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A CEPHALOMATRIC EVALUATION OF RELATIONSHIP BETWEEN POSTERIOR DENTOALVEOLAR HEIGHT AND ANTERIOR CRANIOFACIAL HEIGHT – AN INVITRO STUDY ON NAVI-MUMBAI POPULATION

Dental Science

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ABSTRACT

Objective: 1.The aim of the study was to evaluate the relationship between posterior dentoalveolar height and anterior craniofacial height in Navi-Mumbai population. 2. To evaluate the relationship between posterior dentoalveolar height and anterior craniofacial height among average, horizontal and vertical growth pattern individuals by using multiple regression analysis.

Materials and Method: The study was conducted by using pre-treatment lateral cephalograms of 75 patients. Age of patients was 15-25 yrs. Tracing of the cephalogram was done for identification of the landmarks 3 angular, 3 linear and 5 vertical parameter that is total 11skeletal parameter were correlated with maxillary molar dentoalveolar height (MxMDH) and mandibular molar dentoalveolar height (MdMDH).

Result: MxMDH and MdMDH were found positively correlated with lower anterior facial height. MdMDH was more positively correlated with lower facial height than MxMDH. There was positive correlation between Chorological age and MdMDH.

Conclusion: Increase or decrease of lower anterior facial height directly depends on posterior molar dentoalveolar height. Lower anterior facial height was more dependent on MdMDH than MxMDH. Chronological age positively influenced MdMDH.

KEYWORDS

Lower anterior facial height, Maxillary molar dentoalveolar height, Mandibular molar dentoalveolar height.

Introduction:

During growth and development of face, compensatory dentoalveolar changes bring about positional changes in the jaws, which is one of the factors responsible for the end result being short, normal or long face. The relation of dentoalveolar height with craniofacial height is of great importance from orthodontic perspective. During facial growth and development, normal occlusion can be attained and maintained despite some variations in facial pattern, primarily as a result of dental compensation.[1,2,3]

Several investigators like Zafar et al, Janson et al and Enonki et al reported no difference in incisor and molar heights in long or short faces when compared to normal faces.[4,5,6] On the contrary, other investigators like Stephen et al, Field et al, Bishara et al and Beckmann et al reported that maxillary and mandibular incisor and molars heights are greater in long faces as compared to the normal faces.[7,8,9,10]

To arrive at a proper diagnosis & treatment plan and to obtain expected result with ultimate stability, it is essential for the orthodontist to have knowledge regarding the relationship between posterior dentoalveolar height & anterior vertical craniofacial component.[15,16]

Therefore this study was designed to evaluate the relationship between posterior dentoalveolar height and anterior craniofacial height by means of multiple regression analysis.

Materials and Method:

The study was conducted by using pre-treatment lateral cephalograms of 75 patients who visited Department of Orthodontics and Dentofacial Orthopaedics, of local Dental College and Hospital in Navi-Mumbai. Standardized Lateral cephalograms were taken by a single operator using a Cephalostat device. The Lateral cephalograms were taken of subjects in natural head position and with full intercuspal position as shown in (Figure no.1). Natural head position was recorded by the subject looking in the mirror into his own eyes in a self balanced and relaxed head position. The mirror was positioned at a distance of 1 meter in front of the subject. Based on the inclusion and exclusion criteria the sample size of 75 cephalograms was selected.

Fig.1.Positioning of the Patient for lateral cephalogram

Inclusion criteria:

1. Age group between 15- 25yrs.
2. Complete Permanent dentition (except 3rd molar).
3. Residence of Navi-Mumbai with Maharashtrian ethnic background.

