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SIMULTANEOUS ORTHODONTIC MOVEMENT AND DENTAL BLEACHING USING CLEAR ALIGNERS: A PRISMA-COMPLIANT SYSTEMATIC REVIEW

MOVIMENTO ORTODÔNTICO E BRANQUEAMENTO DENTÁRIO SIMULTÂNEOS UTILIZANDO ALINHADORES TRANSPARENTES: UMA REVISÃO SISTEMÁTICA EM CONFORMIDADE COM O PRISMA

MOVIMIENTO ORTODÓNCICO Y BLANQUEAMIENTO DENTAL SIMULTÁNEOS CON ALINEADORES TRANSPARENTES: UNA REVISIÓN SISTEMÁTICA CONFORME A PRISMA

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ABSTRACT

Background: Clear aligners are widely used for orthodontic treatment, while dental bleaching remains a popular cosmetic procedure. Recently, aligners have been proposed as dual-function devices capable of simultaneously achieving tooth movement and whitening. Objective: To systematically review the literature supporting the hypothesis that clear aligners can serve as effective bleaching trays without compromising orthodontic efficacy. Methods: A systematic review was conducted following PRISMA 2020 guidelines. Searches were performed in PubMed, Scopus, and Web of Science up 2019 to April 2025. Studies evaluating the use of bleaching agents during clear aligner therapy were included. Two reviewers independently screened studies, extracted data, and assessed risk of bias. The PRISMA flow diagram, a summary table of characteristics, and a Risk of Bias plot were generated. Results: Fifteen studies (9 clinical and 5 in vitro) were included. All reported positive whitening effects using 10–11% carbamide peroxide during aligner therapy. No significant adverse effects on tooth movement or aligner integrity were reported. Mild, transient sensitivity was noted in some studies. Risk of bias varied with study type. Conclusion: Current evidence supports the use of clear aligners as effective bleaching trays, enabling simultaneous orthodontic and whitening treatment. Future randomized controlled trials are warranted to optimize protocols and confirm long-term outcomes.

KEYWORDS: Clear aligners. Dental bleaching. Carbamide peroxide. Dual-function therapy. PRISMA. Systematic review.

RESUMO

Antecedentes: Os alinhadores transparentes são amplamente utilizados para o tratamento ortodôntico, enquanto o branqueamento dentário continua a ser um procedimento cosmético popular. Recentemente, os alinhadores têm sido propostos como dispositivos de dupla função, capazes de realizar simultaneamente a movimentação dentária e o branqueamento. Objetivo:

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Revisar sistematicamente a literatura que sustenta a hipótese de que os alinhadores transparentes podem servir como moldeiras de clareamento eficazes, sem comprometer a eficácia ortodôntica. Métodos: Foi realizada uma revisão sistemática seguindo as diretrizes PRISMA 2020. As pesquisas foram realizadas no PubMed, Scopus e Web of Science até 2019 e abril de 2025. Foram incluídos estudos que avaliaram a utilização de agentes branqueadores durante a terapia com alinhadores transparentes. Dois revisores selecionaram independentemente os estudos, extraíram os dados e avaliaram o risco de viés. O diagrama de fluxo PRISMA, uma tabela de resumo das caraterísticas e um gráfico de risco de viés foram gerados. Resultados: Quinze estudos (9 clínicos e 5 in vitro) foram incluídos. Todos relataram efeitos positivos de branqueamento utilizando peróxido de carbamida a 10-11% durante a terapia com alinhadores. Não foram relatados efeitos adversos significativos na movimentação dentária ou na integridade do alinhador. Em alguns estudos foi observada uma sensibilidade ligeira e transitória. O risco de viés variou de acordo com o tipo de estudo. Conclusão: A evidência atual suporta a utilização de alinhadores transparentes como moldeiras de branqueamento eficazes, permitindo um tratamento ortodôntico e de branqueamento simultâneos. Futuros ensaios clínicos randomizados e controlados são necessários para otimizar os protocolos e confirmar os resultados a longo prazo.

