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## Dynamic smile analysis for age related changes

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### Abstract

**Introduction:** The Dentofacial esthetics is the primary reason for seeking orthodontic treatment. Angle's paradigm of achieving ideal occlusion should certainly remain the primary functional goal of orthodontics but esthetic outcome is also important for patient satisfaction.

**The objective of Materials and Methods:** The subjects were divided into four groups based on age and videography was used to study the anatomic and physiologic peri oral age-related changes during rest and smile related to upper lip length, upper lip thickness, interlabial gap at smile and buccal corridor.

**Results:** The upper lip length showed increase with age. The upper lip thickness significantly decreased with age with increasing age the upper lip length decreased from rest to smile. Interlabial gap is significantly decreased with the age. Buccal corridor didn't show any significant change.

**Keywords:** Lip length, lip thickness, buccal corridor, smile

### Introduction

The Dentofacial esthetics is the primary reason for seeking orthodontic treatment.<sup>01</sup> The Angle's paradigm of achieving ideal occlusion should certainly remain the primary functional goal of orthodontics but esthetic outcome is also important for patient satisfaction and therefore essential to overall treatment outcomes<sup>[02]</sup>.

Ackerman *et al*<sup>03</sup> commented that an attractive smile is a requisite for winning elections, and a beautiful smile sells products for companies whose subliminal message in an advertisement is "look better, feel younger".

Smile can be defined as a "facial expression characterized by upward curving of the corners of the mouth, is often used to indicate pleasure, amusement or derision.<sup>04</sup>"Smiles can be either posed or social smile and spontaneous or enjoyment smile<sup>[5, 6]</sup>.

Ackerman *et al* classified the stage I as posed smile and stage II as unposed smile. Posed smile is voluntary and is not accompanied by emotion. The lip animation is fairly reproducible, similar to the smile that may be rehearsed for photographs or school picture. The unposed smile is involuntary and is induced by joy or mirth. The lip elevation is more animated in unposed smile. The posed smile is routinely used when evaluating facial esthetics and smile characteristics and can be generated on command<sup>[3, 5]</sup>.

Lip position and the amount of tooth and gingival display during smiling and speech are important diagnostic criteria in orthodontics, dentofacial surgery and esthetic dentistry.<sup>08</sup>

During the development of appropriate diagnosis and treatment planning for a patient, the hard and soft tissues are usually analyzed in 3 dimensions: sagittal, vertical, and transverse. But recently the time has been recognized as the fourth dimension<sup>[6, 9]</sup>. because with time the patients hard and soft tissues undergo some changes with age, those are called Senile changes which may affect underlying hard and soft tissues and there functions per se. So by possessing the appropriate knowledge about the various age related changes, it can help an Orthodontist in attaining the better and long lasting pleasing smile<sup>[10, 11]</sup>.

Conventional diagnostic and treatment planning use static profile photographs and lateral Cephalogram to depict the patients profile and Tooth lip relationship at rest<sup>[7, 12-16]</sup>. Because of the influence of various factors on facial profile and smile esthetics like musculature, emotional influence etc., it becomes prudent to study all those factors not only during the static position but also during the dynamic state.

Therefore, the objective of this study was to use videography to study the anatomic and physiologic peri oral age-related changes of the smile related to upper lip length, upper lip thickness, interlabial gap at smile, percent buccal corridors. Additionally, we analyzed perioral changes from rest to smile in various subjects and compared them on the basis of age.

### Materials and Methods

The present study was conducted on 176 subjects randomly selected from the students, staff, residents, faculty and parents/guardians of patients at the Govt. Dental College and Hospital Srinagar to evaluate the smile in different age groups.

Initial data were collected sequentially on 176 subjects; of these 16 subjects were excluded because of various video graphic errors

The remaining 160 subjects were divided in four groups with the following age ranges

**Group I:** 15 to 20 years.

**Group II:** 21 to 30 years.

**Group III:** 31 to 40 years.

**Group IV:** 41 to 50 years.

### Inclusion Criteria

1. Class I subjects with well-balanced faces/orthognathic profile.
2. No previous orthodontic treatment or maxillofacial surgery.
3. Complete permanent dentition.
4. Good periodontal health.
5. Non caries anterior teeth.

### Exclusion Criteria

1. Gross facial asymmetry.x`
2. Visible periodontal disease.
3. Prosthetic or Restorative work on tooth.
4. Excessive attrition.
5. Missing teeth that could have been visible on smile

The research protocol was approved by the Ethics Committee of Govt. Dental College and hospital Srinagar.

