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Original Article

Comparison the effect of casein phosphopeptide amorphous calcium phosphate and fluoride varnish on dentin hypersensitivity reduction

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Abstract

Introduction: Nowadays, several casein components such as casein phosphopeptide amorphous calcium phosphate (CPP-ACP) are vastly considered as a suitable replacement for fluoride component. The aim of this study was to compare the effect of CPP-ACP paste and fluoride varnish on dentin hypersensitivity reduction.

Materials & Methods: In this clinical trial study, thirty adult patients between the ages of 20-50 years, presenting with the chief complaint of dentin hypersensitivity were examined. The loss of dentin was less than 0.5mm. The subjects divided into three groups: In groups I and II, patients were treated using CPP-ACP and fluoride varnish following manufacturer instructions. Group III received placebo gel. A visual analog scale was used to assess subjects' response to compressed air and ice stimuli at baseline, 7 days, 28 days and 60 days after treatment. Data was analyzed by One Way Analysis of Variance (ANOVA), Duncan Post Hoc test using the SPSS software version 21.

Results: The results showed significant statistical difference between the groups ($P<0.05$). In fluoride varnish group and CPP-ACP paste group, the dentin hypersensitivity significantly decreased when baseline scores compared to post treatment scores at 7, 28, 60 days ($P<0.05$). There was no significant statistical difference in dentin hypersensitivity reduction in fluoride varnish and CPP-ACP paste groups.

Conclusion: The results of this study showed that both of fluoride varnish and CPP-ACP paste effectively reduced dentinal hypersensitivity compared with placebo-control group.

Keywords: Casein, Dentin sensitivity, Fluoride varnishes

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مقایسه اثر خمیر حاوی CPP-ACP و وارنیش فلوراید بر کاهش حساسیت عاجی

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چکیده

مقدمه: امروزه ترکیبات مختلف کازئین مانند کازئین فسفوپپتید آمورفوس کلسیم (CPP-ACP) به طور وسیعی به عنوان جایگزین مناسب برای ترکیبات فلوراید در نظر گرفته می‌شود. هدف از این مطالعه مقایسه اثر خمیر CPP-ACP و وارنیش فلوراید بر افزایش حساسیت عاجی بود.

مواد و روش ها : در این مطالعه بالینی۳۰ بیمار بالغ با طیف سنی ۲۰ تا ۵۰ سال که شکایت اصلی آن‌ها حساسیت دندانی بود در مطالعه شرکت کردند. از دست دادن عاج کمتر از ۰/۵ میلی‌متر بود. افراد به سه گروه تقسیم شدند در گروه ۱ و ۲ به ترتیب افراد با CPP-ACP و وارنیش فلوراید براساس دستورالعمل کارخانه سازنده درمان شدند. گروه ۳ ژل پلاسبو دریافت کردند. یک مقیاس آنالوگ بصری برای ارزیابی پاسخ افراد به هوای فشرده شده و تحریک یخ در زمان پایه، ۷ روز، ۲۸ روز و ۶۰ روز بعد از درمان استفاده شد. جهت تجزیه و تحلیل آماری از آزمون آنالیز یک‌طرفه واریانس آنوا، آزمون تعقیبی دانکن و نرم افزار Version SPSS ۲۱ استفاده شد.

یافته ها: نتایج مطالعه تفاوت آماری قابل توجهی بین گروه‌ها نشان داد. در گروه وارنیش فلوراید و گروه خمیر حاوی CPP-ACP، حساسیت عاجی به طور قابل توجهی نسبت به زمان پایه در مقایسه با نتایج بعد از درمان در روزهای ۷، ۲۸، ۶۰ کاهش یافت ($P< 0.05$). در گروه وارنیش فلوراید و خمیر CPP-ACP از نظر آماری تفاوت قابل توجهی در حساسیت عاجی وجود نداشت.

نتیجه گیری: نتایج نشان داد که هر دو ماده وارنیش فلوراید و خمیر CPP-ACP به طور موثری باعث کاهش حساسیت عاجی در مقایسه با گروه کنترل می‌شود.