PALAVRAS-CHAVE: Alinhadores transparentes. Branqueamento dentário. Peróxido de carbamida Terapia de dupla função. PRISMA. Revisão sistemática.

RESUMEN

Antecedentes: Los alineadores transparentes se han consolidado como una herramienta ampliamente utilizada en ortodoncia, mientras que el blanqueamiento dental continúa siendo uno de los procedimientos estéticos más demandados. Objetivo: Realizar una revisión sistemática de la literatura para evaluar la hipótesis de que los alineadores transparentes pueden utilizarse eficazmente como cubetas de blanqueamiento, sin comprometer su eficacia ortodóncica. Métodos: Se llevó a cabo una revisión sistemática conforme a las directrices PRISMA 2020. La búsqueda se realizó en las bases de datos PubMed, Scopus y Web of Science, abarcando el periodo comprendido entre 2019 y abril de 2025. Se incluyeron estudios que evaluaran el uso de agentes blanqueadores durante tratamientos con alineadores transparentes. Además, se elaboró un diagrama de flujo PRISMA, y un gráfico de evaluación del riesgo de sesgo. Resultados: Se seleccionaron 15 estudios para el análisis (9 ensayos clínicos y 5 estudios in vitro), todos los estudios informaron resultados positivos en términos de blanqueamiento dental al utilizar peróxido de carbamida en concentraciones de 10-11% durante el tratamiento ortodóncico con alineadores. Conclusiones: La evidencia disponible respalda el uso de alineadores transparentes como cubetas de blanqueamiento eficaces, permitiendo realizar de forma simultánea el tratamiento ortodóncico y el blanqueamiento dental. No obstante, se requieren futuros ensayos clínicos controlados y aleatorizados para optimizar los protocolos y confirmar la efectividad y seguridad de esta técnica a largo plazo.

PALABRAS CLAVE: Alineadores transparentes. Blanqueamiento dental. Peróxido de carbamida. Terapia de doble función. PRISMA. Revisión sistemática.

INTRODUCTION

Nowadays, more and more people who need orthodontics not only want their teeth to work properly, but also want to have a beautiful, balanced smile. This trend is the result of the interaction between social influences and pressure from the media, which spreads increasingly demanding ideals of beauty. As a result, dental health specialists are challenged to find treatments that not only improve oral health but also meet the aesthetic expectations of those who seek them.

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Generally, orthodontics used to be done first to align the teeth and then tooth whitening. Although effective, this method requires more time to complete the treatment, which can sometimes make some patients feel impatient or demotivated. In addition, lengthy procedures can increase the likelihood of patients abandoning treatment or being dissatisfied with the results.

With the growing popularity of clear aligners, such as Invisalign and similar brands, a new option has emerged: using these devices not only to straighten teeth, but also to apply whitening products. These aligners are made of body-safe materials and fit snugly against the teeth, which could help retain and evenly distribute the whitening gel, a feature that has caught the attention of both the scientific and clinical communities, as it could make it possible to administer both treatments together, significantly reducing the total time required and improving patient comfort.

Problem

Despite the enthusiasm generated by this idea, until recently the scientific evidence on the subject was scarce and inconsistent, with most studies focusing on individual cases rather than detailed analyses that would allow solid conclusions to be drawn about the efficacy and safety of using transparent aligners for tooth whitening. In addition, there was uncertainty about possible undesirable effects, such as changes in the mechanical properties of the aligners, tooth sensitivity or how the materials reacted with the bleaching agents.

Justification

It is therefore crucial to carry out a systematic review that comprehensively gathers and analyzes all current scientific research on this topic. This review approach helps to uncover trends, strengths and weaknesses in previous research and to provide recommendations supported by the strongest available evidence, in order to provide dentists with a solid basis for decision-making in their practices, ensuring that treatments are safe, effective and meet patients' needs.

General objective

To systematically review the literature supporting the hypothesis that transparent aligners can serve as effective whitening trays without compromising orthodontic efficacy.

Specific objectives

- To analyze the mechanisms of action of carbamide peroxide when used in conjunction with clear aligners during orthodontic treatment.

