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Effects of a Ferric Oxalate Dentin Desensitizer: Sem Analysis

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Abstract: The problem of dental hypersensitivity has posed considerable problems in dentistry for a long time; a product containing ferric oxalate has been tested recently. The desensitizer was tested on 20 teeth extracted for orthodontic reasons; the samples were analysed under SEM to check the effectiveness of dentin tubule occlusion in relation to application times. Then, the product was applied in vivo in a single layer in some patients, in a double layer in others. Subsequently, an acid solution was applied on the surface of the tooth covered with the product; pain reappeared in some patients after a single application, while no pain reappeared in those patients treated with a double layer. This means that the thickness of the desensitizer layer is very important as regards its effectiveness in time.

Key words: Dentin desensitizer, dental hypersensitivity, dentin tubules

INTRODUCTION

Dental hypersensitivity is one of the problems which have already been reported by the dentists for a long time, but which has still not been resolved completely.

About 30% of the global population suffers from dentin hypersensitivity; many studies have shown that canines and premolars are the dental elements most concerned. The causes which can determine the symptoms are varied and can be divided in two main groups: Erosions and abrasions (Fiocchi and Legeros, 1997; Tung *et al*., 1997; Chabanski and Gilliam, 1997).

Erosions consist in the loss of hard substance due to chemical dissolution with possible dentin tubule opening. They can be determined by internal and external factors; among the main internal factors are recurrent vomiting, in which the dental elements come into contact with gastric acids (for example, in anorexic patients), gastroesophageal reflux (for example, in patients affected by hiatus hernia). Among the main external causes is the consumption of drugs, such as antihistaminics and antiparkinsonians, which determine a reduction of salivary gland secretion and therefore a secondary reduction of the buffering action of saliva. Also a prolonged alcohol consumption leads to erosion.

The main cause of abrasion is linked to a wrong brushing technique, which can traumatize the hard dental tissues and even determine gingival recession and root surface exposure. This abrasive mechanism can subsequently be associated with erosion, with hard tissue softening caused by the acids. Among the other causes are gingival recession, enamel erosion and bacterial plaque. The above causes determine dentin tubule exposure and the onset of pain (Irwin and McCusker, 1997; Ide *et al*., 1998; Ferrari *et al*., 1999).

Numerous theories (mechanical, chemical, thermal, hydrodynamic) have been formulated to explain the onset of pain.

The hydrodynamic theory is the most widely accepted today; it is based on the principle according to which external stresses, by determining dentin tubule exposure, cause a rapid movement of dentin fluid, which stimulates peripheral pulp pressoceptors and causes pain (Pereira *et al*., 2002; Tay *et al*., 2003; Wolfart *et al*., 2004).

To remedy these symptoms, ferric oxalate desensitizers have been used recently.

This study reports the results of a biomorphological investigation carried out on one of the latest desensitizers by means of SEM analysis, aimed at checking the effectiveness of dentin tubule occlusion and at gathering useful data for predicting its possible effectiveness in time.

MATERIALS AND METHODS

The analysis was carried out on 20 dental elements extracted for orthodontic reasons, which showed abrasions at the cervical third of the crown. The samples were subjected to smear layer removal with specific products (Tubulicis or similar); after that, a first group of

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10 dental elements was treated with ferric oxalate dentin desensitizer for 10 seconds; in the second group of 10 dental elements, the desensitizer was applied for 20 seconds.

The samples were tested with Sensodyne Sealant desensitizer (Glaxo SmithKline), a 6% ferric oxalate aqueous solution; the precipitation of oxalate crystals should determine dentin tubule occlusion, stopping fluid movement inside the tubules and breaking up pain transmission to nervous receptors.

After this treatment, in both cases the treated surfaces were exposed to a water jet for 10 seconds. Then, the samples were processed for SEM observation.

SEM observations were carried out using a Laica Stereoscan 420 microscope with a 15 kV acceleration voltage.

A further analysis was also carried out *in vivo* to evaluate product effectiveness and its duration in time. The product was applied to 30 patients who showed painful symptoms due to erosions or abrasions. Fifteen patients were treated with the desensitizer applied in a single layer (group A), while other 15 patients received 2 layers of the product (group B).

The patients were re-evaluated about one week later; a remission of the symptoms was observed in all the cases.

