

## CARIES REMINERALIZATION AND ARRESTING EFFECT IN CHILDREN BY PROFESSIONALLY APPLIED FLUORIDE TREATMENT – A SYSTEMATIC REVIEW

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### ABSTRACT

Background: As a low-cost and easily operated treatment, the use of professionally applied topical fluoride was approved for preventing dental caries and remineralising early enamel caries or white spot lesions. It is also used to arrest dentine caries. The aim of this study is to investigate the clinical efficacy of professional fluoride therapy in remineralizing and arresting caries in children. Method: A systematic search of publications from 2000 to 2016 was conducted using four databases: PubMed. The key words used were “fluoride” AND “remineralization”. The title and abstract of initially identified publications were screened. Clinical trials about home-use fluorides, case reports, reviews, non-English articles and irrelevant studies were excluded. The full texts of the remaining papers were retrieved. Manual screening was conducted on the bibliographies of the remaining papers to identify relevant articles. Results: A total of 1346 papers were found, and 11 studies were included in this review. 3 studies were randomized control trials and 8 were in vitro studies that investigated the remineralising effect on enamel and dentinal caries using fluoride varnish and casein phosphopeptide (CPP)- Amorphous calcium phosphate (ACP) , GC tooth mousse and sodium fluoride, stannous fluoride, calcium sucrose phosphate, sliver fluoride , silver nitrate and potassium fluoride. 10 studies reported an arresting effect and remineralization of white spot lesions on enamel and dentine caries using fluoride varnish, or silver fluoride followed by the CPP-ACPF. One study showed that stannous fluoride has highest potential for remineralization compared to CCP-ACPF. Another study showed that clinpro TM XT varnish released consistently and substantially more fluoride than fluoroprotector and fluoritop SR. Conclusion: Professionally applied fluoride varnish can remineralise early enamel caries and CPP-ACPF remineralizing effect on white spot lesion when applied constantly over a period of 12 months.

### INTRODUCTION

World-wide, the contribution of dental caries to the burden of oral diseases is about 10 times higher than that of periodontal disease, the other common oral condition. Owing to its globally high prevalence, dental caries is a “pandemic” disease characterized by a high percentage of untreated carious cavities causing pain, discomfort and functional limitations. Untreated carious cavities; furthermore, have a significant impact on the

general health of children and on the social and economic well-being of communities. A surgical approach to the elimination of carious lesion was developed a century ago; this approach was necessary at that time, because there was no valid alternative. The focus in caries has recently shifted to the development of methodologies for the detection of the early stages of caries lesions and the non-invasive treatment of these lesions. The non-invasive treatment of



early lesions by remineralization has the potential to be a major advance in the clinical management of the disease. Remineralization of white-spot lesions may be possible with a variety of currently available agents containing fluoride, bioavailable calcium and phosphate and phosphate. This concept bridges the traditional gap between prevention and surgical procedures, which is just what dentistry needs today[1].

Among the available strategies, the use of fluorides has been shown to be highly effective in managing WSLs. Fluoride increases the remineralization of the outer enamel and decreases the demineralization of the inner enamel, resulting in significant mineral gain[2,3 & 4].

Enhanced oral hygiene plays a significant role in preventing SECC. Studies have shown that using fluoride varnish, together with oral hygiene practices and dietary counseling, leads to the remineralization of WSL and decreases early childhood caries (ECC)[5&6]. Although fluoride enables enamel remineralization, the presence of calcium and phosphate ions in the supragingival plaque is also necessary to promote the process[7].

The rationale for caries preventive effect of fluoride has been known for many decades. The fact that fluoride can be incorporated into the crystalline lattice of dental hard tissues, resulting in a tissue less soluble in acid environment, has been the scientific corner stone for caries prevention[8]. For many years professionally applied topical fluorides have been used effectively to prevent caries, especially in children. Professionally available fluoride is in the form of gels, foams, (containing around 12,300 ppm of fluoride) used effectively for inhibiting dental caries especially in children[9].

