REVIEW ARTICLE

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In-office *vs* at-home tooth bleaching: A narrative review of efficacy and safety

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ABSTRACT

To compare in-office (chairside) and at-home (dentist-supervised) vital tooth bleaching techniques in terms of efficacy, longevity, safety, sensitivity, and patient-reported outcomes. A narrative review of the literature was conducted using PubMed, Scopus, and Cochrane Library, including randomized trials, systematic reviews, and meta-analyses published between 2000 and 2025. Studies directly comparing in-office and at-home bleaching with peroxide-based agents were selected. Outcomes of interest included immediate color change, relapse over time, incidence and intensity of tooth sensitivity, and adverse effects on enamel or pulp. Emphasis was placed on high-quality evidence from the last five years. Both techniques achieved significant, perceptible whitening. Numerous meta-analyses showed no clinically meaningful difference in bleaching efficacy when treatment protocols were followed. At-home bleaching (10–16% carbamide peroxide) and in-office bleaching (25–40% hydrogen peroxide) produced comparable ΔE and shade guide improvements. Some studies suggested slightly greater long-term color stability with at-home bleaching, likely due to longer contact time and ease of touch-ups. Sensitivity occurred frequently with both methods (incidence 37–90% at-home, 17–100% in-office), but was typically more intense in-office and milder but more recurrent with at-home use. No irreversible pulp or enamel damage was reported. Light activation did not enhance whitening outcomes or reduce sensitivity. Both methods were well accepted by patients. In-office and at-home bleaching are equally effective and safe. In-office offers faster results but a higher risk of acute sensitivity; at-home provides gradual whitening with lower intensity side effects and better long-term maintainability. Choice of technique should be individualized based on sensitivity profile, desired speed, compliance potential, and lifestyle.

KEY WORDS: tooth bleaching; hydrogen peroxide; carbamide peroxide; tooth sensitivity; color stability; cosmetic dentistry

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INTRODUCTION

The desire for whiter teeth has become increasingly common in recent years, paralleling growing public demand for cosmetic dentistry [1]. Tooth bleaching – the lightening of tooth color using chemical agents – is now a routine procedure in dental practice. Tooth discoloration can be extrinsic (surface stains from foods, beverages, smoking, etc.) or intrinsic (internal tooth pigment changes due to factors like aging, fluorosis, tetracycline exposure, or trauma). Bleaching is most effective for extrinsic and age-related discoloration, penetrating enamel and dentin to oxidize pigmented molecules, thereby producing a lighter tooth shade. Two principal techniques for vital tooth bleaching are widely employed: in-office bleaching, done by dental professionals in the clinic, and at-home bleaching, in which patients apply dentist-prescribed bleaching agents using custom-fitted trays at home [1].

In-office (chairside) whitening typically uses high concentrations of hydrogen peroxide (H_2O_2) gel (approximately 25–40% H_2O_2) applied to the teeth under direct supervision. The gums and soft tissues are carefully isolated (e.g. with rubber dam or protective gels) to prevent chemical burns from the strong oxidizing agent. The bleaching gel may be applied in one or more sessions of about 15–30 minutes each, often during a single appointment. Sometimes a light or laser is used to heat or "activate" the peroxide, although extensive evidence indicates that light activation does not significantly enhance whitening efficacy or longevity of results [1]. Meta-analyses have concluded that use of light does not improve the bleaching outcome in terms of final shade, nor does it affect the risk or intensity of tooth sensitivity, regardless of the peroxide concentration [1]. (In fact, one umbrella review found that in-office bleaching with a light-activated low-concentration gel

achieved similar results to in-office bleaching with a high-concentration gel without light [2]). Therefore, the presence or absence of a light should not be mistaken as a fundamental difference between at-home and in-office techniques—rather, it is a variable within in-office techniques. In contrast, at-home bleaching involves lower concentrations of bleaching agents, most commonly carbamide peroxide (CP) in concentrations of about 10–20% (which releases ~3–7% hydrogen peroxide) or equivalent low-strength hydrogen peroxide gels (around 6–10%). Patients perform the treatment themselves, wearing a custom-made tray or other delivery device containing the gel, typically for several hours daily or overnight, over a span of 1–3 weeks (depending on the formulation and protocol). This approach was first introduced by Haywood and Heymann in 1989 as "nightguard vital bleaching" with 10% carbamide peroxide in a tray[9]. It quickly gained popularity for its ease of use and proven effectiveness.

