Morphometric analysis of the posed smile A comparison between normal occlusion, class 1 malocclusion and non-extraction treated group

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Abstract

Aim: Lips-Dentition relationships play a special role during smile. Present study compared the relationship of lips and teeth during posed smile in subjects with normal occlusion , class 1 malocclusion and non-extraction treated cases .

Materials and methods: 20 cases with normal occlusion according to Andrews` and without facial malformation (N) , 22 cases with moderate crowding (C 1) and 12 well treated patients without any extraction and facial malformation (T) with the age between 15 – 20 years old were selected. One photograph in rest position and another in posed smiling were taken in standard position. 12 variables on photos were measured by use of a smile mesh. ANOVA and Krukal-wallis tests were used for analysis.

Results: Commissure width and Smile width was significantly greater in group N than groups C1 and T ($P<0.001$). Upper lip curvature in non-extraction treated group was concave but in others were convex ($P<0.022$). Inter-canine width in group N was significantly higher than treated patients ($P<0.03$).

Conclusion: There is a direct relation between anatomic form of lips in rest and in smiling. Orthodontic treatment can cause some changes in lips form during smiling (IJO 2006;1:163-7).

Key Words: Morphometric analysis, Posed smile class 1 malocclusion, Non-extraction Treatment.
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Beautiful smile is an original expectation of orthodontic treatment. Lips-dentition relationships play a special role during smiling. According to Ackerman et al 1 there are 2 stages in smiling : 1 – spontaneous or unposed smile that is dynamic and presents the feeling of the person , 2 – posed smile that is static and can be an individual characteristic of a person and more reproducible than unposed smiling.

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Orthodontic literature contain more studies about skeletal structure than soft tissue structure, more studies about the profile of patients than their frontal view and more studies about structure in static position than dynamic functional movements. One consequence of these biases and traditions is that there have been remarkably few investigations of the effects of orthodontic treatment on the esthetics of the smile whereas the fact is that the appearance of the smile is clearly of substantial clinical importance and often one of the key criteria by which patients judge the success of their own treatment.[2] In addition, many researches in this field rely on some raters` point of view and are subjective rather than objective. Hulsey et al evaluated the lips-dentition relationships in 20 cases with normal occlusion

and 20 treated patients. After taking photos in posed smile, the attractiveness of smiles were assessed by 20 raters without information about treatment protocol .They reported less smile score (less attractiveness) in treated cases versus normal group.[3] Wholley and Woods in their cephalometric study on effect of premolar extraction on curvature of upper and lower lips found no difference between 1st and 2nd premolar extraction in lips curvature.[4] Ackerman in 1997 designed a software named as smile mesh for analyzing 11 characteristic of smile.[1] In another study he evaluated the video clips of 50 patients with Class-I skeletal and dental patterns saying the syllable "chee" and smiling . Each animation image was analyzed using a SmileMesh™. The results suggest that anterior tooth display at speech and smile should be recorded independently but evaluated as part of a dynamic range.[5] This videographic method is reliable for measurement of tooth display and lip position in spontaneous and posed smiling and speaking. Application of the method is warranted especially when obtaining an emotional smile is difficult, such as cleft lip and palate or disfigured patients.[6] Kim and Gianelly in 2003 compared posed smile and arch width in 12 extraction versus 12 non-extraction cases.[7] 50 raters evaluated the close up smile photos and gave to each photo a number between 1 to 10 according to individual feeling about esthetics. They didn't find any difference between two groups.[7] Tataruniate et al. in their longitudinal research about facial attractiveness found that it does not depend on any single facial feature but orthodontic treatment has especial positive effect in men.[8]

The aim of present cross sectional study was objective evaluation of relationship of the lips and teeth during posed smile in fellows with normal occlusion, class 1 malocclusion and non-extraction treated patients by the use of a smile mesh.

