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Research Article

Deepbite Malocclusion: Analysis of Underlying Components in Different Facial Growth Patterns

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Abstract

Background: Deep bite malocclusion should not be approached as a disease entity; instead, it should be viewed as clinical manifestation of underlying discrepancies. The present study aim to evaluate parameters of deepbite in various growth patterns.

Materials and Methods: Sample of 90 patients divided into groups of varying growth patterns: Vertical (FMA≥27°), Horizontal (FMA≤22°), Normal (FMA 22°-27°), were studied for cephalometric and dental measurements.

Results: Curve of spee was major contributor to deep bite in all growth patterns. Gonialangle, and maxilla mandibular alveolar base heights were correlated with deep bite in horizontal growers. Inclination of maxillary and mandibular incisors was responsible for deep bite in vertical growth pattern.

Conclusion: This analysis of deep bite components could help clinicians design individualized mechanotherapies based on underlying cause, rather than being biased toward predetermined mechanics when treating deep bite malocclusion. Hence, orthodontists should look for not just leveling of curve of spee but also the growth pattern of patient.

Keywords: Deep bite; Growth patterns;Curve of spee

Introduction

A deep overbite is a common malocclusion encountered in an orthodontic practice.Severe deepbites (overbite 5 mm) are found in nearly 20% of children and 13% of adults, representing about 95.2% of vertical occlusal problems[1].A deep bite malocclusion overlies a multitude of hidden skeletal or dental discrepancies. Accordingly, a deep bite should not be approached as a disease entity; instead, it is a clinical manifestation of an underlying skeletal or dental discrepancy. Previous studies addressing deep overbite focused on detecting the changes in the dentoalveolar morphology[2,3] accompanying the changes in overbite.Other studies aimed to evaluate the effect of age on the change in overbite[4]and relate the increase in bite depth to other malocclusions[5].

Ceylan and Eroz[2]studied some components of deep overbite in 4 groups of patients (20 patients in each group) with variable bite depths. Among their significant findings was that the gonial angle was the largest in the open-bite group and smallest in the deepbite group. Baydaset al[4]studied the effect of the depth of the curve of Spee on bite depth in a sample of 137 subjects. They were divided into 3 groups; normal, flat, and deep curves of Spee, and the groups were compared. The results showed statistically significant correlations between the depth of the curve of Spee and overjet and overbite.

Certain components were deemed to share in a developing deepbite malocclusion, thus classifying deepbite into dental and skeletal deepbite according to the causative factor. Various dental and skeletal components of deepbite have been studied by many investigators.

Regarding dental deepbite, a deep curve of Spee[3,6]and an increased buccal root torque[7]of the maxillaryincisorswere proven to be correlated with deepbitemalocclusions. The overerupted maxillary and mandibularanterior alveolar basal heightsand the undereruptionof the maxillary and mandibular posteriorsegmentswere also shown to have positive correlationswith deepbite malocclusions[2]. Extraction of the mandibular incisors leads to a collapse of that arch with consequent deepening of the bite[8].

A skeletal deepbite could result from a discrepancy in the vertical position of the maxilla, the mandible, or their cant[9].Few studies[10, 11] have dealt with the components of skeletal deepbite; it was shown that the vertical component of mandibular growth has a more remarkable effect than the rotational component,and that the mandibular skeletal changes were twice as important as the mandibular dental changes and about 2.5 times as important as the maxillary changes in inducing overbite changes[11].These parameters have a strong influence on the treatment planning. As a result it is important to understand the role of all dento skeletal components in occurrence of deep overbite in patients with different growth patterns.

The aim of our study is to study the parameters of deep overbite in vertical, horizontal and normal growth patterns.

Materials and Method

This is a retrospective study with sample comprising of pre Treatment lateral cephalograms and study models of 90 patients with deepbite, selected from approximately 400 patient records at the outpatient clinic of the Department of Orthodontics. The study was approved by the ethical committee as it involved the analysis of previous model and cephalometric data of the patients.

