Changes in Patient Evaluation of Completed Orthodontic Esthetics after Dental Bleaching

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ABSTRACT

As dental professionals, we tend to assess separately different treatment modalities; our patients, however, may only be aware of the total outcome, not discerning the contribution from each treatment. Orthodontists focus on dentoskeletal positioning, usually leaving other areas of esthetics such as tooth shade to other dental colleagues. Laypeople may not see the same differentiation. We suggested that patients would be more pleased with their orthodontic outcomes when cosmetic bleaching was done afterwards, not discriminating between the benefits derived from orthodontics alone and those derived from bleaching. Seventy-five orthodontic patients were selected for the study. Two experimental groups underwent different bleaching protocols, while the third control group received no bleaching. A visual analog scale questionnaire evaluating different aspects of their orthodontic outcome was given to each participant 2 days after treatment and again 1 month later. The first survey was filled out prior to the bleaching procedure, while the second survey was post bleaching. None of the participants were informed that the questionnaire was related to the bleaching. A calibrated photospectrometer was used to measure the dental shade prior to bleaching and again at 1-month follow-up. The two bleached groups had significant shade improvement and a significant overall increase in their orthodontic evaluation, while the patients in the control group displayed a decrease in their assessment of their orthodontic treatment. Altering smile esthetics through bleaching does not change any of the parameters that orthodontists strive to correct, yet it has a positive effect on the patients' perception of previous orthodontic treatment.

CLINICAL SIGNIFICANCE

Patients are more satisfied with previous orthodontic treatment when it is coupled with cosmetic bleaching. When providing multidisciplinary treatment, we dental professionals may tend to assess the outcome of each segment separately. To patients, however, there is an additive effect, and their opinion is based on the overall composition of the outcome.

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INTRODUCTION

The orthodontic practitioner has the opportunity to modify dental alignment, occlusal relationships, skeletal morphology, and overall facial esthetics. Often, it is only the last of these that motivates patients and their parents to seek and pursue orthodontic treatment.¹ Orthodontists are vigilant in the consideration of facial esthetics through the relative position of the

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dentition. Recently, however, reports in the literature have also advocated that orthodontists provide other esthetic procedures such as gingival recontouring, adjusting tooth morphology, and even botox injections.^{2–4}

Because patients desire an esthetic outcome rather than merely the proper dental and skeletal relationships that conventional orthodontics provides, the overall gestalt of orthodontics and other esthetic procedures should elicit greater treatment satisfaction than orthodontics alone.⁵

One area of esthetics that orthodontists have traditionally left to other dental professionals is dental bleaching. Classically, dental shade has no consideration when planning or executing orthodontics and naturally does not affect the quality of the orthodontic outcome. Although to the dental professional, malocclusion and dental shade are completely unrelated, patients may not perceive this difference when seeking esthetic improvement.⁵ We hypothesized that patients have a more holistic view of esthetics than the dental professionals' disjointed one and would therefore be more pleased with their orthodontic outcomes when it is coupled with a purely esthetic procedure, such as cosmetic bleaching, rather than just orthodontics alone.

Available to the dental practitioner are various vital dental bleaching protocols. The two major categories are procedures that are done in the office and the fabrication of custom bleaching trays into which the patient administers the bleach at home. The reported advantages of the in-office procedure which may, or may not, utilize a photoactivator and catalyzing light, include being compliance-free and obtaining instant results. The quality of the bleaching, however, is comparable either using a patient administered, at-home kit or using an in-office procedure.⁶⁻⁸ Patients can grow weary after comprehensive orthodontics, and proper compliance with an at-home bleaching system may be difficult to achieve, resulting in a less than ideal dental bleaching effect. We compared both in-office and at-home systems to assess any differences in dental results or patient satisfaction.

Chroma, hue, and value are the three factors required to define any color. Value, or the relative lightness or darkness of any given color at any saturation level, is the aspect of color that is most changeable via vital dental bleaching. Whereas the traditional dental Vita shade guide is not quantifiable to assess tooth color, the Commission Internationale de l'Eclairage (CIE) determined standard, numerical values that are used globally to define any color.⁹ Dental technology, such as the photospectrometer used in this study (Vident, Brea, CA, USA), has adopted this measurement system and permits the precise, quantifiable measurement of tooth color, which permits accurate comparison.^{10,11}

It can be difficult to measure patient satisfaction of treatment outcome. A survey utilizing a visual analog scale (VAS) was selected to permit infinite choices for the respondents yet allowing for computable results.¹²⁻¹⁴ The seven questions were selected to assess different aspects of their orthodontic treatment, and diction was controlled to make it understandable by all of our patients. The structure of the questions were precise to address issues which when evaluated by the patient retrospectively should remain unaffected by orthodontic treatment (question 1), unaffected by dental bleaching (questions 2, 3, 5, and 6), or may be affected by both orthodontics and bleaching (questions 4 and 7).

