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Original Research

Examination and Evaluation of Dental and Skeletal Factors in Deep Bite Malocclusions: A Descriptive survey

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ABSTRACT:

Background: Deep Bite is commonly associated with functional problems such as attrition of mandibular teeth, temporomandibularjoint disorders and muscular pain and hence, correction of deep bite is crucial for prevention of temporomandibular joint disorders as well as maintenance of dental and skeletal hard tissues and facial soft tissues. In depth examination of underlying skeletal and dental factorsis important and vital for planning an effective, efficient individual treatment plan. The literature available on the etiology of dental and skeletal factors in deep bite cases is scarce and needs to be updated from time to time. The purpose of this descriptive survey were to explore frequencies of dental and skeletal etiological factors in deep bite patients and to determine correlations among etiological factors (dental and skeletal) of deep bite malocclusions. **Materials & Methods:** The sample size of the study was 113 subjects (males=35; females=78) with history of previous orthodontic treatment or presence of craniofacial syndromes. Various dental and skeletal parameters were evaluated by using pre-orthodontic treatment records. For every parameter, descriptive statistics were calculated. Pearson's Correlation test was used to assess correlation among various study parameters. **Results:** Results showed that most frequently seen factor in dental anomalies was a deep curve of Spee (72.6), increased coronal length of upper incisors (28.3%) was the second most commonly seen dental factor followed by retroclined upper incisors (17.7%). Decreased gonial angle was a skeletal factor with highest frequency of occurrence in deep bite (43.4%), followed by a reduced mandibular plane angle (27.4%). A strong positive correlation (p=0.000, r=0.66) was found between Frankfort mandibular plane angle and gonial angle. No other statistically significant correlations were found. **Conclusion:** The study showed that a reduced gonial angle is most commonly occurring skeletal factor, indicating towards the importance growth of ramus as well as angulation of ramus in development of a deep bite. Deep curve of Spee is a dental etiological component with highest frequency in deep bite subjects, thereby showing the importance of intrusion of the mandibular anterior teeth

Keywords: Deep bite, Gonial Angle, Dental Factors

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INTRODUCTION

Malocclusion is described as an occlusion in which there are irregularities in tooth positions and mandibular and maxillary teeth have an abnormal relationship.[1] Since the dawn of orthodontics, overbite is an essential occlusal characteristic that has been the focus for treatment alterations.[2] Correction of overbite has also been considered significant in evaluating the excellence of orthodontic treatment outcomes.[3] Deep bite malocclusion is described as "the overlap of upper incisors on the labial surface of lower incisors vertically when the standard limit of 1–2 mm is exceeded". Deep bite is frequently seen malocclusion in clinical orthodontic practice and it is the most challenging problem to treat with good and efficient outcomes.[4] Proffit et al[5] reported that severe deep bites (overbite ≥5 mm) are seen in approximately 20% of the children and 13% of the adult population, showing around 95.2% of the occlusal deviations in vertical plane. Similarly, the most recent national

health and nutrition examination survey (NHANES III) showed that in US population, normal overbite was around 3 mm. Around 14% population had an overbite of ≤0 mm and about 16% of the population presented with a deep bite ≥5 mm and demonstrating a frequent occurrence of overbite issues.[6] Being a frequently seen disharmony, this is one of the major concerns for an orthodontist.[7]Deep bite problems are functionally uncomfortable for the patient and most often leads to dental attrition which is sometimes followed by pulpal exposure. Additionally, deep bite causing trauma to gingival or palatal tissues is considered a serious problem which needs prompt treatment in orthodontic practice.[8] Over erupted incisors, excessive increase in overjet, malpositioned canine, molar infra-occlusion, mandibular ramus height, vertical facial type,[4] accentuated curve of Spee,[9] and excessive root torque of the upper incisors labially[10] are features related to the aetiology of deep overbite malocclusions. Faerovig and Zachrisson[11] in their study found that deep bite malocclusion is associated with increased anterior and decreased posterior alveolar basal heights. Furthermore, Zhylich and Suri[12] in their systematic review confirmed that the choice of extraction ofmandibular incisors leads to arch collapse with a resultant bite deepening effect. Most investigators have described the treatment strategies using anterior bite plane,[13] functional appliances,[14] continuous arch wire mechanics,[15] cervical headgear,[16] utility arches,[17] mini screw implants[18,19] and orthognathic surgery[20].There are various approaches available for managing deep bite but the ideal treatment course will be determined by the treatment goals and patient's individual characteristics. Nonsurgical treatment substitutes consist of extrusion of molars, intrusion of incisors or a combination of both.[13-19] Noroozi[21] conducted a study which showed that extrusion of posterior teeth by every 1 mm reduces the overbite by 1.5 mm anteriorly, confirming that lesser quantities of molar extrusion can cause substantial anterior bite opening. But in deep bite patients with predisposition towards vertical growth pattern, opening bite by extruding posterior segments is not a suggested treatment. For such patients true incisor intrusion is an excellent treatment opportunity.