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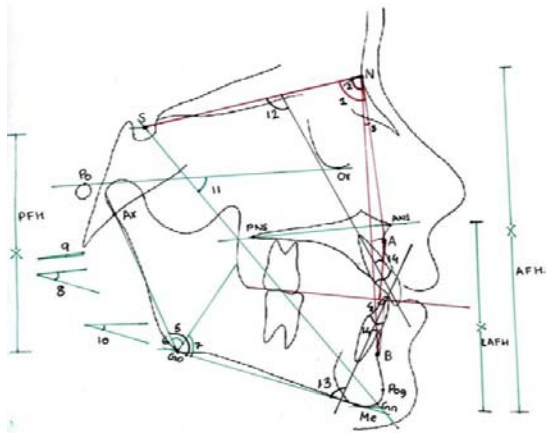

Figure 1: Skeletal and Dental Cephalometric Parameters used In the Study. Horizontal Skeletal Parameters: 1-Sna; 2-Snb; 3-Anb; 4-Wits; Vertical Skeletal Parameters: 5-Gonial Angle; 6- Uga; 7-Lga; 8-Bpa; 9-Pp-Fh;10-Mpa; 11-Y-Axis;Lafh;Pafh-Afh/Pfh×100; Dental Parameters: 12-U1-Sn; 13-L1-Mp; 14-U1-Na; 15-L1-Nb

All the selected cases in the study fulfilled the following criteria: (1) Age ranged from 12 to 26 years, (2) deep overbite more than 5 mm, (3) complete eruption of the second molars, (4) no history of orthodontic treatment, (5) no severe craniofacial disorders, and (6) no missing teeth.

The records for each case enrolled into the sample included panoramic, lateral cephalometric radiographs and a well trimmed study model. Records of 400 pateints were then screened to identify cases with deep bite from which 90 patients were randomly selected for cephalometric analysis. Lateral cephalometric radiographs of the 90 cases were traced and analyzed to identify underlying skeletal pattern.

The 90 patients were broadly divided into 3 groups:

GROUP I: Vertical Growth pattern (FMA ≥ 27°) n=30

GROUP II: Horizontal Growth patternFMA ≤ 22°) n=30

GROUP III: Normal Growth pattern (FMA 22° -27°) n=30

The groups were studied for the following cephalometric parameter (Figure: 1,2)

1. SKELETAL:

A. Vertical

- Gonial angle

1. Upper gonial angle(UGA)

2. Lower gonial angle(LGA)

- SellaNasion – mandibular plane angle (SN-MP angle)
- Basal plane angle(BPA)
- Mandibular plane angle(MPA)
- Palatal plane – Frankfort plane(PP-FH)
- Posterior/anterior facial height(PAFH)
- Lower anterior facial height(LAFH)

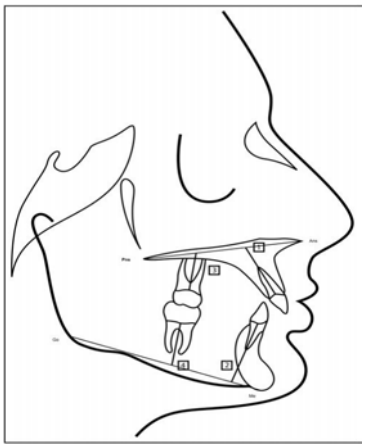

Figure 2: Dental Cephalometric Measurements. 1- MxABH; 2- MnABH; 3- MxPBH; 4- MnPBH).

- Maxillary anterior alveolar basal height(MxABH)
- Maxillary posterior alveolar basal height(MxPBH)
- Mandibular anterior alveolar basal height(MnABH)
- Mandibular posterior alveolar basal height(MnPBH)

B. Anteroposterior

- SellaNasion A Point(SNA)
- SellaNasion B Point (SNB)
- A Nasion B Point(ANB)
- Y axis
- Wits appraisal
- DENTAL:
- Upper Incisor – SellaNasion Angle (U1-SN0
- Lower Incisor – Mandibular Plane Angle (L1-MP)
- Upper Incisor – Nasion A Point Angle(U1-NA)
- Lower Incisor –Nasion B Point Angle (L1-NB)
- Overbite
- Curve of spee

Statistical Analysis

Descriptive statistics were calculated, including the mean standard deviation and coefficient of variation of each dental and skeletal component of deepbite malocclusion, with the contribution of each component.

The Pearson correlation coefficient was used to correlate the various deepbite components.

All statistical analysis was done by SPSS 16.0 software.

Results

The statistical analysis of the measurements showed the following results.

Table 1: Mean and standard deviation of cephalometric and dental parameters.