Both methods rely on the same fundamental chemistry: peroxide compounds break down into free radicals (reactive oxygen species) that penetrate through enamel prism structure and oxidize organic pigmented compounds in the dentin and enamel. By cleaving the double bonds of chromophores (the molecules responsible for tooth color), these agents render the pigments lighter or colorless, resulting in a whiter appearance. Notably, hydrogen peroxide is the active bleaching radical in both systems (carbamide peroxide decomposes into hydrogen peroxide and urea). The difference lies in concentration and contact time: in-office techniques deliver a strong dose in a short time, whereas at-home techniques use a weaker dose over an extended period to achieve a comparable effect.

Safety is an important consideration with any bleaching. Hydrogen peroxide, especially at high concentrations, is a potent oxidizer that can cause tissue irritation or damage if misused. Professional in-office systems have built-in safety measures, such as professional isolation of soft tissues and controlled application by trained personnel. Carbamide peroxide (urea peroxide) is a stabilized compound that breaks down slower; its use in custom trays allows the saliva to buffer and dilute the peroxide, generally resulting in a gentler treatment per session. Numerous studies and reviews have established that bleaching, when properly conducted, does not cause permanent structural damage to teeth. Transient changes like slight decreases in enamel microhardness or mineral content have been noted in some laboratory studies, but saliva and remineralization can readily reverse these changes, and no clinically significant enamel loss or damage occurs under recommended use [3]. Pulpal health is likewise maintained: while the bleaching agents can diffuse to the pulp and cause transient inflammation (the cause of sensitivity), no irreversible pulpitis or necrosis has been directly linked to vital bleaching in healthy teeth at typical concentrations [2]. Indeed, a recent systematic review on at-home bleaching reported that most patients maintain stable tooth color for 1–2.5 years after treatment with no long-term adverse effects, and only cases of severe initial discoloration show higher relapse over time [4]. Modern bleaching products often incorporate desensitizing agents (e.g. potassium nitrate, fluoride, amorphous calcium phosphate) to help mitigate sensitivity and protect the enamel during treatment [5]. For example, many in-office kits include fluoride or calcium to offset demineralization, and at-home kits may be accompanied by desensitizing gels for use in the tray after bleaching [5].

Given the widespread use of both in-office and at-home whitening, it is important to understand how they compare in outcomes and side effect profiles. Patients often ask which method will make their teeth whiter or which results last longer. Earlier studies and anecdotal perceptions sometimes presumed that the prolonged exposure of at-home bleaching might yield better long-term whitening, whereas in-office offers immediate gratification. To address these questions, a growing body of evidence from clinical trials and systematic reviews has compared the two techniques directly. This review will summarize the scientific evidence on the efficacy, longevity, and safety of in-office vs. at-home tooth bleaching, highlighting any advantages or disadvantages of each approach.

AIM

The aim of this review is to evaluate and compare the effectiveness of in-office (professional) versus at-home (take-home) tooth bleaching techniques, as well as to assess differences in post-bleaching sensitivity and other relevant clinical considerations (such as color relapse, patient satisfaction, and safety to hard tissues). The goal is to determine whether one technique offers superior outcomes or fewer side effects than the other, based on current evidence, and thus to guide clinicians in evidence-based recommendation of bleaching options.

MATERIALS AND METHODS

A literature search was performed to collect relevant publications comparing in-office and at-home tooth whitening. The databases PubMed/MEDLINE, Scopus, and Cochrane Library were queried using keywords and MeSH terms such as "tooth bleaching," "teeth whiten-

ing,""in-office,""at-home,""take-home,""vital bleaching," "hydrogen peroxide," and "carbamide peroxide." The search included articles published in English without an upper date limit, focusing primarily on the last two decades as tooth bleaching techniques became mainstream. Both randomized controlled trials (RCTs) and controlled clinical trials comparing at-home and in-office whitening were sought, as well as systematic reviews and meta-analyses on the topic. Key inclusion criteria were studies on vital (living) teeth bleaching that directly compared an in-office bleaching regimen to a dentist-supervised at-home regimen. Studies evaluating combination techniques (e.g., in-office followed by at-home), over-the-counter products (unsupervised home use), or non-vital tooth bleaching were excluded or considered only for background information.

