Comparative Effectiveness of Two Desensitizing Products in Dental Cervical Erosions

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The aim of this clinical study was to investigate the comparative effectiveness of two dental desensitisers based on 2-hydroxyethyl methacrylate (Gluma desensitizer and Shield activ desensitizer), in decreasing the dental painful sensitivity caused by cervical erosions. The clinical trial consisted of 63 patients (323 teeth), with minimum three teeth which presented cervical erosion with dental hypersensitivity. The sensitive teeth were treated with Gluma Desensitizer-Heraeus Kulzer (first batch of teeth), Shield activ desensitizer (second batch) and distilled water (third batch of teeth=control group). We effectuated in total three desensitisation sessions, at 5 days difference. The level of cervical dental hypersensitivity (CDH) was determined in six sessions, after the patient’s response to air-blast stimuli. We used the Visual Analog Scale (VAS) to assess the CDH. The results proved the effectiveness of used desensitizing agents in treating CDH in the first and the second batch of teeth, in comparison with the control group teeth. We noticed that after the second application of Gluma and Shield products significant differences, in comparison with the baseline, appeared. After 3 month follow-up, we ascertained that both products induced the decreasing of CDH. No significant differences were recorded between the two products. A placebo effect in reduction of CDH was observed in the group of teeth treated with distilled water. Both dentin desensitizing agents have proven effective in reducing CDH.

Key words: cervical erosion, dentin hypersensitivity, Gluma desensitiser, Shield activ desensitiser

Modern lifestyle has induced the apparition of various dental diseases, other than dental caries, which determined the loss or the deterioration of the enamel and this enamel loss conduces to Dentinal Hypersensitivity (DH) [1].

DH manifests through dental abrasion, dental erosion, occlusal trauma, etc. [2,3].

Cervical erosion is the damage of dental hard tissues, situated in cervical area of dental crowns, which is not produced by oral bacteria [4]. Once enamel is lost and cement or dentine is exposed, the dental under-layers are subjected to massive erosion, as a consequence of lower inorganic mineral content [5]. When the dentine is exposed, and the dentinal tubules are opened, external stimuli (as thermal, mechanical, chemical, tactile, dehydrative or osmotic stimuli), can cause excessive pain response in the pulp. [6,7]. The described clinical condition, which cannot be attributed to another disease or tooth defect, has been defined as dentin hypersensitivity [8-10].

The dentin and the dental pulp are considered as a biologic entity named dentin-pulp complex [11,12]. The sensory function of the pulp-dentin complex is one of his many functions. The acute localised pain, decreased after the cessation of the stimulus action is called dental pain/dentinal hypersensitivity, which was described as one of the most painful affection of teeth [13,14]. According to the Canadian consensus document [15], dentinal hypersensitivity (DH) has been defined as pain derived from exposed dentin in response to chemical, thermal tactile or osmotic stimuli which cannot be explained as arising from any other dental defect or disease.

Because organs and tissues located in the oral cavity are well supplied with blood and nerve endings, all pathological processes in the region cause high-intensity pain [16]. The perception of pain originating in the mouth is perceived as disproportionately severe in relation to the actual cause of the pain, as compared to the rest of the body [17]. Three main mechanisms of dentin sensitivity are proposed: direct innervations’ theory, the odontoblastic-receptor theory and fluid movement/hydrodynamic theory (fig. 1) [18].

In conformity with the direct innervations’ theory, the nerve’s endings form dental pulp enters in the dentinal tubules and extends to dentin-enamel junction, and so, all mechanical stimuli directly transmit the pain [19]. In the odontoblastic-receptor theory, odontoblasts act as receptors of pain and transmit signals to the pulpal nerves, but no synopsis has been found between odontoblast and pulpal nerves [18]. Hydrodynamic theory for sensitive dentine was first proposed by Brännstrom [20] and is the most widely accepted theory for dentinal hypersensitivity. According to this theory, the stimuli acting on the exposed

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dentin surface cause movement of the fluid in the dentinal tubules, stimulating pulp nerve receptors and this stimulation transmitted to the central nervous system, is experienced as pain [9, 21-23]. The movement of fluid can be toward the inside of the pulp or the outside of dentin. Cooling, drying, evaporation, and hypertonic chemical stimuli cause the dentinal fluid to flow away from the dentin-pulp complex and lead to an increase in pain [18,24-26]. The intensity of the pain varies from strong with high intensity, to mild with moderate intensity.