MATERIALS AND METHODS

Seventy-five participants were selected from the patient pool in a university setting. Inclusion criteria were a minimum age of 16 (mean age 18.4), English speaking, and compliant with their comprehensive orthodontic treatment, as subjectively reported by the treating resident and faculty member.



Figure 1. One hundred-millimeter visual analog scale with seven items that each participant was asked to evaluate.

Patients were excluded if they had anterior restorations, previous bleaching, or anterior decalcifications.¹⁵ Four patients did not complete the study, leaving 71 participants (43 females and 28 males). These four failed to come back for the follow-up survey.

The participants were randomly assigned to one of three groups. A control group (N = 24) received no bleaching at all. One group received an at-home bleaching kit (Discus Dental, Culver City, CA, USA) with custom trays and standardized written and verbal use instructions (N = 23). The third group (N = 24) had a one-time in-office bleaching procedure (Discus Dental). Each of the in-office bleaching procedures was performed by one of the chief investigators.

At the end of the comprehensive orthodontic treatment, 2 days after the removal of all orthodontic appliances, all participants were asked to fill out a survey assessing their orthodontic treatment outcome (T1). Each question asked the participant to gauge their evaluation on a 100-mm VAS (see Figure 1). The participants in the bleaching groups were told that the bleaching was complimentary, and the relationship to the surveys was not revealed.

At the same appointment, the participants in the home bleach group received a bleaching kit, custom trays, and use instructions. Sixteen percent carbamide peroxide gel with self-dispensing syringes was used. The manufacturer's recommendation of nighttime wear for 18 nights was followed. Utilizing the dental photospectrometer, the value measurement (CIE standardized 0-100) for each of the maxillary anterior six teeth in the midfacial region was recorded. As colors can read differently based on the surrounding light sources, the ambient light was controlled to the manufacturer's recommended 5,500°K for all value measurements in the study. This was achieved by blocking outside light infiltration and using regulated 5,500°K light fixtures (Verilux, Waitsfield, VT, USA) in the operatory.

The in-office bleach group returned within a week of debanding for their bleaching procedure with a

TABLE 1. MEAN RESPONSES FOR EACH GROUP.						
	Control T1	Home Bleach T1	Office Bleach T1	Control T2	Home Bleach T2	Office Bleach T2
The position of your teeth	21.31	20.49	20.19	20.27	18.63	18.40
before treatment						
The position of your teeth now	87.25	86.14	83.36	83.76	92.44*	90.82*
Your bite	85.49	82.40	73.90	82.06	93.75*	88.11*
Your smile	80.18	85.50	77.93	76.49	93.02*	90.19*
How straight your teeth are	83.67	85.18	84.41	76.82	93.14*	92.50*
Your profile	76.13	75.30	75.07	73.45	87.35*	89.21*
Your overall orthodontic	84.82	86.67	85.32	76.06	93.30*	95.53*
treatment						

T1 = two days after removal of orthodontic appliances prior to any bleaching procedure; T2 = follow-up one month later, postbleaching. Mean millimetric measurements for each survey question at T1 and T2. Larger numbers represent greater patient satisfaction for that item. *Represents significant difference between T1 and T2, p < 0.01.

peroxide gel containing a photofenton ultraviolet light activator. Prior to isolation, the same tooth color measurements were determined for this group as the homekit goup. The manufacturer's recommended protocols regarding isolation, bleach application, light activation, and postbleach patient instructions were followed.

All patients were recalled 1 month after debanding (T2) ostensibly to check the fit of their orthodontic retainers. All of the patients had been retained by the type of retainers best suited to their particular case; these included clear Essixtype retainers, various styles of Hawley retainers, and fixed lingual retainers. None of the patients had active retention (such as a spring aligner or positioner). Each participant again filled out the same survey. After filling out the survey, each of the participants in the bleaching groups had the same midfacial tooth color measurements recorded.