Exclusion criteria:

1. Previous or ongoing orthodontic treatment.
2. Unilateral or bilateral posterior cross bite.
3. Missing teeth.
4. Abnormal functional oral habits.
5. Periodontal disease.
6. Extensive dental restorations or crown.
7. Mandibular or Maxillary skeletal and dental asymmetry in all the three planes of space.
8. Dental anomaly with respect to molars

Recording of the data: The pre-treatment orthodontic patients' lateral cephalograms were taken in a standardized technique with the patients in natural head position (Fig.1).Tracing of the cephalograms were done by a single operator on the lead acetate paper using the armamentarium consisting of 0.3mm Steadier pencil, set squares, eraser, ruler, tracing box and rechecked by a different operator (Fig.2).

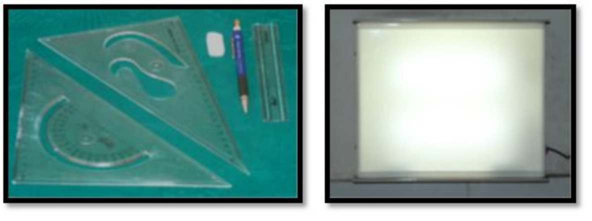


Fig.2 Armamentarium used for tracing- Set square, Millimeter ruler, Steadler Pencil (0.3mm), Eraser, Tracing Paper & Box.

Cephalometric tracing and identification of the landmarks was done and cephalometric planes were constructed (Fig.3, 4). Linear, vertical and angular measurements were used in this study as follows

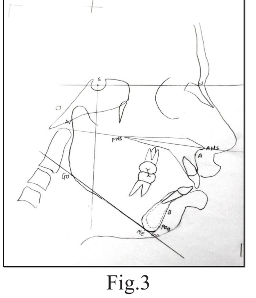


Fig.3

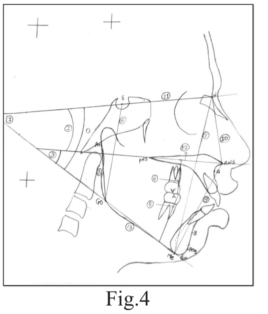


Fig.4

Fig.3 Skeletal cephalometric Landmarks and Planes: sella (S), the midpoint of the cavity of sella turcica; nasion (N), the anterior point of the intersection between the nasal and frontal bones; point A (A), the most posterior point on the anterior surface of the maxilla; point B (B), the most posterior point on the anterior surface of the symphyseal outline; menton (Me), the intersection point of the posterior symphysis contour and the inferior contour of the corpus; pogonion (Pg), the most anterior point of the contour of the chin; gonion (Go), the point on the contour of the mandible determined by bisecting the angle formed by the mandibular and ramal planes; articulare (Ar), the intersection point of the inferior cranial base surface and the averaged posterior surfaces of the mandibular condyles; ANS point (ANS), the most anterior point of the bony hard palate in the mid-sagittal plane; PNS point (PNS), the most posterior point of the bony hard palate in the mid-sagittal plane. S-vertical plane, a line perpendicular to Na-S line, through S point; palatal plane (PP), a line that connect ANS to PNS; mandibular plane (MP),a line that connects Go to Me;N-S, a line that connects N to S

Fig.4 Cephalometric Tracing: 1. SN-MP, 2.SN-PP, 3.PP-MP, 4.MxMDH, 5.MdMDH, 6.Se-Go, 7.N-Me, 8. Ar-Go, 9.ANS-Me, 10.N-ANS, 11.SN (mm), 12.PP (mm), 13.MP (mm).

Linear parameter- 1. SN: Linear measurement of a line that connects sella to nasion.

2. PP: Linear measurement of a line that connects ANS (anterior nasal spine) to PNS (Posterior nasal spine).

3. MP: Linear measurement of a line that connects gonion to menton. (Length of body of mandible)

Vertical parameter

4. MxMDH: Maxillary molar dentoalveolar height: The distance between the mesiobuccal cusp
tip of the upper first molar to the palatal plane.

5. MdMDH: Mandibular molar dentoalveolar height: The distance between the mesiobuccal cusp tip of the lower first molar to the lower border of the mandible.

