

IN-OFFICE BLEACHING: LIGHTS, APPLICATIONS, AND OUTCOMES



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In-office bleaching dates back to 1848 but has enjoyed a tremendous recent resurgence of usage since the 1990s after tray bleaching popularized the bleaching options. With this occurrence, there are several questions about in-office bleaching that continue to surface. First, does the light make a difference in the final outcome of in-office bleaching? Second, does one in-office bleaching yield the same results as tray bleaching? And, finally, would a combination of in-office and tray bleaching yield a better final outcome? The purpose of this article is to explore these questions based on the current literature.

Lights have been associated with in-office bleaching since the 1800s. That association was a logical development in the early days of bleaching since we know that heat and light speed up a chemical reaction. Many different techniques and materials were tried in the late 1800s to lighten first non-vital and then vital teeth. The traditional technique for in-office bleaching as we recognize it today was formally described in the early 1900s in *Dental Cosmos*^{1,2}, which was one of the precursors to the *Journal of the American Dental Association*. The clinical observation was that the teeth appeared lighter with the use of the light immediately after treatment. However,

their clinical experience was also that it took one to four visits to obtain patient satisfaction.

The in-office bleaching technique was popular in the late 1800s and early 1900s. During this time, there were many articles about bleaching and esthetics appearing in the dental journals, and discussions about the chemistry of bleaching at conventions and dental meetings. However, most of the bleaching literature disappeared from journals at the end of the early 1900s, possibly due to World War I, the Great Depression, and World War II. Bleaching resurfaced in the late 1950s in response to fluorosis problems in certain parts of the country coupled with the more affluent post-World War II society, which was interested in esthetics. When acid-etching techniques entered the dental world in the 1970s, that step was also included in the in-office bleaching process, again because, clinically, the tooth appeared lighter immediately after treatment.

Recently, a call for evidence-based dentistry has caused the profession to re-examine some of the traditional bleaching treatment options and concepts. More education and insights into the scientific method, with the use of control and treatment groups, have uncovered new insights into the bleaching process.

Soon evidence about the permeability of the tooth to peroxide and other low-molecular-weight materials emerged. Studies showed that peroxide could easily pass through intact enamel and dentin to the pulp in 5–15 minutes. Hence, there was no need to acid-etch or condition the tooth surface to make the surface more bleachable. In 1991, Hall demonstrated that acid-etching did not improve the efficacy of bleaching, and that the etching step should be dropped from the in-office procedure.³ Typically, etching only gives the appearance of whitening due to the frosty surface of the enamel changing the optical properties.

The question of how effective the lights are with in-office bleaching remained unanswered, partially due to a general lack of funding for research on esthetics. Research in 2000 demonstrated that the application of a rubber dam alone would cause a lightening of the tooth for a ΔE of 6.26, which is approximately six to 12 shade changes on the Vita Classic shade guide, depending on where the tooth colour measurement begins. This rubber dam lightening phenomenon is often seen in dental student clinics and may be termed “rubber dam bleaching.” When new young dental students are placing their first composite restoration, the patient remains under the rubber dam for a long period of time. The dehydration effect of isolation on teeth is demonstrated when a rubber dam is used to isolate the teeth for an hour or more. The tooth dehydrates under these conditions, which then results in six to 12 shade changes on a Vita Shade guide, without any actual bleaching having occurred. The “lightened” teeth return to a normal colour after a period of hours or days—hence, the admonition for dentists to always select a composite shade prior to rubber dam isolation.

Since it also has been determined that teeth do not all bleach at the same rate or to the same extent, what was needed to help answer these in-office bleaching and light questions was either an extremely large number of patients or a “split-arch” design on each patient. In the split-arch study design, one side of the arch serves as the control and the other receives the treatment. This approach allows accurate testing of the technique with far fewer subjects than does the traditional large clinical trial, and it tests similar teeth with the different treatment conditions. This design was first demonstrated in print by Hein and colleagues in 2003 in the Clinical Research Associates

(CRA) group.⁴ His group tested one side of the arch with light-activated bleaching and the other side without light activation. He found no difference in the efficacy of bleaching.

Later, an article appeared in *Journal of the American Dental Association* that implicated that the light makes a difference.^{5,6} However, the colour was measured immediately after removal of the rubber dam, which introduces the confounding bleaching effect due to isolation dehydration. Most other bleaching studies have shown that the proper time to measure the colour change from bleaching is at least 2 weeks after the termination of bleaching treatment and may be as long as 6 weeks with higher concentrations of materials. This delay in colour-measurement avoids the dehydration effect of the isolation technique, and it allows the oxygen generated from bleaching to dissipate from the tooth. Additional oxygen in the tooth from the bleaching process seems to affect both the optical qualities and the bond strengths to the tooth by approximately 25% immediately after bleaching. Although the particular company cited in the article has restricted research on the current product, CRA had tested the original product, which consisted of a 50% hydrogen peroxide activated by a laser, and found that the laser did not make a difference in bleaching efficacy.⁷

In late 2005 and early 2006, several scientific articles appeared that finally clarified what clinicians seem to report about in-office bleaching and lights. In January 2006, Kugel and colleagues compared a light-activated in-office bleaching material with a chemically activated material that did not involve the use of a light. They used a split-arch design so that each mouth served as its own control.⁸ They found that immediately after bleaching, the light-activated side appeared lighter. However, in 2-week post-treatment evaluations, there was no difference between the light-activated side and the non-light-activated side. The investigators observed that the immediate change in the light-activated material seemed to be related to the dehydration effect of the isolation and heat of the light rather than any improvement in bleaching efficacy.