VARIABLE	GROUP 1 (Vertical Growth Pattern FMA≥27°)					GROUP 2(Horizontal Growth Pattern FMA≤22°)					GROUP 3(Normal Growth Pattern FMA= 22°to 27°)				
	Mean	Std. Dev	Min	Max	Coef of Variation (%)	Mean	Std. Dev	Min	Max	Coef of Variation	Mean	Std. Dev	Min	Max	Coef of Variation
SNA	82.0	4.2	75.0	89.0	5.2%	82.9	3.1	75.4	88.8	3.8%	82.7	2.9	77.3	89.0	3.5%
SNB	75.6	3.9	66.3	82.5	5.1%	77.5	3.4	69.6	83.7	4.4%	77.0	3.0	71.1	84.0	3.9%
ANB	6.4	2.3	0.5	11.2	35.2%	5.4	2.3	0.1	9.0	42.9%	5.7	1.7	2.0	8.3	28.9%
Y-AXIS	62.8	3.7	54.5	71.9	5.8%	58.5	3.0	54.0	66.0	5.2%	60.3	3.6	52.0	69.0	5.9%
WITS	2.2	4.0	-9.1	9.7	184.2%	1.7	5.1	-8.1	12.0	300.0%	1.3	4.0	-9.8	7.0	301.3%
LAFH	60.5	5.2	45.0	69.4	8.6%	56.7	7.3	37.5	72.9	13.0%	58.1	6.3	48.0	71.3	10.8%
PAFH	64.0	5.6	44.2	72.9	8.8%	72.9	5.3	59.7	85.7	7.3%	68.8	4.1	59.5	77.0	6.0%
GONIAL ANGLE	127.0	5.4	115.0	135.9	4.2%	117.8	7.3	97.7	130.0	6.2%	121	6.5	107.5	131.8	5.3%
UGA	52.8	4.0	45.0	60.4	7.5%	53.7	6.8	40.9	72.0	12.7%	54.5	5.7	43.8	70.0	10.4%
LGA	74.0	4.3	61.7	82.3	5.8%	64.1	5.2	48.0	72.0	8.2%	65.5	13.9	2.0	76.0	21.2%
BPA	22.8	5.5	0.8	35.1	23.9%	17.8	5.8	10.0	42.6	32.8%	18.1	3.0	10.0	25.0	16.8%
PP-FH	2.2	2.9	-3.6	6.9	130.5%	1.1	3.2	-4.6	7.6	295.9%	2.9	1.7	-0.5	5.2	58.1%
U1-SN	108.8	12.7	69.7	129.4	11.7%	110.3	14.9	73.0	135.3	13.5%	114	13.1	82.3	142.0	11.5%
L1-MP	101.1	9.2	82.0	118.0	9.1%	104.3	11.1	87.9	124.0	10.6%	99.9	18.0	26.0	123.0	18.1%
CURVE OF SPEE	2.5	0.9	1.0	5.0	37.9%	3.1	0.8	1.5	5.0	27.3%	3.4	1.4	2.0	8.0	41.6%
OVER BITE	5.8	1.3	4.0	9.0	21.9%	6.7	1.7	4.0	10.0	25.7%	7.0	1.6	4.0	10.0	23.0%
SN-MP	33.5	5.0	20.9	49.0	14.8%	23.2	5.4	11.5	37.6	23.4%	27.5	3.9	19.9	35.7	14.4%
U1-NA	26.9	12.5	-20.0	45.9	46.3%	27.4	13.5	-5.1	46.5	49.5%	29.1	12.6	3.0	46.7	43.2%
L1-NB	32.3	8.8	13.4	47.0	27.2%	25.1	8.0	9.0	46.0	31.9%	28.4	9.5	5.0	43.1	33.5%
MPA	30.1	3.4	19.1	37.0	11.3%	19.0	3.2	10.6	22.0	16.7%	24.9	2.5	22.4	35.0	10.2%
MxABH	19.9	3.2	14.4	28.1	16.2%	18.8	2.3	15.3	23.8	12.4%	20.3	3.3	17.1	28.1	16.1%
MxPBH	14.0	2.0	11.3	18.3	14.3%	16.1	8.5	9.5	37.2	53.2%	18.4	9.3	11.3	36.3	50.5%
MnABH	32.9	2.1	27.2	36.0	6.4%	28.4	5.5	14.8	36.7	19.5%	27.0	6.0	16.5	36.1	22.2%
MnPBH	22.7	2.2	18.09	27.55	9.7%	22.9	2.8	20	32.36	12.2%	23.0	3.8	17.01	27.55	16.7%

The means, standard deviations, and percentages of contribution of the dental and skeletal components ofdeep overbite are given (Table 1).The skeletal and dental parameters were correlated to deep over bite using the Pearson correlation coefficient test.