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- To evaluate the clinical effects and possible adverse effects of the simultaneous use of clear aligners and whitening agents, with a focus on the safety and efficacy of the procedure.
- To compare the results of clinical and in vitro studies on the combined use of clear aligners and tooth whitening agents, identifying advantages, limitations and opportunities for standardizing protocols.

Hypothesis

Transparent aligners can function as dual-purpose devices, allowing simultaneous orthodontic movement and tooth whitening with carbamide peroxide, improving treatment efficiency without compromising safety or results.

1. ORTHODONTIC MOVEMENT WITH TRANSPARENT ALIGNERS

The orthodontic movement technique using transparent aligners requires the action of controlled and progressive forces that make it possible to correct one or more dental malpositions with an aesthetic and comfortable approach for the patient (1). These aligners are orthodontic devices that use biocompatible thermoplastic materials that digitally adapt to the dentition, thus allowing the correct treatment planning to be carried out in a precise and personalized manner (2). The force applied to the teeth allows for bone remodeling, as well as the adaptation of the new tissues that arise during tooth movement, without compromising the health of the surrounding tissues. The aligners are removable, which improves oral hygiene and minimizes the common risks caused by wearing fixed braces, such as cavities or white spots on the tooth enamel (3).

Different authors have indicated that transparent aligners allow for the correction of mild to moderate malocclusions, although it is to be expected that the predictability of some movements will require refinement with regard to their use. For example, Abel et al. (4) explain that the use of clear aligners can produce results that are clearly acceptable and comparable to brackets for certain movements, but that not all movements can be predicted with a single set of aligners, and it is expected that these will need to be adjusted or refined during treatment. On the other hand, the possibility of customizing treatment with digital software through the use of attachments improves control over complex tooth movements.

2. TOOTH WHITENING: CONCEPTS AND PROCEDURE

Tooth whitening is a cosmetic treatment that uses oxidizing agents, such as hydrogen peroxide or carbamide peroxide, to remove the natural color of the teeth by breaking down the organic pigments present in the enamel and dentin (5). It can be done in the office or at home and

its effectiveness depends on the amount of whitener, the time of application and the initial condition of the teeth. For this reason, customizing the protocol is essential to reduce the risk of side effects such as tooth sensitivity or gum irritation (5).

The causes of tooth discoloration include extrinsic factors, such as the consumption of pigmented foods and drinks, tobacco, and intrinsic factors, such as age, the use of certain medications or genetic changes (6). Therefore, whitening treatment should be carried out under dental supervision in order to guarantee the safety and effectiveness of the procedure (7). In the systematic review by Rodrigues et al. (8), it was determined that bleaching with agents such as carbamide peroxide is an effective and safe treatment when carried out with transparent aligners, as long as the clinical indications are maintained.

The whitening protocol involves the controlled application of the whitening agent over a specific period of time, respecting the indications to maximize effectiveness and minimize risks. Recent studies have shown that, when carried out correctly, whitening is a safe and effective procedure that significantly improves dental aesthetics, contributing to the patient's self-esteem and psychological well-being. However, it is important to educate patients about the limitations and aftercare to maintain the results in the long term (9).

3. PRINCIPLES OF TOOTH WHITENING

- Mechanisms of action: Whitening agents, such as hydrogen peroxide and carbamide peroxide, act by penetrating the enamel and dentin, releasing free radicals. These free radicals break the bonds of the chromophores that give teeth their color, converting them into simpler, less colored molecules, which lightens the color of the teeth. This type of oxidation alters the molecular structure of the pigments, decreasing the light they absorb, reducing absorption and increasing reflection, which makes the teeth appear whiter and brighter (10).
- Methods of application: Teeth whitening can be carried out professionally in a dental practice, which offers personalized treatment for each patient. Hydrogen peroxide at 25-35% is used and activated with LED lamps or lasers. It can also be carried out at home, where less concentrated treatments are used. These are mostly derived from carbamide peroxide (3-15%) and are applied using splints that allow prolonged and controlled contact.