Titles and abstracts were screened to identify comparative studies. Full texts of eligible studies were obtained and analyzed. Data extracted included sample size, bleaching agents and concentrations used, treatment protocols (number of sessions or days of use), outcome measures (such as color change quantified by shade guides or spectrophotometry, immediate and long-term color stability), and reported side effects (especially the incidence and severity of tooth sensitivity). Because the included evidence spans heterogeneous study designs and outcome reporting, a narrative (descriptive) synthesis is provided rather than a quantitative meta-analysis. However, findings from high-level evidence like systematic reviews are given particular weight. The results are organized around the primary outcomes of whitening efficacy and color stability, and the secondary outcomes of tooth sensitivity and safety. Only findings pertinent to the comparative question (in-office vs. at-home) are highlighted. In-text reference numbers correspond to the bibliography, which is formatted in Vancouver style and contains only the works cited in this review.

REVIEW

WHITENING EFFICACY AND COLOR STABILITY

Immediate Bleaching Outcomes: The literature consistently shows that both in-office and at-home bleaching techniques are effective at significantly lightening tooth color. Numerous clinical trials have directly compared the color change achieved by each method. In general, no statistically or clinically significant difference in immediate whitening efficacy is found between at-home tray bleaching and in-office (chairside) bleaching when each is carried out properly [3, 6]. For example, Giachetti et al. conducted a randomized trial with a 9-month follow-up and reported that a 14-day at-home 10% carbamide peroxide regimen produced virtually the same degree of whitening as a single session of in-office bleaching with 38% hydrogen peroxide, with both groups showing comparable color improvements (measured by spectrophotometer) one week post-bleaching [3]. Other studies echo these findings: Mondelli et al. compared different methods (including in-office 35% H_2O_2 and at-home 15% CP) and found all methods yielded effective whitening with similar immediate color changes (no method was clearly superior) [4]. Patients typically achieve an improvement of several shade guide units (SGU) or a notable increase in lightness (Δ*L) and decrease in yellowness (Δb*) with either approach.

It is worth noting that in-office bleaching can provide visible results faster – often within a single dental visit – whereas at-home bleaching attains the result more gradually over one or two weeks. Despite this difference in treatment timeline, by the end of the full treatment course the degree of whitening is comparable. A recent comprehensive meta-analysis (2025 update) confirmed that there is no significant difference in overall bleaching efficacy (measured in shade change) between in-office and at-home techniques. In that analysis, the mean color improvement in standard shade guide units (ΔSGU) was essentially equivalent for the two methods [5]. Interestingly, the same meta-analysis noted that measurements in the CIELab color space (ΔE*, which captures color difference with a spectrophotometer) were slightly in favor of at-home bleaching on average (a small but statisztically higher ΔE for at-home)[5]. This subtle difference might be due to the longer cumulative exposure of the teeth to peroxide in at-home protocols, potentially allowing more thorough penetration of enamel and dentin. However, the difference in ΔE was modest, and the evidence quality was rated low, meaning it may not translate to a perceptible clinical advantage.

LONG-TERM COLOR MAINTENANCE

An important consideration is how well the whitening results last (i.e., relapse or recurrence of staining). Both techniques have shown durable effects over months to years, though some relapse (partial rebound of tooth color toward baseline) is common with time due to dietary stains and aging. Available studies with follow-up periods indicate that color stability is generally similar for in-office and at-home whitening. Giachetti et al.'s trial found that at 9 months post-treatment, tooth color remained significantly improved compared to baseline in both groups, with no significant difference between

the in-office and at-home patients in terms of shade retention [3]. Mondelli et al. observed patients for 2 years after bleaching and reported all methods had maintained a lighter shade than baseline; the slight differences in relapse between techniques were not statistically significant [4].

