The Effect of 2-hydroxylethyl Methacrylate on Enamel Abfraction

ANAMARIA BECHIR[1]*, MARIANA PACURAR[2], ANGELA CODRUTA PODARIU[3], SIMONA MUCENIC[2], EDWIN SEVER BECHIR[2]

[1] "Titu Maiorescu" University of Bucharest. Faculty of Dentistry, Department of Dental Specialities, 67A Gheorghe Petrascu Str., Bucharest, Romania

[2] University of Medicine and Pharmacy of Tirgu Mures, Faculty of Dentistry, 38 Gheorghe Marinescu Str., Tirgu Mures, Romania

[3] University of Medicine and Pharmacy „Victor Babes" Timisoara, Faculty of Dentistry, Department 1, 14A Splaiul Tudor Vladimirescu, Timisoara, Romania

The loss of the hard dental structures represented by dentin and enamel may be due by either to a process of wear of the teeth (erosion, abrasion, wear, abfractie), or by a combination thereof. The aim of this study was to compare the effectiveness of two types of dental materials (Gluma desensitizer-Heraeus Kultzer and Geristore-DenMat) in decreasing the dentin sensitivity of the teeth affected by abfraction. The study included a total of 15 patients presenting at least two teeth with abfraction, a total of 35 teeth. Selected patients to participate to this study presented a moderate tooth sensitivity to thermal and chemical agents. The dental materials used to this study were deposited on the surface of the harmed with abfraction of all patients and the treatment was conducted by following the same procedure for each material in part. The results of study demonstrate that the effectiveness of the two dental materials used to reduce the sensitivity of teeth with abfraction was different. The best results were observed in teeth treated with Geristore.

Keywords: dental sensitivity, abfraction, desensitizing materials

The mechanism by which the pain associated with dentinal hypersensitivity is currently believed to occur is Brännström's hydrodynamic theory. This theory states that stimuli (thermal, chemical, tactile or evaporative) are transmitted to the pulp surface due to movement of fluid or semi-fluid within open dentinal tubules. Anatomically, the areas of the tubules closer to the pulp chamber are wider and the fluid movement away from the pulp activates the nerves associated with the odontoblasts at the end of the tubule; this results in a pain response. The fluid movement stimulates the small, myelinated A-delta fibers, which then transmit to the brain and result in the sensation of well-localized, sharp pain that is associated with dentinal hypersensitivity [1].

Loss of dentin and enamel may be due to any or a combination of the tooth wear processes, including erosion, abrasion, attrition and abfraction [2].

By definition, abfraction explains the loss of enamel and dentin from flexural occlusal forces, particularly at the cemento–enamel junction (CEJ) [3]. The aetiology of the abfraction lesion appears to be multifactorial in nature [4], and the off-axis occlusal forces transmitted through the tooth can be a contributing factor [5]. This occlusal force may be intensified by hyperocclusion, clenching, and bruxism. As teeth bear the occlusal load, the shell of the enamel flexes under the strain. The compressive force of occlusion becomes focused as a sheering force in the region of the CEJ. This area of enamel is most vulnerable to delamination from the underlying supporting dentin because the enamel shell progresses to a thin "feather-edge" of enamel rods or prisms [6].

Clinical appearance is the most important feature for dental professionals to diagnose this condition [7], and at a more advanced stage, it can be very difficult to determine if dentine is exposed or not [8].

To prevent further progression and complications in teeth with abfraction, it is important to identify this condition as early as possible. It is fundamental to diagnose the possible risk factors so that preventive measures can be initiated [9].

The maintenance of the tooth structure represents a great concern in dentistry. For this reason, dental materials used in the management of abfractions must ensure the preservation of the resistance in the involved dental hard structures.

Dentinal hypersensitivity is a relatively common dental clinical condition in permanent teeth caused by dentin exposure to the oral environment as a consequence of enamel and/or cementum loss and it is associated with the exposure of dentin tubules patent to the oral cavity, either after tooth preparation for restorative measures or when teeth exhibit non caries-induced, denuded dentinal surfaces. Upon tactile, thermal or osmotic stimulation of such surfaces painful sensations arise [10].