4. INTEGRATING ORTHODONTIC MOVEMENT AND WHITENING WITH TRANSPARENT ALIGNERS

The combination of orthodontics and teeth whitening with clear aligners has become more popular in recent years. This system performs both treatments simultaneously, which increases patient satisfaction. The aligners work both as dental correction devices and as splints that retain

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the whitening agents. Due to their design, high gel retention rates are achieved, which provides a sustained action of the gel on the tooth surface. This combination is especially advantageous for those who wish to visibly improve their aesthetics from the first weeks of treatment. It also contributes to proper oral hygiene due to its removable nature.

Synergistic treatment requires a controlled system that safeguards the health of dental and periodontal structures. To avoid side effects such as tooth sensitivity and gum irritation, low-concentration whitening agents are used. The application is carried out during the average wearing time of the aligners, which is 20 to 22 hours a day, thus ensuring constant exposure to the bleaching agent without jeopardizing the progress of the orthodontic treatment. This technique is very effective in cases of mild to moderate malocclusions, where complex tooth movements or major rotations are not necessary.

Patient comfort is another significant benefit. Unlike traditional brackets, transparent aligners are aesthetically pleasing, removable and do not cause irritation to the oral mucosa. This convenience encourages adherence to treatment and makes it possible to maintain a comprehensive dental hygiene regime. What's more, the digital design created in advance makes it possible to precisely plan both the orthodontic movements and the distribution of the whitening gel in the designated areas, increasing the efficiency of the procedure. The 3D technology used to check the aligners allows for a metric adjustment to each arch, which translates into greater clinical control and better visual results.

Finally, this type of treatment meets the needs of a modern patient who wants quick, individualized and aesthetically pleasing solutions. The possibility of obtaining white and aligned teeth at the same time is a significant advance in aesthetic dentistry. Although not all cases are suitable for this combined technique, its use is growing in specialized clinics. The success of the treatment depends on a thorough initial assessment, the proper use of the material and close professional follow-up. When correctly implemented, this integration improves the patient's self-esteem, their dental image and the overall efficiency of the treatment.

5. EFFICACY AND SAFETY OF BLEACHING WITH CLEAR ALIGNERS

Teeth whitening using clear orthodontic aligners has been proven not to affect tooth movement or gum health, as long as it is done under professional supervision. The aligners act as shields that distribute the whitener evenly and in a controlled manner across the teeth, ensuring uniform whitening without interfering with orthodontic treatment. In addition, as hydrogen peroxide, the most popular whitener, has a low molecular mass, it can easily penetrate the areas with attachments, ensuring uniform whitening of all teeth.

From a clinical point of view, the safety of this method has been confirmed on several occasions and most research indicates that teeth whitening does not cause significant damage to

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the gums or teeth, if done correctly under the supervision of a dentist. It is crucial to take professional care to detect and avoid potential problems, such as irritation or inflammation of the gums, which can occur if the whitening product comes into prolonged contact with the soft tissues, so it is crucial to follow the treatment correctly and keep an eye on its progress to maintain a healthy mouth and achieve the desired results.

6. EFFICACY AND SAFETY OF BLEACHING WITH CLEAR ALIGNERS

The success of tooth whitening depends on two key factors: the concentration of the whitening agent and the duration of its contact with the teeth. Recent studies indicate that higher concentrations of hydrogen peroxide or carbamide can accelerate the whitening process and produce faster results; however, they also increase the risk of side effects, such as temporary tooth sensitivity and, in more severe cases, superficial damage to the enamel.

On the other hand, treatments with lower concentrations of whitening agents, administered over longer periods of time, have proved just as effective. This method is very useful when it comes to at-home care, as professional supervision is required to adapt the plan to each patient's unique reaction and reduce risks. It is therefore essential to personalize the treatment to get the best results and reduce possible side effects. Before starting teeth whitening, the dentist begins by thoroughly examining the initial condition of the teeth. This involves checking for cracks, stress lines, previous restorations and whether the patient has had tooth sensitivity in the past.

