Topical Fluoride & its Safety for Human Use

Received……..……04/22/2016 Scientific Review …..……..05/24/2016 IAOMT Board Review …...…… Re evaluation	**Biological Support**	Approval Provisional Approval No Opinion **No Approval**…….……**6/22/16**
Explanation of IAOMT position: The IAOMT does not endorse the use of topical fluoride.		

Name of SOC/SR: Topical Fluoride and its Safety for Human Use

Alternative name(s) of SOC/SR: Topical Fluoride: Is topical fluoride effective as an antibacterial agent AND is it safe for human use?

What is this SOC/SR related to: Dentistry

Is this SOC/SR a: Product and Procedure

Do you have a vested financial interest in any part of this SOC/SR? No

Purpose of the SOC/SR: To show the efficacy of topical fluoride including the pros and cons regarding its use.

SR History: Action of topical fluoride:
The mechanism of action of fluoride on tooth enamel has been shown to be primarily topical, and not from ingestion (Buzalaf, Pessan, Honório, and Ten Cate, 2011; Featherstone, 2000; Moreno, Kresak, and Zahradnik, 1977). As far back as the early 1980s, it was established that fluoride controls caries mainly through its topical effect. Fluoride present in low, sustained concentrations (sub-ppm range) in the oral fluids during an acidic challenge is able to absorb to the surface of the apatite crystals, creating the newly formed fluorhydroxyapatite (or fluoroapatite) crystals, inhibiting demineralization. When the pH is re-established, traces of fluoride in solution will make it highly supersaturated with respect to fluoroapatite, which speeds up the process of remineralization. Topical fluoride also provides antimicrobial action. Fluoride concentrations found in dental plaque have biological activity on virulence factors of S. mutans in vitro, such as acid production and glucan synthesis, but the in vivo implications of this are still not clear (Buzalaf et al., 2011).

Briefly describe the SR:
The purpose of this SR is to show the mechanism of action of topical fluoride and describe the benefit or harm to human use. This SR will show the science behind topical fluoride, including but not limited to its recommendations for use.

Specifically, by outline if appropriate, describe the SR:

I. Description of Topical Fluoride
   a. Mechanism of action
   b. Forms and uses – according to dental experts
II. Organized Dentistry/Medicine's Position
III. Argument for Use vs Non-use

I. Description of Topical Fluoride

According to the *Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing, and Allied Health*, fluoride is defined as "any binary compound of fluorine" (Miller-Keene & O'Toole, 2005). This same dictionary defines topical fluoride as "a fluoride applied directly to the teeth, especially of children, in a dental caries prevention program" (Miller-Keene & O'Toole, 2005). This statement leads the reader to assume that topical fluoride is a beneficial caries preventive compound.

The interaction of fluoride with the mineral component of teeth produces a fluorohydroxyapatite (FHAP or FAP), by substitution of F- for OH-. This results in increased hydrogen bonding, smaller crystal lattices, and an overall decrease in solubility (Moreno et. al, 1977).

In addition to protecting against demineralization, another way in which fluoride interacts with enamel to reduce dissolution is through remineralization. This is a process in which partially dissolved enamel crystals act as a substrate for mineral deposition from the solution phase that enables partial repair of the damaged crystals. Therefore, remineralization will counteract some of the demineralization and an equilibrium will develop between the two processes. The carious lesion is the result of demineralization outweighing remineralization. One of the benefits of the demineralization/remineralization interplay is the creation of less soluble mineral in enamel (Wefel & Dodds, 1999).

When fluoride is present in solution, formation of fluoroapatite results in a mineral with an enhanced level of acid resistance. The remineralization process is one controlled by the supersaturation of fluids bathing the teeth in the form of plaque or saliva. The degree of supersaturation will, in part, determine the rate of precipitation of minerals from the solution (Silverstone & Wefel, 1981).

According to the CDC, there are three main mechanisms by which topical fluoride can prevent decay. It can (1) enhance remineralization of carious lesions before they become full-blown cavities, (2) inhibit demineralization, and (3) poison the enzymes in the oral bacteria that produce the acids that erode the teeth (i.e. – antibacterial effect) (Centers for Disease Control and Prevention, 2001). Importantly, none of these three mechanisms depends on teeth having high concentrations of fluoride in their internal matrix. Consequently, each of these three topical mechanisms can occur without a person swallowing a single drop of fluoride their entire life.

