



Predictive factors on the efficacy and risk/intensity of tooth sensitivity of dental bleaching: A multi regression and logistic analysis



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ABSTRACT

Objectives: The aim of this study was to identify predictor factors associated with the whitening outcome and risk and intensity of bleaching-induced tooth sensitivity from pooled data of 11 clinical trials of dental bleaching performed by the same research group.

Methods: The individual patient data of several published and ongoing studies about dental bleaching was collected and retrospectively analyzed. At the patient-level, independent variables (bleaching techniques [at-home and in-office protocols], sex, age and baseline tooth color in shade guide unit [SGU]) as well as dependent variables (color change in shade guide units (Δ SGU), color change in the CIEL*a*b* system (ΔE), risk and intensity of TS in a visual analog scale) were collected. Multivariable linear regression and multivariable logistic regression models were carried out using backward elimination whenever the *p*-values were higher than 0.05.

Results: A significant relationship between baseline color and age on color change estimates was detected ($p < 0.001$). Every increase of one SGU in the baseline color resulted in an increase of approximate 0.66 in the final Δ SGU and 2.48 for the ΔE . For every increase of one year in the participant's age we observed a decrease of the whitening degree of 0.07 for the final Δ SGU and 0.69 for the ΔE . The bleaching technique was shown to be a significant predictor of Δ SGU ($p < 0.001$) but not of ΔE . In regard to TS, baseline color and bleaching technique are significant predictors ($p < 0.001$). The risk of TS for at-home bleaching was 51% (95% CI 41.4–60.6) and for the in-office 62.9% (95% CI 56.9–67.3).

Conclusions: Younger patients with darker teeth reach a higher degree of whitening. Patient with darker teeth and submitted to at-home bleaching presents lower risk and intensity of TS.

Clinical significance: The baseline color of the teeth and the patient's age is directly related to the effectiveness of dental bleaching and TS.

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1. Introduction

The increase in patient awareness of the ability to improve their smiles has been responsible for the boom in esthetic dentistry in recent years. Among all therapies for improving the patient's smile, dental bleaching has been widely employed by dental practitioners, as it is a very conservative, simple, low-cost and safe procedure. A survey conducted in the United Kingdom and published in 2008 revealed that more than 80% of general dental practitioners perform dental bleaching in their offices [1].

Several studies have already reported the effectiveness of at-home and in-office dental bleaching [2–7]. This means that all patients may have their teeth whitened to some degree, although the individual whitening response is affected by multiple factors [8], including those associated with product formulation and usage. The higher the peroxide concentration and the longer the contact time, the faster the whitening [9–11].

Although this explains the differences observed between patients when subjected to different bleaching therapies, it does not justify the individual variations observed after the application of the same bleaching protocol. For instance, most clinical trials [12–15] report a mean change of 3 shade guide units after one in-office bleaching session of 45 min with 35% hydrogen peroxide; however, this protocol may not produce any noticeable color change in some patients, which may impact patients' and professionals' expectations and influence patients' confidence in professionals.

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Table 1Characteristics of the studies from each raw data were collected ($n = 426$ patients).