An acid solution was subsequently applied to the dental surface covered with the desensitizer, both in group A and in group B. The pain due to tubule reopening reappeared in 80% of the patients from group A. The patients from group B did not show any symptoms. This proves that the effectiveness in time of the desensitizer is linked to the thickness of the layer adhering to the tooth.

RESULTS

In group A, SEM analysis showed a moderate dentin tubule occlusion, with infiltration limited to the proximal tract; that is due to crystal depositing on tooth surface.

Group B showed an excellent occlusion; the oxalate deposit layer was even throughout the surface. Occlusion can be seen as a ferric oxalate deposit in the form of crystalline microcomplexes capable of creating a relevant barrier between the patent tubules and the external environment (Fig. 1-4).

This morphological study has been corroborated by clinical investigation; both of them show how the thicker the desensitizer layer adhering to tooth surface, the less the sensitivity of the patient and the longer the life of the restoration.

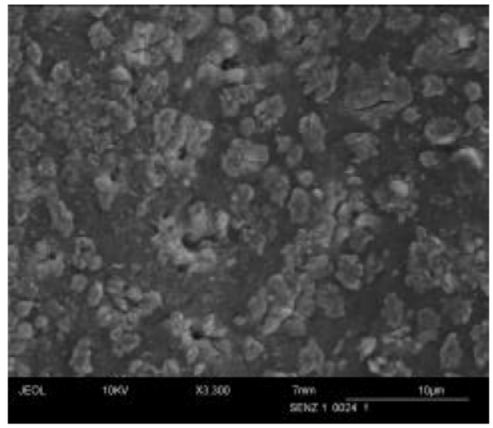

Fig. 1: Dentin tubule opening is partially occluded after treatment with ferric oxalate for 10 min

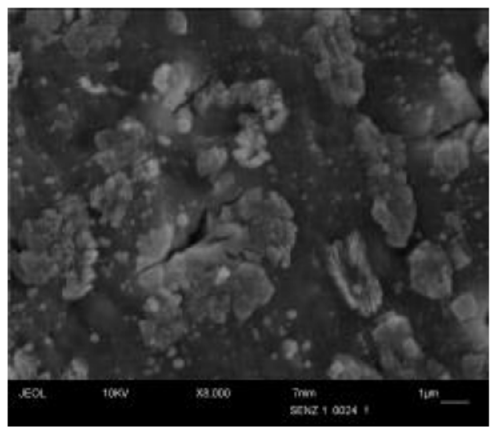

Fig. 2: Detail of the previous picture. Notice the patency of some dentin tubule openings

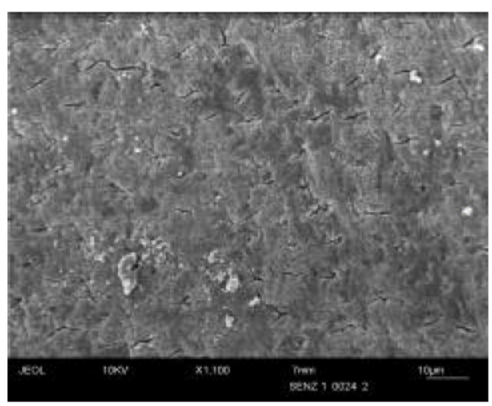

Fig. 3: The sample was treated with ferric oxalate for 20 min. Notice the even distribution of the product

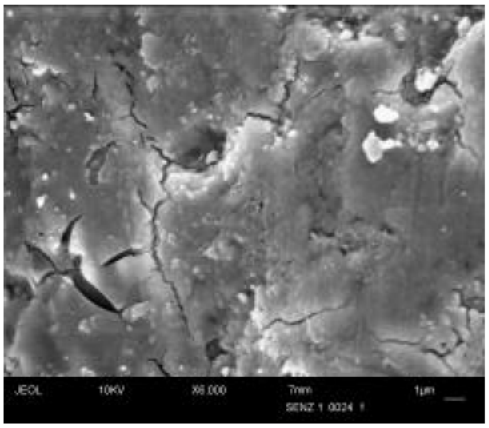

Fig. 4: Details of the previous picture. Notice the small, uneven depressions created by the product at the occluded dentin tubule opening

On the basis of the studies carried out, it can be claimed that the dentin desensitizer tested is able to occlude dentin tubule openings, which is a clinical breakthrough, since it implies symptom remission; however, these types of restorations must be periodically checked and sustained by regular desensitizer application, for example by means of specific toothpastes.

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