Some evidence suggests that at-home bleaching may have a slight advantage in long-term maintenance of tooth color, possibly because patients can perform occasional touch-ups or because the longer initial treatment better oxidizes deep stains. A 2024 systematic review noted that across studies comparing the two techniques, there was a lower recurrence of discoloration (less relapse) when using at-home tray bleaching with carbamide peroxide, compared to in-office alone [6]. In practical terms, this means the at-home group's teeth tended to remain a bit whiter over time before any color regression, although both groups still demonstrated significant whitening at final recalls. For instance, one split-mouth RCT reported that after 3 and 6 months, the in-office side showed more color rebound than the at-home side, despite similar initial whitening [1, 4]. In that study, in-office bleaching had significantly greater relapse by 6 months and higher post-bleaching sensitivity, whereas at-home bleaching maintained color better and with less sensitivity [7, 8]. Over longer periods, maintenance strategies become important: regular dental hygiene and avoiding excessive chromogenic foods/drinks can prolong the effect for both techniques. Clinical reports suggest that without any maintenance, roughly 10% of patients may notice some shade relapse by ~2 years post-bleaching, around 25% by 5 years, and up to 50% by 8 years, depending on lifestyle habits [9]. However, many patients opt for periodic retreatment or "touch-ups," especially those who have at-home trays available, which can substantially extend the whiteness. Indeed, most authors agree that on average the whitening effect can remain stable for at least 1–3 years regardless of technique, with gradual fading thereafter [4]. Some clinicians even combine protocols (an initial in-office session followed by at-home bleaching) to capitalize on immediate results and sustained at-home treatment; however, combination approaches have not shown definitively superior long-term whitening compared to at-home alone, and they can increase total exposure and cost. A recent systematic review concluded that all bleaching types are effective in changing tooth color, and no single method is significantly more effective than others; notably, at-home techniques appeared more effective over time, while combined in-office+at-home techniques did not yield greater efficacy than either alone [10]. Both in-office and at-home bleaching, when done correctly, yield long-lasting improvements in tooth shade, and neither has proven to outperform the other decisively in the long run. The longevity of whitening for both methods is favorable, often on the order of 1–3 years or more before a touch-up might be desired, depending on individual factors.

TOOTH SENSITIVITY AND OTHER SIDE EFFECTS

TOOTH SENSITIVITY

The most frequently reported side effect of vital bleaching is tooth sensitivity (also called dentin hypersensitivity during bleaching). This manifests as transient, sharp sensitivity to thermal stimuli (cold air, liquids) or spontaneous "zing" sensations in teeth, typically during the bleaching period. Both in-office and at-home methods can induce tooth sensitivity, as the peroxide penetrates to the pulp and may provoke a mild inflammatory response. A key question is whether one technique causes more or less sensitivity.

In terms of incidence (risk) of sensitivity, studies show that a large proportion of patients experience at least some sensitivity with either method, but the range is broad. Meta-analyses and trials have reported sensitivity occurring in anywhere from one-third to the vast majority of patients. For at-home bleaching, roughly 37% up to 90% of users have reported transient sensitivity in various studies, whereas for in-office bleaching the incidence ranges from about 17% of patients to nearly 100% in some reports (depending on the product and protocol)[6]. Thus, the likelihood of experiencing sensitivity is high with both approaches. Statistically, many comparisons find no significant difference in whether sensitivity occurs or not between the two techniques [11]. In the latest umbrella review of the literature (aggregating multiple systematic reviews), the risk of developing tooth sensitivity was similar for at-home and in-office bleaching (no significant difference in incidence, $p \approx 0.85$) [11]. Likewise, a 2025 meta-analysis reported that the relative risk of experiencing bleaching-related sensitivity did not differ significantly between at-home vs. in-office treatments [5].

However, when considering the severity or intensity of sensitivity, some differences emerge. In-office bleaching, using strong peroxide for a short duration, tends to produce sensitivity that is more acute but short-lived. Patients often report moderate intensity sensitivity or a sharp "zing" during or immediately after an in-office session, which then subsides within 24–48 hours. By contrast, at-home bleaching can cause sensitivity of mild intensity (often described as slight

twinges or tingling), potentially recurring each day after tray use, but generally more tolerable on a pain scale. The 2025 meta-analysis did find a significantly lower mean intensity of sensitivity with at-home bleaching compared to in-office, suggesting that although both cause sensitivity, the pain was on average milder in the at-home groups [5]. This aligns with clinical observations: the lower concentration peroxide over multiple days causes a diffuse, gentle irritation, whereas one-shot high concentration can provoke a sharper pulp reaction initially. It should be noted that the umbrella review mentioned above concluded that not only was the risk similar, but also the overall intensity of sensitivity did not significantly differ between at-home and in-office when considering the evidence as a whole [11]. The apparent discrepancy in findings may be due to how different studies measure pain or the inclusion of various protocols; in practice, many clinicians find in-office sensitivity, when it occurs, tends to be more intense but brief, whereas at-home sensitivity is more intermittent and mild.