The aim of this study is to systematically review the clinical efficacy of professionally applied fluoride therapy in remineralising and arresting dental caries for children.

**MATERIALS AND METHODS**

Systematic literature review was undertaken using the PubMed MEDLINE database, with a view to identify caries remineralization and arresting effect in children by professionally applied fluoride treatment in order to provide dental practitioners with updated information on most effective fluoride treatments options for remineralization of early caries lesion and prevention of caries. A total of 1346 articles were found by entering key

words “fluorides” and “remineralization” into the pubmed/medline data base.

The search was then further limited to date 2010 till 2016, which narrowed the results down to 500 studies. Publications in the potentially eligible list were searched manually, and title and abstract were screened. Clinical studies about over-the-counter or home-use fluoride products, reviews, discussion papers, case reports, non-English articles and irrelevant studies were excluded. Full texts of the remaining publications were retrieved. Manual search was performed on the bibliographies of these publications to identify relevant papers, which were included for assessment. Finally,10 studies that met the following criteria were selected in this systematic review: the study type is clinical trial on children or in vitro trials and the outcome measurement of the studies should be evaluating the remineralization or arresting effect of caries by professional fluoride treatment. Studies that met the criteria above were included for data analysis. Figure 1 shows a diagram detailing how this literature review was carried out.

**RESULTS**

The selected articles studied the effects and efficacy of fluoride application on remineralization of demineralized enamel and dentine and white spot lesions. Table 1 provides an overview of each of the selected articles: Authors, year of publication, type of topical fluoride used and conclusions reached. Upon analyzing the different kinds of remineralizing products, it appears that fluoride varnish has highest remineralizing potential. It was used as 10% fluoride in one study. Fluoride varnish in 6 studies and as CPP-ACPA and Fluoride in 3 studies. All of the studies showed that topical applied fluoride varnish 4 times a year can be efficiently used in arresting and remineralizing the carious enamel and dentin along with white spot lesion.

CPP-ACP was used in 7 studies used for remineralization of demineralized enamel. It was shown that it has a remineralizing potential when used over a period of 12 months.

Stannous fluoride was used in one study. It showed highest remineralization potential when compared to calcium sucrose phosphate and CPP-ACPF.

In one study, clinpro TM XT varnish showed consistent and substantial release of fluoride when compared to flouritop SR and flourprotector.

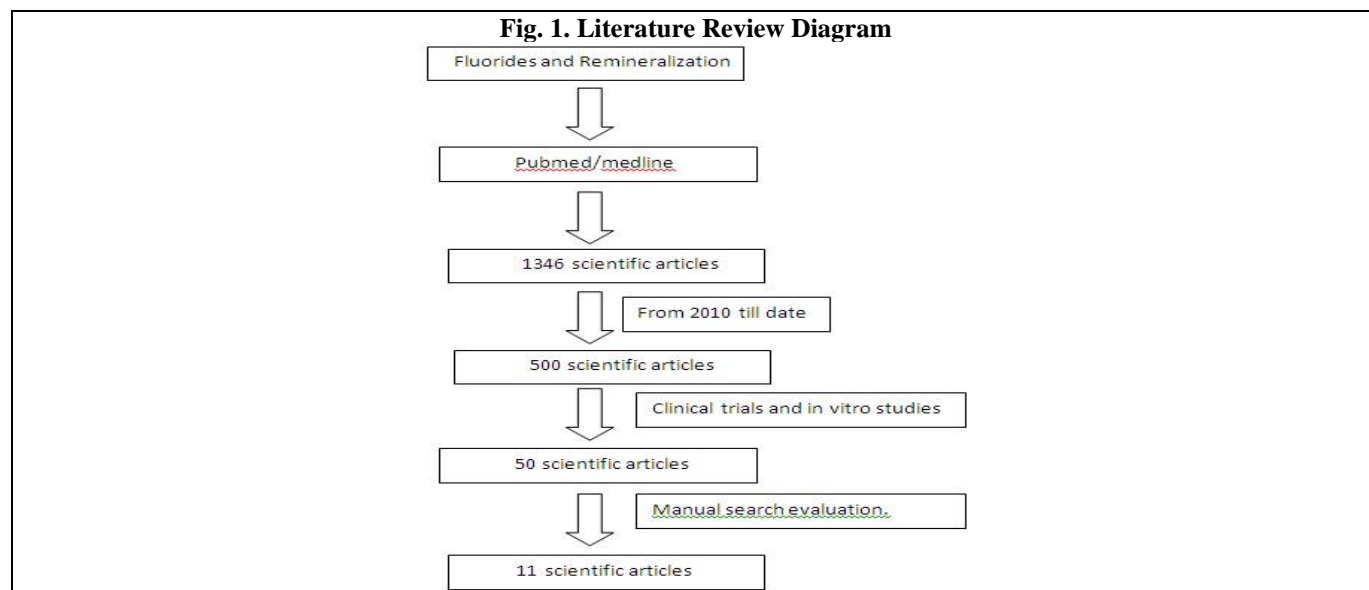
**Table 1. Authors, year of publication, type of remineralizing product used and conclusions reached**

