

Clinical performance of whitening on devitalized teeth: a retrospective observational study

Desempenho clínico do clareamento em dentes desvitalizados: estudo observacional retrospectivo

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ABSTRACT

Objective: This retrospective observational study evaluated the clinical performance of intracoronal whitening and correlated the main factors that interfere with its stability and patient satisfaction. **Material and Methods:** The paper was designed following the STROBE statement. Patients from the Institute of Science and Technology - ICT/UNESP database who underwent nonvital tooth whitening from August 2010 to July 2015 were selected. Data collection was performed by researching the institution records, patients interview, clinical and radiographic examination. Data were analyzed using Mann-Whitney test and Spearman's correlation ($p < 0.05$). **Results:** The initial search on 1275 records resulted in 43 patients, of whom 18 were selected according to eligibility criteria. There was positive correlation only between the degree of patient's satisfaction and the perception of color difference after whitening treatment ($p < 0.05$). Color relapse was observed in all conditions, independently of the period of follow-up ($p > 0.05$). There was no case of external cervical root resorption. **Conclusion:** Color changes after whitening influenced patient's satisfaction. There was no correlation among the color relapse and height of gutta-percha, return interval or cause of darkening.

KEYWORDS

Tooth discoloration; Tooth nonvital; Tooth whitening.

RESUMO

Objetivo: Este estudo observacional retrospectivo avaliou o desempenho clínico do clareamento interno e correlacionou os principais fatores que interferem em sua estabilidade e satisfação do paciente. **Material e Métodos:** O artigo foi elaborado seguindo o STROBE. Pacientes do banco de dados do Instituto de Ciência e Tecnologia – ICT/UNESP que foram submetidos ao clareamento dental em dentes desvitalizados entre agosto de 2010 e julho de 2015 foram selecionados. A coleta de dados foi realizada por meio de pesquisa em prontuários da instituição, entrevista com os pacientes, exames clínico e radiográfico. Os dados foram analisados usando o teste de Mann-Whitney e correlação de Spearman ($p < 0,05$). **Resultados:** A pesquisa inicial em 1275 registros resultou em 43 pacientes, dos quais 18 foram selecionados de acordo com os critérios de elegibilidade. Houve correlação positiva apenas entre o grau de satisfação do paciente e a percepção da diferença de cor após o tratamento clareador ($p < 0,05$). A recidiva da cor foi observada em todas as condições, independentemente do tempo de acompanhamento ($p > 0,05$). Não houve nenhum caso de reabsorção cervical externa. **Conclusão:** As mudanças de cor após o clareamento influenciaram a satisfação do paciente. Não houve correlação entre a recidiva da cor e a altura do gutta-percha, o intervalo de retorno ou a causa do escurecimento.

PALAVRAS-CHAVE

Descoloração de dente; Dente não vital; Clareamento dental.

INTRODUCTION

Tooth discoloration has been pointed out as one of the leading causes of patients' esthetic dissatisfaction [1-3]. Changes in tooth color may occur due to pathophysiological processes or to external factors, such as intake of dietary sources that have dark pigments (wine, coffee, tea), which cause intrinsic and extrinsic enamel or dentin stains [4,5]. Other factors such as pulpal necrosis, trauma, and iatrogenic endodontic treatments have also been reported as the main causes of tooth discoloration [6-8]. The correct diagnosis of the cause of tooth discoloration is of great importance, as it influences the choice and outcome of the treatment [5].

Intracoronary whitening is a conservative alternative for the esthetic treatment of nonvital teeth [5]. In this treatment, two whitening techniques are proposed: the inside-outside technique, which carbamide peroxide and hydrogen peroxide agents are used in low concentrations [9], and the walking bleaching technique [10], where association of sodium perborate and hydrogen peroxide is employed in the pulp chamber, with weekly changes until a satisfactory tooth color was achieved. However, these treatments can cause alterations in the enamel, dentin and cement surface structure, decreasing the microhardness, changing the chemical composition of enamel and dentin and external root resorption [5,11,12].