Fluoride was first added to toothpaste in 1956 by Proctor and Gamble in the form of Crest toothpaste. A form of topical fluoride that can only be applied by a dentist or dental professional is fluoride varnish, which is composed of a high concentration of fluoride as a salt or silane preparation in a fast drying alcohol and resin-based solution. While most fluoride varnishes contain 5% sodium fluoride, some contain 1% difluorsilane in a polyurethane base. Fluoride varnishes are recognized by the FDA for use as desensitizing agents, but, currently, not as an anti-decay agent. There are, however, numerous studies purporting the benefits of fluoride varnish on caries prevention, and many of them are included in this review (Ahovuo-Saloranta, Forss, Hiiri, Nordblad, & Mäkelä, 2016; Anderson et al., 2016; Bansal, Ingle, Kaur, & Ingle, 2015; Ekstrand, Koch, & Petersson, 1980; Gao, Zhang, Mei, Lo, & Chu, 2016; Hawkins et al., 2004; Lawrence et al., 2008; Milsom et al., 2011; Mohammadi, Hajizamani, Hajizamani, & Abolghasemi, 2015; Pahel, Rozier, Stearns, & Quiñonez , 2011; Shaw, Macpherson, & Conway, 2009; Twetman & Dhar, 2015).

II. Organized Dentistry/Medicine's Position

In 2006, the Council on Scientific Affairs (CSA) of the American Dental Association published recommendations for the use of professionally-applied topical fluorides for caries prevention (American Dental Association Council on

Scientific Affairs, 2006). According to the ADA, fluoride is the primary agent available for caries prevention. The local availability of fluoride to the tooth surface has been shown to prevent caries by primarily three mechanisms: 1) inhibiting demineralization of tooth enamel; 2) enhancing remineralization of tooth enamel prior to lesion progression; and 3) inhibiting the enzyme activity of cariogenic bacteria (Featherstone, 2000; Centers for Disease Control and Prevention, 2001).

In November of 2013, a panel of experts convened by the American Dental Association (ADA) Council on Scientific Affairs presented evidence-based clinical recommendations on professionally-applied and prescription-strength, home-use topical fluoride agents for caries prevention as an update to the aforementioned 2006 ADA recommendations regarding professionally applied topical fluoride. The authors of this report conducted a search of MEDLINE and the Cochrane Library for clinical trials of professionally-applied and prescription-strength topical fluoride agents – including mouth rinses, varnishes, gels, foams, and pastes (Weyant et al., 2013). The panel included 71 trials in 82 articles in its review and assessed the efficacy of various topical fluoride caries-preventive agents. Their results confirmed their initial recommendations…that topical fluoride is the best means of decay prevention.

III. Argument for Use vs Non-use

Organized dentistry still promotes topical fluoride as the main anti-cariogenic substance one can apply to their teeth to achieve good oral health. It is referred to as "nature's cavity fighter" by the ADA (American Dental Association, 2005). According to the ADA, fluoroapatite is much stronger and more resistant to decay than hydroxyapatite. Of course, they also promote water fluoridation which has been shown scientifically to fall short of its intended function (Featherstone, 2000).

Despite all that mainstream dentistry has to say regarding the merits of topical fluoride, it is equally important to show the deleterious effects of using it and demonstrate why the IAOMT does ***not*** recommend its use.

1) Sodium fluoride (NaF) has been shown to induce apoptosis in human gingival fibroblasts (Lee et al., 2008). A study published in the *Journal of Toxicology* in 2008 showed NaF to be cytotoxic and produce inflammatory responses in humans. Until this study was published, the cellular mechanisms underlying the NaF-induced cytotoxicity in periodontal tissues were unclear. This study clearly showed that NaF induced apoptosis with concomitant chromatin condensation and DNA fragmentation in HGF (Lee et al., 2008).

2) Stannous fluoride (SnF) causes tissue necrosis and permanent alveolar bone loss when used as a subgingival irrigant in periodontal treatment (Sjöström & Kalfas, 1999). The Umea School of Dentistry in Sweden published a case report showing extensive periodontal tissue necrosis and permanent alveolar bone loss after irrigation of periodontal pockets with stannous fluoride in the *Journal of Clinical Periodontology* in 1999 (Sjöström & Kalfas, 1999).

3) Topical fluoride use in children is related to a significant increase of the fluoride concentration in their urine (García-Camba de la Muela, García-Hoyos, Varela Morales, & González Sanz, 2009). Researchers from the Universidad de Madrid published their findings in a Spanish journal, *Revista Espanola de Salud Publica,* in 2009 showing the urinary fluoride increase by measuring the fluoride-creatinine (F/Cr) ratio differences. The F/Cr ratio was used to minimize the variations of the fluoride levels in urine due to the different rates of secretion. The F/Cr ratio increased significantly after toothbrushing, ranging from 0.61 to 1.25 mg/g (García-Camba de la Muela, García-Hoyos, Varela Morales, & González Sanz, 2009).

