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Color evaluation of a one-shade used for restoration of non-carious cervical lesions: an equivalence randomized clinical trial

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Abstract

Background Obtaining a perfect color match with resin composite presents a significant challenge. The chameleon effect has enabled resin composite to mimic the color of the adjacent tooth structure in vitro. This double-blind, split-mouth and equivalent randomized clinical trial evaluated the color matching of one-shade resin composite with chameleon effect versus multi-shade resin composite in non-carious cervical lesion restorations (NCCLs).

Methods One hundred twenty restorations were performed on NCCLs with two restorative materials ($n=60$). After prophylaxis, the teeth were isolated with rubber dam and one universal adhesive was applied in the selective enamel etching strategy. For both groups, the restorations were inserted incrementally. The values of ΔE_{ab} and ΔE_{00} in the cervical and middle third were evaluated using a digital spectrophotometer before vs. after the restorations. The restorations were evaluated at baseline and after 7 days, 6-, 12- and 18-month of clinical performance according to the FDI criteria (Word Federation Criteria). Statistical analysis was performed using Chi-square test for all parameters. Color change was analyzed by two one-sided t-tests for paired samples ($\alpha=0.05$).

Results Regarding the color measurement no significant difference was observed when Vittra APS (FGM Dental Products, Joinville, SC, Brazil) was compared to Vittra Unique (FGM Dental Products, Joinville, SC, Brazil) for any of the comparisons performed ($p>0.05$). However, the ΔE_{ab} and ΔE_{00} values for the cervical third, both before and after the restorations, were higher compared to the ΔE_{ab} and ΔE_{00} values observed when comparing the cervical and middle thirds after the restorations. After 18 months, five restorations exhibited minimal discrepancies in terms of marginal adaptation or marginal discoloration ($p>0.05$). In all other criteria, including retention rate, no changes were detected at the 18-month recall.

Conclusions The one-shade resin composite used achieve the same color match when compared to a multi-shade resin composite after a period of 7 days in NCCLs. Overall, the restorations scored clinically very good (FDI) at baseline and after 18 months for all outcomes.

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Clinical Significance The use of a one-shade resin composite in NCCLs can be recommended because it has the ability to simplify the restoration procedure and maintaining an excellent clinical performance.

Registration of clinical trials RBR-8txr4fw: 26/05/2022.

Keywords Resin composite, Color, Optical properties, Clinical trial

Background

Resin composites are now widely utilized as restorative materials owing to their excellent aesthetic properties and clinical performance [1, 2]. The industry undergoes continuous technological advancements, enhancing these restorative materials and solidifying resin composite as the primary choice for direct restorations in both anterior and posterior teeth [3].

Despite its excellence as a material, resin composite poses challenges in achieving precise results, notably in accurately identifying the correct color match between the restoration and natural tooth structure [4]. Due to the inherent polychromatic nature of human teeth, achieving a perfect color match with resin composites represents a potentially difficult goal [4]. In the development of resin composites, pigments of diverse chroma, hues, and values have been incorporated to create color through the interplay of chemical energy between pigments and light [5, 6], resulting in what are known as multi-shade resin composites [7]. However, employing these multi-shade composites proves time-consuming for both the clinician and the patient. Attaining aesthetic "success" necessitates the involvement of a highly skilled professional, rigorous adherence to detailed clinical protocols, and a meticulous approach [4, 7].

Currently, materials engineered to blend or create a chameleon effect have empowered resin composite with the ability to mimic the color of the adjacent tooth structure [4, 8, 9]. This phenomenon, termed color blending [8, 10], demonstrates that, under optimal conditions, the composite seamlessly merges with the surrounding tooth, achieving what is known as a "single-shade" or "one-shade" resin composite [9, 10].

Extensive evaluations have been conducted on all optical properties of these innovative materials, encompassing translucency, opalescence, iridescence, and their potential for color adjustment [8, 11–14]. Yet, when comparing one-shade composites with multi-shade composites, conflicting results have emerged [8, 11–14]. Subsequently, some clinical trials [10, 15, 16] evaluate single-shade composites for applications such as diastema closure and direct veneers for permanent anterior restorations [10] and caries lesions in primary teeth [15], after 24 and 12 months, respectively [10, 15]. However, in both studies, the color change was only evaluated subjectively [10, 15]. More recently, single-shade composites have been employed to restore non-carious cervical lesions (NCCLs) compared to multi-shade composites, with objective color evaluation [16]. However, only short-term follow-ups (7 days) were presented. Therefore, it is evident that more clinical studies are needed to assess the disparities between one-shade and multi-shade composites, along with longer clinical follow-ups. The present study is the first to objectively evaluate the color of this resin composite and to clinically assess restorations during an 18-month service period in NCCLs.

The aim of this two-arm double-blind, equivalent, randomized clinical trial was to compare the clinical performance of the one-shade resin composite Vittra Unique (FGM Dental Products, Joinville, SC, Brazil) with the multi-shade resin composite Vittra APS (FGM Dental Products, Joinville, SC, Brazil) in restoring NCCLs. The first null hypothesis of this study is that there will be no difference in color matching between the resins used. The second null hypothesis of this study is that there will be no difference in other clinical parameters between the resins used.

Methods

Ethics approval and protocol registration

The clinical investigation was approved (protocol # 5.344.060) by the scientific review committee and by the committee for the protection of human participants of the Tuiuti University of Paraná (Curitiba, PR, Brazil). The study methodology was conducted in agreement with the Helsinki Declaration guidelines. All participants were informed of the nature and objectives of the study and the informed consent was obtained from all subjects before beginning of the study. This means that all subjects signed and agree to participate of the present clinical trial. It was registered in the Brazilian Clinical Trials Registry (RBR-8txr4fw; Registration Date: 26/05/2022). The description of the experimental design followed the Consolidated Standards of Reporting Trials (CONSORT) [17] with extension of equivalence study designs [18].

Trial design, settings, locations of data collection and recruitment

The present study is a double-blind, equivalence and randomized and controlled clinical trial. It was performed between June 2022 to September 2022, and the 18-month data collection occurred between December 2023 to February 2024. The study was carried out at the clinics of the Faculty of Dentistry of the Tuiuti University of Paraná