6. S-Go: Posterior facial height- The distance between the Sella point and the Gonion point.

7. N-Me: Anterior facial height- The distance between the Nasion point and the Menton point.

8. Ar-Go: Ramus length - The distance between the Articulare point and the Gonion point.

9. N-ANS: Anterior upper facial height -The distance between the Nasion point and the Anterior nasal spine.

10. ANS-Me: Anterior lower facial height -the distance between the ANS (anterior nasal spine) point and the Me point (menton).

Angular parameter

11.SN-MP: The angle between the sella nasion plane and mandibular plane.

12.SN-PP: The angle between SN plane to palatal plane.

13.PP-MP: The angle between palatal plane and Mandibular plane

Statistical method: Multiple regression analysis

Software used: Software used for statistical analysis was Windows (SPSS 13.0, Chicago, Ill; MATLAB).

Statistical analysis:

Data was first analyzed with conventional descriptive statistics, the means, SDs, standard errors of the mean, and ranges (minimum-maximum) were calculated for all the cephalometric measurements. Multiple linear regression analyses with a stepwise backward elimination were performed. The multiple regression analysis is a technique used to model or to predict one variable (dependent variable) from multiple explanatory variables (independent). The stepwise backward approach starts entering all explanatory variables and then sequentially eliminates the variable that contributes the least to the model The maxillary and mandibular molar dentoalveolar heights were considered as the response variables (dependent variables). Explanatory variables (independent variables) entered into the model were 'gender," "age" and the cephalometric measurements set described previously.

Results:

Descriptive statistics for the cephalometric measurements obtained from the whole sample investigated was performed and tabulated. (Table no.1)

Table no.1: Mean values evaluated from the findings

Variable	N	Minimum	Maximum	Mean	Std.Deviation
Age	75	15.0	25.0	20.187	3.2867
SN-MP (deg)	75	15.0	50	32.813	6.7377
SN-PP (deg)	75	1.0	15.0	7.000	3.1665
PP-MP (deg)	75	10.0	44.0	26.080	5,9178
MxMDH(mm)	75	17.0	28.0	21.533	2,1519
MdMDH(mm)	75	24.0	36.0	29.587	2.9869
S-GO (mm)	75	41.0	88.0	69.533	6.7870
N-Me (mm)	75	92	122.0	104.907	6.7025
Ar-Go (mm)	75	34.0	52.0	41.907	4.2749
N-ANS (mm)	75	38.0	55.0	45.480	3.7466
ANS-Me(mm)	75	50.0	74.0	61.680	5.4554
SN (mm)	75	39.0	77.0	65.067	5.3254
PP (mm)	75	42.0	61.0	49.893	4.3014
MP (mm)	75	55.0	73.0	62.893	4.5428
Valid N	75				

The Correlation coefficient of the various skeletal variables such as Posterior facial height (S-Go), Total anterior facial height (N-Me), Lower anterior facial height (ANS-Me), length of Sella Nasion plane (SN), Age (years) for Maxillary Molar Dentoalveolar Height (MxMDH) and Mandibular Molar Dentoalveolar Height (MdMDH) was analyzed and tabulated (Table 1&2)

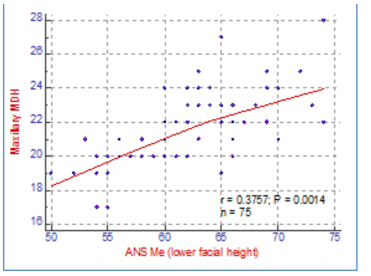
I. After the stepwise elimination for Maxillary Molar Dentoalveolar Height (MxMDH) was done, it was seen that there is positive correlation between MxMDH and ANS-Me. (P<0.01) (Table no.2),

Table no.2: Evaluating MxMDH relation to anterior and posterior craniofacial Parameter.