The correlation of deep bite with anteroposterior, vertical and dental components in norm divergent patients. Curve of spee(P=.032) was found to be significantly associated(Table 2), suggesting that with increase in curve of spee, the bite will increase. In vertical parameter maxillary posterior alveolar height and mandibular incisor had a significant correlation with deep bite suggesting over eruption of incisors and under eruption of maxillary posteriors which may lead to deep bite in normodivergent patients. Rest none of the dental and anteroposterior parameters were significantly related to bite.

The correlation of various skeletal and dental parameters with deep bite in horizontal growth pattern displayed (Table 2). Among the dental components, curve of spee was statistically correlated significantly(P= 0.049) to deepbite suggesting that an increase in curve of spee will increase the bite and vice versa. The other dental components were found to be weakly related to deep bite. In the vertical skeletal components, only gonial angle had a significant negative correlation (P=0.027) with deep bite propounding that decrease in gonial angle (in case of severe horizontal grower) increases the degree of deep bite. The weak correlation of the anteroposterior parameter indicates that deepbite is unaffected by sagittal jaw relationship.

The maxillary and mandibular anterior alveolar base height had a significant correlation(P= 0.045, P= 0.002) to the bite suggesting that the increase in anterior maxillomandibular alveolar base height(over eruption) will lead to severity of bite. In contrast to this, the maxillary and mandibular posterior alveolar base height showed a negative correlation(P=0.044, P=0.013) which can be indicative of over eruption of posteriors leading to deepening of bite or vice versa.

The correlation of various skeletal and dental parameters with deep bite in vertical growth pattern shown (Table 2). U1-NA(P=0.008),U1-SN(P=0.025),L1-MP(P=0.023),L1-NB(P=0.001) were found to have a significant relation with deep bite. The deep bite decreases with increase in inclination of upper and lower incisors.

In the vertical skeletal components, over eruption of maxillary incisors was found to be significantly related to occurrence of deepbite. Other vertical components were weakly correlated to deep bite.

Discussion

A deepbite malocclusion overlies many hidden skeletal and dental components. The awareness of such components by the orthodontist is the clue for the best control of the mechanotherapy to resolve the underlying discrepancy.

Studies targeting the analysis of deepbite malocclusion components were done on analysing only some components of deep bite. The study of Baydas et al. [3] although including 137 subjects, overruled the analysis of the skeletal components and investigated

Table 2: Pearson Correlation Test.

Correlation with Bite		Group 3 FMA 22°-27°	Group 2 FMA ≥22°	Group 1 FMA ≤27°
VARIABLES	Pearson Correlation	p-value	p-value	p-value
ANTERO POSTERIOR VARIABLE				
SNA	-0.198	0.342	0.444	0.82
SNB	-0.248	0.232	0.786	0.668
ANB	0.076	0.717	0.083	0.697
WITS	-0.191	0.621	0.044	0.456
VERTICAL VARIABLE				
GONIAL	0.136	0.518	0.027*	0.789
UGA	0.339	0.105	0.961	0.231
LGA	-0.077	0.715	0.618	0.438
BPA	-0.037	0.862	0.878	0.135
PP-FH	-0.27	0.193	0.755	0.858
Y-AXIS	-0.026	0.901	0.312	0.999
MPA	-0.131	0.541	0.756	0.947
SN-MP	0.215	0.313	0.712	0.858
MxABH	-0.076	0.719	0.045*	0.01*
MxPBH	-0.377	0.043*	0.044*	0.909
MnABH	0.288	0.049*	0.002*	0.871
MnPBH	-0.302	0.142	0.013*	0.997
DENTAL COMPONENTS				
U1-NA	0.03	0.89	0.036*	0.008*
L1-NB	0.046	0.831	0.124	0.001*
U1-SN	-0.044	0.837	0.093	0.025*
L1-MP	-0.059	0.785	0.134	0.023*
CURVE OF SPEE	0.134	0.032*	0.049*	0.011*

only some dental components. Therefore in the present study, the sample comprised of 90 patients, aiming at elucidating the various components of deepbite malocclusion, both dental and skeletal.

Regarding the relation of deep bite to growth patterns, Claro et al. [12]investigated the dependence of over bite on facial growth patterns by analysing 86 cephalograms. They found that there was no relation of over bite and facial growth pattern and deep bite can occur in any type of growth pattern.

The present study was done to analyze the specific contributions of dental and skeletal parameters to the deep bite malocclusion in different growth patterns.

In current retrospective study, cases were selected from the patients' records of the outpatient clinic, Orthodontic Department according to selection criteria to represent the orthodontic population.

All subjects in the current sample were confirmed not to have any previous surgery or orthodontic treatment as this might affect occlusion.