Study	Groups	Study design	Material (brand)	Bleaching protocol	Study sample [sample collected for this study]	Participant's age – mean $\pm$ SD [range]	Baseline Color	Method of color assessment	Method of tooth sensitivity assessment
Rezende et al. [28]	G1: At-home without coffee exposure G2: At-home with coffee exposure	Parallel	16% CP ^d	3 h/daily for 3 weeks	40 [40]	23.1 $\pm$ 5.3 [18–40]	A2 or darker	SGU Vita Classical ^e Spectrophotometer ^f	NRS 0–4 VAS 0–10
Rezende et al. [17]	G1: Dexamethasone + in-Office G2: Placebo + in-Office	Parallel	35% HP ^g	2 sessions, 1 week-interval 45 min (3 $\times$ 15 min) each	63 [60] ^a	22.7 $\pm$ 4.1 [18–33]	A1 or darker	SGU Vita Classical ^e Spectrophotometer ^f SGU Vita Bleachedguide ^h	NRS 0–4 VAS 0–10
Rezende et al. [30]	G1: In-Office + at-home ^a G2: In-Office	Parallel	G1: 35% HP ⁱ + 6% HP ^j G2: 35% HP ⁱ	2 sessions, 1 week-interval 45 min (3 $\times$ 15 min) each	30 [14] ^b	26.1 $\pm$ 8.6 [18–42]	A2 or darker	SGU Vita Classical ^e	NRS 0–4
Reis et al. [27]	G1: In-Office G2: In-Office	Parallel	G1: 35% HP Blue ^k G2: 20% HP Blue ^l	2 sessions, 1 week-interval A single 40–50 min application	60 [45] ^a	27 $\pm$ 8.3 [18–49]	C2 or darker	SGU Vita Classical ^e	NRS 0–4
de Geus et al. [23]	G1: At-home in smokers G2: At-home in non-smokers	Parallel	10% CP ^m	3 h/daily for 3 weeks	120 [60] ^c	25.2 $\pm$ 6.6 [18–46]	A2 or darker	SGU Vita Classical ^e Spectrophotometer ^f	NRS 0–4 VAS 0–10
Bonafé et al. [15]	G1: In-office in sound teeth G2: In-office in restored teeth	Parallel	G1 and G2: 35% HP ^g	2 sessions, 1 week-interval 45 min (3 $\times$ 15 min) each	30 [30]	24.8 $\pm$ 4.5 [18–35]	A2 or darker	SGU Vita Classical ^e Spectrophotometer ^f	NRS 0–4
Bonafé et al. [29]	G1: placebo + in-office G2: desensitizing + in-office	Parallel	G1 and G2: 35% HP ^g	2 sessions, 1 week-interval 45 min (3 $\times$ 15 min) each	30 [30]	24.8 $\pm$ 4.2 [18–35]	A2 or darker	SGU Vita Classical ^e Spectrophotometer ^f	NRS 0–4
Mena-Serrano et al. [31]	G1: In-office 20% HP G2: In-office 20% HP + LED/Laser ⁿ G3: In-office 35% HP G4: In-office 35% HP + LED/Laser ⁿ	Parallel	G1 and G2: 20% HP ^o G3 and G4: 35% HP ^g	2 sessions, 1 week-interval 45 min (3 $\times$ 15 min) each	78 [78]	22.5 $\pm$ 3.8 [18–33]	A3 or darker	SGU Vita Classical ^e Spectrophotometer	NRS 0–4 VAS 0–10
de Paula et al. [24]	G1: Ascorbic acid + in-Office G2: Placebo + in-Office	Parallel	G1 and G2: 35% HP ^g	2 sessions, 1 week-interval 45 min (3 $\times$ 15 min) each	39 [15] ^a	26.8 $\pm$ 8.2 [18–45]	C2 or darker	SGU Vita Classical ^e Spectrophotometer ^f	NRS 0–4 VAS 0–10
de Paula et al. [25]	G1: Etoricoxib + in-Office G2: Placebo + in-Office	Parallel	35% HP ^g	2 sessions, 1 week-interval 45 min (3 $\times$ 15 min) each	30 [30]	25.5 $\pm$ 6.4 [18–42]	C2 or darker	SGU Vita Classical ^e Spectrophotometer ^f	NRS 0–4 NRS 0–100 VAS 0–10
Paula et al. [26]	G1: In-Office + Ibuprofen G2: In-Office + Placebo	Parallel	35% HP ^g	2 sessions, 1 week-interval 45 min (3 $\times$ 15 min) each	30 [24] ^a	29.6 $\pm$ 8.3 [18–56]	C2 or darker	SGU Vita Classical ^e Spectrophotometer ^f	NRS 0–4 VAS 0–10

CP: Carbamide peroxide; HP: hydrogen peroxide; SGU: shade guide units; NRS: numeric rating scale; VAS: visual analog scale; LED: Light-emitting diode.

^a Less data than the original study was used due to missing information.^b Data from this group (combined at-home + in-office bleaching) was not added in this regression analysis as this could not be compared to the other groups.^c Only data from the Brazil center was added to this analysis to standardize the same population in all studies.^d Whiteness Perfect 16%, FGM, Joinville, Santa Catarina, Brazil.^e Vitapan Classical, Vita Zahnfabrik, Bad Säckingen, Germany.^f Vita Easyshade, Vita Zahnfabrik, Bad Säckingen, Germany.^g Whiteness HP Maxx 35%, FGM, Joinville, Santa Catarina, Brazil.^h Vita Bleachedguide 3D-Master, Vita Zahnfabrik, Bad Säckingen, Germany.ⁱ Mix One Supreme 35%, FGM, Joinville, Santa Catarina, Brazil.^j Mix Day 6%, Villevie, Joinville, Santa Catarina, Brazil.^k Whiteness HP Blue 35%, FGM, Joinville, Santa Catarina, Brazil.^l Whiteness HP Blue 20%, FGM, Joinville, Santa Catarina, Brazil.^m Whiteness Perfect 10%, FGM, Joinville, Santa Catarina, Brazil.ⁿ Whitening Lase Light Plus, DMC Odontológica, São Carlos, São Paulo, Brazil.^o The 20% HP gel was produced exclusively for this study by FGM company, keeping the same characteristics of the Whiteness HP Maxx gel^h.

Understanding of patient-related variables that can affect dental bleaching, such as age, gender and baseline tooth color, as well as those that can predispose bleaching-induced tooth sensitivity can help predict patient response to treatment and allow clinicians to determine the best treatment modality for each

individual. Additionally, clinicians may set appropriate expectations to avoid disappointments and frustrations during treatment.

As the individual clinical trials published in the literature do not have a high sample size to allow for such predictions, pooling data

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