### Smile Recording and Measurements

The subjects were explained that this was a study on smile involving a 5 to 10 second video clip of a small part of the face. An informed consent either in English or in Kashmiri was obtained from each subject who agreed to participate in the study

The video graphic equipments for recording the smile were based on the guidelines established by previous studies <sup>[9, 17]</sup>. A Canon DSLR-1300D camera with full video HD recording in 24, 25 and 30 fps, ISO 100-6400 was set on the tripod to record video at a distance of 4 feet from the subject Continuous focusing portrait light were kept behind the camera to prevent shadows in the video.

To avoid errors in head positioning the subjects were instructed to position their head in natural head position by looking straight into a mirror at eye level. If the head position required any correction, then the researcher helped the subject

to keep it in natural head Position.

To standardize the orientation of the video camera lens, the lens was adjusted before the recording begins and it was adjusted to be parallel to the occlusal plane to continuously register the face.

To achieve a relaxed lip position the subjects were asked to lick the lips and then swallow. The recording began 1 second before the subject started speaking and it ended after the smile. A posed smile was recorded in this way with the minimal intrusion of the subject. The posed smile was considered as a voluntary and easily reproducible smile that was routinely used to evaluate the facial esthetics and smile characteristics.

The video clip, thus obtained, was transferred to a computer and then it was converted into sequential images (30 images per second) with a video-editing software program (Adobe Premiere, version 6.0, Adobe) so that the dynamics of smile could be observed frame by frame. Each frame was then analyzed, and finally two frames were selected for the study. The first frame represented the relaxed lip position with the subject's lips at rest, and the second frame represented the subject's natural unstrained posed smile which was the widest commissure-to-commissure smile. Thus the selected final smile image represented a sustained and hence repeatable smile position.

Each file was opened in Adobe Photoshop CS2 and adjusted by using the millimeter ruler. Calibration of the software was done as shown in the previous studies<sup>14</sup>. The following procedure was used to adjust each picture. First, the resolution of the picture was changed to 300 pixels per inch by going to "image >image size." Then, the ruler function was chosen and set to millimeter. In the ruler, a 10-mm area, parallel to the lens, was measured. The measured number was divided into 10 parts (10/measurement on JPEG file) and multiplied by the width value found in image size screen (image>image size).The resulting number was copied and pasted in the place of width reading, and these change were applied to the JPEG file. To check the accuracy of these steps, the 10-mm area on the ruler was measured again and if the values corresponded each other, the measurements were directly recorded from the JPEG file.

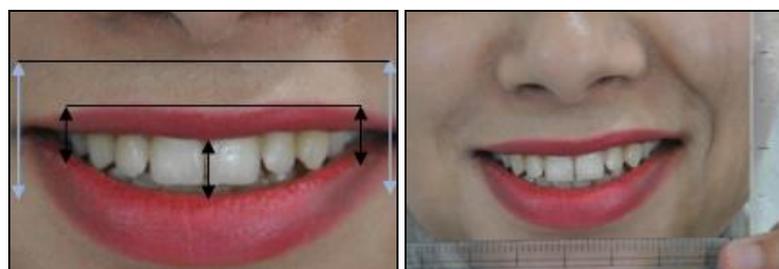
The linear measurements were made on the rest and smile photographs as shown in Figure 1 and 2 and in Table 1.

**Table 1:** Measurements used in this study

Measurement		Description
Upper lip length	ULL	Distance measured between Subnasale and Stomion superius
Upper lip thickness	ULT	Distance measured between Labrale superius and Stomion Superius.
Interlabial gap at smile	IG	Distance measured from the midpoint of the lips when a Patient is relaxed and smiling.
Buccal corridor space	BC	Distance measured from the mesial line angle of the maxillary first premolars to the interior portion of the Commissure of the lips.



**Fig 1:** Measurements at rest



**Fig 2:** Measurements during smile

**Statistical Methods**

The recorded data was compiled and entered in a spread sheet (Microsoft excel) and then exported to data editor of SPSS version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean ±SD and P value of less than 0.05 was considered to be statistically significant.