Author	Year of publication	Remineralizing product	conclusion
Ruchi Vashisht et al	2013	CPP-ACP	These clinical and laboratory results suggested that CPP-ACP containing cream had a slight remineralization effect on the WSL in the 3-month evaluation period.
QH Zhi et al	2013	Silver fluoride; silver nitrate; potassium	Topical application of silver or fluoride ions can increase the mineral density of demineralized enamel and dentine lesions during remineralization



		fluoride.	
Mehta R et al	2013	CPP-ACP; CPP-ACPF	As compared with artificial saliva both CPP-ACP and CPP-ACFP produced significant amount of remineralization of the artificial enamel white spot lesion ( P < 0.001).
Shishir Shetty et al	2013	CPP-ACP; GC tooth mousse; CP-ACPF; GC tooth mousse plus; sodium fluoride.	CPP-ACP effectively remineralizes initial enamel caries, but to a lesser extent in comparison to CPPACPF and NaF. The addition of Fluoride to CPP-ACP shows improved remineralization of initial enamel caries when compared with CPP-ACP and NaF.
Mozhgan Bizhang et al	2015	10% fluoride varnish; 1% chlorhexidine and thymol.	The suggest that the effect of the treatment of demineralized dentin with 10% F- or 1% CHX-1% thymol is better than without any treatment.
Selcuk SAVAS et al	2016	CPP-ACP; fluoride varnish	CPP-ACP containing fluoride varnish provides remineralization of white spot lesions after a single application and seems suitable for clinical use.
Mahtab Me marpour et al	2016	Fluoride varnish; CPP-ACP	Oral hygiene along with four fluoride varnish applications or constant CPP-ACP during the 12month period reduced the size of WSL in the anterior primary teeth.
Shruti GiriSh Virupaxi et al	2016	Clinpro TM XT; fluoritop SR; fluoroprotector	Over a period of 6 months ClinproTM XT Varnish released consistently and substantially more fluoride than other tested products.
Krunal ChoKShi et al	2016	Fluoride varnish; CPP-ACP; FTCP	Fluoride varnish showed the greatest remineralization potential of artificial carious lesions followed by CPPACP Paste and fTCP Paste respectively.
Aparajita Gangrade et al	2016	snF2 CPP-ACPF;CaSP	All remineralizing agents showed improved surface remineralization. However, complete remineralization did not occur within 7 days. SnF2 showed the highest potential for remineralization followed by CaSP and CPP-ACPF.