It is important to emphasize that bleaching-related sensitivity is transient and resolves spontaneously in virtually all cases. Studies have shown that any tooth sensitivity typically disappears within a few days to a week after completing treatment, with no lasting nerve damage. Strategies to manage sensitivity include using desensitizing toothpaste (with potassium nitrate) before and during bleaching, application of fluoride or calcium-based remineralizing gels after each session, shorter application times, and ensuring a few days gap between in-office sessions if multiple are needed [11]. Using a lower concentration in-office gel or performing fewer applications per visit can also mitigate severity, albeit at the cost of possibly needing more sessions for equivalent whitening. Some trials have tested pre-treatment analgesics (e.g., ibuprofen) to reduce bleaching sensitivity, but results are mixed [11].

GINGIVAL IRRITATION

Another side effect to consider is gingival or mucosal irritation. Because in-office gels are very potent, if isolation is not perfect, the gel contacting the gingiva can cause chemical burns (white blanching or ulceration of the gums). Dentists counteract this by applying protective barriers on the gingiva. At-home bleaching can lead to gum irritation if the trays leak or are overfilled with gel, causing the peroxide to overflow onto the gums. Generally, any soft tissue irritation is temporary; the affected gum areas usually recover within a day or two. Patients should be instructed on proper tray use and gel dosage to minimize this risk. Studies comparing methods suggest no major difference in overall incidence of gingival irritation between well-supervised at-home use and properly performed in-office treatment, as both can be made safe. A slight increase in minor gum irritation might occur with at-home if patients improperly apply the gel, whereas in-office has the advantage of professional control. In any case, no lasting periodontal issues have been linked to bleaching; the changes are superficial and reversible.

EFFECTS ON ENAMEL AND RESTORATIONS

Both techniques have been scrutinized for their effects on enamel surface morphology, mineral content, and existing restorations. Research indicates that neither in-office nor at-home bleaching causes clinically significant damage to enamel. Microscopic evaluations (SEM studies) have shown no visible enamel surface changes after completion of bleaching treatments, whether over-the-counter, at-home, or in-office, compared to unbleached controls [8]. Some in vitro studies do note minor alterations: for example, a slight increase in enamel porosity or roughness and a transient reduction in enamel microhardness immediately after bleaching. These effects are thought to result from peroxide's deproteinizing action and the chelation of calcium by ingredients in some gels (especially if they are highly acidic). Crucially, saliva exposure and fluoride use post-bleaching tend to remineralize and restore enamel hardness within days. Neither method appears to strip away enamel prisms or cause measurable loss of enamel thickness. Recent comprehensive reviews uphold that peroxide-based whitening is safe for enamel when instructions are followed, with only minimal, reversible changes observed [3]. Regarding dental restorations (composites, etc.), peroxide can superficially soften composite resin or alter its surface roughness and color. Both at-home and in-office bleaches can cause this to a similar degree. Thus, patients should be informed that existing tooth-colored fillings or bondings might not bleach (and could even require replacement to match the new tooth shade). There is no evidence that one method is gentler on restorations than the other; any peroxide exposure can affect composite, so it's a general consideration for bleaching.

PATIENT ACCEPTANCE AND CONVENIENCE

Each technique has practical pros and cons that may affect patient preference. In-office treatment offers the convenience of one or two appointments and the immediate gratification of seeing results right away, which some patients find highly motivating. It does not rely on patient compliance beyond showing up to the dental

office. However, it typically incurs higher cost (due to clinician time and materials) and the aforementioned risk of more intense short-term sensitivity. At-home treatment is generally more affordable and allows the patient to whiten at their own pace and in their own home, which many find comfortable. The trade-off is that it requires consistent daily use of trays for one or two weeks, and results are gradual. Some patients may not comply fully or may find wearing trays overnight inconvenient. Interestingly, a clinical study on patient acceptance found that the at-home tray technique was the most accepted method compared to others (including in-office and over-the-counter products) [8]. Patients appreciated the gentle, incremental improvement and the ability to control or pause treatment if sensitivity occurred. In contrast, the high intensity of in-office bleaching's result (and possibly the use of lights or long sessions with mouth open) can be uncomfortable for some. Both methods, when explained properly, have high satisfaction rates because the outcome – a whiter smile – tends to meet patient expectations in the majority of cases. The decision often comes down to individual lifestyle and how quickly the result is desired. Some patients even opt to combine approaches (often called "boost" or "jump-start" whitening): an initial in-office session to rapidly improve shade, followed by an at-home regimen to further enhance and stabilize the result. While combination protocols can be effective, studies have not shown them to dramatically outperform either method alone in final shade change [6]. They can, however, carry a higher total risk of sensitivity since the teeth undergo both procedures [12]. In one systematic review, tooth sensitivity was reported to be highest in groups that underwent combined in-office + at-home bleaching, slightly more so than in-office or at-home alone [12]. Therefore, when using a combined approach, extra care with desensitizing measures is warranted.

