

ORIGINAL  
ARTICLE

# Effect of cephalometric dental position on smile characteristics

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**Introduction:** Soft tissue changes and especially smile is one of the most important parameters in diagnosis and treatment planning in orthodontics. The main aim of this study was evaluating the correlation of the smile line with vertical dental parameters of occlusion.

**Materials And Methods:** In this cross sectional study, 46 patients (23 females and 23 males) aged between 18 to 25 years old were selected. The subjects were asked to pose a smile and several variables were measured and recorded which were mainly related to smile line. A lateral cephalometric radiography was ordered for each patient and anatomic landmarks were determined. And then correlation between 6 vertical dental parameters and some smile variables were analyzed. In order to determine association between quantitative variables, correlation coefficient of Pearson was used.  $P < 0.05$  was considered as significant.

**Results:** There was significant correlation between palatal-occlusal plane with quantitative variables such as tooth-lower lip position and inter labial distance during smile. No significant correlation was seen with other smile variables. There was significant correlation between upper 6 to palatal plane with smile width but no correlation was found with other smile variables. Upper 6 to Frankfort plane had significant correlation with clinical crown and smile width but not with other smile variables.

**Conclusion:** According to the result of this study, dental vertical variables affect the vertical component of smile, which means vertical development in the dentition can lead to the distance between some vertical variables of posed smile.

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## Introduction

An attractive smile is the main focus of patient's attention for an acceptable and beautiful appearance. This can lead to more self-confidence (1). Beautiful smile can increase patient's acceptance in the society by affecting the interpersonal communications. Smile is one of the most important facial expressions and affects friendship, agreement and respect in the eyes of other people (2). According to Frush, attractive smile is the most important factor in good appearance and because of its deep effect on sensations its treatment should not be neglected (3).

From the beginning of recent century, orthodontics has become very different from what it was before. One of these differences is more attention to facial esthetics and less attention on details of occlusion. The history of orthodontics which began with Angle has taught us that art of smile is mostly dependent on the ability of clinician to identify the positive elements of beauty in each patient and establishment of a strategy to improve esthetics (5). In orthodontics attention to soft tissue changes and especially smile is of great importance. It is one of the most important parameters in diagnosis and treatment planning.

Smile analysis and smile design have become the key elements in orthodontic diagnosis and treatment planning (6) but there is no acceptable standard for smile analysis and the reason for this is the multi factorial nature of smile and the movement of orthodontics towards esthetic treatment planning which is described by patient (7). The upper central incisors are the key determinant in evaluating smile esthetics, and thus, the assessment of their ideal vertical positioning is an aspect of paramount importance. (4) One of the important factors in smile line characteristic is the skeletal growth pattern of the individual. More vertical growth in posterior maxilla related to anterior part can lead to change in the relation of occlusal plane and lower lip curve when smiling. Growth in brachiocephalic pattern can also lead to flat smile arc (low mandibular plane angle, tendency of S-N line to be parallel with palatal plane and occlusal plane). Patients with this skeletal pattern do not have clockwise rotation of anterior maxillary which is necessary for an ideal smile. In some

cases a counter clockwise tilt may be seen which leads to a flat smile arc. This has not been proved yet (9).

Smile line is one of the most important factors contributing to a beautiful smile (8). Smile line shows the relationship between the arc of maxillary incisors edge and canines to the arc of lower lip in a posed smile from frontal view (7). In an ideal smile arc, the curve of incisal edge of incisors is parallel to the curve of lower lip when smiling. The term consonant describes this parallel relationship (9). In a non-consonant smile the arc of maxillary incisors is more parallel to the lower lip arc when smiling. (9) Sarver in 2001 stated: studies on flat smile arc shows that while high rate of orthodontically treated patients show flatness of smile arc, 5% of non-treated population have experienced smile flatness.