The recurrence of intracoronary whitening has been reported in the literature by several authors [13-15]. The variations in clinical research results that have evaluated the effectiveness of intracoronary whitening may be due to insufficient numbers of cases, different techniques, and final restorations, as well as different definitions of color relapse. The chemical reduction of oxidation products, the marginal breakdown of the final restoration and the permeability of enamel and dentin to extrinsic substances are considered the possible causes of color relapse [16]. However, there are no studies evaluating the clinical performance of the whitening treatment and the main factors that interfere with its stability.

Given the importance of longevity of nonvital teeth whitening and the factors that interfere in the treatment result as the cause of discoloration, the whitening technique used and patient habits, the aim of this study was to evaluate the clinical performance of the whitening treatment in nonvital teeth using the walking bleaching technique and inside-outside technique, correlating the main factors that may interfere in the stability of the whitening and patient satisfaction.

MATERIAL AND METHODS

Study design

This research was developed in the retrospective observational study model and followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (<https://www.strobe-statement.org>). Patients were reviewed within 1 to 5 years after intracoronary whitening to assess the clinical performance of the treatment. The protocol of the study was approved by the local Institute Review Board (CAAE: 59338016.0.0000.007), and all the volunteer patients signed an informed consent form.

Patient selection

One thousand two hundred and seventy-four patients who were treated at School of Dentistry at Institute of Science and Technology of São José dos Campos, São Paulo, Brazil, were initially screened for the study using the institution's records. Patients older than 18 years old and who underwent intracoronary whitening treatment from August 2010 to July 2015 were included in the study.

The participants were recruited over a 5-month period from August to December 2016. After a full general and dental examination, patients with intellectual disability or whose tooth was unavailable for evaluation due to a fixed prosthesis, caries, poor restoration, cracking, or fracture, were excluded.

Data collection

Data collection was performed by

researching records of the Institution, by interviewing the patients and by clinical/radiographic examination.

A structured questionnaire with 15 objective questions was individually applied to the participants by a previously trained examiner, with an estimated time of 20 minutes for each interview. The questionnaire included sociodemographic characteristics (gender, age, and educational level), oral hygiene habits (frequency of dental brushing and flossing), consumption patterns (coffee or soft drinks and smoke), the esthetic perception of color stability, and degree of satisfaction with the result of the whitening treatment.

Institution records were consulted to obtain information such as the cause of darkening and presence of external cervical resorption before tooth whitening, the whitening technique employed, and period of treatment. The clinical and radiographic examination was performed to evaluate the type and position of the tooth, the presence of external cervical resorption, and the height of gutta-percha in the cervical third of root canal by a second examiner. The height of gutta-percha was considered appropriate when located at least 2 mm below the root canal orifice or the cemento-enamel junction.

Data analysis

Data obtained from the application of structured questionnaires, institution's records and clinical/radiographic examination were tabulated and analyzed by descriptive statistics using absolute (n) and relative (%) frequencies. To infer whether there was a correlation between the factors height of gutta-percha, return interval, the cause of darkening and degree of patient satisfaction with the color stability of the bleached tooth, data were analyzed by the Mann-Whitney test and Spearman correlation ($p < 0.05$).

RESULTS

One thousand two hundred and seventy-four records of patients were initially screened

for the study, but 1231 not meeting the inclusion criteria and 25 declining participation were excluded (Figure 1). Thus, 18 patients were analyzed for the clinical performance of intracoronal whitening. Four patients were male (22%), and 14 were female (78%). The age of patients ranged from 18–59 years old (mean age of 45 years). Table 1 shows patients demographics.

The sodium perborate and water were used in patients who have undergone bleaching of nonvital teeth by the walking bleaching technique, while 35% hydrogen peroxide, sodium perborate and water were used in inside-outside technique. The whitening agents were applied for up to four weeks.

The distribution of teeth included in the study and the factors related to the clinical performance of whitening treatment are summarized in table 2. The criteria assessed during the visit of patients are listed in table 3.