In summary, both at-home and in-office bleaching cause transient tooth sensitivity and occasional gum irritation, with no permanent deleterious effects on the teeth or oral tissues documented. At-home treatments tend to have milder sensitivity symptoms and are very safe when dentist-supervised, while in-office treatments produce faster results but with a risk of short-lived, more intense sensitivity episodes. Proper patient education and the use of desensitizing strategies can make either experience relatively comfortable.

DISCUSSION

The comparative evidence reviewed confirms that in-office and at-home tooth bleaching are largely equivalent in their ability to whiten teeth, aligning with the consensus of recent systematic reviews that neither modality is definitively "better" in terms of efficacy [5] [6]. This finding is clinically important: it indicates that dentists can confidently recommend either approach based on patient preferences and case-specific factors, rather than out of concern that one method might fail to whiten as well as the other. Both techniques leverage the same peroxide chemistry, and when concentration × time of exposure is balanced, the outcome in color change converges. In practical terms, an at-home protocol of 10–15% carbamide peroxide for 1–2 weeks can achieve a similar whitening effect to an in-office treatment with 35–40% hydrogen peroxide for about an hour total (often split into 2–3 applications in one visit). The degree of whitening attained depends more on the initial stain level and the total peroxide dose delivered than on the modality of delivery.

One aspect where subtle differences have been observed is color relapse and long-term effectiveness. While both methods maintain results well, the at-home approach might confer a slight advantage in long-term color stability, as noted in some studies [5, 6]. A possible explanation is that the extended exposure in at-home bleaching could better oxidize deeper or more stubborn stains, leading to less rebound over time. Additionally, patients who own bleaching trays can perform periodic touch-up applications (for example, a couple of nights of bleaching every few months) to counteract any staining that reoccurs, thereby prolonging the whiteness. In contrast, after an in-office treatment, a patient would need to return to the office or obtain a take-home kit for maintenance if the color relapses over time. This difference highlights a practical consideration: maintenance of whitening is often easier with an at-home system at hand. Clinicians increasingly integrate this by providing custom trays and gel to patients who underwent in-office bleaching, so they can manage relapse at home subsequently. In effect, the combination approach is popular – using the strength of in-office for a quick initial result and the convenience of at-home for maintenance – even though strictly speaking, the combination hasn't shown significantly greater whitening than at-home alone in controlled research [6]. It does, however, marry the benefits of both: immediate impact and sustained control.

Regarding tooth sensitivity, the discussion corroborates that it is an inherent transient side effect of peroxide use. The findings that at-home bleaching tends to produce less intense sensitivity might influence patient selection: individuals with known sensitive teeth or a lower pain tolerance may be better served with a gentler, at-home regimen where they can stop

or skip days if discomfort arises. Alternatively, if an in-office treatment is preferred (for instance, due to time constraints or the psychological impact of "instant" whitening), the clinician can employ measures to mitigate sensitivity – such as using a desensitizer on the teeth beforehand, avoiding light activation which can heat the pulp, and spacing out sessions. It is also notable that updated evidence suggests no significant difference in the overall risk of sensitivity between methods [11]; earlier assumptions that in-office causes sensitivity more frequently might have been due to older high-intensity techniques or lack of desensitizing agents. Modern bleaching gels often include additives like potassium nitrate or ACP to reduce sensitivity, and these are available for both in-office and at-home products [7]. For example, some in-office kits incorporate fluoride or calcium to help re-mineralize enamel, and many at-home kits come with separate desensitizing gels. Thus, the gap in patient comfort between the two methods has likely narrowed with improved product formulations. Still, in practice, many clinicians observe that in-office treatments, if they cause sensitivity, produce a short, sharp post-operative sensitivity, whereas at-home treatments may cause a lower-grade sensitivity that can persist during the days of treatment. Both scenarios are temporary. The patient's history of sensitivity and preference should guide the choice, and prophylactic use of desensitizing protocols can be employed in either case.

