The Effect of MIpaste Plus and Reminpro on Incipient Caries Using DIAGNOdent and SEM: An Invitro Study

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Abstract: Background: The remineralization of early caries lesion has an effective role on decreasing caries. For initial remineralization of caries lesion, using Compounds of Casein phosphopeptides (CPP) in different studies has been proposed. REMINPRO including Fluoride, Xylitol and Calcium phosphate has just been offered in the market. This study aims to investigate the efficacy of Reminpro and MI paste plus in terms of remineralization of early enamel lesions.

Materials and methods: In 15 samples of healthy enamels of the maxillary first premolar teeth and 15 samples of Primary Mandibular First Molar under the effect of demineralized gel, artificial caries has been created. The samples have been divided in 3 groups of 20. After performing the cycles of demineralization and remineralization during 5 weeks, the samples were investigated by DIAGNOdent and two samples from each group were compared with SEM. To investigate the remineralization of enamel, two-way ANOVA and to compare the groups in pair, the post hoc tests were used.

Results: The mean of mineralization of teeth in the group using reminpro was 25.2 ± 6.16 and in the group using MI paste plus was 23 ± 5.60, which was significantly high.

Conclusions: MI paste plus in mineralization of initial enamel caries were more efficient that reminpro pate.

Keywords: Remineralization■Initial caries■Reminpro■MI paste plus

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INTRODUCTION

Dental caries is a dental microbiological infectious disease which results in the local dissolution and calcified tissue destruction.[1] This disease is reversible in early stages and it is irreversible and destructive after the creation of hole. Due to its dynamic nature, its controlling time is very specific and critical. The biological methods of controlling caries focused on remineralization of initial caries with the aim of controlling demineralization and remineralization.[2] The remineralization process of the initial lesions was first proposed by Koulourides in 1996.[3] Among the different techniques of remineralization, using various compounds of Fluoride is well known.[4] Recently, the protective effect of milk and its products on the development of caries have been considered due to having Casein, Calcium and phosphate[5,6] and accordingly, Cpp-Acp originated from protein of milk was investigated as remineralization factor by Reynolds in 1998 which prevents from development of caries through buffering of Ca and P ions.[7–12] One of the Derivatives of Cpp-Acp is MIpasteplus.

One of the newest compounds is Reminpro. This material is a cream with water-soluble base including Hydroxyapatite (Calcium and phosphate), Fluoride (1450 ppm) and Xylitol. This material can be considered as an effective compound in remineralization. The benefit of this material is its usability in individuals who are allergic to milk products.[13] DIAGNodent was introduced by a German company named Kavo in 1998 which uses Fluorescence Tool induced by Laser light. During the process of Fluorescence, the light is absorbed by short wave length and results in exiting ray with longer wavelength. This tool produces rays with red lights and the wavelength of 655 nm which is absorbed by enamel and dentin and in case of demineralization, the light with be distributed. Higher degree of demineralization results in intensifying Fluorescence which is displayed on the monitor by digits of 0–99.

This system has two orals: one for pits and fissures and the other for flat surfaces. In assessing a diagnostic method, the most important criteria were sensitivity (the ability of determining the caries) and efficacy (likelihood of the consistency of test results with gold standards).[14] Although DIAGNodent is considered as a valuable tool in diagnosing caries, there are concerns about its accuracy, for example a relationship is observed between the digits and there is no depth of caries. The aim of this study is to compare the effects of MIpasteplus and Reminpro on remineralization of dental tissues through microscopic observing using SEM and DIAGNodent.

MATERIALS AND METHODS

Fifteen pulled permanent maxillary premolar teeth due to orthodontic reasons and 15 pulled Primary Mandibular First Molar teeth were selected and kept in distilled water

Table 1. Comparing the mean of demineralization with DIAGNOdent between MIpaste plus, Reminpro and artificial saliva.