MATERIALS AND METHODS

20 cases with normal occlusion (N), 22 cases with class 1 malocclusion (C1) and 12 treated patients (T) were selected according to these criteria:

Group N selected according to Andrews' definition , had complete permanent dentition , class 1 molar & canine relationship , normal overjet & overbite without skeletal malformation , without dental crowding and history of orthodontic treatment . Group C1 were like group N but had mild to moderate dental crowding (less than 5 mm in each arch) and group T had well treated occlusion without any extraction or jaw surgery. Sample size was determined based on following formula :

$$n = \frac{2\left(z_{\alpha} + z_{\beta}\right)^2 \sigma^2}{\left(\mu_0 - \mu_1\right)}$$

Significant level was 0.05 and power level was 0.95 .σ and μ were based on Ackerman study.[1] Samples were selected among fellows between 15 – 20 years old and there were 10 girls in each group. Groups N and C1 were selected among pre-university students of Hamedan . Patients in group T were treated in a private clinic in Hamedan.

One photo in rest position and 5 photos in posed smiling were taken in following condition : head positioning with cephalostate (FH parallel to horizon) , camera-object distance was 40 cm , full flash , speed of diagram was 5.6 and projected area was nasal tip to menton (upper border of projected area was adjusted on nasal tip) . This setting was used for all cases. The beam was exposed on slide films to prevent enlargement bias. Then slides were scanned with 300 dpi resolution. Among 5 photos in smile position, the most perfect one was selected .

A smile mesh was designed and three variables in rest position including commissure width, commissure height and philtrum height and 9 others in posed smile including inter- labial gap, upper incisor curvature, upper lip curvature, smile width, inter canine width, maxillary incisor exposure, lower lip to upper teeth, lower lip curvature and dead space (Figure 1) were measured by the use of smile mesh software in Delphi 5 program . ANOVA was used for comparing 3 groups then in case of significant difference, Tukey HSD test used for couple group analysis .

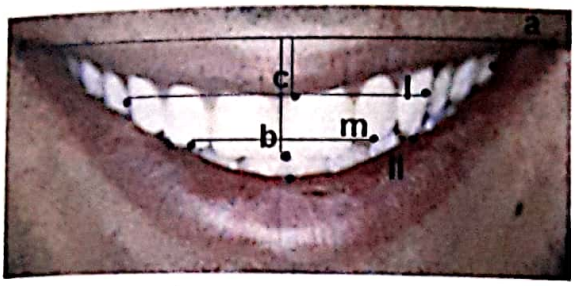

Fig. 1 – points definition

RESULTS

The mean age of groups N , C1 and T were 18.3±1.8 , 19.1±1.5 and 17.5±1.8 years old respectively and didn't show significant difference (P>0.05) . In rest position, commissure width was significantly lesser in group T (82.40±7.12 pixels*) than groups C1 and N (91.30±6.62,

* 2.835 pixel equals to 1 millimeter

95.12±8.23 pixels respectively, P<0.007). Smile width was significantly greater in group N than C1 and T (128.32±8.71, 119.54±10.00, 113.71±6.72 pixels respectively, P<0.004).

Upper lip curvature in untreated groups N & C1 was convex (+0.10±0.73, +0.38±0.65 pixels) but in treated cases was concave (- 0.38±0.72 pixels) and this difference was significant only between group C1 and T . Inter-canine width in group N was significantly higher than treated patients (74.04±5.58 , 68.94±3.95 pixels , P<0.03).

Table 1 presents results according to ANOVA and table 2 shows the results according to Tukey HSD test for variables with significant difference in Table 1.

Table 1 – Mean , Standard Deviation and P-value of 12 variables compared between groups N ,C1,Tusing ANOVA