واژگان کلیدی: کازئین ، حساسیت عاجی، وارنیش فلوراید

Introduction

Dentin hypersensitivity (DH) is a common condition characterized by a sharp pain associated with thermal, tactile, osmotic or chemical stimulus. [1] It affects a significant amount of population of both genders and is more commonly in adults. [2] Moreover, no permanent and effective treatment has been found for it. Hydrodynamic mechanism is the major cause of cervical dentin hypersensitivity. [3,4] Dentin hypersensitivity can be relieved by either blocking the open tubules in order to prevent hydrodynamic mechanism or by stopping neural response to pain stimulus.[5] The following agents are used for this purpose: corticosteroids, silver nitrate, fluoride, oxalate, potassium nitrate and resins.[4-6] As the hydrodynamic mechanism is widely known as the major cause of this condition, surface or intratubular blocking agents or barriers are used in order to decrease the permeability of dentin.[4] Fluoride is a traditional component which has been used as a desensitizing agent up to now. It prevents painful stimuli by decreasing the dentin fluid tubules. Topical fluoride varnish is effective on both caries prevention and treating dentin hypersensitivity but it could lead to the staining. The staining is a temporary side effect washed out in a few hours but it can affect the patients unpleasantly. Toxic effects due to swallowing of excessive amounts of fluoride are major concerns that can lead to mottle enamel and systemic poisoning. [1, 3] Nowadays, several casein components such as casein phosphopeptide amorphous calcium phosphate (CPP-ACP) are considered as a suitable replacement for fluoride. GC tooth mousse is a water based product containing 10% CPP-ACP and is a relatively new one in the treatment of DH.[7, 8] It has been stated that CPP can noticeably stabilize calcium phosphate, changing into the form of CPP-ACP. [9] CPP-ACP has enhanced the remineralization of enamel, because it is known to be a source of phosphate and calcium ions.[10-13] Also, it is able to buffer plaque acid due to releasing amino acids binding protons and thus acting as buffers. [12, 14] CPP-ACP binds easily to the

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surface of the tooth, deposits a high concentration of ACP.[15, 16] One advantage of CPP-ACP is that, it is digestible by people with lactose intolerance. [15] In contrast, clinicians should consider potential side effects of topical fluoride therapy for patients who ingest a significant amount of fluoride. [17] CPP-ACP forms a bond with the hydroxyapatite of the tooth, helping to concentrate the bioavailable calcium and phosphate ions, maintaining a state of supersaturation within the oral environment.[18, 19] Despite the fact that these ions can participate in remineralization of enamel surface [20], they may facilitate the formation of crystals occluding dentinal tubules and subsequently reducing DH. [21]

CPP-ACP can be used as prevention and management of dentin hypersensitivity after bleaching, scaling, root planning and periodontal surgery. Moreover, they can be ingested whereas there are risks in topical fluoride therapy if the patient ingests a huge amount of fluoride.[15] If CPP-ACP paste has the same or more effects on reducing tooth sensitivity it can be substituted with different fluoride containing products for tooth sensitivity such as fluoride varnish. The aim of this study was to compare the effect of CPP-ACP paste (Tooth Mousse, GC Japan) and fluoride varnish (Duraphat, Colgate-Palmolive Co, New York, USA) on dentin hypersensitivity.

Materials &Methods

This randomized clinical trial study was conducted at periodontology and operative department of Khorasgan dental school in some dental clinics in Isfahan. The study was approved by the institutional medical research ethics committee (No: 2049) and registered in IRTC (IRCT201202149008N1). People who participated in this study were selected based on the following criteria:

1. Subjects who complained of DH had to be between the ages of 20 and 50.

2. Subjects had to be available for 2 months duration of the study and to sign the informed consent form.

3. Subjects were required to possess a minimum of two hypersensitive teeth.

4. Teeth should not require restorative treatment.

5. The loss of dentin should not be more than 0.5 mm in depth.

6. Subjects were excluded from the study if they had erosion/attrition, crack and pulpal inflammation in restored teeth, chronic disease, periodontal diseases and patients who received dental treatment in the last one year, teeth planned for abutment or crown, teeth with orthodontic bands, teeth with active caries, and mobile teeth with mobility more than grade one.