Variable	Groups compared	Mean ± SD	P-value	Significant groups at 5% level
Demineralization	Saliva	28.5 ± 5.76	0.964	Nil
	MI paste plus	28 ± 5.60		
	Reminpro	28.20 ± 6.16		

ANOVA ($P < 0.05$ is significant).

at room temperature.[15] The root of each teeth was cut by diamond risk called Diatec swiss (LAB DIAM235, 5M) and then the dentin of tooth was cut in Mesiodistal manner and two buccal and lingual pieces from each dentin has been prepared[16,17] and then the samples were mounted in Acrylic frames. All the surface except for the windows with the dimension of 2 × 4 mm were covered with nail polish.[18] Sixty samples were divided into three groups including A (10 primary teeth, 10 permanent teeth, artificial saliva) B (10 primary teeth, 10 permanent teeth MIpaste Plus (GC, America)) C (10 primary teeth, 10 permanent teeth, (Voco, Germany) REMIN PRO) and the basic numbers of each group were recorded by DIAGNOdent® (KaVo). To perform demineralization cycle, each sample was floated for 5 h in 4 cc mineralized solution[19] (2.2_m MKH_2 Po_4, 5omM aceticacid, 2.2_mM $Cacl_2$). After investigating by DIAGNOdent® (KaVo) and recording the numbers for performing remineralization cycle, samples were placed on the above pastes for amount of 0.4 mg for 5 min.[20] After repeating the remineralization cycle two times in a day for 5 weeks (9 a.m and 4 pm), the samples were investigated with DIAGNOdent® (KaVo) and the final numbers recorded. In order to estimate the changes of surface of enamel in remineralization process, two samples including one primary tooth and one permanent tooth from each group were selected randomly and compared using SEM (LEO, 1455vp).[19]

The ethical issues of the study is performed according to Helsinki principles.

STATISTICAL ANALYSIS

Spss version 20 was used to analyse the data. To investigate the remineralization of enamel, two-way ANOVA and to compare the groups in pair, the post hoc tests were used.

RESULTS

DIAGNOdent readings increased linearly with clinical histologic measurements.[3] The instrument was reported to be able to distinguish with good sensitivity between sound tooth structure (values 3−7), white spot lesion (values 7−9) and demineralization to deeper carious lesions extending into dentin (values > 9). The result of Table 1 indicated that demineralization in three experimental groups was nearly similar.

Table 2 reveals that the most remineralization is occurred in MIpaste plus group. In addition, using Tukey test it was determined that the remineralization in MIpaste plus group is significantly better than Reminpro and artificial saliva groups.

Table 3 shows that remineralization in permanent teeth is significantly higher than deciduous teeth.

In control group (artificial saliva), the topography of healthy enamel with special porous defects and enamel rods are manifested. The week lines of mineralization around the porosity were observed.

DISCUSSION

One of the biggest concerns of dentists, is the issues related to creation of initial caries lesions and its development.[9,15,21] Two main methods were proposed in order to deal with this problem such as restoring the lesions with restorative materials and stimulating remineralization processes.[3] One of the local materials using for enhancing remineralization processes, is Fluoride[22−24] which is not usable due to the likelihood of Fluorosis especially in young children.[3]

The local use of compounds such as Casein phospho peptides (CCP-ACP), were also proposed for remineralization of demineralized lesions.[25−31] This compound which lacks Fluoride such as MI PASTE (GC, America) and contains Fluoride such as MI PASTE PLUS(GC, America) can be found in the market and are not usable in individuals who are allergic to the proteins of milk.[26]

The new paste called REMIN PRO (VOCO-GbH, Cuxhaven, Germany) has just been offered in market. Many researches about the remineralization effect of Fluoride and other materials such as CPP-ACP, Xylitol, Calcium phosphate were perform with or without Fluoride.[25−31] But no research about this kind of paste has been performed. In this research, regarding the increase of initial caries lesions, the effect of REMIN PRO compared to MI

Table 2. Comparing the mean of remineralization with DIAGNOdent between MIpaste plus, Reminpro and artificial saliva.

Variable	Groups compared	Mean ± SD	P-value	Significant Groups at 5% Level
Remineralization	Saliva	27.5 ± 5.76	0.047	(sig)
	MI paste plus	23 ± 5.60		
	Reminpro	25.20 ± 6.16		

q (P < 0.05 is significant).

PASTE PLUS on remineralization of this lesion has been investigated after creating the caries-like lesions in primary and permanent teeth.

The results from the research showed that both pastes brought in remineralization of demineralized enamel. But this increase was significantly higher in MI paste plus (P = 0.00). In samples which were exposed to artificial saliva, the significant increase in remineralization was not observed (Tables 1 and 2).