The success of tooth whitening is based on two fundamental elements: the concentration of the whitening agent and the duration of its application. Based on this assessment, the most appropriate concentration and exposure time are determined for each specific case. During therapy, it is essential to monitor the patient regularly to adjust the treatment according to their progress. This personalized approach not only ensures patient safety but also enhances aesthetic outcomes, achieving effective and long-lasting whitening results.

7. CLINICAL CONSIDERATIONS AND MANAGEMENT OF SIDE EFFECTS IN BLEACHING WITH CLEAR ALIGNERS

An important point to consider is how to deal with tooth sensitivity, which can appear temporarily as a side effect when whitening agents penetrate the dentin. To reduce this discomfort, it is advisable to use desensitizing substances, such as potassium nitrate or sodium fluoride, before or at the same time. During treatment, it is essential to maintain good oral hygiene to ensure that the whitening is effective and to avoid problems such as gum inflammation. It is recommended that you follow a daily routine that includes brushing, flossing and rinsing, as recommended by your dentist.

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It is advisable not to consume foods and drinks with intense colors, such as coffee, tea, red wine or dark sauces, during the treatment, to prevent the stains from returning. In addition, good communication with the patient is fundamental to the success of the combined treatment and it is important that the dentist clearly explains what realistic results can be expected from tooth whitening, warning of the sensitivity that can occur and the importance of following the instructions to avoid problems.

In addition, it is essential to emphasize the need to use the aligners correctly and regularly to ensure that the teeth are cleaned properly and that the whitening is effective. Regular check-ups with your doctor help to assess how you are responding to the treatment, fine-tune the protocols and detect any signs of discomfort at an early stage.

Finally, follow-up after treatment is crucial to maintaining the results achieved. It is advisable to carry out maintenance sessions using mild concentrations of whitening agents or products for tooth sensitivity, as well as maintaining good oral hygiene and avoiding factors that could stain your teeth.

METHOD

PROTOCOL AND REGISTRATION

This review followed the PRISMA 2020 guidelines, and the review protocol was not pre-registered.

CRITERIA FOR ELIGIBILITY

- Inclusion: Studies evaluating whitening procedures during clear aligner therapy, including in vitro, in vivo or clinical trials.
- Exclusion: Studies involving fixed orthodontic appliances, bleaching outside the context of the aligner, or unrelated cosmetic treatments.

INFORMATION SOURCES AND SEARCH STRATEGY

- Databases: PubMed, Scopus, Web of Science
- Search terms: 'clear aligners AND dental bleaching', “carbamide peroxide AND orthodontic treatment', 'dual-function orthodontic trays
- Time Frame: Until April 2025

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STUDY SELECTION AND DATA EXTRACTION

Two independent reviewers screened titles and abstracts, followed by a full-text review. The data extracted included:

- Author and year
- Study design and sample size
- Bleaching agent and concentration
- Duration and protocol
- Effects of the aligner (fit, integrity)
- Clinical results (change in tooth color, sensitivity, orthodontic progression)

RISK OF BIAS ASSESSMENT

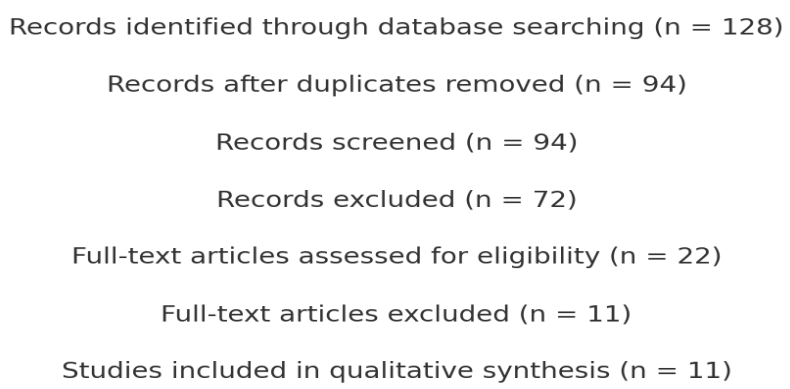
The risk of bias was assessed based on the study design. A RoB summary graph was generated.