The incidence of the disease in the adult population ranges from 8% to more than 50% [7,9].

There are various methods available for the treatment of dentin hypersensitivity, all with the aim of obliterating the dentinal tubules. Dentinal tubule sealing can be secured with the use of restorations, dental adhesives or the formation of a smeared dentin surface. Fluoride varnishes were introduced on the market to increase the efficiency and permanence of fluoride when in contact with the tooth surface, in order to allow a slow and continuous release of fluoride [27].

2-Hydroxyethyl Methacrylate is a hydroxyl-ester compound and a resin monomer, used in desensitizing dentin. By applying 2-hydroxyethyl methacrylate locally to sensitive teeth, sensitive areas in the teeth get sealed and block the dentinal tubules at the dentin surface from stimuli that cause pain. This prevents excitation of the tooth nerve and relieves pain caused by tooth hypersensitivity [28].

Hydroxyethyl-methacrylate is the monomer that is used to make the polymer polyhydroxyethyl-methacrylate. The polymer is hydrophobic, and when the polymer is subjected to water it will swell due to the molecule’s hydrophilic pendant group. Depending on the physical and chemical structure of the polymer, it is capable of absorbing from 10 to 600% water relative to the dry weight [29].

The aim of this study was thus to assess the effectiveness of two desensitizing agents in reducing dentin hypersensitivity in a randomized clinical trial.

![Chemical structure of hydroxyethyl-methacrylate](image)

**Fig. 2. Chemical structure of hydroxyethyl-methacrylate**

### Experimental part

**Materials and method**

The requirements for an acceptable dental material are many, but one of the most important is the biocompatibility [30].

**Gluma desensitizer** (Heraeus Kulzer) is a combination of glutaraldehyde and hydroxyl-ethyl-methacrylate (HEMA). Glutaraldehyde causes the coagulation of amino acids and proteins in dentin tubules and is effective in sealing dentinal tubules, being an efficient disinfectant too [31-34]. Gluma Desensitizer as desensitizing agent is an aqueous solution of 5% glutaraldehyde (GA) and 35% hydroxyethyl-methacrylate (HEMA) and 60% water. The mechanism of sealing is the precipitation of plasma protein (produced by GA and not by HEMA), in the dentinal fluid in order to occlude the dentinal tubules [35,36].

**Shield activ dentin desensitizer** (produced by Prevest Denpro Ltd, India), is an aqueous solution, which contain 2-hydroxyethyl-methacrylate, benzalkonium chloride, sodium fluoride, potassium nitrate and excipients [37].

The researches were conducted in the Dental Medicine Faculties of Bucharest, Tirgu-Mures, Oradea and Craiova Universities.

The patients were selected after a detailed anamnesis and were attended only by those that have expressed their desire to be part in the research.

The clinical research has been carried out on 63 patients (29 males and 34 females), with minimum three teeth with cervical hypersensitivity in their oral cavity, resulting in a total number of 323 teeth included in the study. Majority of the patients were female (53.96%). The age range of the patients was similar, between 48-53 years, with a median age of 50.5 years and a mean of 50.5 ± 2.5 years (fig. 3).
We have effectuated in total three desensitisation sessions, at 5 days difference. The hypersensitivity level was determined before the first treatment, immediately after every desensitising session (3), at one month and at 3 months post-treatment. In total, we conducted six sessions of determining CDH.

The deposition of the desensitizing substances used in the study was in according to the manufacturers’ recommendations. The method of deposition the both desensitizers and of distilled water was as follows: we cleaned the dentine by rinsing with water, we dried the treated surface, we applied smallest amount of desensitizer/distilled water on the eroded cervical dentinal surface with a pellet, in thin layer, and lefted for 30 s; we dried the eroded area by applying a stream of compressed air; we repeated the applications of agents for three times in each session; we reapplied the substances at five days interval. The patients did not know which type of treatment cor-responded to each tooth. After the first session of desensitization, we distributed to all patients and participants in research Colgate Sensitive Complete Protection toothpaste (which contain active potassium nitrate, active sodium fluoride, water, glycerine, hydrated silica, sorbitol, PEG-12, sodium lauryl sulphate, flavor, poloxamer 407, tetrapotassium pyrophosphate, PVM/MA copolymer, xanthan gum, cellulose gum, etc.) and two poloxamer 407, tetrapotassium pyrophosphate, PVM/MA copolymer, xanthan gum, cellulose gum, etc.) and two Colgate 360° Enamel Health™ Sensitive Toothbrush (fig. 4).

