

# Analysing the smile arc in class 2 patients before and after orthodontic treatment

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## ABSTRACT

### Background

Smile analysis is part of a facial analysis and allows dentists to recognize positive and negative elements in each patient's smile. Depending on the type of malocclusion, facial pattern of the patient and mechanics adopted, orthodontic treatment can prove either beneficial or harmful to smile esthetics. Thus, it is reasonable to regard smile analysis as an important tool for diagnosis and orthodontic treatment planning.

The purpose of this study was to evaluate the Analysing smile arc to determine the degree of improvement in the smile and incisal exposure after orthodontic treatment of patients with Class II malocclusion. The aim of this study is to analyse the smile arc and incisor exposure in class 2 patients before and after orthodontic treatment.

### Materials and methods

Frontal photographs were taken both before and after orthodontic treatment. Landmarks were placed on each tracing made from the photograph. Thereafter, landmarks were digitised into an x and y coordinates system. The Class II pretreatment and post-treatment groups of smile arc and incisor exposure conditions were compared using fishers chi square test.

### Result

The overall analysis of the study indicates that there are improvements in features of the smile arc and incisor exposure of the patients who have undergone treatment for Class II malocclusion. Even after treatment, the Class II subjects showed a difference from the control subjects regarding their smile arc. The coordinates of the class II pretreatment group and post treatment group in smiling conditions, clear significant ( $P < .05$ ) differences in vertical axis.

### Conclusion

Orthodontic treatment induced larger amount of lip movement change during smiling, which may reflect the esthetic and emotional changes in the patients after treatment.

## INTRODUCTION

The 'smile line', the curve that traces along the maxillary incisal edges and onwards to the canine cusps, has been shown to be important in assessing the harmony of the smile. The degree of harmony is assessed by evaluating the relationship between the smiling line and the curvature of the upper border of the lower lip. In the field of orthodontic treatment, the improvement of the facial esthetics is considered an intellectual study and is the cornerstone of orthodontics [1]. The smile that express from the facial movements and is the clear outcomes of the facial structures. The perception of smile arc varies from person-to-person and is influenced by personal experiences and social environment [2]. One of the most important opportunities of orthodontic treatment is to improve the esthetic and morphological harmony as well as the function of the oral and maxillofacial region. The soft tissue of the face plays an important role in facial esthetics and the orthodontist is frequently questioned about facial changes after treatment [3]. The soft tissue is recognized by most of the orthodontists that the success of orthodontic treatment is closely related to improvement of the soft tissue profile.

The appearance of the lip morphology and smile is most importance and one of the key criteria by which patients themselves aware of the success of their own orthodontic treatment. This is why the lip morphology is an integral part of the diagnosis and planning, and a key point in the treatment. The main effort of contemporary evidence-based orthodontics is to create a clear-cut treatment and to evaluate the outcomes of the treatment. By placing a grid over the smile photograph, Hulsey [4] measured a sample of orthodontically treated patients and compared them with a sample of untreated orthodontic patients with normal occlusion. He concluded that a key component present in an esthetic smile was a consonance between the arcs formed between the incisal edges of the maxillary anterior teeth and the curvature of the lower lip.

The improvement of facial esthetics has rapidly become one of the desirable objectives of orthodontic treatment. The objective of orthodontic treatment is to achieve a harmonious relationship between the skeletal, dental and soft tissue for the improvement of the function and facial esthetics. If an orthodontist is to adapt his treatment to modifying facial appearance, it would seem important to know what change will usually occur within the soft tissues after orthodontic treatment. Zachrisson stated that clinical assessment prior to orthodontic treatment should always include an evaluation of the soft tissues at rest and during function. Wylie stated " the goal of orthodontic treatment should be the attainment of the best possible esthetic result, dentally and facially [7]." At present,

orthodontic patients are concerned with their dynamic appearances during conversation and smiling, in addition to their static appearances. Roy Sabri also stated that patients come to orthodontist mainly to improve their smiles [8].

Class II malocclusion has features of upper anterior teeth protrusion resulting in upper lip protrusion and convex facial profile, which are considered unfavourable esthetically. Class II malocclusion has subdivisions which is, when the class II molar relationship occurs on one side of the dental arch only, the malocclusion is referred to as a subdivision of its division. class II malocclusion treatment comprises of growth modification by orthodontic treatment with or without extraction in patients with mild to moderate skeletal discrepancies and orthognathic surgery in adult patients with severe skeletal discrepancies .Prior to orthodontic treatment, the clinical assessment should always include an evaluation of the soft tissue at rest and during function because the morphology of the soft tissues themselves is a major factor in determining the overall facial profile[9]. At present, there is little reliable information regarding how much of the change in the facial expression is due to orthodontic treatment.

