

Short Communication

SEM Analysis of a Peroxide Gel Whitening Protocol Associated to Light on Bovine Teeth

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Keywords

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- Pain sensitivity
- Tooth face
- Light

Abstract

In dental offices, tooth whitening is the treatment that mostly increases in numbers in the last years. This protocol is considered an aesthetic one due to the benefits to patients' sense of welfare, by the improvement on the smile aspect. However, literature shows that, after the procedure, patients may experience pain sensitivity. In this context, the present study utilized a SEM technique to compare the whitening on the superficial posterior tooth face, in three different cases: using a peroxide gel only, peroxide gel associated to light and light only. The results showed that the abrasion in teeth surface is greater with the use of gel than with light only.

BACKGROUND SECTION

Dental bleaching is a secure technique applied in dental offices, and this procedure produces a "whiter" smile for patients. This is a common protocol performed by clinical professionals. However, literature usually reports cases of sensitivity created after this procedure. Due to the increasing interest of researchers and pharmaceutical industry in improving this protocol, applying a peroxide gel on teeth during short times, associated or not to light became a traditional practice. Literature showed, though, a new possibility for the future applications: the use of light only as a bleaching agent on teeth [1,2].

AIMS

This paper reports a qualitative analysis of images between three different dental office treatments: the most traditional one with peroxide gel only, gel associated to light, and an application of violet light only in teeth.

METHODS

Samples

Twenty bovine teeth were cut in parallel to the dental root (Figure 1).

Organization of the procedure

Dental bleaching procedures were separated in four groups (Table 1), with each group composed by 5 samples of the bovine teeth, and classified as follows: control group (without treatment); gel group (dental bleaching with gel only); light plus gel group (dental bleaching with gel associated to light on the

teeth), and light group (dental bleaching with violet light only, at 408 nm).

Procedure

For each group of five samples, a different protocol was used; in addition, a first control group was performed in which the samples did not go through a whitening protocol.

Gel group

For the tests, a transparent gel of 35% hydrogen peroxide,



Figure 1 Posterior surface of teeth samples ready for a dental bleaching procedure.

Table 1: Samples distribution.

Number of samples	Whitening protocol
5	Control
5	Gel
5	Violet Light + Gel
5	Violet Light

manufactured by PDT PHARMA® dental products (Cravinhos, Brazil), was used. Gel was applied on the teeth and left during 40 min, and washed afterwards with water at environment temperature [2].

Light plus gel group

This protocol involved application of the same gel on tooth surface, with simultaneous application of a violet light (408 nm). The light was delivered during 1 min, followed by dark intervals of 30 seconds, during a total time of 30 min - with total light time of 20 min (Figure 2).

Light group

Violet light (408 nm) only was applied, delivered during 1 min followed by dark intervals of 30 seconds, during a total time of 10 min, and with total delivered fluency rate of 165 mW/cm² [3].

Preparation of samples for analysis

Each sample was covered in sputter coater (SCD 004), manufactured by BAL-TEC (Curitiba, Brazil); the protocol was 15 mA during 70s, which produces a gold coat with thickness 10 nm on the teeth surface.

Analysis in SEM

Surface characterization was performed by a Scanning Electron Microscope (SEM) – Inspect S50, 25.00 kV, pressure 2.04x10⁻⁴ Pa and ETD detector, operated in high vacuum. All images were obtained at the LCE-DEMa-UFSCar laboratory (São Carlos, Brazil).

RESULTS AND DISCUSSION

A previously published study by Panhoca et al., described the protocols used in this paper; however, that study analyzed only color aspects, showing that light applied in the bovine tooth results in bleaching [3].

Another factor previously studied was the identification of the morphological and structural changes in consequence of dental bleaching, using an environment scanning electron microscope (ESEM) to assess the qualitative aspects on the superficial changes [4,5].

Acquisition was made as a preliminary test with an Inspect S50 (not showed here) in LCE-DEMa-UFS Car laboratory, in which samples were treated and tested in different situation in high vacuum, using an EDT detector [6].

After this first evaluation of images and parameters design for SEM, assessment was performed and no damage was identified in samples. To understand the superficial aspect, figures are presented in a sequence: first, image in 500x enhancement (Figure 3), followed by an image in 1000x enhancement (Figure 4), and then in 2000x enhancement (Figure 5).

Comparison of Figures (3A-5A) images evidences that 500x do not show exposition of enamel prisms, while amplification in 1000x and 2000x apparently do not evidence any channels.