Independent variables	*Coefficient*	*Std. Error*	*rpartial*	*t*	*P*
(Constant)	-0.2336				
S_Go	0.05732	0.02918	0.2318	1.965	0.0535
N_Me	0.1054	0.06238	0.2007	1.690	0.0956
ANS_Me	0.1968	0.05886	0.3757	3.343	0.0014*
SN	-0.08300	0.04661	-0.2111	-1.781	0.0795

*denotes significant predictor P<0.05

The scatter plot of ANS-Me to MxMDH shows the strength of association which can be visualized in the best fit line.(Graph.no.1)



Graph.no.1 Scatter plot of MxMDH vs ANS-Me

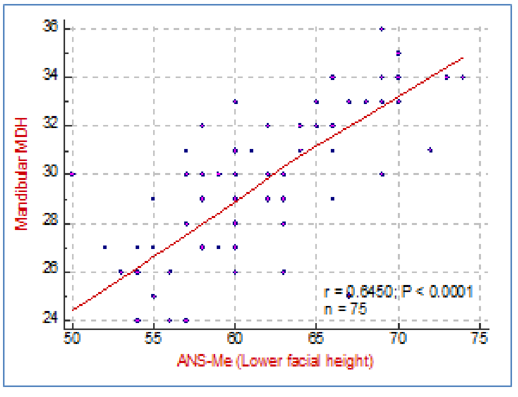
II. After the stepwise elimination for Mandibular Molar Dentoalveolar Height (MdMDH) was done, it was seen that there is positive correlation between MdMDH and ANS-Me. (P<0.01) (Table. No.3)

Table no.3.: Evaluating MdMDH relation to anterior and posterior craniofacial Parameter

Independent variables	*Coefficient*	*Std. Error*	*r partial*	*t*	*P*
(Constant)	-1.5984				
ANS_Me	0.3157	0.04439	0.6450	7.112	0.0001*
Age	0.2487	0.06925	0.3922	3.592	0.0006*

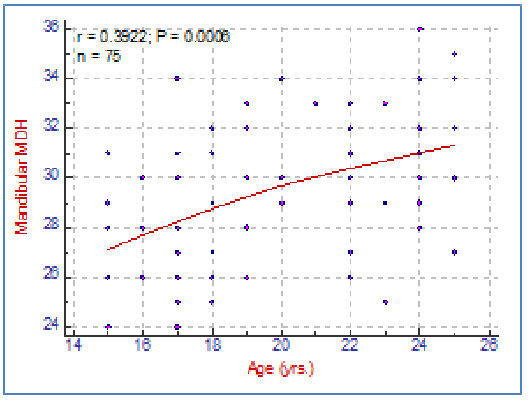
*denotes significant predictor P < 0.05

The scatter plot using ANS-Me with MdMDH which shows the strength of association which can be visualized in the best fit line. (Graph no.2),



Graph no.2: Scatter plot of MdMDH vs ANS-Me

Chronological age was also found to be in positively correlated with MdMDH. (P<0.01) MdMDH shows the strength of association which can be visualized in the best fit line. (Graph no.3)



Graph no.3: Scatter plot of MdMDH vs Age

No other craniofacial parameters were found to be significantly correlated with MxMDH and MdMDH.

The positive correlation of the lower anterior facial height to dentoalveolar heights was more pronounced for mandibular posterior dentoalveolar height (r=0.6450) than for the maxillary posterior dentoalveolar height (r=3757). i.e. the scatter plot plane of MdMDH was more steeper and strength of association is more visualized in best fit line than that of MxMDH. (Graph no.1&2)

Discussion:

The eruption of teeth is essential for growth and development of the entire dentoalveolar apparatus. One of the factors controlling growth of alveolar bone is teeth eruption and it resorbs when teeth are exfoliated or extracted. The dentition in both arches is carried forward and downward along with the development of maxilla and mandible, maintaining the teeth in intercuspation. Hence the alveolar processes serve as important buffer zones helping to maintain occlusal relationships during differential mandibular and midface growth.