Smile analysis is part of a facial analysis and allows dentists to recognize positive and negative elements in each patient's smile. Depending on the type of malocclusion, facial pattern of the patient and mechanics adopted, orthodontic treatment can prove either beneficial or harmful to smile esthetics. Thus, it is reasonable to regard smile analysis as an important tool for diagnosis and orthodontic treatment planning. The purpose of this study was to evaluate the Analysing smile arc to determine the degree of improvement in the smile and incisal exposure after orthodontic treatment of patients with Class II malocclusion[10].

### Methods and materials

Frontal photographs were taken both before and after orthodontic. The frontal photographs of the patients were taken at the two stages of the start of the pre-extraction orthodontic treatment and after post-extraction treatment in a normal seated posture with the head fixed by ear rods, with the help of camera lens and the subject at rest and posed smiling condition. The subjects wore no facial cosmetics/makeup. The frontal photographs were printed on A4 size paper, and tracings were made and smile arc before and after orthodontic treatment were added using tracing paper. Landmarks were placed on each tracing made from the photograph. All subjects presented a complete permanent dentition with the possible exception of third molars. The sample was selected at the Saveetha University of Chennai, India .The sample included in the study are individuals aged 18 to 25 years, from the frontal photographs landmarks were digitised into an x and y coordinates system with the sub-nasal point as the origin. The Class II pretreatment and post-treatment groups of smile conditions were compared respectively, using Chi square tests.

### Result

After the evaluation of the smile arc of the 20 photographs, the smile arc photographs of the pre orthodontic treatment were statistically compared with the smile arc photographs of the post orthodontic treatment. Figure 3 shows examples of the photographs used in the study. Thus, it was observed whether the smile arc of the post orthodontic treatment improved when compared to the smile arc of the pre orthodontic treatment.

Table (1) shows that there is significant differences of the smile arc between pre orthodontic treatment and post treatment.

CHANGE IN THE SMILE ARC FOLLOWING ORTHODONTIC TREATMENT (in mm)				
	Pretreatment	Post treatment	Difference	<i>Fishers chi square test</i>
1	30.5	34.7	4.20	0.0289
2	29.6	32.5	2.90	0.0088
3	26.5	28.4	1.94	0.0007
4	32.3	34.4	2.30	0.0001
5	33.2	36.2	3.20	0.0041
6	28.6	30.1	2.40	0.0001
7	27.4	31.2	3.54	0.0836
8	24.8	27.9	3.64	0.0198
9	26.8	29.1	3.45	0.0145
10	34.5	38.8	4.53	0.0181
11	27.8	30.1	3.45	0.0123
12	23.2	25.6	2.45	0.0024
13	26.7	27.7	1.24	0.0234
14	29.1	30.9	1.45	0.0126
15	30.4	32.2	2.34	0.0023
16	35.7	37.8	2.34	0.0026
17	28.4	32.3	2.46	0.0362
18	33.5	36.7	3.46	0.0041
19	34.5	35.4	1.46	0.0103
20	26.8	29.9	3.45	0.0234

\*P < 0.05.

Table (2) shows that there is significant differences of the smile arc between pre orthodontics and post orthodontic treatment.

	INCISOR EXPOSURE IN CLASS 2 PATIENT FOLLOWING ORTHODONTIC (%)		
	Pretreatment	Post treatment	Difference
1	80%	90%	10%
2	75%	80%	5%
3	90%	100%	10%
4	85%	90%	5%
5	50%	75%	25%
6	85%	90%	5%
7	95%	100%	5%
8	90%	100%	10%
9	50%	75%	25%
10	100%	100%	0
11	35%	50%	15%
12	50%	75%	25%
13	75%	85%	10%
14	75%	80%	5%
15	100%	100%	0
16	70%	80%	10%
17	60%	75%	15%
18	90%	100%	10%
19	80%	85%	5%
20	80%	90%	10%

The incisor exposure of most of the class II patient was 70% of pre-treated class II group and 80% in post treated class II group. On smiling condition, post treated class II group showed increased value than pre treated class II group ( $P < .05$ ). The class II pretreatment group in smile condition, both lips and mouth corners positioned downward where as after orthodontic treatment it shows improvement in smile arc into straight arc in most of the cases when smiling there was statistically significant difference between two groups, except lip out line region.

The coordinates of the class II pretreatment group and post treatment group in smiling conditions, clear significant ( $P < .05$ ) differences in vertical axis. In this Conditions maxillary shows mild prognathism.

After treatment the result shows that, the post treated group shows incisor exposure conditions was larger than pretreated group, as well as upper and lower lip ratios were significantly difference. There is average of 10% increase in the incisor exposure after orthodontic treatment.

After orthodontic treatment, both smile arc and incisor exposure showed a significant difference during smiling conditions. Especially on smiling condition class II group showed more upwards and straight movement of the mouth corners than pre-treated group. In the smile conditions, post-treatment group showed there is significant difference in the smile arc and incisor exposure due to soft tissue activity and changes after orthodontic treatment of class II group inferior to those of control.