Another discussion point is the role of light activation in in-office bleaching. Dental marketing of in-office systems often touts special lamps or lasers to "accelerate" bleaching. However, current high-level evidence indicates that lights (whether LED, UV, or laser) do not significantly improve the bleaching outcome in terms of final shade or longevity [1]. They may slightly speed the release of peroxide or dehydrate the teeth to give an immediate lighter appearance, but meta-analyses have found no meaningful effect on the degree of whitening, and in some cases lights may increase the risk of post-operative sensitivity due to heat in older lamp systems [13]. Importantly, a 2018 systematic review and meta-analysis by Maran et al. concluded that activating in-office gel with light neither enhanced color change nor affected sensitivity when compared to in-office bleaching without light [1]. The most recent umbrella review (2024) similarly reported no difference in bleaching efficacy between light vs. non-light in-office protocols, and also noted that the use of light did not increase the intensity or risk of sensitivity [14]. Therefore, the presence or absence of a light is largely a matter of product design and marketing, not a determinant of success. Dentists can assure patients that light activation is optional and has no major impact on outcome. The key factor is the chemistry and contact time of peroxide on teeth. It's worth mentioning that some newer approaches have investigated using lights or lasers in novel ways – for example, applying low-intensity laser irradiation in hopes of reducing sensitivity via photobiomodulation [15]. There is preliminary evidence that certain laser protocols (e.g. a combination of infrared and visible light during bleaching) might reduce post-bleaching sensitivity duration and intensity [15], essentially by a biostimulatory effect on the pulp, but these methods do not make the teeth whiter than standard techniques [16]. In summary, light/laser activation is not necessary for effective bleaching and does not dramatically alter results; it should not be a decisive factor when comparing at-home vs in-office, since at-home techniques inherently do not use light and yet achieve equivalent outcomes.

From a regulatory and safety perspective, at-home bleaching is limited in some jurisdictions by the concentration of peroxide allowed without professional oversight. For instance, the European Union regulations permit only up to 6% hydrogen peroxide in products sold directly to consumers (higher concentrations must be applied by a dentist) [2]. In the United States, the American Dental Association (ADA) has given its Seal of Acceptance to dentist-dispensed home bleaching products containing 10% carbamide peroxide, affirming their safety and efficacy for home use [7]. These endorsements underscore that dentist-supervised at-home bleaching is considered a safe treatment when proper protocols are followed. Meanwhile, in-office treatments, using higher peroxide percentages, are restricted to professional application – which provides a safety net through professional technique and isolation. The presence of a dental professional also means any adverse reaction can be promptly managed. It bears repeating that both techniques, as traditionally practiced, have excellent safety records. Even though animal studies have shown that very high concentrations of peroxide can induce pulp inflammation or necrosis in extreme circumstances (e.g. in rat molars or when applied repeatedly to exposed human pulp tissue) [17], these scenarios do not translate to normal clinical use. In vital teeth with intact dentin, no cases of irreversible pulp damage have been reported from bleaching agents in the concentrations and durations used in practice. Nonetheless, clinicians should avoid overuse of high-concentration bleaching and adhere to recommended exposure times to minimize any risk of pulpal irritation.

Patient selection and clinical judgment remain paramount in choosing the bleaching method. Both

techniques have limitations. For example, neither will significantly change the color of restorations (crowns, veneers, fillings), so those might need replacement for color matching after bleaching. Severely discolored teeth (such as tetracycline-stained teeth) often need longer treatment: extended at-home bleaching (several months of nightly use) has been shown to gradually lighten tetracycline stains, whereas in-office alone might not achieve as much change due to the depth of stain. On the other hand, a very quick result might be needed for a special event, in which case an in-office session is justified. Patients with very sensitive teeth might do better with a slower, at-home approach or a lower concentration in-office treatment over multiple shorter visits. Ultimately, the bleaching outcome depends on patient-specific factors (initial tooth shade, type of staining, enamel thickness, etc.) as well as adherence to instructions. The dentist should tailor the treatment plan to the individual – in some cases recommending an at-home kit, in others an in-office treatment, or a combination – knowing that the end result (whiteness) can be reached via either route. Importantly, the dentist should manage expectations and educate the patient that neither method is permanent; good oral hygiene and occasional maintenance are needed to keep teeth white after bleaching.