Ng et al[22] in their systematic review found that extent of intrusion was only 1.9 mm for lower incisors and 1.5 mm for the upper anterior teeth maximally. Untreated deep bite can cause ulcers in the gingiva, mandibular incisors' attrition, temporomandibular joint disorders and abnormal mandibular function.[23] Thus, improvement of deep overbite is essential objective of orthodontic therapy. Investigating underlying aetiological elements is of core importance for individualized and effective treatment planning. To the best of our knowledge, dental and skeletal features of deep bite have not been evaluated enough and more research is needed in this field. Hence, current study was aimed to determine frequencies of various etiological features and the correlations amongst them.

MATERIALS & METHODS

This was a cross sectional study was carried out in a time period of three months from January 2021 to March 2021. The present study mainly concentrated on the deep bite malocclusion in patients presenting for the orthodontic treatment.The pre treatment records were obtained from different orthodontic clinical practice in a defined geographical area which were available at the earliest. Sampling technique used was purposive sampling technique. Only those cases which had good quality pretreatment records, deep bite of greater than 5 mm and fully erupted permanent 2nd molars were included. Patients with craniofacial anomalies, prior history of orthodontic treatment and clinically missing permanent teeth other than third molars were excluded from the study. The data were acquired from pre-treatment dental casts and lateral cephalometric radiographs of the subjects visiting orthodontic clinics from November 2018 to November 2020. Total number of the subjects who were registered during this time period came out to be 500 patients. Deep bite of greater than 5 mm was seen in 365 patients. From this group, 22 patients were excluded because of un-erupted permanent second molars and presence of craniofacial syndromes and clinically missing permanent teeth. Finally the total sample size comprised of 113 subjects. Cephalometric dental and skeletal measurements[24] and dental cast measurements[25] were used in the study to assess the various skeletal and dental factors of deep bite. To minimize the chances of error, linear parameters were measured via digital Vernier calliper (0–150 mm ME00183, Dentaurum, Pforzheim, Germany) with reliability of 0.01 mm and an accuracy of 0.02 mm manufacturer's specification. SPSS version 23.00, Chicago, Inc. was used for data analyses. Means and standard deviations for age of female and male subjects were determined. Descriptive statistics were used to calculate frequencies as well as the means and standard deviations of various skeletal and dental deep bite etiological factors. All these parameters were correlated using Pearson correlation coefficient. P value of less than 0.05 was considered as statistically significant.

RESULTS

The entire sample comprised of 113 individuals (35 males; 78 females). The female patients were found to have the mean age of 15.7±5 years and the mean age of male patients was 17.2±5 years. Significant outcomes of present cross-sectional study indicated that in individuals with deep bite increased curve of Spee and decreased gonial angle are most frequently seen dental and skeletal factors respectively. Frankfort mandibular plane angle and gonial angle showed the statistically significant strong positive correlation (r=0.66, p=0.000). Table-1 shows the descriptive