STATISTICAL ANALYSIS

Using a digital caliper accurate to 0.01 mm, linear measurements were taken for each of the responses on the VAS, using 0 mm as least satisfactory, 50 mm as neutral, and 100 mm as most satisfactory. All surveys were measured by one investigator. To assess accuracy, 20 random surveys were selected and remeasured by the other investigator. Measurement

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$$\sqrt{\frac{\Sigma d^2}{2n}}$$
 was 0.037.

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Student's *t*-tests were used to compare each item on the VAS within each group from T1 to T2. Also, using *t*-tests, the difference from T2 to T1 was compared between groups for each of the question items. An analysis of variance was used to compare the differences in T1 and T2 responses between each of the test questions (questions 2–7).

The mean change in color value for each of the anterior six maxillary teeth between T1 and T2 was calculated with SD. This was compared, using *t*-tests between the two bleach groups for each of the teeth.

RESULTS

Descriptive statistics for all groups at T1 and T2 are shown in Table 1. Paired *t*-tests showed significant differences for survey items 2 to 7 for both bleach groups. Neither the values for the control group nor the first question for any group proved to be significant.

The difference in value for each survey item between T1 and T2 is demonstrated in Figure 2. With



Figure 2. Millimetric difference between T1 and T2. A positive number represents an increase in value (satisfaction) from T1 to T2, while a negative number denotes a decrease in value (satisfaction) over time. *Represents a value that is significantly different than the control (p < 0.01). T1 = two days after removal of orthodontic appliances prior to any bleaching procedure; T2 = follow-up one month later, postbleaching.

exception of the first VAS question, paired *t*-tests demonstrated significant differences between the bleaching groups and the control group on all items. There were no significant differences identified between the two bleach groups. There were no significant differences between the response changes between individual test questions (questions 2–7).

The differences in value measurements obtained from the photospectrometer for the six anterior teeth are demonstrated in Figure 3. Whereas all of the differences are significant (p < 0.01) when comparing T1 to T2, none of the six teeth measured were significantly different when comparing the two bleaching groups to each other.

DISCUSSION

The first item on the survey, which asked the patients to assess their preorthodontic condition, was used to establish the validity of the T1 and T2 measurements. Across all groups, the mean change from T1 to T2 was only a very insignificant -1.58 mm. Consistent responses over time for this question enabled valid comparison of the other survey items from T1 to T2.

Although bleaching can have no effect on the position of teeth, occlusion, or profile, the patients were significantly more pleased with these aspects of their orthodontic treatment when bleaching was done immediately following comprehensive orthodontics.





Figure 3. Difference from T1 to T2 in Commission Internationale de l'Eclairage (CIE) Lab value measurements for the maxillary six anterior teeth. A larger number denotes a greater change in value. There was no significant difference in the dental value improvement between the at-home and the in-office bleaching groups. T1 = two days after removal of orthodontic appliances prior to any bleaching procedure; T2 = follow-up one month later, postbleaching.

> For the bleaching groups, a greater increase was expected in response to questions that could be influenced by the bleaching. Counterintuitively, none of the increases were significantly different than any of the others, and in fact, although not statistically significant, the greatest increases were seen in response to questions (numbers 3 and 6) that could have no relationship to bleaching. It has been previously noted that patients' perception of needed cosmetic treatments does not correlate well with dentists' views.¹⁶ Patients seem to blur the differences between different qualities based upon their overall view.

Also intriguing is that the nonbleached control patients displayed a decrease on all survey items from T1 to T2. Although none of the reductions were statistically significant, when asked about overall treatment satisfaction, control patients were 9.99 mm less satisfied at T2 than at T1. Only very limited studies assessing patient satisfaction with orthodontic treatment are available, and none of these studies have controlled or compared the time since appliance removal¹⁷⁻²⁰; the results of our control group indicate that further investigation into the post-treatment emotions of our patients is warranted.

Although the response to dental bleaching in patients who just had orthodontic appliances removed may be different to "nonorthodontic patients,"21 results were consistent with previous reports demonstrating that the quality of bleaching achieved with the two different protocols are not statistically different. One of our inclusion criteria was patients who had been compliant with their orthodontic treatment; as home bleaching also requires good patient compliance, a more representative cross section of our patient pool may have elicited a poorer bleach result in that group.

CONCLUSIONS

When vital dental bleaching is done after comprehensive orthodontics, patients reported an increased satisfaction with the orthodontic outcome. This result is irrespective of bleaching technique. Patient satisfaction is heightened by grouping dissimilar cosmetic procedures compared with evaluating the components individually.

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