Research Article

Analysis of Skeletal and Dentoalveolar Components in Patients with Deep Bite Malocclusion

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ABSTRACT

Introduction: Deep bite is a common malocclusion in the Nepalese population. Temporomandibular disorder, periodontal damage, teeth attrition and interference with mastication are the main consequences of deep bite. Various methods of deep bite correction are available. A good understanding of different underlying causes of deep bites may help in the selection of correct treatment modalities. The main objective of this study was to evaluate skeletal and dental components in the Nepalese population.

Material and Methods: Fifty cases of deep bite and fifty normal overbite cases were selected from 230 cases of the Department of Orthodontics, CMC, Chitwan. Manual cephalometric tracing and dental cast measurement were conducted for seventeen skeletal and twelve dental components of deep bite. Mann-Whitney U Test and Pearson correlation test were performed for evaluation of the effect of different components and interobserver reliabilities respectively.

Result: Among all skeletal components, Gonial angle (p=0.004, occurrence=72%), lower facial height/upper facial height×100 (p=0.014, occurrence =72%), lower facial height/total facial height×100 (p=0.02, occurrence=68%) and Mandibular plane angle (P=0.037, occurrence 63%) had major role. Among the dental components, overjet (p=0.001, occurrence=90%) and curve of Spee (p=0.001, occurrence 84 %) had the highest effect on deep bite. Saddle angle and lower molar length had the least effect on deep bite.

Conclusion: Among the skeletal components, gonial angle, lower facial height to upper facial height ratio, lower facial height to total facial height ratio and mandibular plane angle contributed the most to deep bite development. Increased overjet and curve of Spee among were the dental components with great role in deep bite. Saddle angle and lower molar length had the least contribution to deep bite development.

KEYWORDS: Cephalometry; Deep bite; Malocclusion

INTRODUCTION

Overbite is defined as vertical overlapping of lower incisors by upper incisors which is normally 2-4 mm or 5 -25 %. Sometimes, up to 40 % of overbite without temporomandibular disorders can be considered as normal overbite.[1] So, overlapping more than 40% is considered a deep bite which may be associated with a potential deleterious effect on the stomatognathic system.[1] It is one of the most common malocclusions encountered in orthodontic practice.[2] Almost 67% of patients have a deep bite in the Nepalese population.[3] Proffit found more than 5 mm overbite in 20 % of children and 13% of adults in his study.[4] There are various consequences of deep bite. Temporomandibular joint problems, damage to periodontium, tooth wear, and interference with mastication are frequently seen with deep bite. A mild deep bite may not need correction, but a moderate to severe deep bite should be addressed at the correct time from both an esthetic and functional point of view.[1] Various methods of deep bite corrections are available in orthodontics which is selected on the basis of the etiology of deep bite. So good understanding

of different underlying causes of deep bite has always been mandatory for the success of deep bite correction.[5]

Different skeletal and dental components as the underlying cause of deep bite have been investigated in various studies. Most of the studies show gonial angle as the highest skeletal contributing factor and severe Curve of Spee as the highest dental contributing factor.[6-8] Decreased basal angle, decreased mandibular plane angle, increased upper anterior facial height (UAFH), increased ramus length, increased posterior facial height and increased Jarabak ratio can be seen in deep bite.[7]

In addition, Trouten et al found a downward rotation of the palatal plane, and a more forward position of the ramus, in deep bite cases.[8] Beckmann et al found small lower facial height in deep bite, whereas Al-Zubaidi and Obaidi found no difference in lower anterior facial height (LAFH) in deep bite and normal bite patients. Upper incisor length was the second highly contributing dental component. The lower and upper incisor lingual inclination had the least effect on deep bite.[6] Naumann et al found that skeletal components had a greater effect on deep bite than dental components and mandibular components had more influence than maxillary components.[9]

Though few studies have documented different components of deep bites, none of the research has been conducted in the Nepalese population to date. The purpose of the present study is to evaluate the effect of different skeletal and dental components of deep bite in the Nepalese population.