Variables	Group N		Group C1		Group T		P value
	Mean	SD	Mean	SD	Mean	SD	
commissure width	95.12	8.23	91.30	6.62	82.40	7.12	0.000*
commissure height	44.83	5.47	43.86	6.64	39.90	4.12	0.083
philtrum height	42.04	4.60	42.08	6.00	38.20	4.41	0.112
inter labial gap	26.65	5.04	27.37	7.47	23.05	3.67	0.162
upper incisor curvature	2.46	1.14	2.58	1.27	2.88	0.93	0.63
upper lip curvature	0.10	0.73	0.38	0.65	- 0.38	0.72	0.022*
smile width	128.32	8.71	119.54	10.00	113.71	6.72	0.000*
inter canine width	74.04	5.58	71.94	5.15	68.94	3.95	0.036*
maxillary incisor exposure	20.24	5.50	19.37	5.30	20.03	6.15	0.85
lower lip curvature	6.84	2.53	7.13	2.99	6.54	2.83	0.84
lower lip to upper teeth	3.70	1.82	3.73	1.73	4.96	2.81	0.20
dead space	0.99	0.01	0.98	0.01	0.98	0.02	0.83

* Significant difference at the level of 95%

Table 2 – Mean Difference , Standard Error and P-value of 4 variables with significant difference in couple of groups using Tukey HSD test

Variables	Mean difference (Standard error)			P value		
	N / C1	N / T	C1 / T	N / C1	N / T	C1 / T
commissure width	3.82 (2.16)	12.72 (2.79)	8.90 (2.81)	0.192	0.000*	0.007*
Intercanine width	2.10 (1.50)	5.10 (1.94)	3.00 (1.95)	0.350	0.030*	0.280
Smile width	8.77 (2.62)	14.61 (3.37)	5.83 (3.40)	0.004*	0.000*	0.208
Upper lip curvature	-0.274(0.02)	0.486 (0.26)	0.760 (0.26)	0.380	0.160	0.016*

* Significant difference

DISCUSSION

This cross sectional study evaluated the relationship of lips and teeth during posed smile in teenagers whose muscle function of the face has developed and senile changes have not occurred yet. Interestingly in spite of different sample size in 3 groups (that was one of the difficulties of study), significant differences were noticed in some variables. It has been more robust if sex differences had been considered.

Results showed that the commissural width was greater in normal group than treated and crowded groups and the differences were significant between normal and treated groups also between treated and crowded groups. This result may be due to the influence of soft tissue pressure in developing malocclusion. Present study could not show the cause – effect relationship between commissure width and crowding incidence but the results are in concordance with the functional matrix theory that explains the blueprint for the design, construction and growth of a bone lies in the muscles, tongue, lips, cheeks, mucosa, etc.[9]

Treated cases had concave form of upper lip curvature during smiling. This concavity may be due to protrusion of incisor teeth during non-extraction treatment, however; there were not lip incompetency in any cases. Normal group had approximately straight line but cases with

crowding malocclusion showed significant convex upper lip curvature, it may be the result of the adaptation to the crowded teeth or tightness of the muscles.

Inter-canine width in normal group as expected before was more than crowded and treated groups. Howe et al 10 during an investigation reported the importance of arch dimension (arch width) in developing crowding. Non extracted treated cases had stable results after removing retentive appliance that insists on taking care of inter-canine width during treatment. It seems the pressure of peri-oral muscles (specially in commissure) cause reduction of inter-canine width and leads to crowding.

Roden-Johnson et al. in their study about the effect of buccal corridor space on smiling found that present or absence of buccal corridor space had no effect on the ratings of the smiles in well treated and untreated normal cases.11 It is in agreement with present study that there was not shown significant difference in dead space between 3 groups.

It must be considered that present study have not evaluated the attractiveness of smiling which is related to many factors also Tataruniate et al in their study found that orthodontic treatment improves the appearance of the teeth but does not necessarily make a person look more attractive.[8] Then variables with significant difference in this study may not necessarily lead to different esthetics.

study we found that the tooth most commonly missing was the maxillary lateral incisor. Although the percentage of missing laterals was high it was undetermined in some patients whether their teeth were extracted owing to mobility or were missing congenitally.

A detailed history could not be generated from some patients. As far as impactions are concerned, maxillary canines were impacted most frequently. Their impaction can be attributed to.

CONCLUSION

There is a direct relation between anatomic form of lips in rest position and in smiling. Orthodontic treatment can cause some changes in lips form during smiling. It is suggested to evaluate smile variables in 2 sexes separately.

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