

application and allowed it to remain on the teeth surfaces. This allows for high concentration of fluoride to be in contact with tooth enamel and enter bacterial cells and inhibit various cellular processes. In acidic conditions, fluoride acts on the mineral phases of the tooth as well as reduces the acid tolerance of bacteria. Low levels of fluoride can cause complete arrest of glycolysis by *Streptococcus mutans* [22]. A continuous and sustainable effect can be achieved with periodic topical fluoride applications and could reduce the microbial levels in children at high risk for caries.

Apart from sodium fluoride, Embrace™ varnish contains xylitol coated calcium phosphate (CXP™). A disadvantage of adding these salts to fluoride ions in varnishes is the formation of poorly soluble calcium fluoride phosphate phases during storage and can lead to a decrease in the number of bioavailable fluoride ions. On contact with saliva, the xylitol coating dissolves and allows the calcium and phosphate ions, to continuously react with fluoride ions to form protective Fluor apatite on the teeth. Xylitol, a naturally occurring five-carbon sugar polyol cannot be fermented by oral bacteria. *Streptococcus mutans* incorporates xylitol into the cell and converts it to xylitol-5-phosphate through the phosphoenolpyruvate phosphotransferase system, resulting in the development of intracellular vacuoles and cell membrane degradation [23]. *Streptococcus mutans* then dephosphorylates xylitol-5-phosphate and expels this dephosphorylated molecule from the cell, consuming energy leading to bacterial starvation and inhibition of growth [24]. Adhesion of these microorganisms to the tooth surface and their acid production potential are also reduced [25,26]. The xylitol coating also imparts an acceptable taste and helps to gain compliance during application.

Fluoride varnishes containing calcium and inorganic phosphate have shown measurable release of calcium and fluoride ions [27]. A comparative study on fluoride varnishes found Embrace™ with CXP™ to have greater cumulative fluoride release but low substantively, indicating its use in patients with high caries risk and requiring more frequent follow-up or reapplication [28]. Embrace™ varnish with CXP™ has been shown to release ten times more fluoride over a 4 h period than other fluoride varnishes [28]. Therefore, this mechanism can be beneficial in infants and children with oral environments that are exposed to repeated acidic challenges.

Fluoride application can have inhibitory effects on the virulence factors and composition of the cariogenic biofilm formation [29,30]. In the present study, single application of Embrace™ varnish with CXP™ to both mother and child in mother-child pairs showed significant reduction at 6 months in levels of plaque *Streptococcus mutans* in the child. However, this reduction was not as highly significant as compared to the reduction seen following varnish

application only to the child. These findings indicate that vertical transmission from mothers may have made only a minor contribution to their child's *Streptococcus mutans* levels and the children could have acquired *Streptococcus mutans* from other sources via horizontal transmission. Also, varnish application only to the mother, appeared to have no beneficial effect and there was an increase in *Streptococcus mutans* levels of their child. Therefore, preventive measures targeting only maternal transmission is not adequate and there is a need for application of these measures to other individuals that are closely associated with the child.

Pre-school children frequently receive affectionate kisses from family members and care takers. These children are extremely susceptible to bacterial colonization. The sharing of utensils, toys and playing in close proximity with others is a common practice. The outcome of this study draws attention to protecting children in nurseries and crèches, who may be at risk of microbial acquisition and transfer from one child to another. Annual or semi-annual application of fluoride varnish with CXP™ can be beneficial in children with early childhood caries. Involving parents, educating care givers and implementing preventive measures from an early age can help in reducing dental caries in children in the community.

CONCLUSION

In mother-child pairs, application of a fluoride varnish with xylitol coated calcium phosphate to only child and both mother-child significantly reduced *Streptococcus mutans* in dental plaque of the child.

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