MATERIAL AND METHODS

This was a retrospective cross-sectional study which included pre-treatment study casts and lateral cephalograms of orthodontics patients of the Department of Orthodontics and Dentofacial Orthopedics of Chitwan Medical College, Nepal. The study was initiated after obtaining ethical clearance from the institutional review committee of Chitwan Medical College. A total of 100 cases (50 samples of normal overbite and 50 samples of deep bite) were selected from 230 case records. The sample size was calculated by utilizing the following formula for a finite population:

$$n = \frac{\frac{Z^2\, p(1-p)}{e^2}}{1 + \frac{Z^2\, p(1-p)}{e^2 N}}$$

Where, Z=1.96 at confidence level = 95%; p=0.13 (13%)[4] with a margin of error (e) = 0.05 (5%); N= 230,

The study samples were patients between 14 and 34 years. The inclusion criteria were: 1) permanent dentitions with erupted second molars (2) acceptable study cast and lateral cephalograms with equal and less than 30 % overbite for control group and equal or more than 70% of overbite for case group. The exclusion criteria were: (1) history of orthodontic treatment (2) presence of any systemic disease and craniofacial anomalies, and (3) missing tooth, supernumerary tooth and tooth anomalies.

Manual cephalometric tracing was conducted on standard tracing paper on a view box for cephalometric parameters to measure all skeletal and some dental components. A digital Vernier calliper was used to measure deep bite, Curve of Spee, upper and lower incisor crown lengths, upper and lower molar crown heights, and overjet on dental casts (Table 1 and Table 2). Ten cases were randomly selected and reanalysed by a different observer for the assessment of inter-observer reliability.

Table: 1 Skeletal components

Mandibular plane angle (FH-Go Me)
Basal angle (Ans Pns- Go Me)
Saddle angle (SN-SAr)
Articular angle (S-Ar-Go)
Gonial angle (Ar-Go-Me)
Sum of Bjork (Sum of Gonial, Articular and Saddle angle)
Inclination angle (Pnline-AnsPns)
Palatal plane angle (SN-Ans Pns)
Ramus-FH angle
Jarabak index (Posterior facial height /Anterior facial height ×100
Total anterior facial height (TAFH) (N-Me)
Upper anterior facial height (UAFH) (N-A)
Lower Facial height (LAFH) (A-Me)
Lower Facial height/Total Facial height×100 (LAFH/ TAFH)
Lower Facial height/ Upper Facial height ×100 (LAFH/ UAFH)
Ramus length (Ar-Go)
Posterior facial height (PFH) (S-Go)

Table: 2 Dental Components of Deep Bite

Maxillary anterior alveolar and basal height
Maxillary posterior alveolar and basal height
The inclination of the upper incisors (U1-PP)
Inclination of Lower incisors (L1-MP)
Mandibular anterior alveolar and basal height
Mandibular posterior alveolar and basal height
U1 Clinical Crown Length
L1 Clinical Crown Length
Curve of Spee
U6 Clinical Crown Length
L6 Clinical Crown Length
Overjet

Statistical methods

Version 20 SPSS was used for data analysis. Since the data were found to have followed non-normal distribution, median and skewness, standard error of skewness and percentiles as tools of descriptive statistics for each variable were calculated. Mann-Whitney U Test was conducted for the evaluations of the contributions of different components of deep overbite and normal overbite. Pearson correlation test was performed for inter-observer reliabilities. The level of significance was set at ≤ 0.05.

RESULTS

The results of the statistical analysis of all skeletal and dental components are shown in table 3 and table 4 respectively where minimum, maximum, median, interquartile range (IQR) and p-value of each component are given. Among skeletal components gonial angle (p=0.004) had the greatest contribution in the development of deep bite followed by LFH/UFH×100 (p=0.014), LFH/TFH×100 (p=0.02), mandibular plane angle (p=0.037). Similarly, among dental components, overjet (p<0.001), and curve of Spee (p<0.001) had the highest effects on deep bite development among all dental components. Maxillary anterior alveolar and basal height (p=0.043) was the next highest dental component followed by maxillary posterior alveolar and basal height (p=0.023), mandibular posterior alveolar and basal height (p=0.026) and lower incisor clinical crown length (p=0.008).

In the present study, the occurrence of different components in the deep bite group was also calculated. Among all skeletal components, gonial angle (72%), LFH/UFH×100 (72%), LFH/TFH×100 (68%) had the highest occurrence, whereas saddle angle (32%) had the least occurrence in the case group. Similarly, increased overjet (90%), Curve of Spee (84%) and lower incisor clinical crown length (76%) had the greatest and lower molar clinical crown length (40%) had the least occurrence in the deep bite group than the normal group. (Fig: 1 and Fig 2).

Mandibular plane angle, inclination angle, ramus-FH, lower facial height, maxillary anterior alveolar and basal height, the inclination of lower incisors and L6 clinical crown length had significant value in Pearson correlation for inter-observer reliability. In the rest components, no significant difference was found in inter-observer measurements.

