Original Article

COMPARISON OF DENTOALVEOLAR HEIGHTS IN RELATION TO VERTICAL FACIAL PATTERN

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ABSTRACT

Objective: *The objective of the present study was to evaluate the dentoalveolar heights among different vertical growers and to find differences between the groups.*

Material and Methods: *This study was designed as a cross-sectional study at the Department of Orthodontics and Dentofacial Orthopedics, Khyber College of Dentistry Peshawar using a sample of 100 patients. The sample included 35 male subjects and 65 female subjects. The data of patients was obtained in the form of good quality cephalograms and traced manually. The subjects were divided into 3 groups depending upon the divergence of mandibular plane angle: normodivergent(32±4°), hyperdivergent(≥ 37°) and hypodivergent(≤27°). There were 43 patients in normodivergent group, 30 in hyperdivergent and 27 in hypodivergent group. The dentoalveolar heights were measured as perpendicular distances from the upper incisal tip and mesiobuccal cusp of upper first molar (upper anterior dental height and upper posterior dental height respectively) to the palatal plane in millimeters. Similarly lower incisor and mandibular first molar heights were measured as perpendicular distances to the mandibular plane(Go-Me) as lower anterior dental height and lower posterior dental height respectively.*

Results: *One way ANOVA revealed significant differences between the groups (p-value ≤ .05).The upper anterior dental height showed statistically significant difference among the groups (p-value 0.049) being 27.26±3.13mm for hyperdivergent group while 24.96±3.95mm for hypodivergent group. Lower anterior dental height also showed significant difference among the groups (p value- .046). No significant difference was found between the groups for lower posterior dental height and upper posterior dental height. This shows that vertical dysplasia is associated with dentoalveolar compensations which are more pronounced in anterior maxillary and mandibular regions.*

Conclusions: *Our study concluded that well differentiated Oral Squamous.*

Key words: *Dentoalveolar compensation, Mandibular plane, Incisor, Molar height, Vertical pattern.*

INTRODUCTION

A proportional and harmonious facial pattern results from compensatory mechanism within the dentofacial complex. Deviation of maxilla or mandible from its normal growth pattern is camouflaged by craniofacial structures to variable extent1. Similarly dental compensation occurs in order to mask anteroposterior and vertical basal bone discrepancies for a normal occlusal relationship[1,2].

Different combination of sagittal and vertical dimensions results in facial types of multidimensional nature. Intimate interaction of orofacial structures (teeth, muscles and bone) occurs during growth, increasing or masking initial deformities[3]. Vertical dysplasias are in many cases associated with sagittal dysplasia and therefore, a single parameter is not sufficient to accurately identify a given facial type[4]. Disproportions and malpositions of the structure often lead to malocclusions or facial deformities.

In vertical plane, skeletal discrepancy results in either long face or short face which is often accompanied by an abnormal vertical development of posterior dentoalveolar region as a compensatory mechanism[5]. Dentoalveolar compensation has two main components. The first component is related to vertical development of the basal and dentoalveolar height while the second part affects incisor inclination[6-8]. An accurate estimation of dentoalveolar dimension is a

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key to successful treatment. Orthodontists have long been interested in the difference in diagnosis, treatment planning and treatment responses between hyperdivergent and hypodivergent facial types. The decision of extraction, requirement of anchorage, mechanics and retention period are affected by the growth pattern which an individual possesses[9].

Schudy[10] stated that mandibular plane angle is useful in describing different facial types and should be considered in treatment planning. Bishara and Augspurger[11] reported that changes in the mandibular plane angle are associated with facial and dental characteristics.

Some authors reported the mandibular length, anterior upper and lower dentoalveolar height to be responsible for variable facial height[12]. Studies relating dentoalveolar heights according to sagittal pattern found no significant difference in dentoalveolar heights among sagittal facial patterns[13] except for upper posterior dentoalveolar heights[5]. Betzenberger[14] reported a decrease in maxillary and mandibular posterior dentoalveolar heights in high angle malocclusion while other studies reported a decrease in dentoalveolar height in hypodivergent and an increase in hyperdivergent subjects[4,15]. Due to variable results in the literature comparing dentoalveolar heights with vertical dysplasia, this study was designed in order to determine the height of dentoalveolar segments of the maxilla and mandible and to compare them among individuals with different vertical skeletal discrepancies for possible contribution towards vertical facial pattern.

METHODS AND MATERIALS

A cross-sectional study of 100 subjects in the form of pretreatment lateral cephalogram was conducted at the Department of Orthodontics, Khyber College of Dentistry Peshawar, from September 2016 to November 2016. The data of the patients was obtained from the Department record and patients with age ranging from 12-30 years with fully erupted incisors and first molars, any vertical divergence and cephalograms of good quality and clearity were included in the study.