There are two main forms of smile (5) known as social and enjoyment smile. Social smile is a posed smile which a person may use in social relations or taking a photo. The facial expression is static and sometimes teeth and gum can be seen (5). Enjoyment smile is an unconscious smile which shows the emotions at the moment. In this type of smile the exposure of lips and gum exposure is maximum and anterior teeth can be seen. It is explained as warm, tasteless and so on. In treating smile, social smile is repeatable. It can be developed and may change with time (5). Dentilabial smile is when the teeth can be seen behind the lips. In this type of smile, teeth play the main role as the focus of attention in face (3).

In the art of managing smile, orthodontists face two challenges: the first problem is that orthodontist should verify which elements of smile are needed to be corrected or improved. The positive elements which should be remained and protected have to be recognized. The positive relations should be identified to make sure they are protected when managing other aspects of the problem (7).

The second challenge is that treatment strategy should respond to major concerns of patient. Complete treatment should not focus on only one problem. It should involve facial and smile beauty and balance together (7). Direct measurement allows the clinician to

determine lip-tooth relationships in dynamic and at rest position. Observation of smile is a good start but measuring tooth-lip relationships is important for planning of the smile (7). The main aim of this study was evaluating the correlation of the smile line with dental parameters of occlusion.

## Material & Methods

This was a cross sectional analytical study. 46 patients (23 females and 23 males) aged between 18 to 25 years old were selected. The patients were selected from private orthodontics offices, orthodontics Department of Tehran University of Medical Sciences and students of Tehran University dental school. The patients did not have any history of orthodontic treatment. They also had the following inclusion criteria:

Overjet between 0 to 4 mm; Overbite between 2 to 6 mm; Normal upper lip length; No severe malocclusion; No history of head and neck surgery; No maxillary canting.

The subjects were asked to pose a smile and several variables were measured and recorded. In order to do smile analysis, as posed social smile is a repeatable smile, we asked patients to smile in this way. The patients smiled several times and the one, which was repeated more than others were considered as posed social smile and related variables were recorded. These were mainly related to smile line. The recorded variables of face were as follows:

1. Tooth – upper lip position: The distance between upper lip and incisal edge of maxillary incisors in mm
2. Tooth – lower lip position: The distance between lower lip and incisal edge of maxillary incisors in mm
3. Interlabial gap on smile: The distance between upper and lower lip when smiling, in mm
4. Gingival display: Amount of gingival display when smiling, in mm
5. Crown height: The height of maxillary central incisors, in mm
6. Tooth-upper lip smile form: The position of the upper lip relative to maxillary incisors on smile. It was divided into three categories: low smile, average smile, high smile
7. Smile width: The distance between corners of the lip in posed smile, in mm.

A lateral cephalometric radiography was ordered for each patient and anatomic landmarks were determined. The radiographies were traced. All the cephalograms were taken by the same technique, the lips were relaxed and teeth in occlusion. Since lateral cephalograms were provided from different centers, their magnification was compared. In all the centers the distance between X ray tubes to midsagittal plane was 150 cm and the distance between films to the midsagittal plane was different according to patient's size and guidelines of the center. The maximum difference was 1 cm. This could lead to magnification difference of less than 1 percent.

Since the clinical measurements were performed on soft tissue and it was prone to change by repeating the measurements, five samples were evaluated three times each. Kappa test was used in order to test the reliability between measurements (kappa 0.8). Those values, which were more than 0.6, indicated high agreement. The smile was divided to three categories according to (Name the reference). In order to determine association between quantitative variables, correlation coefficient of Pearson was used. The significance level was set at  $P < 0.05$ .

## Results

According to the results of this study, 19 patients (41.3%) were known as high smile. 17 (37%) had average smile and 10 (21.7%) were low smile. Males and females were different in this respect. The most common form of smile was average smile in males and high smile in females.

There was significant correlation between pal-occlusal plane with quantitative variables such as tooth-lower lip position and inter labial distance during smile. No significant correlation was seen with other smile variables. There was significant correlation between upper 6 to palatal plane with smile width but no correlation was found with other smile variables. Upper 6 to Frankfort plane had significant correlation with clinical crown and smile width but not with other smile variables. Lower 1 to mandibular plane and tooth lower lip position were significantly correlated. (Table 1)

**Table 1.** Analysis of correlation between vertical dental variants and smile qualitative variants in both sexes\*.

R= correlation coefficient

P= 2- tailed significance

Significant correlations (P&lt; 0.005) are shown by bold characters.