As transient or temporary deep bite could be related to lack of full eruption of posterior teeth. Accordingly, the age of subjects selected for this study ranged from 12-26 years. This was to assure full eruption of all permanent dentition with consequent reliability of the assessment of anterior deep bite. This goes in accordance with Naeemet al.(2008) who conducted a similar study on patients with mean age of 17.5 years. On the other hand Lauc (2003) evaluated the prevalence of malocclusion among a sample aged between 7-14 years.

Regarding the gender criteria in the study both the genders were included in the groups. It was found by Mohamed Abuelazayemet al.[16]. thatthere was no difference in the prevalence of deep bite between males and females and there was no difference in the prevalence of specific skeletal pattern between males and females with deep over bite. This supported the gender criteria in present study.

In this study it was found that patients with normal growth pattern had exaggerated curve of spee as the highest contributing factor of deep bite. This finding has been repeatedly confirmed by many authors. It reflects the importance of the mandibular dentoalveolar factor in deepbite malocclusions, emphasizing the need for extruding the mandibular buccal segment and intruding the mandibular incisors in most deepbitemechanotherapies. It has been proven that every 1 mm of posterior extrusion opens the bite anteriorly by 1.5 mm.This finding shows that small amounts of molar extrusion can result in significant anterior bite opening.

Over eruption of lower incisors and under eruption of maxillary posteriors are also the contributing factor in the normodivergent patients. This is supported by study done by Beckmann et al. [13] who studied 460 patients having varying overbites. They measured the alveolar basal height and concluded that maxillary and mandibular basal height are increased in deep bite cases as compared to normal or open bite cases.

Many skeletal and dental parameters contributed to deep bite in horizontal growers. The highest contribution was of curve of spee which is similar to normal growers.

Gonial angle was found to be significantly correlated to deep bite in horizontal growers. This is in agreement with El-Dawlatly et al. [14] who have found gonial angle was the highest shared skeletal factor in deepbite malocclusion and gonial angle highly represents the mandibular plane rotation, more than the mandibular plane angle. Thus it was the mandibular rotation which contributed to the deep bite and it was a skeletal cause in horizontal growers.

A highly significant association of overeruption of maxillary and mandibular incisors and infraocclusion of maxillary and mandibular posteriors was noted in horizontal growers. This is in agreement with Beckmann et al. [13] who concluded the similar findings in patient with deep bite.Al–Zubaidi SA, Obaidi HA[15]also concluded that there was overeruption of mandibular incisors in deep bite cases. The positive correlation between the overeruption of the maxillary and mandibular incisors in this study shows the need for a thorough consideration of intruding the mandibular incisors in most patients in whom maxillary incisor intrusion is to be attempted, and vice versa. This would be beneficial for the clinician, who can distribute the required intrusion between the maxillary and mandibular incisors, thus preventing higher ranges of intrusive mechanics that could cause a risk of root resorption and jeopardize the stability.

Among vertical growth pattern, inclination of upper incisor was found to be highly correlated to bite.Christopher et al. [7]

has conducted a study on effects of incisor angulation on overbite andfound that changing the inclination of the maxillary incisors has a direct effect on the amount of overbite. There is a negative correlation between the inclination of the maxillary incisors and the amount of overbite, and it was proven that a decrease of 6°in their inclination results in a 0.3-mm increase in overbite. This is in accordance with our study in case of vertical growers. Thus increasing the inclination of incisors will lead to opening of bite.

Curve of spee is found to be a strong factor affecting deep bite in vertical growers. The clinician needs to level the curve of spee by intruding the incisors according to the incisor display of the patient.

This analysis investigating the dental and skeletal components in different facial growth patterns contributing to the development of deep overbite, their significance, and correlations draws certain guidelines for the orthodontist that could help in more efficient treatment of these malocclusions. The clinician can focus on the main underlying component, design an individualized treatment plan, and tailor a mechanotherapy protocol suitable patient of variable growth patterns.

Conclusions

1. A deep curve of Spee was the highest contributing dental factor in all facial patterns, confirming the importance of intruding the mandibular incisors in deepbitemechanotherapy.
2. In normal facial pattern, it was the over eruption of incisors and infra occlusion of posteriors leading to deepbite.
3. In horizontal growth pattern, the gonial angle contributed to deep bite along with over eruption of maxillary and mandibular incisors and infra eruption of posteriors.
4. In vertical growth pattern, inclination and over eruption of incisors was the major contributing factor of deep overbite.
5. A thorough analysis of all deepbite components reduces the clinician's bias toward predetermined mechanics in treating these patients and allows for more individualized treatment planning and mechanotherapy.

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