The present study showed that Lower anterior facial height (LAFH) is in directly proportional to the Maxillary molar dentoalveolar height and mandibular molar dentoalveolar height (MxMDH and MdMDH), which is in agreement with the findings of Martina R et al.[15] who suggested that increase in LAFH resulted in increase of MxMDH and MdMDH, decrease in LAFH resulted in decrease in length of MxMDH and MdMDH. In long face subject the length of LAFH increased due to increase in MxMDH & MdMDH and in short face subject the LAFH is decreased due to decrease in MxMDH & MdMDH.[4,7,8,9,10,16,17,19]

The result of regression model of the present study showed that LAFH was more positively correlated with MdMDH (r=0.6450) than MxMDH (r = 0.3757). So, increase and decrease in the LAFH is more dependent on MdMDH than MxMDH. A study done by Singh A et al found that molar dentoalveolar heights are significantly different between excess, normal and decreased LAFH. i.e. molar dentoalveolar height is directly proportional to LAFH which is similar to the results of the present study. Singh A et al also found that MxMDH is more positively correlated to LAFH than MdMDH which is in contrast to the results of the present study.[20]

The results of present study also showed significant positive correlation between MdMDH and Chronological Age (r=0.3622) So, MdMDH was found to be increased with increase in age of the samples. This result could be attributed to the late mandibular growth in subjects. Similarly Buschang et al and Bhatia and Leight et al found that both MxMDH and MdMDH increases with increase in age in subjects of age group 10 to 15 years of age.[21] however they found that MxMDH is more positively correlated than MdMDH with chronological age. Martina R et al and Janson et al found that both the maxillary and mandibular molar dentoalveolar height was not influenced by age.[4,15]

A potential explanation to this may be that different statistical approach were used in this present study, which took into account the simultaneous contribution of multiple factors to the individual variation of the molar dentoalveolar heights. Furthermore, the variability of age of the subjects selected for this study was rather restricted because most of the patients investigated were young adults.

Nevertheless, it is suggested that the results of the regression analysis support previous studies such as Nahoum, Opdebeeck, Cangialosi, Schendel, Tsang, Fields, Johnson, Bishara, Beckmann, Proffit and Isaacson et al [3,4,7,8,9,10,16,12,22,23,24] They stated that excessive dentoalveolar development is a general characteristic of subjects with long-face morphology and a deficient dentoalveolar development is a characteristic of subjects with short-face morphology. In this present study, because there was simultaneous contribution of multiple craniofacial features on molar dentoalveolar heights, thus, the findings cannot be directly compared with previous studies.

In the treatment of hyperdivergent cases intrusion of molars is one of the effective treatment. After intrusion of molars, mandible moves upward and forward direction. i.e. mandible gets auto rotated in counter clockwise direction. Vadgaonkar V et al found that maxillary Le Fort I surgery involving superior repositioning of maxilla created autorotation of the mandible. i.e. the 0.5 degree of autorotation results with 1 degree of maxillary posterior segment rotation in clockwise directions.[25] Similarly, Sherwood et al found that 1.99 mm dentoalveolar intrusion of molar results in 2.6 degree reduction in mandibular plane angle.[26] Kurdo et al found that 5.1 mm intrusion of molar reduces the mandibular plane angle by 5.6 degree.[27] Thus the intrusion of molars and subsequent counter clockwise rotation of mandible can mimic the result of bi-jaw surgery, in case the patient is in not in favour of surgical approach, in severe hyperdivergent cases with associated skeletal sagittal dysplasia.