\*Spearman's rho

Vertical dental Variants		Upper 1 to palatal plane	Upper 6 to palatal plane	Upper 1 to Frankfort plane	Upper 6 to Frankfort plane	Lower 1 to mandibular plane	Lower 6 to mandibular plane
Tooth upper lip position	R	<b>0.334</b>	0.195	-0.051	0.007	0.080	-0.070
	P	<b>0.019*</b>	0.194	0.737	0.964	0.597	0.642
Smile width	R	0.272	<b>0.291</b>	<b>0.381</b>	<b>0.479</b>	<b>0.321</b>	<b>0.436</b>
	P	0.067	<b>0.050</b>	<b>0.009*</b>	<b>0.001*</b>	<b>0.030*</b>	<b>0.002*</b>
Clinical crown	R	0.132	0.007	<b>0.451</b>	<b>0.318</b>	0.131	0.154
	P	0.382	0.962	<b>0.002*</b>	<b>0.031*</b>	0.385	0.307
Incisal edge to lower lip	R	-0.125	0.142	<b>-0.324</b>	-0.068	-0.103	-0.124
	P	0.408	0.345	<b>0.028</b>	0.654	0.497	0.412
Tooth lower lip position	R	0.149	0.194	0.158	0.198	<b>0.435</b>	0.219
	P	0.323	0.196	0.294	0.188	<b>0.002*</b>	0.143

## Discussion

The results showed that there was significant correlation between upper 1 to palatal plane and qualitative variant tooth upper lip position. This means that by increase in distance between upper central incisors to palatal plane, patient's smile shifts from low to high smile which is quite expected. Because by increase in this space the degree of upper teeth and gum show also increases and the patient shifts to gingival smile line. This study showed that upper 1 to palatal plane had significant correlation with tooth upper lip position. Increase in upper 1 to palatal plane actually shows an increase in the dentoalveolar process of anterior maxilla. (10) This finding confirms the results of Pecks; Peck L and Kataja M in 1992. It also confirms the results of Pecks and Peck L work in 1995(11), because in both those studies increase in vertical dimension of anterior maxilla was an effective indicator of gingival smile line. There is significant correlation between upper 6 to palatal plane and upper 6 to Frankfort plane with smile width. In other words by increase in the distance of upper first molar to palatal plane and Frankfort plane, smile width increases. May be it is related to increase in vertical growth of face because when the vertical distance between upper first molar and palatal plane or Frankfort

plane increases it indicates that mandible had tendency to rotate downward and backward. The vertical height of face increases and affects smile width.

This study demonstrated that there was significant correlation between vertical distance of upper 6 to Frankfort plane and clinical crown height. It means that with increase in the distance between upper first molar to Frankfort plane, we can expect extrusion of central incisors and also increase in their clinical crown height. There is correlation between lower 1 to mandibular plane and lower 6 to mandibular plane distances with tooth lower lip position. Therefore increase in the distance of lower incisors and also lower first molar to mandibular plane is accompanied with increase in the distance of upper central incisors to lower lip. This study also showed that lower 1 to mandibular plane and lower 6 to mandibular plane distance are significantly correlated with smile width. When these distances are higher the smile width is also increased. Lower 1 to mandibular plane and interlabial distance during smile are significantly correlated. Increase in the distance between lower central incisors to mandibular plane is accompanied with increase in the distance between lips when smiling. It was also shown that lower 1 to mandibular plane is significantly correlated with tooth

lower lip position. That means with increase in the distance of lower central incisors to mandibular plane, lower lip has more tendency to get far from upper central incisors.

## Conclusion

According to the result of this study, dental vertical variables affect the vertical component of smile, which means vertical development in the dentition is correlated with vertical variables of posed smile.

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