Those subjects who were treated orthodontically, had missing or restored permanent incisors and molars, jaw asymmetry and dental anomalies were excluded. Lateral cephalograms were taken by the same X-ray device Kodac - 9000 C machine with film size of 11×14", tube voltage of 70 Kv and exposure time on average of 1.8 sec.

The patients were divided into three groups according to the SN- Mandibular plane angle into normodivergent (32±4º), hyperdivergent (≥37º) and hypodivergent (≤27º) groups. The cephalometric landmarks and angle are defined in Fig I. Dentoalveolar heights were measured for maxillary and mandibular incisor and first molar as:

1. UADH: upper anterior dental height measured as perpendicular distance from maxillary incisor edge to palatal plane(mm)
2. LADH: lower anterior dental height measured as perpendicular distance from mandibular central incisor edge to mandibular plane(mm)
3. UPDH: upper posterior dental height measured as perpendicular distance from mesiobuccal cusp tip of maxillary first molar to palatal plane plane(mm)
4. LPDH: lower posterior dental height measured as perpendicular distance from mesiobuccal cusp tip of mandibular first molar to mandibular plane(mm)

Cephalometric tracings for dentoalveolar height and vertical pattern were made and measured by two operators and recorded in data collection form. For inter examiner reliability 20 radiographs were randomly selected after two weeks interval and measured to exclude study error.

STATISTICAL ANALYSIS

All statistical analyses were performed using SPSS software for windows (IBM; SPSS version 20.0). For numerical variables like age, UADH, LADH, UPDH and LPDH mean and standard deviation values were assessed. For dentoalveolar heights mean differences were made with analysis of variance (ANOVA) between three groups of normal, excess and short vertical pattern.

Pearson correlation test was applied for assessment of correlation between dentoalveolar heights and three vertical parameters i.e normodivergent, hypodivergent and hyperdivergent.

The p value ≤0.05 was set as statistically significant. For inter examiner reliability, twenty cephalograms were randomly selected and retraced. The paired t-test was applied for error between measurements.

RESULTS

The descriptive statistics of the studied sample in the form of Mean±SD is given in Table-1. The mean age of the sample investigated was 18.43±4.96 years with the hypodivergent group showing advanced age of 20.85±5.27 years. The sample consisted of 43 normodivergent, 30 hyperdivergent and 27 hypodivergent patients. Gender distribution showed 65 females and 35 male patients.

The dentoalveolar heights among different vertical groups with mean values in mm ±SD are presented in Table-2. The upper anterior dental height and lower anterior dental height in hyperdivergent group is more compared to other groups, i.e 27.26±3.13 and 38.41±4.23 mm respectively. The upper posterior dental height UPDH was less for the hypodivergent group when compared to hyper- and normodivergent groups but is not statistically significant.

The analysis of variance ANOVA for dentoalveolar heights among different vertical groups shows

Table-1: Descriptive statistics of the data according to age distribution among different vertical groups

Vertical groups	Age (yrs±SD)
Normodivergent (43)	17.09±4.57
Hyperdivergent (30)	18.16±4.54
Hypodivergent (27)	20.85±5.27
Mean	18.43±4.96

Table-2: Mean dentoalveolar heights of the sample according to Md-plane angle (mm±SD)

Dentoalveolar heights	Normodivergent	Hyperdivergent	Hypodivergent
UADH	26.04±3.41	27.26±3.13	24.96±3.95
LADH	35.96±4.33	38.41±4.23	36.22±4.31
UPDH	21.08± 4.75	21.08±2.99	20.40±4.22
LPDH	27.38±3.74	28.51±3.96	27.53±3.96

Table-3. Pearson correlation of dentoalveolar heights with vertical facial types

SN-Md plane categories (Sig. 2-tailed)	UADH	UPDH	LADH	LPDH
	0.245*	0.061	0.195	.099

*correlation is significant at≤ 0.05 level

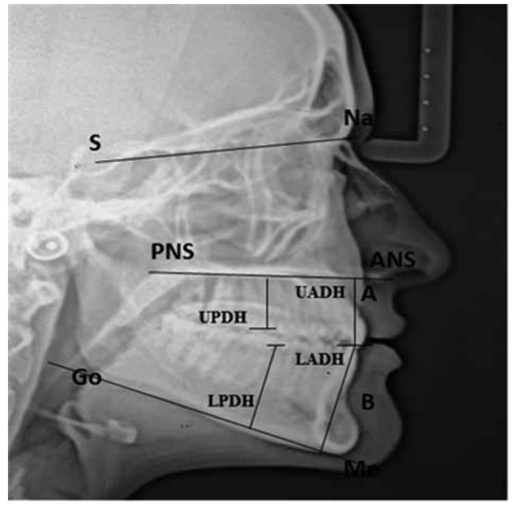

Fig I. Cephalometric landmarks and planes5: Sella(S) The midpoint of the cavity of sella turcica ; Nasion (Na):The anterior point of the intersection between nasal and frontal bones; PointA :The most posterior point on the anterior surface of maxilla; Point B :The most posterior point on the anterior surface of the symphyseal outline; Gonion (Go): A point on the curvature of angle of mandible determined by bisecting the angle formed by the mandibular and ramal planes; Menton (Me): The lowest point on the symphyseal shadow of the mandible; Anterior nasal spine(ANS) The anterior tip of the sharp bony process of maxilla at the lower margin of the anterior nasal opening; Posterior nasal spine (PNS): The posterior spine of the palatine bone constituiting the hard palate; SN plane: A line that connects sella and nasion point; Md plane: A line that connects Go and Me; Angle ANB: The angle between Na- A plane and Nasion- B plane; SN –Md plane angle:The angle between SN plane and Md plane