Table 3: Significance of different skeletal components of deep bite

	Normal (control group)					Deep Bite (case group)				Mann-Whitney U test
S. No.	Components	min	Median	IQR (Q3-Q1)	max	min	Median	IQR	max	p-value
1	Mandibular plane angle	17	24.00	29-21	43	7	22.50	25.00-20.00	32	0.037*
2	Basal angle	13	24.00	28-20	40	10	24.50	28.00-21.75	32	0.732
3	Saddle angle	109	122.75	126.25-119.00	135	109	124.50	129.00-121.75	137	0.069

4	Articular angle	128	143.00	148.50-139.00	168	126	142.00	148.250-135.00	162	0.508
5	Gonial angle	113	129.00	131.00-123.75	142	109	125.00	129.00-118.75	140	0.004*
6	Some of Bjork	378	393.00	400.25-389.75	411	365	393.00	398.00-388.75	407	0.326
7	Inclination angle	77	86.00	89.00-83.00	107	77	85.00	88.25-82.75	96	0.666
8	Palatal plane	3	9.00	11-7	18	3	8	10.00-5.00	15	0.750
9	Ramus-FH angle	68	77.00	81.25-73.75	98	61	79.50	84.00-74.75	94	0.211
10	Jarabak index	53.71	66.49	69.742-63.322	76.27	55.1	66.05	70.10-61.80	79	0.920
11	Total anterior facial height	84	177.00	121.00-110.75	147	81	116.50	121.00-111.00	137	0.997
12	Upper anterior facial height	40	55.00	58.00-52.00	64	39	55.00	58.25-53.00	70	0.782
13	Lower facial height	46	61.00	64.00-57.00	79	46	59.50	64.00-55.00	75	0.409
14	LAFH/TFH×100	44.14	52.96	54.23-50.72	56.48	24.3	51.60	53.17-49.89	67.91	0.020*
15	LAFH/UAFH×100	85.96	112.62	117.375-102.9500	131.37	80.32	107.058	114.80-99.57	112.367	0.014*
16	Ramus length	30	45.00	49.00-41.00	62	26	46.00	50.50-42.00	85	0.280
17	Posterior facial height	55	76.00	81.00-69.750	104	59	77.00	82.25-70.75	93	0.553

Table 4: Significance of different dental components of deep bite

	Normal (control group)					deep bite (case group)				Mann-Whitney U test
S. No.	Components	Min	Median	IQR	max	min	Median	IQR	max	p-value
1	Maxillary ant alv basal ht	12.5	19.00	21.00-17.00	25	13	20.00	23.00-18.00	32	0.043*
2	Maxillary post alv basal ht	10	16.00	18.00-14.875	22	7	15.00	17.00-12.00	28	0.023*
3	Upper incisor inclination	105	122.00	124.250-117.00	133	99	123.00	130.00-1116.00	137	0.244
4	Lower incisor	76	96.00	103.625-91.750	120	74	95.00	100.00-90.00	110	0.252
5	Mand ant alv basal ht	23	32.00	34.00-28.750	43	24	32.00	34.250-29.00	41	0.852

6	Mnd posterior alv basal ht	15	25.00	26.250-22.00	32	16	23.00	25.00-20.00	30	0.026*
7	U1 clinical crown length	7	9.50	10.00-9.000	11	7	9.00	10.00-8.375	11	0.323
8	L1clinical crown length	5	7.75	8.00-7.00	11	4.5	7.00	7.625-6.500	10	0.008*
9	Curve of spee	0.5	1.50	2.00-1.00	3	0.5	2.25	3.100-1.712	4.25	<0.000*
10	U6 clinical crown length	4	6.00	6.50-5.00	7	3	5.50	6.00-4.50	10.5	0.147
11	L6 clinical crown length	4	6.00	6.50-5.50	7	5	6.00	7.00-5.50	11	0.615
12	Overjet	0.5	2.00	3.00-0.87	9	1	5.00	8.00-4.00	16	<0.001*

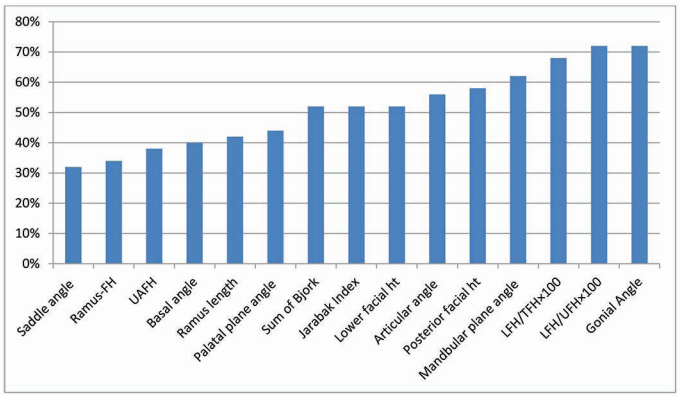

Fig. 1: Percentages of occurrence of skeletal components in deep bite malocclusion

