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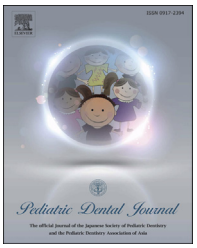

Research Paper

Synergetic remineralization effectiveness of calcium, phosphate and fluoride based systems in primary teeth

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ABSTRACT

Objective: To assess remineralization of primary teeth enamel under the presence of fluoride, calcium and phosphorous ions using microhardness and surface roughness testing.
Design: Artificial caries lesions were created in enamel surface of 144 human primary molars. Specimens were randomly assigned according to remineralizing agent into six groups: 1) Artificial saliva, 2) Fluoride varnish, 3) Clinpro™white varnish, 4) Relief, 5) Tooth Mousse Plus, 6) Vanish^{XT}TM. Surface micro-hardness and surface roughness were evaluated at baseline, after demineralization, after 2 and 4 weeks remineralization and after exposure to acid challenge.
Results: All test groups showed superior results to the control. The surface micro-hardness of Clinpro™ group by 4 weeks remineralization showed statistically the highest value with the least softening as exposed to acid challenge. Concomitantly, by 4 weeks remineralization, Clinpro™ agent was able to regain enamel surface roughness incomparable to that of baseline value statistically the least of test groups.
Conclusion: Calcium-phosphate and fluoride remineralizing systems possess added remineralization potency in comparison to artificial saliva. Clinpro™ varnish showed the greatest remineralizing action and the least softening by acid challenge.

1. Introduction

White spot lesions affecting the cervical area of the primary teeth in young children represent the incipient sign of Early Childhood Caries (ECC). ECC represents a serious dental public health dilemma that necessitates comprehensive control via careful detection and precocious intervention. Several factors found to stay behind the wide spread prevalence of ECC. Extended teeth exposure to milk or sugar concentrated liquids particularly while sleeping eventually lead to demineralization and progressive carious lesion. In addition, ingestion of food with erosive potential frequently provided by mothers to their children at breakfast can accelerate caries progress [1,2]. The carious lesion at its early stages of demineralization presented clinically as white lesion near the cervical margins [3]. Proper intervention at this stage aims to prevent further

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progressive destruction of the valuable dental tissues. The consequence of un-treated ECC effect won't be limited only to defective oral health status, but also extends to further affection of the child general health and delayed growth [4,5].

Minimally invasive dentistry concerns primary on maximum conservation of the valuable tooth structure [6]. The novel concept of remineralization is considered one of the minimally invasive dental paradigms. The remineralization process can be acquainted as successful net mineral gain into the crystal voids formerly created by demineralization in the dental structures via provision of calcium and phosphate in the presence of fluoride supplied from external source to the tooth structure.

Several approaches have been proposed to enhance remineralization of early stage of demineralized lesion [7,8]. The mechanism of fluoride action relayed mainly on its antibacterial effect and encouraged apatite crystal precipitation [9]. However, the bioavailability of calcium and phosphate radicals represent the determinant factor for remineralization enhancement despite the fundamental role of fluoride to yield stable mineral precipitate [10,11]. Several remineralizing agents have been introduced into the market and proposed to provide promising remineralizing action via synergetic effect of calcium-phosphate and fluoride. These remineralizing systems can be assorted according to the delivery form of the calcium-phosphate into crystalline, unstabilized amorphous or stabilized amorphous formulae. There are different calcium-phosphate crystalline phases with different solubilities [12]. One of these crystalline phases is tricalcium phosphate (TCP) which can be functionalized via milling using sodium lauryl sulfate to enhance its remineralizing potential [13]. The addition of functionalized TCP to remineralizing systems containing fluoride not only enhances remineralization potency but also offers no adverse effect on fluoride advantages and further could yield remineralization of subsurface enamel defects [14,15]. The unstabilized amorphous calcium-phosphate (ACP) agents relay on the provision of calcium and phosphate salts from separate chambers in dual delivery system. As they dissolve into aqueous medium, calcium and phosphate radicals become liberated resulting in sedimentation of ACP and in existence of fluoride ions, an amorphous calcium-fluoride-phosphate (ACFP) will be formed and found to enhance remineralization process and dental caries prevention [16]. These compounds are unstabilized precipitate and considered the precursors of hydroxyapatite and fluorohydroxyapatite hence limiting their subsurface penetration and remineralization [17]. On the other hand, Casein Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP) production, utilizes casein phosphopeptide milk protein noncomplex to settle amorphous calcium phosphate ACP or in the presence of fluoride to form amorphous calcium phosphate fluoride ACPF into subsurface enamel remineralization and providing calcium and phosphate supply to the demineralized lesion [18,19].

Resin modified glass ionomer based varnish producers claimed that it can furnish an outstanding capacity to enhance remineralization of early caries lesions. It has a unique mechanism of action relaying on the sealing potency originating from the resinous ingredient integrated in the material penetrative vigor into the lesion augmented with the chemical reactivity with the surrounding tooth structure. Furthermore, it has an elaborated healing potential arising from extended emission of calcium, phosphorous and fluoride ions [20]. However, comparing different approaches of calcium-phosphate and fluoride ions on the remineralizing tendency of demineralized lesions being scanty explored in researches. In addition, the steadiness of the built up mineral harvest subsequent to acid softening were scarcely studied in the literature. Thus, the aim of this study is to assess the effect of calcium and phosphate on enamel remineralization by fluoride in primary teeth using surface micro-hardness, and surface roughness methods.

2. Materials and methods

2.1. Materials

The Different remineralizing agents evaluated in this study and specimens grouping are shown in Table 1.

2.2. Specimens preparation

One hundred forty four exfoliated deciduous mandibular second molars were collected from 10- to 12-year-old children attending the Pediatric Dentistry Clinic, Cairo University, Egypt; during the period from June 2014 until December 2014. Approval clarification for the collection and use of human teeth in this study was obtained from the Research Ethics Committee, Faculty of Oral and Dental Medicine, Cairo University. Teeth free from any clinically visible abnormality were selected for the present study. All samples were cleaned from soft tissue remnants using slurry of fluoride free pumice

Table 1 – Details of remineralizing agents employed in the study and specimen grouping.

Remineralizing agent			Manufacture
Product	Category	Code	
DuraShield	Fluoride varnish, 22,600 ppm fluoride	FV	Sultan Healthcare, Englewood, NJ
Clinpro™ white varnish	Functionalized tri-calcium phosphate, 22600 ppm fluoride	ƒTCP	3M ESPE, USA
Relief	Amorphous calcium phosphate (0.375%), 1100 ppm fluoride	ACFP	Discus dental, USA
Tooth Mousse Plus	Casein phosphopeptide amorphous calcium phosphate (10%), 900 ppm fluoride	CPP-ACFP	GC Dental, Japan
Vanish™ XT	Extended contact varnish based on resin modified glass ionomer technology	RMGI	3M ESPE, USA

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