The evidence base for tooth bleaching is quite robust, with multiple RCTs and several systematic reviews in the last decade. The agreement among high-level studies that at-home and in-office methods are equivalently effective strengthens confidence in our conclusions. However, some limitations exist in the literature: not all studies use the same concentration or regimen, making direct comparisons tricky. For instance, an at-home protocol in one study might involve 2 weeks of nighttime use, whereas another study might use 2 hours/day for 1 week – these could yield different outcomes, yet both are labeled "at-home." Similarly, in-office protocols can vary (one vs. two sessions, with or without light, 35% *vs* 40% peroxide, etc.). These variations introduce heterogeneity. The systematic reviews attempt to account for this by pooling similar studies, but there is always some uncertainty. Moreover, patient subjective factors (like how they perceive sensitivity or satisfaction) can be hard to quantify and compare. Despite these variables, the overarching trends are consistent.

Future research could explore optimizing combination protocols (to see if there is a way to significantly reduce sensitivity while achieving the same whitening in less time) or investigate new bleaching agents (such as non-peroxide whiteners like PAP – phthalimidoperoxycaproic acid – as alternatives). But as of now, hydrogen peroxide-based bleaching remains the gold standard, and the practitioner can choose between an at-home or in-office delivery knowing that each has its place and can produce a brighter smile safely.

CONCLUSIONS

In summary, both in-office and at-home tooth bleaching techniques are effective modalities to achieve significant tooth whitening, and current evidence-based comparisons do not show a clear superiority of one over the other in final outcome. The main points of conclusion are:

- **Bleaching Efficacy:** In-office and at-home bleaching produce equivalent improvements in tooth color. When comparing properly administered protocols, neither method yields significantly whiter teeth than the other. Both can achieve satisfying, natural-looking whitening results across a range of vital tooth discolorations.
- **Longevity:** Whitening results from both techniques are long-lasting (often 1–3 years or more). There is no strong difference in relapse rates, though at-home treatments may have a slight edge in maintaining color over time, possibly due to easier touch-ups. Overall, both require maintenance in the long term (good oral hygiene and periodic re-bleaching) to sustain the brightest shade. Most patients can expect a durable result for at least a year or two before any noticeable color rebound, and even then the teeth remain lighter than baseline in the absence of heavy staining.
- **Safety and side effects:** Both methods are safe for teeth and surrounding tissues when used as directed. Transient tooth sensitivity is the most common side effect in each case, affecting a large portion of patients but resolving after treatment completion. In-office bleaching tends to cause sensitivity of higher intensity immediately post-treatment, whereas at-home sensitivity is typically milder but can persist in low levels throughout the treatment period. The overall risk of experiencing some sensitivity is similar for both. No permanent enamel damage or other serious adverse effect has been documented with either method; any minor enamel changes are reversible and soft tissue irritation is temporary and avoidable with proper technique.
- **Patient factors:** The choice between in-office and at-home should be individualized. In-office bleaching offers rapid results in a controlled setting (ideal for those desiring instant gratification or under time constraints), while at-home bleaching offers convenience, lower cost, and more gradual whitening (suitable for those willing to commit to daily application and seeking a gentler process). Patient preference, compliance likelihood, tooth sensitivity history, and budget are all considerations. Both methods have high patient

satisfaction when expectations are properly managed, and a combination approach can be used to leverage the advantages of each (immediate change plus easy long-term maintenance). It should be noted that use of lights/lasers in in-office treatment is optional and does not fundamentally improve outcomes, so patients should not equate "laser whitening" with a better result.

In conclusion, a dentist can recommend either in-office or at-home bleaching with confidence in its efficacy and safety profile. Both are valuable tools in cosmetic dentistry. The equivalence in outcome means that factors such as patient lifestyle, tolerance for sensitivity, and need for professional supervision can drive the decision. By understanding the nuances of each technique, clinicians can better tailor tooth whitening treatments to individual needs, ensuring effective results with minimal side effects. Continuing research and well-designed clinical trials will further refine these guidelines, but at present, the evidence supports that a bright, white smile is achievable via both routes to nearly the same extent.

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CONFLICT OF INTEREST

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