Sealing the dentinal surface diminishes the movement of fluids inside the tubule and is capable of reducing dentinal hypersensitivity [11].

During the years a variety of topically applied professional dental products have been made available to block the tubular liquid shifts, acting mostly by polymer sealing, precipitation of fine-grained salts, or precipitation of dentin fluid proteins [12].

Nowadays, two main methods are used in the treatment of dentinal hypersensitivity: tubular occlusion and blockage of nerve activity by means of direct ionic diffusion, increasing the concentration of potassium ions acting on the pulpal nerve sensorial activity [13].

Experimental part

Materials and methods

The requirements for an acceptable dental material are many, but one of the most important is the biocompatibility [14].

Gluma Desensitizer (GmbH) desensitizing agent is an aqueous solution of 5% glutaraldehyde (GA) and 35%

* *email: anamaria.bechir@gmail.com Tel.: (+40) 0722205221*

HEMA. Through its properties, compensates for differences in moisture content in the dentin surface. This enables regeneration of the collagen fibrous tissue. Its composition of an ethanol-water base guarantees a high level of safety for the user [15].

It is suggested that the Gluma Desensitizer components react with the serum albumin of the dentinal liquid, precipitating the protein, and that simultaneously or subsequently the reaction of Gluma Desensitizer with albumin induces polymerization of HEMA [16].

The resin ionomer Geristore (DenMat Company) is a hydrophilic, nonaqueous, polyacid-modified composite resin composed of fluoride releasing glass, mainly barium fluorosilicate, and a polymerisable organic matrix [modified Bis-GMA, including 2-hydroxyethyl-methacrylate (2-HEMA)] combined with a photoinitiator [17].

HEMA can react with dentin collagen due to its ester group38 and its hydroxyl group with collagen because of its hydrophilic nature.

The chemical structure HEMA and Bis-GMA are shown in table 1 and 2.

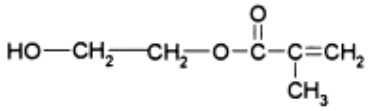

Fig. 1. Chemical structure of HEMA

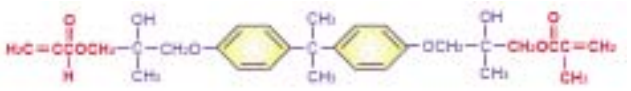

Fig. 2.Chemical structure of bis-GMA

An easier to dispense version of this material is Geristore Syringeable.

The presentation form of the used dental materials in our researches (Gluma Desensitizer and Geristore syringeable) are shown in table 3.

Fig. 3. Presentation form of gluma desensitizer and of geristore syringeable

The aim of this study was to compare the effectiveness of two types dental materials (Gluma Desensitizer-Heraeus Kultzer and Geristore-DenMat), which were used for decreasing the sensitivity of the teeth with abfraction lesions, by depositing these materials on the abfracted surface of damaged teeth.

The study included a number of 15 patients, with at least 2 teeth with abfraction, in total 35 teeth with abfraction lesions. The patients were divided in two batches.

In the first batch of patients (7, 17 teeth with abfraction), the selected teeth were coated with Gluma desensitiser, after their isolation and drying with the air spray from the dental unit. The desensitizer was applied in two layers with disposable applicators, waiting 30 s between coatings.

In the second batch of patients (8, 18 teeth with abfraction), the selected teeth were filled with Geristore hybrid ionomer–composite dental material, after the application of Gluma desensitiser. The adequate colour was chosen and combined with 50 – 50 % Geristore A and B, using a mixing pad and a plastic stick, until a homogenous paste was obtained. The material was applied in the cavities with abfraction and then light cured. After the completion of the setting reaction, the material was finished with a fine Arcansas finishing stones, under water spray.

The selected patients to take part in this study had presented moderate dental sensitivity at thermal and chemical agents.

The dental materials which were used in this study were deposited on the surface of the damaged teeth of all patients which presented abfraction. The treatment was conducted by following the same procedure for the two desensitizing material.