Another study in February of 2006 demonstrated that it takes more than one visit with in-office light-activated bleaching to achieve patient satisfaction.⁹ In this study, the range was one to four visits; even then, some people were not satisfied with the results.

Several of the patients chose to continue bleaching with at-home tray bleaching rather than have an additional in-office treatment. Only 26% of the patients were satisfied with one in-office bleaching treatment, and these were generally patients with an initial shade of A2 or lighter on a Vita Classic shade guide.

Patients often want one in-office treatment to take the place of using an at-home tray treatment. However, clinical evidence from the past 100 years indicates what recent research has confirmed—the range of treatment visits for maximum lightening with in-office bleaching is one to four applications, and it depends on the individual patient tooth colour and response rate of that tooth, rather than the concentration or technique of the bleaching material. Bleaching is time and concentration dependent to a certain extent, but the main limiting factor is the rate of colour change the tooth can accomplish.

A CRA survey in 2005 compared the usage of at-home tray bleaching with in-office bleaching, and it asked for reasons why the dentists use the light.¹⁰ Some dentists stated that they use the light because it came with the system, some use the light because patients ask for it, and some use the light because it is good for marketing.

In the journal *Operative Dentistry*, Auschill and colleagues made a comparison among the three classes of bleaching (in-office, tray bleaching, and over-the-counter [OTC] strips).¹¹ To achieve a six-shade change, this group concluded that 7 days of 10% carbamide peroxide in a custom-fitted tray would be roughly equivalent to three in-office bleaching treatments or 16 days of a popular OTC bleaching strip.

In a 2007 *Operative Dentistry* article, a number of different in-office light-activated products were tested.¹² As with other reports, there was an immediate whitening of a ΔE of 6 at week 1, followed by a sudden drop by week 2 to a level of approximately 2 ΔE . Although the sample size was small, the pattern among all the products was very similar—a sudden spike in the colour followed by a significant relapse. For most products, the relapse is to a colour lighter than the original, but the colour change does not remain at the immediate post-bleaching level.

The original instructions of a popular light-activated in-office product used in the television program *Extreme Makeover* actually recommends

following the one in-office treatment with at-home tray treatment to complete the bleaching process. What this in-office–tray approach accomplishes is to start the whitening process with a high concentration of hydrogen peroxide as well as create the illusion of whitening from the dehydration with one in-office treatment, and then—before the colour relapse occurs as described above—use the tray system at home to bring the teeth to the desired whitening level as they rehydrate.

For many years, it was thought that some form of light would make the whitening process work more quickly because, from a chemistry standpoint, heat and light speed up a chemical reaction. What we are now learning is that the tooth has a finite limit on how fast it will change colour and how white it will become that is specific to each individual. Once the limit for each particular person's teeth is reached, it apparently does not matter what else is attempted to boost the bleaching, the tooth colour will not change any further. All other “whitening effects” at that point are related to dehydration. Just as we have different, genetically determined hair and eye colours, we apparently all have different maximum tooth colours and different rates of change. That is why some people can tray-whiten their teeth in 3 nights, whereas for others it takes 6 weeks; and why some people can get successful results with one in-office treatment, whereas others need multiple visits. Whitening is more tooth specific than it is product or technique specific.

In-office whitening will continue to be a treatment option in the dental bleaching armamentarium. Not every person can or wants to wear the tray delivery products. Dentists should inform their patients that, although one in-office treatment will lighten their teeth, patients may need multiple treatments to reach their maximum or desired whiteness. Patients need to be prepared financially and emotionally for the possibility of additional treatments since we are unable to predict either the rate or maximum colour change of a tooth prior to bleaching. Lights may have their place to encourage subsequent home compliance by boosting the initial perception that whitening is occurring while waiting for the tray bleaching technique to finally whiten the teeth. However, care should be used in expecting any product or system to overcome the limitations imposed by a patient's genetic coloration and a tooth's rate of change.

After reviewing these cited articles and others written since,¹³⁻¹⁵ the following conclusions concerning the original questions may be drawn.

1. The light does not make a difference in the final outcome of in-office bleaching; instead, it primarily contributes to the illusion of whitening through dehydration in the first week. This occurrence may encourage compliance for the patient to continue with tray bleaching or to return for subsequent in-office treatments. There is a significant relapse in colour after in-office bleaching.
2. One in-office bleaching does not yield the same results as tray bleaching. Rather, multiple treatments may be needed based on the initial discoloration, with three visits being the average. Patients must be willing to have and pay for multiple in-office treatments to reach their maximum whitening. Sensitivity is greater with in-office treatments than with tray bleaching, especially with longer in-office treatments, so steps must be taken to minimize or relieve sensitivity.
3. A combination of in-office and tray bleaching yields a better final outcome than a single in-office treatment. However, the final bleaching result is the same regardless of the treatment used (tray, in-office, OTC) if there are enough bleaching treatments with a reputable product over a long enough time. Hence, the total fee for both procedures may not justify the outcome, so the cost-benefit ratio of combining techniques must be presented to the patient. Compliance may be helped by the immediate peroxide/dehydration of an in-office treatment, but the final outcome is still dependent on the tooth's response to peroxide when enough proper treatments are applied.

A further in-depth reading of the attached articles along with the questions will further elaborate on the current insights concerning in-office bleaching.

References

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