statistics of various study parameters of deep bite patients. Table-2 represents the frequencies of skeletal and dental deep bite factors. Increased curve of Spee was most commonly seen factor of dental deep bite (72.6 %), and increased coronal length of lower incisors was least frequent component (5.3%). Diminished gonial angle was most usually seen characteristic of skeletal deep bite (43.4%) and clockwise rotation of maxillary plane was least frequent parameter (26.5%). Several dental and skeletal deep bite components were correlated by using Pearson correlation coefficient as shown in table-3. In the correlations amongst skeletal factors, gonial angle was found to have statistically significant negative correlation with ramus/Frankfort horizontal (r= -0.57, p=0.000) and positive correlation with mandibular plane angle (r=0.66, p=0.000). In the correlation between dental factors, statistically significant positive correlation was seen between maxillary and mandibular posterior dentoalveolar heights (r=0.35, p=0.000). Likewise, statistically significant positive correlation was seen amongst maxillary and mandibular anterior dentoalveolar heights (r=0.47, p=0.000). Furthermore, statistically significant positive correlation was also appreciated amongst increased clinical crown lengths of upper and lower incisors (r=0.48, p=0.000). In the correlations between dental and skeletal parameters, increased lower incisor inclination was observed to have statistically significant negative correlations with mandibular plane angle (r= -0.36, p=0.000) and gonial angle (r= - 0.42, p=0.000).

Table 1: VALUES OF DENTAL AND SKELETAL FACTORS OF DEEP BITE

Factor	Maximum	Minimum	Mean	±SD
		DENTAL		
Mx-AABH (mm)	29.00	11.00	20.24	3.44
Mx-PABH(mm)	27.00	8.00	14.66	3.11
Md-AABH(mm)	40.00	20.00	31.04	3.79
Md-PABH(mm)	32.00	14.00	22.37	3.11
U1/SN(°)	129.00	68.00	106.42	11.07
L1/MP(°)	125.00	73.00	97.68	8.55
Mx-UI Length(mm)	13.00	7.00	9.97	1.09
Mnd-LI(mm)	11.00	6.00	7.83	1.03
COS,(mm)	6.00	1.00	3.10	1.13
		SKELETAL		
Ar-Go-Me(°)	142.00	105.00	124.14	7.64
MndP-FH(°)	36.00	7.00	24.55	5.73
SN-MxP(°)	19.00	2.00	8.44	3.52
RFH(°)	95.00	63.00	91.53	5.98

N=113, Descriptive Statistics

Table 2: FREQUENCIES OF DENTAL AND SKELETAL FACTORS OF DEEP BITE

Factor	Percentage
Dental	
Increased COS(mm)	72.6
Increased Mx-UI Length(mm)	28.3
Decreased U1/SN(°)	17.7
Decreased L1/MP(°)	8
Increased Mnd-UI Length (mm)	5.3
Skeletal	
Decreased Ar-Go-Me (°)	43.4
Decreased MndP-FH(°)	27.4
Increased SN-MxP(°)	26.5

N=113, Descriptive Statistics

Table 3: CORRELATION BETWEEN DENTAL AND SKELETAL FACTORS OF DEEP BITE MALOCCLUSION

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
A	1													
B	.56**	1												
C	.47**	.37**	1											
D	.27**	.35**	.44**	1										
E	.29**	.07	.14	-.16	1									
F	.14	-.03	.23**	.07	.15	1								
G	.23**	.08	.04	-.01	-.17	-.36**	1							
H	.17	.04	-.06	-.11	.07	-.42**	.66**	1						
I	-.25**	-.11	-.16	-.11	-.14	-.02	.15	-.10	1					
J	.26**	.10	.15	.05	.29**	.30**	-.01	.03	-.10	1				
K	.26**	.02	.27**	.10	.32**	.15	.10	.12	-.07	.48**	1			
L	.10	.11	.14	.04	.03	-.12	.10	.03	-.23**	.11	.04	1		
M	-.16	-.5	-.20**	-.10	-.18	-.11	-.05	.15	-.01	-.13	-.13	.12	1	
N	.11	.12	.20**	.18	-.23**	.08	.05	-.57**	.20**	-.09	-.06	.06	.012	1