Figures (3B-5B) show a treatment with light plus chemical

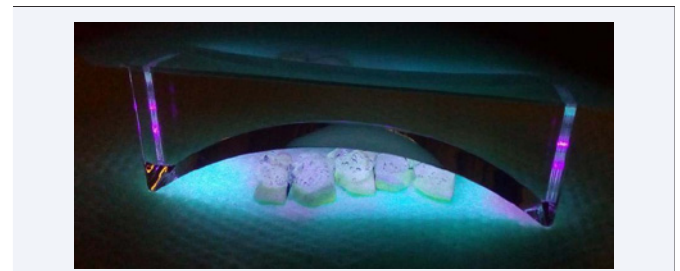


Figure 2 Bleaching process with light irradiation on bovine teeth associated to hydrogen peroxide (35% v/v).

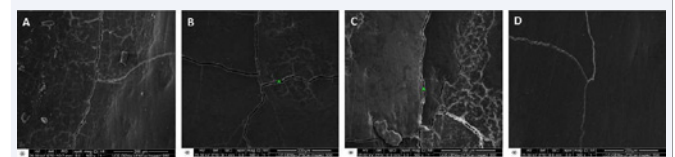


Figure 3 A-) Control group, no treatment; B-) Photobleaching protocol, light plus gel group; C-) Dental bleaching, gel-only group; D-) Dental photobleaching (light-only) group (500x enhancement).

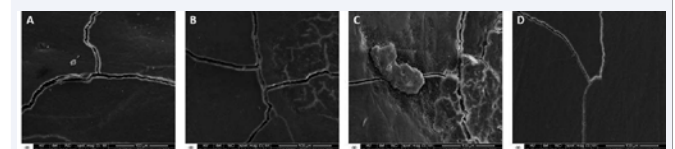


Figure 4 A-) Control group, no treatment; B-) Photobleaching protocol, light plus gel group; C-) Dental bleaching, gel-only group; D-) Dental photobleaching (light-only) group (1000x enhancement).

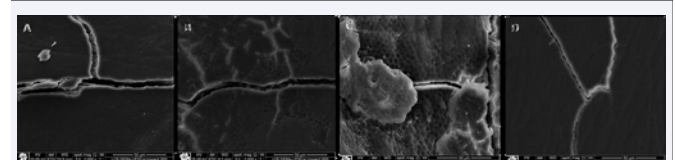


Figure 5 A-) Control group, no treatment; B-) Photobleaching protocol, light plus gel group; C-) Dental bleaching, gel-only group; D-) Dental photobleaching (light-only) group (2000x enhancement).

solution (H₂O₂ gel), according to methodology description. Initial visual inspection in 500x and 1000x enhancement do not allow detecting tubules in the samples, however in 2000x enhancement it is possible to identify regions in which an exhibition of dentine is noticeable [7-10].

For samples in Figures (3C-5C), only gel was applied on teeth surface. In 500x enhancement, channels are not identified, but for 1000x enhancement, in the center of the figure, small regions show surface damage. With 2000x enhancement, it is possible to clearly identify and characterize large areas as channels [7-10].

Literature explains this as a consequence of the treatment, because chemical substances produce damage on the surface of the tooth, and a correlation is observed between bleaching produced by hydrogen peroxide and sensitivity: about 70% of

chemical whitening processes are associated to the incidence of sensitivity as a consequence [11].

This correlation may be associated to the molecular weight of the H_2O_2 molecule (34 u), which is thus small and may undergo diffusion through the basic structure of the tooth. The effectiveness of the bleaching process may be related to the chemical solution creating an interaction with the organic matter present in tooth surface, and thus breaks its chemical bonds [12,13].

Finally, Figures (3D-5D) show tooth surface after the light-only procedure (without chemical solution). For 500x magnification, no channel areas are detected in comparison to the effects observed in Figures (3B/4B/5B) and (3C/4C/5C).

CONCLUSION

The results presented in this study show there are visual differences between the teeth after bleaching process. No quantification of teeth surface decalcification was possible, however, and next steps shall involve this as an important result for a final conclusion.

Visual comparison between bovine tooth surfaces treated with whitening protocols showed there was difference between gel-only, light plus gel, and light-only protocols. The aspect investigated in this study was the characteristic of the tooth surface after treatment. Results showed that the physical aspect was modified differently by different bleaching techniques - in fact, application of gel only resulted in images with the greatest difference when compared to the control groups.

Another important observation was the verification that, apparently, no dentinal channels become exposed when only light is applied on the tooth surface. This could reduce the probability of pain sensitivity incidence in patients after whitening protocols.

Thus, this study is a first report on how the application of aggressive chemical solutions may lead to changes on the dental

surface which relate to dental sensitivity on patients after dental whitening protocols, which is supported by images showing the rough aspect of enamel after chemical abrasion, with a clear exposition of the enamel prisms.

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