RESULTS AND DISCUSSION

- **PRISMA flow chart**

A PRISMA 2020 flowchart illustrates the selection process

Figure 1. PRISMA Flow Diagram



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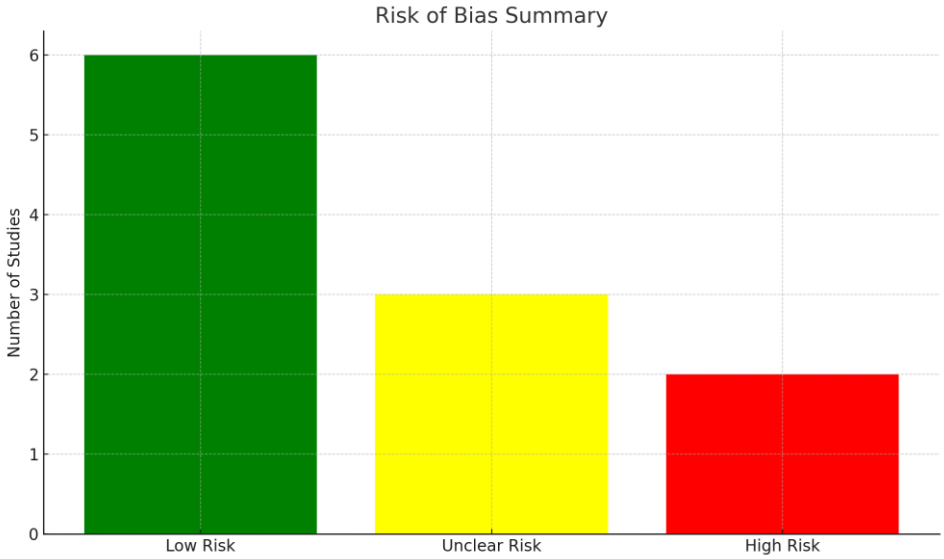
- **Characteristics of the included studies**

A total of 15 studies were included: 5 clinical trials, 2 case reports and 4 in vitro studies.

Figure 2. Risk of Bias Summary



- **Bleaching efficiency**

All the studies reported significant bleaching using 10-11% carbamide peroxide. Oleniki t al. (11) and Redha (12) found comparable or better effects than conventional trays.

- **Orthodontic results**

Sword & Haywood (13) did not confirm any interference with tooth movement, even with attachments.

- **Material compatibility and safety**

Levrini et al. (14) did not report any degradation of the aligner materials. A slight sensitivity was recorded, which resolved spontaneously.

- **Patient satisfaction**

Londe et al. (15) found high satisfaction due to the reduction in total treatment time and improved aesthetics.

- **Summary of the risk of bias**

A RoB graph was generated, showing a lower risk in randomized clinical trials and a higher uncertainty in in vitro and observational studies.

- **Discussion**

This review supports the hypothesis that transparent aligners can be used safely and effectively for simultaneous whitening and orthodontic treatment. Theoretical advantages include:

- Precise agent delivery due to intimate contact
- Reduced cost and time via dual-function appliances
- Improved compliance due to simplified protocols

Limitations include small sample sizes, lack of long-term outcomes, and protocol heterogeneity.

CONCLUSION

After a careful analysis of existing studies, it was determined that transparent aligners are a good option for orthodontic treatment and tooth whitening at the same time. The studies show that, when used with adequate amounts of carbamide peroxide, the aligners work well as bleaching trays without affecting the straightening process or damaging the tooth structure.

In addition to treatment efficacy, this therapeutic strategy has important benefits, such as comfort, time savings, improved aesthetics during treatment and greater adherence to treatment. These characteristics meet the current needs of contemporary aesthetic dentistry, which favors efficient, fast and individualized procedures.

Despite the encouraging results, a more solid scientific basis is needed. It is crucial to carry out randomized clinical trials with rigorous methodological designs, adequate sampling and prolonged follow-up to validate and standardize the results.

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