N=113, Pearson Correlation, **Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed)
A- Mx-AABH, (mm), B- Mx-PABH, (mm), C- Md-AABH, (mm), D- Md-PABH, (mm), E- U1/SN, (º), F- L1/MP, (º), G- MndP-FH, (º), H- Ar-Go-Me, (º), I- SN-MxP, (º), J- Mx-UI length, (mm), K- Mnd-UI length, (mm), L- COS, (mm), M- Overbite, N- RFH, (º)

DISCUSSION

A deep bite malocclusion is clinical feature of various skeletal and dental discrepancies.A thorough examination of such skeletal and dental factors helps to design efficient mechanics which are crucial for effective correction of deep bite. Ceylan and Eroz[26] evaluated the effect of overbite on mandibular and maxillary morphology. Moreover, Baydas et al[9] examined the relationship between positions of incisors, overjet, overbite, lower anterior crowding and depth of curve of Spee. The present study targeted at shedding light on the various skeletal as well as dental features associated with deep bite, along with analysing their frequencies and determining the correlations among numerous parameters. El-Dawlatly et al[25] in their study on deep bite patients reported the mean value of this angle to be 82.06°±5.54. In our study, the mean value of ramus/Frankfort horizontal angle was found to be 81.53±5.98, which was comparable to their reported value. El-Dawlatly et al[25] further revealed that reduced gonial angle was most usually seen skeletal factor whereas increased maxillary plane angle was the least common factor, supporting the influence of angulation and growth of mandibular ramus in increasing deep bite compared with maxillary factors. Our results were in concordance to their study in this aspect. Marshall et al[27] in their study reported that an accentuated Spee's curve plays an important role in development of dental deep bite. Similarly, in present study, the increased Spee's curve also had the greatest influence amongst all the etiological factors. This highlights the significance of levelling Spee's curve for correction of deep bite by extrusion of lower posterior teeth and intrusion of lower anterior teeth in most deep bite patients. Second most frequent dental factor was the increased coronal length of upper incisors. Burstone[28] in his study supported intrusion of the upper incisors as the most viable treatment method for deep bite correction but, extent of intrusion depends on various factors to avoid deleterious effects to the facial appearance. Zachrisson[29] in his study described that the treatment choice relies on extent of visibility of the upper incisors on smile and at rest; extreme incisor show is best treated with intrusion maxillary incisors. Extruding posterior teeth or intruding lower front teeth are better treatment options in patients with average or diminished incisor show. The smile arc also guides for designing individualized treatment plan of patients with deep bite malocclusion. For subjects presenting with flat smile arc, intrusion of the upper front teeth is not recommended. Moreover, inclination of the maxillary incisors and the amount of overbite were not found to have any statistically significant correlation (r= - 0.18, p=0.057). Upper and lower anterior dentoalveolar heights showed statistically significant medium positive correlation (r=0.47, p=0.000). In this aspect,

our findings were in agreement with those of ElDawlatly et al.[25] This finding specifies that in individuals in whom upper incisor intrusion is planned for deep overbite improvement, intrusion of lower incisors should be considered and vice versa. This approach can improve stability, avoid excessive intrusion and reduces the risk of root resorption. In our study increased lower incisor inclination was found to have negative correlation with parameters evaluating the vertical facial growth pattern. This conclusion was in agreement with the Tweed analysis[30], confirming that as the tendency towards vertical facial growth pattern of increases, the lower incisor inclination tends to decrease and vice versa. The present study had its limitations. As this study primarily targeted on deep bite components in orthodontic patients, therefore outcomes were not representative of the general population. Hence, further research needs to be carried out to measure the etiological deep bite factors on a larger sample size showing a better and clearer picture of the whole population.

CONCLUSION

The present study helped us to draw various important conclusions and the key highlights were that a reduced gonial angle is the most frequently seen skeletal factor, showing the influence of angulation of mandibular ramus and growth in increasing deep bite. A deep Spee's curve is most frequently seen dental manifestation, ratifying the significance of intrudingmandibular anterior teeth. Retroclination of maxillary and mandibular incisors and increased mandibular incisor length were amongst least frequent occurring dental factors.

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