthodontist about the possible mechanotherapy and execution of a proper treatment plan in solving the problem.

The studies that were carried out to analyze the components of deepbite malocclusion were done on very small sample size. Some deepbite components were studied by Ceylan and Eroz [3] in only four groups with variable bite depths, with each group consisting of 20 subjects. A study that overruled the skeletal components and analyzed only dental components was carried on 137 subjects. In our study, lateral cephalometric radiographs and study models of 60 patients with class ii division 1 malocclusion along with deep overbite were chosen as sample, aimed at evaluating the various components of deepbite malocclusion, whether dental or skeletal in nature, and specific contribution and analysis of each component was carried out, in addition to that correlation of different components was done to find out any significant correlation between different components.

According to these results, among the skeletal components that were studied, Frankfurt to mandibular plane angle and gonial angle showed the significant contribution towards the development of deep overbite in subjects with class II division 1 malocclusion and were the significantly shared and contributing factors in deep overbite malocclusion. The growth rotation of mandible is better described by gonial angle which may be upward forward or downward backward rotation as in deepbite and open bite cases respectively, which again is an interesting finding that gonial angle is an important indicator of mandibular rotation than mandibular plane angle per se. When correlation was being found between gonial angle and mandibular plane angle with the newly introduced Frankfurt to mandibular plane angle, a positive correlation was found only with the gonial angle and other skeletal components in our study didn't significantly contribute to the skeletal deep bite.

Table 3: Values of dental and skeletal components in deep bite malocclusion.

Component	n	Minimum	Maximum	Mean	SD	P value
Mx-AABH	60	8	28	18.6	3.37	0.002
Mx-PABH	60	8	13	11.23	1.3	0.005
U1/SN°	60	89	120	109.13	7.09	0.009
Md-AABH	60	24	35	29.13	2.63	0.006
Md-PABH	60	15	25	20.17	2.6	0.01
L1/MP°	60	82	108	96.17	6.22	0.002
MndP-FH°	60	13	35	24.2	5.1	0.0017*
Ar-Go-Me°	60	108	131	120.33	6.09	0.0018*
SN-Mx°	60	2	15	7.43	3.05	0.007
Ramus/FH°	60	75	89	82.27	3.87	0.009
Palatal height index %	60	25	56	41.6	6.95	0.007
Intercanine width	60	19	30	26.333	2.15	0.003
Intermolar width	60	36.5	46	41.57	2.5	0.04
Curve of spee	60	1.5	5	3.467	1.09	0.0013*
Length of the clinical crown, U1	60	8	11	8.5	1.09	0.014
Length of the clinical crown, L1	60	8	10	10.2	0.92	0.016

Statistically significant: *P<0.001

Among the dental components the exaggerated curve of Spee was repeatedly found to be having main role in developing dental deepbites [8]. In our study, the excessive curve of Spee was the potential causative factor and had the highest contribution among all the dental components which were included in our study i.e.; inclination of maxillary and mandibular incisors, lower intercanine and intermolar width, palatal height index was not significantly contributing to dental deep bites. These findings suggest that the mandibular dentoalveolar factors are more crucial and important in deepbite malocclusions, and we should employ the treatment mechanotherapy which will extrude the mandibular posterior dentoalveolar segments and intrude the anterior dentoalveolar segments per se. It has been proven that every 1 mm of posterior extrusion opens the bite anteriorly by 2 mm [16]. This finding shows that small amounts of molar extrusion can result in significant anterior bite opening. So, our study suggests that among skeletal factors it is mainly the rotation of mandibular plane that contributes to the skeletal deep bite and when the deep bite is dental in nature, the exaggerated curve of Spee is mainly found. So, our treatment plan should be executed accordingly for correction of deep bite malocclusion.

Conclusion

Deep bite malocclusion may be skeletal or dental in nature. In our study among the skeletal components gonial angle was the highest shared and significant contributing skeletal component towards deepbite, confirming the importance of the growth rotation of mandible which is better depicted by gonial angle in a developing deepbite and mandibular plane to Frankfurt horizontal plane angle was the second highly contributing skeletal component.

Among the dental components deep curve of Spee was the highest contributing dental factor, confirming the importance of employing the treatment mechanics which will extrude the posteriors and intrude the anteriors while correcting a deepbite in subjects with class ii division 1 malocclusion.

The lingual inclinations of the maxillary and mandibular incisors, lower intercanine and intermolar width, and palatal height index were among the least shared components in deepbite malocclusions.

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