In high angle cases, mandibular plane angle can be reduced by mesial movement of posterior teeth due to wedging effect. Schudy et al found that, the premolar extraction is associated with mandibular over closure and resulted in reduction of vertical dimension. After premolar extraction, molar moved in forward direction and due to wedging effect the mandible is autorotated in counter clockwise direction.[28] Sassouni, Nanda et al also agreement with these.[29]

In low angle cases, true deep overbite is prominent characteristics due to infraocclusion of molars. The eruption of the molars can be achieved by using a flat anterior bite-plane on an upper removable appliance to free the occlusion of the buccal segment teeth. If worn conscientiously, it limits further occlusal movement of the incisors and allows the lower molars to erupt, thus reducing the overbite. This method is however indicated in a growing patient to accommodate the resulting increase in vertical dimension; otherwise the molars will re-intrude under the forces of occlusion and action of the mandibular elevator muscles once the appliance is withdrawn.[30]

Dentoalveolar regions are considered more prone to environmental influences than to inherited influences and it has also been suggested that during growth, the teeth erupt adapting to the space resulting from the growth pattern of the upper and lower jaws. Furthermore, it is a common experience that dentoalveolar heights can be modified, to some extent, by orthodontic treatment. For these reasons, in our regression model, the molar dentoalveolar heights have been considered as response variables (dependent variables).

The results of this study could be of interest in view of their potential clinical implications in orthodontics or orthognathic surgery because orthodontic or surgical correction of extreme vertical face discrepancies are often based on the assumption that excessive vertical facial types are characterized by excessive dentoalveolar development and vice versa.[31]

It must be stressed that this study investigated a sample of subjects who belong to Navi Mumbai population with Maharashtrian ethnic background. These were referred to the orthodontic department for clinical consultation because of dental or skeletal malocclusions. However the urban cosmopolitan population today consists of people having mixed heritage of diverse inheritance due to frequent inter-racial marriages. Therefore, these results cannot be inferred as norms for Navi-Mumbai population with Maharashtrian ethnic background. Further studies may provide normative values for the relationship between molar dentoalveolar heights and craniofacial morphology in individuals of general population without malocclusion.

Recommendations for studies in future:

Similar studies can be carried out on rural population involving subjects of pure Maharashtrian ethnic origin to establish norms. More research in future needs to be done to evaluate the relation between anterior craniofacial height with anterior dentoalveolar height (maxillary and mandibular incisal height) in Navi-Mumbai population. Also future studies can be considered to find out dentoalveolar compensation in high and low angle cases in Navi Mumbai population.

Conclusion:

The present study concluded that:

1. The anterior lower facial height is positively correlated to maxillary molar dentoalveolar height (MxMDH) and mandibular molar dentoalveolar height (MdMDH).
2. The regression model showed that anterior lower facial height is found more positively correlated with mandibular molar dentoalveolar height (MdMDH) than maxillary molar dentoalveolar height (MxMDH)
3. Chronological age is positively correlated with mandibular molar dentoalveolar height (MdMDH).

References :