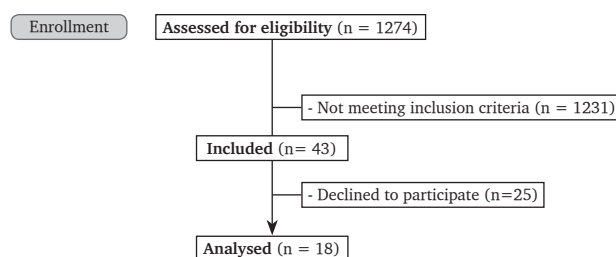


Figure 1 - Flow diagram of the retrospective study.

Table 1 - General characteristics of the patients included in the study

Characteristics		n
Gender	Male	4
	Female	14
Age	18-40 years old	5
	41-60 years old	13
Educational level	Basic education	6
	High school	9
	Higher education	3
Coffee or soft drinks	Yes	17
	No	1
Smoke	Yes	2
	No	16

Table 2 - Distribution of teeth included in the study and factors related to the clinical performance of whitening treatment

Characteristics		n
Type of tooth	Central incisor	10
	Lateral incisor	5
	Canine	3
Position	Maxillary	18
	Mandibular	0
Cause of darkening before tooth whitening	Iatrogenic	12
	Necrosis	4
	Trauma	2
Whitening technique	Walking	12
	Inside-outside	6
Return interval after tooth whitening	1-2 years	11
	3-5 years	7

Table 3 - Criteria assessed during the visit of the patients

#ID	Age	External cervical resorption	Height of gutta-percha	Patient's satisfaction	Color stability
1	54	No	Appropriate	Satisfied	Yes
2	47	No	Inappropriate	Unsatisfied	No
3	42	No	Inappropriate	Unsatisfied	No
4	47	No	Appropriate	Unsatisfied	No
5	59	No	Inappropriate	Satisfied	Yes
6	59	No	Inappropriate	Satisfied	Yes
7	38	No	Appropriate	Unsatisfied	No
8	50	No	Appropriate	Unsatisfied	No
9	50	No	Inappropriate	Unsatisfied	No
10	47	No	Appropriate	Satisfied	No
11	16	No	Inappropriate	Satisfied	Yes
12	40	No	Appropriate	Satisfied	Yes
13	52	No	Inappropriate	Satisfied	Yes
14	48	No	Appropriate	Unsatisfied	No
15	36	No	Inappropriate	Unsatisfied	No
16	48	No	Inappropriate	Unsatisfied	No
17	48	No	Appropriate	Unsatisfied	No
18	33	No	Appropriate	Satisfied	No
Total	Average age of 45.22	Yes 0 No 18	Appropriate 9 Inappropriate 9	Satisfied 6 Unsatisfied 12	Yes 6 No 12

In the follow-up period of 1 to 5 years after whitening, none of the teeth included in the study presented external cervical resorption. The height of the gutta-percha was considered

inappropriate in 50% of the patients but did not present a positive correlation with the color stability in the referred follow-up interval. There was no correlation between the color relapse and the monitoring period or cause of darkening ($p > 0.05$) as shown in table 4. There was a positive correlation only between the degree of patient's satisfaction and color stability after whitening treatment ($p < 0.05$) (Table 4).

Table 4 - Correlations between the factors with color stability by the Spearman's correlation ($p < 0.05$)

Factors	Correlations	
	r	p-level
Color stability x Height of gutta-percha	-0.236	0.346
Color stability x Return interval	-0.161	0.523
Color stability x Cause of darkening	-0.057	0.821
Color stability x Patient's satisfaction	0.707	0.001

DISCUSSION

This retrospective observational study evaluated the clinical performance of whitening treatment in nonvital teeth. It is a study which was adequately designed following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

Despite the determination of main factors that can interfere in the stability of the whitening, it is difficult to evaluate dental aesthetics or the effectiveness of intervention, only with professional assessment because it may hide other factors [17,18]. Therefore, information obtained from the patients should be supplemented, since that their perceptions of oral health are important in assessing needs and determining outcomes oral health [19,20].