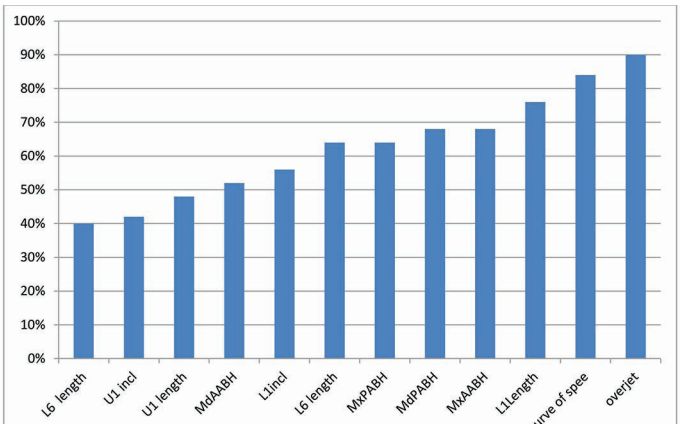

Fig. 2: Percentages of occurrence of dental components in deep bite malocclusion.

DISCUSSION

Deep bite is one of the frequently encountered vertical discrepancies in dental practices. It has both functional and esthetic effects. So it has to be addressed during orthodontic treatment. Knowledge of different components of deep bite is the key factor in the proper management of deep bite. This study aimed to analyze the effect and occurrence of different skeletal and dental components in the development of deep bites. Trounten et al. compared the curve of Spee in normal overbite, open bite and deep over bite cases and found an increased curve of Spee in deep bite groups and intermediate and negative curvature in normal and open bite groups, respectively.[8] In our study, the exaggerated overjet (p<0.001) and curve of Spee (p<0.001) had a very strong contribution to deep bite among all dental and skeletal components. In the present study maxillary anterior alveolar basal height (p=0.043), maxillary posterior alveolar basal height (p=0.023), lower incisor length (p=0.008) and mandibular posterior alveolar basal height (p=0.026) were statistically significant but mandibular anterior alveolar basal height was not significantly different. The study conducted by Al-Zubaidi and Obai-di reported no significant difference in the maxillary and mandibular anterior alveolar and basal height when compared with normal overbite.[10] Mostafa et al. reported the negligible effect of lower incisor length in deep bite.[6]

Decreased gonial angle (p=0.004) had the highest contribution to the development of deep bite among skeletal components which was similar to the earlier studies.[6,8] The ratio of the lower anterior facial height to upper anterior facial height (p=0.014) was the second most significant finding among skeletal components. Mandibular angle (p=0.037) was also a significant component in deep bite as reported by other researchers.[6,7] Fattahi et al. and Trouten et al. reported

that the ratio of the lower anterior facial height to the total anterior facial height was the most significant component in deep bite development.[7,8] This study also showed good agreement with previous studies.

Decreased Gonial angle had the greatest occurrence and decreased saddle angle had the least occurrence among skeletal components. Similarly, increased overjet had the greatest occurrence and decreased height of the crown of the lower first molar was the least found dental component in the present study. Whereas in the study conducted by Mostafa et al. decreased gonial angle was the most found skeletal component and curve of Spee was the highest contributing dental component and increased length of lower incisors was the least contributing dental component.[6]

In the present study, the occurrence of different components in the deep bite group was also calculated. The limitation of the study was that the comparison of the case group had been done with the measured value of the control group. No standard value of different components of deep bite in the Nepalese population exists to date. So, a study on identifying normal values of different components of overbite in patients having normal occlusion in the Nepalese population is necessary.

CONCLUSION

Gonial angle had the highest contribution in deepbite. In the acute gonial angle case direction of the growth pattern is horizontal which is favourable for the anterior positioning of the mandible with myofunctional appliance. Similarly, LFH/UFH, LFH/TFH and mandibular plane angle also have a significant relation with deep bite among skeletal components. Among dental components, increased overjet and curve of spee contributed the most to deepbite. Saddle angle and lower molar length had the least contribution to deep bite development.

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