### Discussion

The facial esthetic is one of the important social concerns in current society. Eighty percent of patients comes to orthodontic treatment for esthetic reasons. Therefore, orthodontic treatment has gained momentum in modern society, and therefore, will attract even more attention in the future. The success of orthodontic treatment is routinely assessed by smile esthetics, and the lips are the controlling factor in the smile[11].

The advantage of this facial photograph based study is that the procedure is simple and economical, and the number of samples is easily increased. In addition, these photographs are usually available in the orthodontic office, and they are rated as more attractive than the profile views[12]. However, the present study revealed that there were significant differences of the coordinates of landmarks at rest and on smiling between the Class II pretreated and post treated group.

Figure (1)



Figure (2)



Figure (1 & 2) shows changes in the smile arc and incisal exposure before and after orthodontic treatment.

The frequencies, means, standard deviations, and statistic groups for the esthetic evaluations according to the factors examiner and group, are exhibited in Table (1 & 2). The mean change in the smile arc before and after orthodontic treatment was 3.10 mm.

Factor that may have influenced the results, causing this difference between studies, is the light conditions and distance between the camera and patient may differ when the photographs are taken. Therefore, there may have been differences in the standardisation of light conditions and camera distance between studies, impairing comparison between them.

According to the literature, an esthetically pleasing smile usually shows symmetry and proportion between teeth, gingiva, and lips. The position of the mouth corners or lip commissures also affects the smile symmetry, and there must be regressive proportion of the teeth exposure created by curvature of the dentoalveolar arch.

Most of the previous research regarding soft tissue morphology and behavior analysis was done by a lateral cephalometric or videographic method. On the other hand, the facial soft tissue has not yet been sufficiently studied, and an analysis based on the anterior-posterior (AP) facial photograph is very rare. Holberg et al reported a high displacement to be measured around the corners of the mouth, the lower lip, cheek, and nasal wings. Therefore, it is important to assess the soft tissue changes in the smile, especially in the lips area after orthodontic treatment, and it is essential to the achievement of the successful orthodontic treatment goal. Mackley stated that there was a definite improvement of the smile in the average scores because of orthodontic treatment [6,12,13]. In this study, quantitative evaluation of the morphological changes of the lips, using frontal photographs of the Class II patients was done.

The advantage of this photograph based study is that the procedure is simple and economical, and the number of samples is easily increased. In addition, these photographs are usually available in the orthodontic office, and they are rated as more attractive than the profile views. In the measurement and analysis of the smile, however, there is one limitation in the methodology because of the reproducibility of a natural smile. However, according to pilot study, Ishikawa et al reported that significant differences were found between the coordinates obtained in the smile while saying cheese and the coordinates of the natural smile. Another limitation is the difficulty in collecting a natural smiling photograph, because before orthodontic treatment, the patients have an unusual alignment and occlusion. In addition, they might feel shy about smiling [14-15].

The overall analysis of the study indicates that there are improvements in features of the smile for the patients who have undergone treatment for Class II malocclusion. Even after treatment, the Class II subjects showed a difference from the control subjects regarding their smile; namely, the downward movement of the upper lip and the mouth corners of the Class II subjects was smaller than that of the control group. Perhaps immediately after treatment, the lips cannot adapt properly in the new position and need time for adaptation. Furthermore, the braces worn during orthodontic treatment for about 2 years might have been interrupting the natural movement of the lips. This study, therefore, can be used in future research regarding the soft tissue analysis after retention.

#### Conclusion

This study showed that both the upper and lower lips in the smile of the Class II pretreatment group moved to an inferior position, and the upward movement of the upper lip and mouth corners was smaller in comparison with the control group. These characteristics of the Class II smile were improved by the orthodontic treatment, this is found by the differences in comparison with the pre-treatment and immediately after treatment. Lay people did not consider the improper smile arc and tooth alignment as an important factor influencing their esthetic evaluations [16]. More studies on smile arc and incisor exposure are required to help understand the esthetic appearance of the young and adult individuals. Current trends in orthodontics place greater emphasis on smile esthetics [17]. Although the concept of smile analysis is not new but is often not incorporated in orthodontic treatment planning. It is observed that all the elements of smile analysis should be considered as guidelines and reference points for beginning esthetic evaluation, diagnosis and subsequent treatment planning [18]. Smile is considered as one of the most important expressions contributing to facial attractiveness. An attractive or pleasing smile enhances the acceptance of individual and contributes to good status in society [19-20]. With patients becoming increasingly conscious of a beautiful smile, smile esthetics has become the primary objective of orthodontic treatment. Modern orthodontics deals not only with the traditional dental and skeletal aspects, but also face as first priority. One of the important esthetic parts in orthodontics is to attain a balanced smile which may be with normal positioning of teeth and soft tissue movements.



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