

Effect of nonextraction and extraction orthodontic treatments on smile esthetics for different malocclusions

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Introduction: Smile esthetics is a critical factor for evaluating orthodontic treatment outcomes. In this study, we evaluated the differences in esthetic perceptions and smile variables between extraction and nonextraction treatments for different malocclusions. **Methods:** Ninety participants were divided into 3 groups according to their pretreatment overjet (group I, 0-4 mm; group II, >4 mm; group III, <0 mm), with 15 extraction participants and 15 nonextraction participants in each group. Posttreatment frontal smiling photographs were evaluated by 30 raters (10 orthodontists, 10 general dentists, 10 laypeople), and 9 smile variables were measured. **Results:** Smile perception for the group II extraction subjects was higher than for the nonextraction subjects by the orthodontists and general dentists. Regardless of the type of treatment, group III subjects were rated lower than those in groups I and II. The arch form index, maxillary incisor show, and smile arc were greater in the extraction participants. In multiple regression analysis, nonextraction and group III correlated negatively with the esthetic score. Maxillary incisor show, tooth number display, and buccal corridor ratio correlated positively with the esthetic score. **Conclusions:** Group II extraction subjects were rated higher than the nonextraction subjects by dental professionals. A smile with greater maxillary incisor show, number of displayed teeth, and buccal corridor ratio was considered more esthetic. (Am J Orthod Dentofacial Orthop 2018;153:81-6)

Smile esthetics has always been the focus of orthodontic treatment. It has become a main reason that patients seek orthodontic treatment,¹ and patients now evaluate their treatment outcomes not only by the occlusion and alignment but also by the smile esthetics.

In orthodontics, tooth extractions are a common treatment modality. Previous studies mainly focused on lateral profile changes regarding tooth extractions and concluded that extraction treatment could result in an improved lateral profile for many patients with some combination of crowding and protrusion.^{2,3}

For the frontal smile esthetics, authors used patients' posttreatment frontal smiling photos for evaluation and found no significant differences in the esthetic scores between extraction and nonextraction groups.⁴⁻⁹ Through a

comprehensive search for eligible studies, a systematic application of eligibility criteria, and a rigorous analytical approach, we statistically combined the data from relevant studies. Results of our meta-analysis showed no difference between extraction and nonextraction treatments.¹⁰ A systemic review also concluded that 4 premolar extractions and nonextraction treatment have no predictable effect on the overall esthetic assessment of the smile because individual variability could influence the smile perception as esthetically pleasing or not.¹¹

Because previous studies regarding frontal smile esthetics pooled all participants for analysis without considering the large variations among patients, they could not determine whether extraction treatments were more satisfactory than nonextraction treatments (or vice versa) in terms of smile esthetics.

The purpose of this study was to compare extraction and nonextraction treatments on smile esthetics for different malocclusions including subjective esthetic perceptions by panel raters and objectively by measuring the smile variables.

MATERIAL AND METHODS

A total of 90 participants were randomly selected from a sample of 600 patients organized in an Excel spreadsheet (Microsoft, Redmond, Wash) from the orthodontic

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All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

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department of our hospital in Taipei, Taiwan. This study was approved by the institutional review board of Taipei Medical University Hospital (No. 201503035). The inclusion criteria for the participants were (1) all permanent dentition, (2) completed orthodontic treatment with fixed appliances from 2011 to 2014, and (3) a complete set of posttreatment records, including study models, panoramic radiographs, and intraoral and extraoral photographs. Participants with a large skeletal discrepancy for which surgical orthodontic treatment might be indicated were excluded from the study. To investigate the difference between extraction and nonextraction for different malocclusions, the participants were further divided into 3 groups according to their pretreatment overjet: group I (0–4 mm), group II (>4 mm), and group III (<0 mm). Each group contained 30 participants who received extraction ($n = 15$) or nonextraction ($n = 15$) treatment. The age and sex distributions were the same in both the extraction and nonextraction subjects in all groups. Although the total treatment duration was longer for the extraction than the nonextraction subjects, this difference was significant only in groups I and III.

Each participant's posttreatment frontal smiling photograph was taken using a digital camera (550D; Canon,) and stored in JPEG format. According to the standard operation procedure of our department, a well-trained photographic assistant instructed the participants to say "7" or "cheese" while holding their heads in a natural position. Photoshop software (Adobe Systems, San Jose, Calif) was used to manage the photographs, which were cropped to show only the perioral area and converted to black and white images to minimize the influence of other facial characteristics and skin color. PowerPoint (Microsoft) was used to show the photographs to the raters in a random order.

Raters, comprising 10 laypeople, 10 general dentists, and 10 orthodontists, performed subjective evaluations of the smile esthetics. The ages of the raters were between 30 and 50 years, and the general dentists and orthodontists had more than 5 years of clinical experience. Laypeople were randomly contacted in the mass rapid transit station. The raters had the same age and sex distributions, and no difference was noted in the years of clinical experience between the general dentists and orthodontists.

Each rater used a visual analog scale to score the smile esthetics of each photo. The scale was created on a 100-mm uninterrupted line anchored at 0 on the left (very unattractive) and 10 on the right (very attractive). The raters made their decisions independently, with no information regarding the participants. They were allowed to review the slides and revise their scores until they reached a final decision.

Nine smile variables were measured from the post-treatment frontal smiling photographs by using the linear measurement tool in Photoshop (Fig). The tool rounded the measurements to the nearest 0.01 mm. Because of the differences in the magnification of the photographs, exact linear measurements could not be obtained. Therefore, to minimize bias, smile variables except tooth number display and midline were measured as ratios.

Seven smile variables were ratios (Fig): (1) smile arc ratio, distance of the maxillary incisor edge to the intercanine connecting line divided by the distance of the lower lip to the intercanine connecting line; (2) maxillary incisor show, distance of the maxillary incisal edge to the upper lip divided by the incisor width; (3) mandibular teeth exposure, visible mandibular incisor length divided by the mandibular incisor width; (4) arch form index, intercanine width divided by intermolar width; (5) buccal corridor ratio, intercommisure width divided by intercanine width; (6) smile index, intercommisure width divided by the interlabial gap; and (7) interlabial gap, interlabial gap divided by intercanine width.

Two smile variables were not ratios: (1) midline, upper and lower dental midlines (on, 1; off, 0) and (2) tooth number display: exposed maxillary teeth.

Statistical analysis

Statistical analyses were performed using the R Data Analysis and Guiding System (Chinese Association of R Software Research and Application, Taiwan). We randomly assigned the 30 participants in each group into 2 treatments (each treatment had 150 measurements), which provided 87% power to detect a difference between means at a significance level of 5% by using a 2-sided t test. A power test was performed to ensure an adequate sample size. A 2-sample t test was used to compare the esthetic scores and smile variables between the extraction and nonextraction subjects in each group. One-way analysis of variance was used to compare smile perceptions among the 3 types of raters. Multiple regression analysis was used to evaluate the effects of tooth extraction treatment and groups on the smile esthetic score and to identify whether any variables influenced the smile esthetic scores. The level of significance was established as $P < 0.05$ for all statistical tests.

RESULTS

Table I shows the mean esthetic scores of the extraction and nonextraction subjects stratified by group. In group II, extraction was rated higher than nonextraction. No differences were observed in groups I and III. Moreover, regardless of the type of treatment, the group III

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