**Results**

Table 2 shows the descriptive statistics and significance of mean differences of rest position measurements, the upper lip length showed increase with age at rest from 19.43 ±3.29 in Group 1 to 23.01 ±1.50 in Group 4. The upper lip thickness were significantly decreased with age from 9.75 ±1.81 in

Group 1 to 8.60 ±1.26 in Group 4. There was significant difference between group 1 and group 3 (P<0.05) and group 1 and group 4(P<0.05) in upper lip length. There was highly significant difference found between group 1 and group 4 in upper lip thickness (P<0.05)

Table 3 shows the descriptive statistics and significance of mean differences of smile Measurements. The upper lip length showed increase with age at rest from 15.67 ±1.96mm in Group 1 to 17.11 ±1.81mm in Group 4. The upper lip thickness was significantly decreased with age from 8.31 ±1.34mm in Group 1 to 6.87 ±1.43mm in Group 4. The interlabial gap increased from with age from 10.80 ±2.35mm in Group 1 to 8.42 ±2.4mm in Group 4.

**Table 2:** Descriptive statistics and significance of mean differences of rest position measurements

Linear Measurements in Rest photograph (mm)	Groups	Mean ±SD
ULL	Group 1	19.43 ± 3.29
	Group 2	22.03 ± 2.90
	Group 3	22.80 ±2.31
	Group 4	23.01 ±1.50
ULT	Group 1	9.75 ± 1.81
	Group 2	9.60 ± 1.43
	Group 3	9.12 ± 1.73
	Group 4	8.60 ± 1.26

**Table 3:** Descriptive Statistics and Significance of Mean Differences of Smile Measurements

Linear Measurements in Smile photograph(mm)	Groups	Mean ± SD
ULL	Group 1	15.67 ± 1.96
	Group 2	16.12 ± 1.90
	Group 3	16.57 ± 1.86
	Group 4	17.11 ± 1.81
ULT	Group 1	8.31 ± 1.34
	Group 2	7.91 ± 1.10
	Group 3	7.40 ± 1.29
	Group 4	6.87 ± 1.43
IG	Group 1	10.80 ± 2.35
	Group 2	10.20 ± 3.01
	Group 3	9.71 ± 2.65
	Group 4	8.42 ± 2.41
BC	Group 1	1.40 ± 0.26
	Group 2	1.32 ± 0.018
	Group 3	1.29± 0.021
	Group 4	1.24 ± 0.031

## Discussion

Smile is “facial expression characterized by upward curving of the corners of the mouth, is often used to indicate pleasure, amusement or derision” [4]. The upper and lower lips frame the display zone of the smile.

The buccal corridor is measured from the mesial line angle of the maxillary first premolars to the interior portion of the commissure of the lips [6] t is the ratio of the intercommissure width divided by the distance from first premolar to first premolar. It is termed as “negative space” in orthodontics.

The extra-oral static photographs of dynamic smile are usually recorded in standard orthodontic records. A major disadvantage of using static pictures is that the researcher does not know whether he has captured the intended frame in that one single snapshot. To overcome this a digital video had been introduced [6, 9, 17] In the present study the upper lip length at rest increased from 19.43 ±3.29 mm (Group 1) to 23.01±1.50mm (Group 4) and it was significant. This is in accordance with the study conducted [14, 18-20]. The present study shows with increasing age the upper lip length during smiling increased from 15.67±1.96 mm (Group 1) to 17.11±1.81 (Group 4). Similar results were found in various previous studies [20, 18]. These changes are due to the atrophy of muscles when the person ages leads to the decrease in lip volume, loss of lip architecture and lip lengthening. In our study, with increasing age the upper lip length decreased from rest to smile. It is due to decrease in the muscle’s ability to raise the upper lip as the person ages.

Upper lip thickness In our study decreased with increasing age from 9.75±1.81 (group 1) to 8.60±1.26 (group 4). This is in accordance with the study conducted by Bhavna Singh *et al* [19]. During smiling the upper lip thickness significantly decreased from 8.31± 1.34(Group 1) to 6.87±1.43 (Group 4). Apparently, the intrinsic fibers of the lip musculature that are responsible for maintaining the lip thickness must be affected, resulting in thinning of lips by the aging process. Similar results were found in the previous studies conducted [14, 19].

Interlabial gap is significantly decreased with the age from 10.80 ±2.35mm in Group 1 to 8.42 ±2.4mm in Group 4 which depicts that smile becomes narrower vertically with age. Similar results were found by other authors [14, 20].

In this present study, the buccal corridor decreased from 1.40±0.26 (Group I) to 1.24±0.03 (Group IV) with increasing age but it is not statistically significant. This shows that the buccal corridor plays only a minimal role in esthetic evaluation of smile.

## Conclusion

- As the age advances, the upper lip length increased both at rest and during smile position.
- Upper lip thickness decreased with age and more so on smiling.
- Smile gets narrower vertically as the person ages.

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