The measurements of sensitivity were determined by the patient's response to air-blast stimuli. A verbal rating scale was used and scored as follows: 0 = no discomfort; 1 = discomfort but no severe pain; 2 = severe pain during stimulation; 3 = severe pain during and after stimulation. To facilitate results, we considered:

-Scale 0 and 1, which is equal to 0 degree tenderness;

-Scale 2 and 3, which is equal to the level 1 tenderness.

The sensitivity level was determined before and after the desensitising session, at 6 days, at 3 weeks, at 6 weeks, and at 3 months post-treatment.

Results and discusions

The values obtained in the evaluation of dentinal sensitivity in the teeth with abfraction, after desensitization with Gluma are shown in table I.

The values obtained in the evaluation of dentinal sensitivity in teeth with abfraction after desensitization with Geristore are shown in table 2.

The findings of our study have demonstrated the prolonged desensitization effect in teeth with abfraction of Geristore hybrid ionomers-composite dental material, in comparison with the simple coating with Gluma solution.

The requirements for an acceptable dental material are many, but one of the most important is the biocompatibility. In addition to certain biological requirements, such as cariostatic properties, lack of pulp irritability or systemic toxicity, a filling material should possess low water absorption and should not dissolve in the oral fluids [18].

Table 1

EVALUATION OF DENTINAL SENSITIVITY IN TEETH WITH ABFRACTION AFTER DESENSITIZATION WITH GLUMA

Determination / Responses	Sensibility scale				Degree of sensitivity	
	0	1	2	3	0	1
First determination	-	8	9	-	8	9
Second determination	11	3	3	-	14	3
Third determination	7	7	3	-	14	3
Fourth determination	3	8	6	-	11	6
Fifth determination	1	9	7	-	10	7
Sixt determination	-	10	7	-	10	7

Determination / Responses	Sensibility scale				Degree of sensitivity	
	0	1	2	3	0	1
First determination	-	7	11	-	7	11
Second determination	6	12	-	-	18	-
Third determination	18	-	-	-	18	-
Fourth determination	18	-	-	-	18	-
Fifth determination	17	1	-	-	18	-
Sixt determination	16	2	-	-	18	-

Table 2
EVALUATION OF DENTINAL SENSITIVITY IN TEETH WITH ABFRACTION AFTER TREATMENT WITH GERISTORE

Varnishes have been recommended for the treatment of dentine hypersensitivity, but their action is transitory and usually lasts only a few hours [19].

The researches of Qin et al. [16], suggest that Gluma acts as a desensitizer by means of two reactions. First, the glutaraldehyde reacts with part of the serum albumin in the dentinal fluid which induces albumin precipitation, and then a second reaction of glutaraldehyde with albumin induces HEMA polymerization.

The researches of Schüpbach P. and al, concluded that glutaraldehyde content of Gluma desensitizer can intrinsically block dentinal tubules and the formed deposition in the dentinal tubules may counteract the hydrodynamic mechanism for dentinal sensitivity [20].

The reported advantages of resin ionomers used in dentistry include insolubility in oral fluids, increased adhesion to tooth structure, dual cure capabilities, and low cure shrinkage, low coefficient of thermal expansion, radiopacity, fluoride release and biocompatibility [21].

While it is a self - adhesive material, Geristore does not need retentive cavity preparations. Thus, the practician saves chair time and conserves healthy tooth structure. Speed can help ensure success with pediatric and geriatric patients [22].

Conclusions

This clinical study has demonstrated that Geristore could be used as a barrier for teeth with dentin sensibility, to repair the abfraction lesions and that the use of Geristore hybride ionomer in the treatment of abfraction presented a better desensibilization, with a longer term action, in comparison with the use of Gluma desensitizer.

After the severity of the dentin sensitivity, the clinical management of abfraction is realised by in-office therapies, including recent materials and technologies that have been introduced.

In most circumstances, the least invasive, most cost-effective treatment is the use of a desensitizing solution, which can be used both in-office and at-home treatment.

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