7. Subjects who took antihistamines, antidepressant and sedatives drugs in one month before the study started or while the study being done were excluded. Furthermore, pregnant or lactating women were also excluded. The study was approved by the institutional medical research ethics committee. The patients made informed about the treatment procedure and signed a consent form before entering the study.

The subjects were randomized to minimize bias. Thirty adults between the ages of 20 to 50 who suffered from tooth sensitivity were studied. Patients were randomly categorized in 3 groups, group 1 patients were under treatment regimens based on the fluoride varnish company's instruction, group 2 was patients with GC Tooth Mousse paste and the third group was as a control group. The randomization procedure was carried out by using sequentially numbered opaque sealed envelope prepared with unrestricted (simple) randomization. Each treatment agent was written and sealed in envelopes before beginning the study.

The operator who carried out all the treatment opened an envelope for each case at the beginning of the treatment. Before the application of fluoride varnish, the cervical dentin of the tooth was air dried then the varnish was applied in a uniform thickness by a specific applicator for 3 minutes according to manufacturer's instruction. The patients were asked not to drink, eat or wash their teeth at least two hours after the procedures in order to prevent the mechanical removal of the applied varnish. In GC Tooth Mousse category which contained 10% CPP_ACP the tooth surface was similarly dried and generous amounts of paste were applied to the tooth surface in 3 minutes by means of hands and patient was asked to prevent further salvation since the paste stays longer in the tooth resulting in a better result. Moreover, fluoride varnish and GC Tooth Mousse were used 3 times during the first day, first week and 4th week of the study but no treatment was done on the 60th day. The level of tooth sensitivity was measured in the first dental observation (before beginning the treatment) and after the treatment in the first week (7th day), 4th week (28th day) and two months later (60th day). For measuring the sensitivity, Visual

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Analog Scale was used. The patients were asked to describe their tooth sensitivity by putting a vertical line on a line of 10cm length. On this measurement line, 0 indicates no sensitivity and 10 as a very severe pain .Sensitivity to air was examined using air blow in a room temperature for a period of 5 seconds and 2cm away from the tooth. Sensitivity to cold was measured by placing an ice carpool in a sensitive tooth for 5seconds. In all these experiments, sensitivity to air was examined before sensitivity to cold.

Results

The results were analyzed using One Way Analysis of Variance (ANOVA) with repeated measures of time as primary variables. The mean values of VAS scores are presented in table 1. One Way ANOVA test showed no statistically significant difference in DH mean score (Air P=0.99, Ice P=0.94) among 3 groups before treatment, but this test showed difference in DH mean scores (Air, Ice) among 3 groups after 7^{th} day; (Air P=0.02, Ice P=0.002), 28^{th} day (Air, Ice P<0.001), 60^{th} day (Air, Ice P=0.001). Post Hoc Duncan indicated no significant difference in DH mean scores (Air, Ice) between 2 groups (CPP-ACP paste and Fluoride Varnish) after 7^{th}, 28^{th}, 60^{th} days (P>0.005) but in control group was significantly greater than other two groups (P<0.005). ANOVA with repeated observation test suggested that DH mean scores (Air, Ice P<0.001) in Tooth Mousse group and Fluoride Varnish group significantly decreased, but this decrease in control group was not significant (Air P=0.09, Ice P=0.125).