Table-4. Comparison of dentoalveolar heights among different vertical groups (ANOVA)

	Mean square	F	Sig.
UADH	37.91	3.113	0.049
LADH	58.65	3.171	0.046
UPDH	4.487	0.260	0.772
LPDH	12.30	0.821	0.443

a study where UADH was found to be greater in hyperdivergent individuals[13]. In another study conducted by Enoki[12], the same was observed; greater AUDH in the excessive anterior lower facial height group. Other studies investigating the skeletal open-bite groups found that the incisor height was significantly elongated when compared to control group[19,21]. Lower statistically significant difference (0.049 and0 .046 for UADH and LADH respectively). Pearson correlation between dentoalveolar heights and vertical categories revealed significant correlation for UADH (0.245*) as shown in table-3. The inter-observer reliablitiy was assessed with paired t- test which showed strong agreement between the examiners (correlation= 0.975).

DISCUSSION

This cross-sectional study was conducted in order to determine the dentoalveolar heights among individuals with different vertical facial pattern and to compare these among the groups. It has been suggested that any treatment modality is inadequate unless individual facial type is given considerable importance. Therefore, vertical growth should either be stimulated or inhibited depending upon the individual patient needs[16].

Vertical dysplasias are in many cases associated with sagittal dysplasia and therefore, a single parameter is not sufficient to accurately identify a given facial type[4]. Dentoalveolar segment of the maxilla and mandible has the natural capability to compensate for the underlying skeletal discrepancy. This phenomenon is referred as "dentoalveolar compensation"[6,8,17]. It can be concluded that vertical facial type may be related to morphological and dentoalveolar pattern of both jaws.

A number of studies have investigated the relationship between dentoalveolar adaptations to craniofacial vertical pattern[5,8]. Several approaches have been used in the literature for the selection of different vertical pattern on the basis of dental and cephalometric variables such as amount of dental overbite[7], the mandibular plane angle[11,13] the ratio between upper and lower facial height[15] or visual perception of increased or decreased lower facial height[18]. With these approaches of cephalometric and dental criteria, defining vertical facial type is inevitably arbitrary. In our study, we selected SN-Md plane angle as criteria for defining vertical facial morphology as has been used in other studies[5,13,19,20].

The present study observed that the height of dentoalveolar segment in the upper anterior region is more in hyperdivergent facial type i.e 27.26±3.13mm compared to 26.04±3.41mm and 24.96±3.95mm in normodivergent and hypodivergent pattern respectively. This finding is in agreement with the results of anterior dental heights were significantly greater in hyperdivergent group in comparison to normodivergent (38.41±4.23mm vs. 35.96±4.33mm) as reported in other studies[8,17].

On the other hand molar heights when compared among different divergence groups yield decreased value for hypodivergent group which is not statistically significant. Martina[5] concluded that the amount of molar dentoalveolar heights is negatively influenced by the divergency of the jaws while is affected positively by anterior lower face height. Similarly Enoki[12] found no statistically significant difference in the heights of molar region in three groups studied. Recently Betzenberger[14] reported a decrease in posterior dentoalveolar height in the maxilla and mandible of high angle malocclusion. In contrast to these findings Fields[18] found larger dental heights in long face type and smaller in short face type. Other studies on skeletal openbite reported the same[19, 20].

The effect of sagittal malocclusion on dentoalveolar height has been evaluated and reported to produce no significant effect[13,15]. The clinical implication of this study is that the anterior dental height has an important bearing on orthodontic treatment as it has been found to be increased in vertical growers. Therefore, while planning treatment for vertical facial type adequate consideration should be directed toward intrusion of anterior teeth in order to achieve normal overbite.

This study found and compared dentoalveolar height among different vertical groups and provided valuable data in this region as local data was lacking on this aspect. The limitation of our study is that we did not evaluate the effect of sagittal dysplasia on dentolveolar segment which should also be considered although literature has found no significant difference in this regard.

CONCLUSIONS

1. Among vertical growers the anterior dental height is significantly increased when compared to normal and horizontal growers.
2. Posterior dental height is not significantly different in different vertical patterns.
3. Lower anterior dental height is significantly greater in hyperdivergent group in contrast to normodivergent group.

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