Many researches have been done about the effect of using MIpaste plus on remineralization of the tooth enamel, and it is determined that this paste has the potential of increasing the remineralization of the tooth enamel in lab and clinical conditions which are consistent with our results.[18–20,32–35]

MIpaste plus contains Xylitol, 900PPM Fluoride and Casein phospho peptides Amorphous and Calcium phosphate 10%[36] while the effective materials in Remin Pro contains Xylitol, 1450 ppm Fluoride and hydroxyapatite.

MIpaste plus contains CPP-ACP 10%. Casein phosphopeptides (CPP) is the main protein in milk and nano complexes of Casein phosphopeptides, Amorphous and Calcium phosphate derives from proteins of milk, casein, calcium and phosphate. Casein phosphor peptides is able to localize amorphous calcium on the surface of tooth which results in increasing the level of calcium phosphate of plaque and acts as a saver and also results in buffering of free ions of calcium and phosphate and helps retain supersaturated condition.[19,26] According to various studies, CPP-ACP can result in remineralization of caries lesions.[18–20,32–35] These findings are similar to the obtained results in this study and there is no inconsistency.

One of the most effective materials in Reminpro is Hydroxyapatite. There are different studies about the effect of Hydroxyapatite on increasing the remineralization of enamel.[18,20,27–35,37,38] Tschoppe et al studied on the property of remineralization of lesion of the subsurface of enamel and dentin and found that the paste containing Hydroxyapatite is more effective that the paste containing Amine fluoride (0.014%) in terms of remineralization of enamel and demineralized dentin.[28]

Unfortunately, there is not study about comparing the effect of Hydroxyapatite and CPP-ACP on remineralization of demineralized enamel but Haibua Pan[37] mentions that Hydroxyapatite is more Biocompatible than ACP. The second difference between these two pastes is the high density of Fluoride in REMIN PRO which contains Fluoride 61%.[39] Thus, the more the density of Fluoride in REMIN PRO is, the more likely the remineralization will be. The level of Fluoride in REMIN PRO is 1450 ppm which is higher than that in MI PASTE PLUS that equals 900 ppm. Shen et al[40] reported a synergic effect between CPP-ACP and Fluoride and found that the compound of CPP-ACP 10% with 900 ppm Fluoride results in increasing remineralization of demineralized enamel compared to the paste containing 5000 ppm Fluoride and 1000 ppm Fluoride.

Xylitol is the common material of both pastes whose anti-decay property is approved by various studies.[29,30]

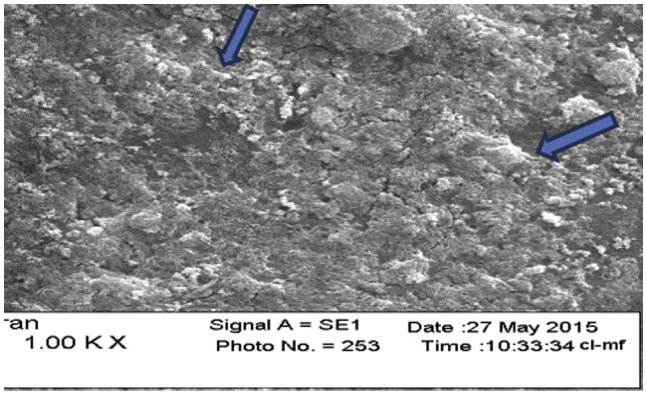
Table 3. Comparing remineralization between the primary and permanent teeth.

Variable	Groups compared	Mean ± SD	P-value	Significant groups at 5% level
Remineralization	Deciduous	29.57 ± 0.504	0.000	(sig)
	Permanent	18.89 ± 0.481		

ANOVA (P < 0.05 is significant).

Assessment with SEM.

Figure 1. Permanent tooth after remineralization in artificial saliva.



According to Amaechi[41] et al, adding Fluoride and Xylitol simultaneously to orange juice has the synergic effect on decreasing erosion in enamel.

Rochel[29] et al. investigated the effect of pastes containing Fluoride and Xylitol on erosion of enamel in a laboratory study and concluded that both pastes containing "1030 ppm Fluoride", "Xylitol 10% and 1030 ppm Fluoride" singly cause the loss of enamel decrease due to erosion.