Table 1. The visual analog means and standard deviations for air and ice sensitivity measurements at base line, 7, 28 and 60 days

Group	Air Before Treatment	Air 7^{th} Day	Air 28^{th} Day	Air 60^{th} Day	Ice Before Treatment	Ice 7^{th} Day	Ice 28^{th} Day	Ice 60^{th} Day
CPP-ACP	4.62±1	3.23±0.6	2.38±0.76	1.84±0.89	6.50±0.97	4.40±0.96	3.30±0.94	2.80±1.22
Fluoride Varnish	4.63±0.9	3.68±1.33	2.78±1.18	2.10±1.10	6.66±1.21	4.66±1.63	3.50±2.07	3.33±1.96
Control	4.65±1.65	4.65±1.65	4.35±1.83	3.88±2.23	6.70±1.86	6.64±1.86	6.23±2.07	5.94±2.30

Discussion

According to the results of the present study, both Fluoride varnish and CPP-ACP were able to reduce DH significantly compared to control group (P<0.05). This might be due to the similarity of their mechanism of action which was occluding dentinal tubules. The reduction of DH had a constant proceeding in the period of two months from the baseline of this study. So that the most reduction of hypersensitivity was in the 60th day. In this investigation, there was no difference for DH in the control group (P>0.05).

Topical fluorides components have been applied for many years to reduce DH. [22-25] It is assumed that they make a barrier by precipitating CaF_2 at the exposed dentinal tubules. Several studies have investigated the effects of single application of topical fluoride varnish. Some investigators observed no reduction in DH probably because fluoride was unable to occlude dentin tubules efficiently after a single application. [26-28] In contrast, Ritter et al. [4] stated that a single application of topical fluoride varnish significantly reduced cervical DH. In that randomized clinical trial study, 5 percent sodium fluoride varnish was applied for treatment of cervical dentin hypersensitivity. The investigators used a visual analog scale (VAS) to assess subjects' responses to compressed air and ice stimuli at six weeks before baseline, at baseline and at two, eight and 24 weeks after treatment. They concluded that the test varnish was effective on reducing cervical dentin hypersensitivity. In the study of Corona et al. [29], the efficiency of the treatment was assessed at three examination periods: immediately after first application, 15 and 30 days after the first application. The results were similar to our study. Formation of deposits in tubules varied greatly from case to case thus; it reduced the accuracy of the investigation. In this study, fluoride varnish was applied three times, because repeated applications could contribute to crystal formation that was larger in dimension and consequently reduce DH. The results illustrated that this method of fluoride varnish application declined DH for two months. It is possible that the desensitizing effects of this product lasted much longer, but we made no evaluations after 2 months. The

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durability of our results was promising to some extent, because it may be expected that the CaF2 precipitations can be washed away by saliva and toothbrush abrasion and subsequently reduce the therapeutic effects of fluoride varnish.

Despite the fact that the natural presence of fluoride varnish has not been investigated clinically, it is believed that it can provide an additional barrier effect against DH. Natural presence of fluoride varnish in the resins along with its repeated application was responsible for the lasting effectiveness of this procedure. Some studies strongly support the hypothesis that the re-mineralization effect of CPP-ACP can confine the occurrence of erosion that may lead to DH. [30, 31]

This study was in accordance with other clinical studies in which the treatment of the patients with CPP-ACP was believed to be highly effective on managing DH. [21, 32] In one study, Tooth Mousse showed a rapid and sustained desensitizing action and was effective on reducing the cervical dental hypersensitivity. In another study, participants who responded positively to intraoral testing for dentin hypersensitivity using a split-mouth-designed study were recruited. Sensitivity was assessed by means of thermal and thermal/evaporative stimuli using VAS.

Applying GC Tooth Mousse Plus was successful in relieving the sensitivity of the patients, which was similar to our findings. One of the studies suggested that the efficacy and short-term therapeutic effect of CPP-ACP were not enough to treat the DH. However, our findings were inconsistent with these results probably due to absence of an appropriate control group in that study. [33]

The efficacy of fluoride varnish and CPP-ACP in treating DH should be studied further by using other stimuli. Overall, we did not include similar numbers of men and women as subjects, considering that the influence of the sex imbalance on the results was undecided, it showed the need for further investigations.

Conclusion

The results of this study indicated that both of fluoride varnish and CPP-ACP effectively reduced dentinal hypersensitivity compared with control group. However, we found no statistically significant differences between the desensitizing efficacies of them.

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Conflict of interest: We declare that there is no conflict of interest.

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