The frequency of patients that did not attend to recall times is a limiting factor for longitudinal and transverse studies [15]. In this study, only 18 patients were evaluated, which characterizes one of its limitations. However, this limitation does not affect

the validity of the findings, since factors that compromise the stability of whitening treatment can be evaluated in a reduced period, and clinically relevant factors might be suggested. In addition, few studies have evaluated the clinical performance of whitening treatment and its correlation with the patient satisfaction/perception with different samples and results [17,18,20-23].

Most of the teeth presented color change regardless of the follow-up interval assessed and the cause of the darkening (Table 3), which confirms the findings in other studies [13,15]. In the study by Deliperi and Bardwell [14], when assessing the efficacy of whitening in 26 non-vital teeth, color relapse was observed in 13 teeth after two years. Amato and colleagues [13] showed that 22 of the 35 cases (62.9%) remained stable after 16 years, with the color similar to that of adjacent teeth, while 13 cases (37.1%) presented color change. Abbott and Heah [15], when analyzing 255 teeth, reported that some of the evaluated teeth had color relapse after 2-5 years and this was possibly related to the failure of the restoration. Recently, other authors [24] observed similar effectiveness of two whitening techniques in 18 patients after two weeks, and after one year, the authors noted that there was no color relapse.

The color relapse rate in bleached and endodontically treated teeth is relatively high, and the mechanism has not yet been fully elucidated. In some studies, color relapse is reported after two years [13,14], others report that recurrence occurs only from the fifth year [15,25,26]. In cases where no color relapse was detected after dental whitening, patients considered the treatment satisfactory and the color acceptable (Table 3). Previous studies [17,20] had shown that the presence of tooth discoloration could produce impact in the oral health-related quality of life, with individuals reporting problems to smile or being unsatisfied with the appearance of their teeth. This may be related to the average age of patients. It was reported that the elderly

noticed less impact regarding aesthetics than younger ones [27]. Thus, they might favor the observation of a “negative” impact of the whitening treatment. This could also explain the dissatisfaction of the majority of patients in the present study. If the study patients were older, perhaps the results could be different.

In this study, the distribution was 14 female and 4 male patients, which is in accordance with the demographic distribution of patients who require endodontic treatment, being 2:1 for women and men, respectively [28,29]. The results showed that 10 of the 14 women evaluated, presented tooth discoloration due to iatrogenic endodontic treatment. This finding confirms that incomplete removal of obturator materials from the pulp chamber might lead to the darkening of endodontically treated teeth [30-33]. Such materials, when in direct contact with dentin, penetrate into dentin tubules altering their chemical composition and affecting their optical properties [34,35].

In other studies, trauma was considered the most common cause of tooth discoloration [13,15]. It was also verified that the distribution of darkened teeth found in this study is consistent with the location of teeth reported in dental trauma studies and requiring intracoronal whitening [13,15,24,36], with a higher prevalence in maxillary central incisors.

Cases of external cervical resorption might be directly related to the use of highly concentrated whitening agents for more extended periods, trauma or heat application (thermo-catalytic technique) [37-42]. The etiology of resorption has not yet been fully explained, and its reported incidence ranges from 1% to 13% [40-42]. Radiographic assessment did not show any process of radicular resorption regardless of the whitening technique (inside-outside), as indicated in previous studies by Amato and colleagues [13], Abbott and Heah [15], Kim and colleagues [43], Lise and colleagues [24] and Reston and colleagues [44], who

performed evaluations after 1 to 16 years of whitening.

The results of this study reinforce that intracoronal whitening is a straightforward and fast esthetic approach, with visible and satisfactory outcomes over a short period, resulting in the improvement in aesthetics, with minimal side effects. No correlation has been found in this study between some of the determinants of the success of whitening treatment in devitalized teeth. Therefore, this research may be helpful as the basis for a prospective longitudinal study with a more extended evaluation periods. Also, future studies should associate the whitening to changes in quality of life of patients, which is an essential part of the overall evaluation of treatment.

CONCLUSIONS

Based on the findings on this retrospective observational study, it can be concluded that:

1. Color changes after whitening influenced patient's satisfaction.
2. There was no correlation among the color relapse and height of gutta-percha, return interval or cause of darkening.

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