One of the limitations of the present studies is that, although the golden standard for assessing the level of remineralization of one tooth is Transverse Micro Radiography (TMR), due to its inaccessibility in Iran, high cost and being time consuming, using it in the present study was unlikely. One non-invasive diagnostic method to determine remineralization which was used in this study is diagnodent Fluorescence. This tool uses Fluorescence to measure the initial demineralization. The report of different articles showed the value of diagnodent as a reliable noninvasive tool to determine the caries. The basic values, demineralization and remineralization were recorded after observing all of the samples with diagnodent. Comparing the amounts of remineralization of artificial saliva with the amounts of demineralization showed that certain amounts of demineralization occurred. So, saliva, singly, has certain amounts of remineralization potential but in comparing to the other materials, it cannot increase the level of releasing calcium and phosphate. In case of efficacy of MI paste plus compared to reminpro, the effect of synergist of CCPACP and Fluoride can be a probable cause which is consistent with the similar studies.[32,33] According to these studies, due to the low density of added Fluoride (900 ppm) to these products such as MI paste plus, the interference between ACP complex and Fluoride ion and decreasing the effect of ACP is not probable. And we can justify the low efficacy of reminpro in which the higher density of its Fluoride results in decreasing the effect of ACP in this paste. Also, the higher amount of remineralization on the permanent teeth can be attributed to the higher thickness of enamel of these teeth. Scanning electron microscope (Quanta 200) was also used to investigate the superficial changes of enamel (Figs. 1–3). From the positive points in this study, we can point to the high amount of samples (around 20 samples in each group).

Figure 2. Permanent tooth after remineralization in Reminpro.

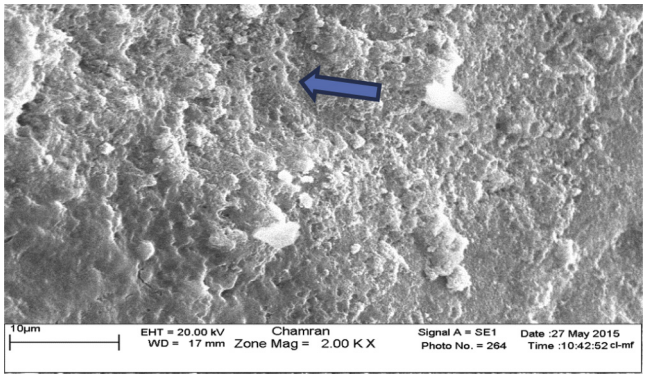
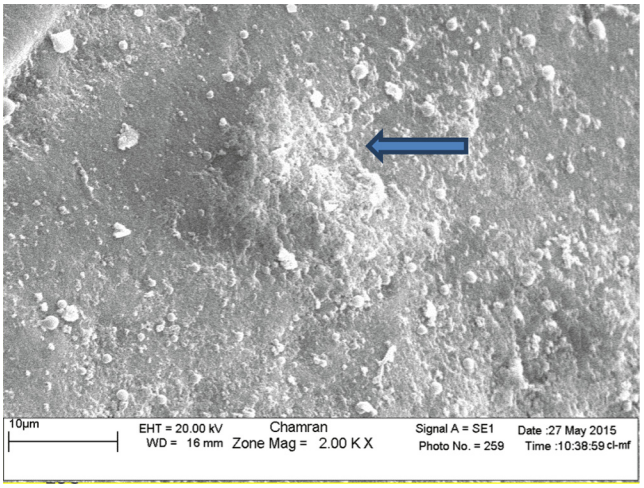


Figure 3. Permanent tooth after remineralization in MI paste plus.



In reminpro group, the lines of mineralization were clearer and thicker than that of saliva group and were observable along with the porosities.

In group MI paste plus, the mineral depositions were clearer than the previous groups.

This study was done in 5 weeks which is more than time duration in similar studies.[18,19,33] It is recommended that the efficacy of these pastes in In vivo conditions be investigated.

CONCLUSIONS

Using MI PASTE PLUS and REMIN PRO results in increasing the level of remineralization of demineralized enamel samples but in demineralized enamel samples which were exposed to artificial saliva, there was not any significant increase in the level of superficial remineralization. MI paste plus results in a slight increase in superficial mineralization in enamel samples (P = 0.00) (Table 2). The level of remineralization in permanent teeth was more than that in primary teeth (Table 3).

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