1. Bjork A, Skieller V, et al. Facial development and tooth eruption. An implant study at the age of puberty. Am J Orthod. 1972; 62:339–83.
2. Solow B. The dentoalveolar compensatory mechanism: background and clinical implications. Br J Orthod. 1980; 7:145–61.
3. Isaacson JR, Isaacson RJ.et al. Extreme variation in vertical facial growth and associated variation in skeletal and dental relations. Angle Orthod. 1971; 41:219–29.
4. Janson G, Metaxas A, et al. Variation in maxillary and mandibular molar and incisor vertical dimension in 12-years-old subjects with excess, normal, and short lower anterior face height. Am J Orthod. 1994; 106:409–18.
5. Ismail Ceylan. The Effects of Overbite on the Maxillary and Mandibular Morphology Angle Orthod. 2001;71:110–15.
6. Zafar UI,Shaikh A, et al. Dentoalveolar heights in skeletal class I normodivergent facial patterns. Journal of the College of Physicians and Surgeons Pakistan 2012; 22(1):5-9.
7. Schendel S, Eisenfeld J, et al. The long face syndrome vertical maxillary excess. Am J Orthod. 1976; 70:398– 408.
8. Fields H, Proffit W, et al. Facial pattern differences in long-face children and adults. Am J Orthod. 1984; 85:217–23.
9. . Bishara S, Augspurger E, et al. The role of the mandibular plane inclination in orthodontic diagnosis. Angle Orthod. 1975;45:273–81.
10. Beckmann S, Kuteirt R, et al. The RPS, Tuinzing DB. Alveolar and skeletal dimensions associate with lower face height. Am J Orthod. 1998; 113:498–506.
11. Yavuz I, Cylen I, et al. Longitudinal posteroanterior changes in transverse and vertical craniofacial structures between 10 and 14 years of age. Angle Orthod. 2004; 74:624–29.
12. Opdebeeck H, Bell WH, et al. The short face syndrome. Am J Orthod. 1978; 73:499–511.
13. Betzenberger D, Ruf S, et al. The compensatory mechanism in high-angle malocclusion: a comparison of subjects in mixed and permanent dentition. Angle Orthod. 1999; 69:27–32.
14. Subtelny J D, Sakuda M, et al. Open-bite, diagnosis and treatment. Am J Orthod.1964 ; 50 : 337 – 58.
15. Martina R, Farella M, et al. Molar dentoalveolar and craniofacial heights. Angle Orthod. 2005; 75:974-9.
16. Proffit W. Contemporary orthodontics. In: Proffit WR, White RP, et al. Late stages of development. 3rd ed. St Louis,Mo: CV Mosby; 2000;104–05.
17. Nahoum H. Vertical proportions: a guide for prognosis and treatment in anterior open-bite. Am J Orthod.1977; 7:128- 46
18. Opdebeeck H, Bell W et al. Comparative study between the SFS and LFS rotation as a possible morphogenic mechanism. Am J Orthod. 1978; 74:509–21.
19. S. H. Beckmann, R. B. Kuitert, et al Alveolar and skeletal dimensions associated with overbite. Am J Orthod.1998; 113: 443-52.
20. Singh A, Sharma V, et al. A ceplalometric evaluation of lower face height and its relationship with dentoalveolar vertical dimension. J Ind Ortho Soc 2006; 39:204-12.
21. Buschang P, Carrillo R.et al. Maxillary and mandibular Dentoalveolar Heights of French-Canadians 10 to 15 Years of Age. Angle Orthod. 2008; 78:1: 70-76.
22. Nahoum HI, Horowitz SL, et al. Varieties of anterior open bite. Am J Orthod. 1972; 61:486-92.
23. Cangialosi T. Skeletal morphologic features of anterior open-bite. Am J Orthod. 1984; 85:28–36.
24. Tsang W, Cheung L, et al. Cephalometric parameter affecting severity of anterior open-bite. Int J Oral Maxillofac Surg. 1997; 26:321–26.
25. Vadgaonkar V, Gangurde P, et al. Orthodontic and surgical perspectives in management of a sever skeletal open bite.BMJ Case Report 2014 May 16;2014.
26. Sherwood K, Burch J, et al. Closing anterior open bites by intruding molars with titanium miniplate anchorage. Am J Orthod.2002;122:593-600.
27. Kuroda S, et al. Severe anterior open-bite case treated using titanium screw anchorage. Angle Orthod.2004; 74:558–67.
28. Schudy F. The control of vertical overbite in clinical orthodontics. Angle Orthod.1968; 38:19–39.
29. Sassouni V, Nanda S. Analysis of dentofacial vertical proportions. Am J Orthod. 1964; 50:801–23.
30. Selwyn-Barnett B, et al. Rationale of treatment for Class II division 2 malocclusion. Br J Orthod. 1991 Aug; 18(3):173-81.
31. Schudy F. Vertical growth versus anteroposterior growth as related to function and treatment. Angle Orthod. 1964:34:75-93.