**Fig. 1. Literature Review Diagram**



## DISCUSSION AND CONCLUSION

Despite worldwide improvements in the oral health, dental carious is still a major oral health problem in most industrialized countries, affecting 60%-90% of school

children and the vast majority of adults[10]. The current concept regarding cariogenesis is that a caries lesion, either clinically invisible or detectable, is the accumulation of



numerous episodes of demineralization and remineralization, rather than a unidirectional demineralization process. The periods during which there is return to the resting pH is when remineralization occurs. Thus, it can be stated that remineralization is the process by which partly-dissolved crystals are induced to grow by accretion of calcium and phosphate ions from solution. Remineralization is an important natural repair process that counteracts cariogenic challenge[11]. Fluoride is recognized as a remineralizing agent, interacting with oral fluids on the interface of enamel and subsurface regions of teeth, and combining with calcium and phosphate ions to form fluorapatite. The anticaries benefits of fluoride depend on the use of an effective concentration and frequency of application[12].

Of the articles selected for this review, fluoride varnish is the most frequently used professionally applied topical fluoride treatment for arresting and remineralizing the early caries lesion. The fluoride varnishes have gained immense popularity in the field of pediatric dentistry due to its ease of application thereby facilitating its use in preoperative children, patients with exaggerated gag reflex, those demanding special health care needs and also in children exposed to head and neck radiation<sup>9</sup>. studies have shown the use of fluoride varnishes to be effective in the prevention of early childhood caries and reduce caries by 25%-45%[13, 14].

Fluoride plays a major role in caries prevention by inhibiting demineralization, enhancing remineralization, and inhibiting plaque bacteria. Common fluoride delivery system includes water, toothpaste, supplements, mouth rinses, gels, foams, mouse and varnish. All have variable fluoride concentration, ranging from 0.5 to 22,600 sub ppm[15].

Casein Phosphopeptide-Amorphous Calcium Phosphate (CPPACP) was introduced as a remineralizing agent in the year 1998[16]. It comprises of nanocomplexes of milk protein CPP with ACP. It has been claimed that it promotes remineralisation of the carious lesions by

maintaining a supersaturated state of essential minerals, at the same time it also hinders colonization of dental surfaces by cariogenic bacteria[17].

Fluoride Varnish showed a significant increase in the remineralization potential as compared to CPP-ACP paste and functionalized Tricalcium Phosphate at both time intervals ( $p < 0.05^*$ ) CPP-ACP paste showed a significantly higher remineralization potential than functionalized Tricalcium Phosphate when the two were compared ( $p < 0.05^*$ )[18].

CPP-ACP effectively remineralizes initial enamel caries, but to a lesser extent in comparison to CPPACPF and NaF. The addition of Fluoride to CPP-ACP shows improved remineralization of initial enamel caries when compared with CPP-ACP and NaF[19].

SnF<sub>2</sub> showed the highest potential for remineralization followed by CaSP and CPP-ACPF. Having said that, SnF<sub>2</sub> shows gingival irritation and has metallic taste. To overcome these drawbacks, CaSP can be used as an effective tool for remineralization of early enamel caries as it is economical and has shown improved microhardness than that of CPP-ACPF[20].

In conclusion Fluoride occurs naturally in our environment and is always present in our lives. Exposure can occur through dietary intake, respiration and fluoride supplements. Fluoride can be toxic in extremely high concentrations. The European Academy of Paediatric Dentistry (EAPD) recommends a preventive topical use of fluoride supplements because of their cariostatic effect[21]. Fluoride varnish is effective in remineralizing the early enamel caries at the surface level. ACP-CPP cream is effective, but to a lesser extent than fluoride varnish in remineralizing early enamel caries at surface level. Combination of fluoride varnish and ACP-CPP does not provide any additive remineralization potential when compared to fluoride varnish alone at the surface level[22].

The number of clinical trials that studied the arresting effect of dental caries is limited, more clinical trials should be performed

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