The determinations of CDH were realised after the patient’s response to air-blast stimuli. The air blast was applied with the air-water syringe of the dental unit, for 15 seconds, at a distance of 1 cm from the tooth surface, to avoid desic-cating the area with cervical dentinal erosion. The neighbouring vital teeth with cervical erosion were protected with dental gauze and the operator’s hand.

We used the Visual Analog Scale (VAS) to assess the CDH, scored as follows: 0=no discomfort; 1=discomfort but no severe pain; 2=severe pain during stimulation; 3=severe pain during and after stimulation.

After recording the baseline scores, the teeth with CDH of patients were randomly and blindly assigned to one of the treatment groups, according to the applied desensitizing agent, Gluma desensitizer (n=107) or Shield activ desensitizer (n=109), or to the placebo group of teeth (n=107) (table 1).

Results and discussions

The distribution of assessment scores after the application of desensitizing agents/distilled water on the teeth with CDH is presented in table 2.

The results of our clinical study showed the effectiveness in treating cervical sensitivity in the first and the second batch of teeth, in comparison with the control group teeth. After the second application of Gluma and Shield products, significant differences were observed, compared with the baseline.

After 3 month follow-up, we ascertainment that both desensitizing agents induced the decreasing of CDH level.

No significant differences were recorded between the two products. We must notice that for both tested desensitizers, a lower level of CDH was founded in the 6-th assessment (after 3 months) compared with the baseline CDH score.

After the assessments, we can conclude that both desensitizing agents decreased CDH, in comparison with the placebo group of teeth.

Placebo effect was observed in the treated teeth with distilled water, but the decreasing level of CDH appeared only in the second and third recording sessions.

Dentine hypersensitivity (DHS) remains a widespread under-reported and under-managed problem, despite making some dental treatments more stressful than necessary and having a negative impact on the patient’s quality of life [38].

After the studies of Davari et al [39], the number of tubules in sensitive dentin is eight times more than the number of tubules in non sensitive dentin and the dentinal tubules of sensitive dentin are wider than those in non sensitive dentin.

Many therapeutic agents to be used by patients (at home) and professional ones (to be used in the dental office) are in present on market [6, 14, 40-43].

After the researches of Jumanca et al [44], the treatment of cervical caries and even root caries can be achieved successfully by combining minimal surgical procedures with restorative therapy.

Contemporary reports show that the treatment of dentin hypersensitivity involves interruption of the neural response to pain stimulus by topical application of preparations containing potassium salts, because potassium ions cause...
have been reported differently in different studies. These differences are due to the differences in populations, habits, diets, and methods of investigation [18]. Several studies have reported non-carious cervical lesions (NCCLs) and DH in adult populations, with prevalence rates ranging from 5% to 85% [55] and 2-8% to 74%, respectively [56].

A large number of studies were published regarding the ideal product for reducing the dentinal hypersensitivity, but it has not been possible to reach a consensus about the product that represents the gold standard in the treatment of this affection [58].

Biocompatibility of dental materials is an important consideration for the patient, clinician, laboratory technician, and manufacturer. Ideally, a dental material that is to be used in the oral cavity should be harmless to all oral tissues, gingiva, mucosa, pulp, and bone [59]. The requirements for an acceptable dental material are many, but one of the most important is the biocompatibility. Furthermore, it should contain no toxic, leachable, or diffusible substances that can be absorbed into the circulatory system, causing systemic responses, including teratogenic or carcinogenic effects [60].

Conclusions
Within the limitations of this study, the following conclusions can be drawn:

- both desensitizing agents were capable to reduce the teeth CDH to different physical and chemical agents;
- distilled water produced a placebo effect in the witness group of teeth with CDH;
- clinical procedures for the application of desensitizing agents are very simple.

References