4) Fluoride gels, which are often prescribed to children (particularly those undergoing orthodontia), can result in gastric mucosal injuries, even at low concentrations (Spak et al., 1990). A study published in the *Journal of Dental Research* in 1990 showed how concentrations of fluoride gel as low as 1.23% F (typical amount

prescribed) caused gastric injuries in the antral and corpus regions of the stomach (Spak et al., 1990). The subjects used in this study underwent gastroscopies before and after fluoride application which showed obvious histological changes in their stomach mucosa layers including petechiae and erosions two hours after applications.

Beyond the science showing whatever anti-cariogenic effect topical fluoride may have, the systemic problems far outweigh the benefits. Additionally, fluoride is not essential for any process in the human body and is unnecessary for good oral health. Diet and home-care are the major actors governing the oral environment and not fluoride applications (topical, systemic via fluoridation, or supplements). This review does not address oral fluoride supplements, but it is important to note that fluoride supplements have never been approved by the FDA as a caries preventative and yet are prescribed for that very reason.

Manufacturer(s), distributer, or publisher: N/A

References:

Ahovuo-Saloranta, A., Forss, H., Hiiri, A., Nordblad, A., & Mäkelä, M. (2016). Pit and fissure sealants versus fluoride varnishes for preventing dental decay in the permanent teeth of children and adolescents. *The Cochrane Database of Systematic Reviews*, *1*, CD003067-CD003067.

American Dental Association Council on Scientific Affairs. (2006). Professionally applied topical fluoride: Evidence–based clinical recommendations. *The Journal of the American Dental Association*, *137*(8), 1151-1159.

American Dental Association. (2005). Fluoride: nature's cavity fighter. *J Am Dent Assoc.*, *136*(12): 1783. http://www.ada.org/~/media/ADA/Publications/Files/patient_57.pdf?la=en

Anderson, M., Dahllöf, G., Twetman, S., Jansson, L., Bergenlid, A. C., & Grindefjord, M. (2016). Effectiveness of Early Preventive Intervention with Semiannual Fluoride Varnish Application in Toddlers Living in High-Risk Areas: A Stratified Cluster-Randomized Controlled Trial. *Caries Research*, *50*(1), 17-23.

Bansal, A., Ingle, N. A., Kaur, N., & Ingle, E. (2015). Recent advancements in fluoride: A systematic review. *Journal of International Society of Preventive & Community Dentistry*,*5*(5), 341.

Buzalaf, M. A. R., Pessan, J. P., Honório, H. M., & Ten Cate, J. M. (2011). Mechanisms of action of fluoride for caries control. *Monogr Oral Sci*, 22:97-114. doi: 10.1159/000325151. Epub 2011 Jun 23.

Centers for Disease Control and Prevention. (2001). Recommendations for using fluoride to prevent and control dental caries in the United States. *Mortality and Morbidity Weekly Review,* 50(RR14):1-42.

Ekstrand J, Koch G, Petersson L. (1980). Plasma fluoride concentration and urinary fluoride excretion in children following application of the fluoride-containing varnish Duraphat. *Caries Res*; 14: 185- 189.

Featherstone, J. D. (2000). The science and practice of caries prevention. *The Journal of the American Dental Association*, *131*(7), 887-899.

Gao, S. S., Zhang, S., Mei, M. L., Lo, E. C. M., & Chu, C. H. (2016). Caries remineralisation and arresting effect in children by professionally applied fluoride treatment–a systematic review. *BMC Oral Health*, *16*(1), 1.

García-Camba de la Muela, J. M., García-Hoyos, F., Varela Morales, M., & González Sanz, Á. (2009). Demonstration of fluoride systemic absorption secondary to toothbrushing with fluoride dentifrice in children. *Revista Española de Salud Pública*, *83*(3), 415-425.

Hawkins, R., Noble, J., Locker, D., Wiebe, D., Murray, H., Wiebe, P., Frosina, C. & Clarke, M. (2004). A comparison of the costs and patient acceptability of professionally applied topical fluoride foam and varnish. *Journal of Public Health Dentistry*, *64*(2), 106-110.

Lawrence, H. P., Binguis, D., Douglas, J., McKeown, L., Switzer, B., Figueiredo, R., & Laporte, A. (2008). A 2□year community□randomized controlled trial of fluoride varnish to prevent early childhood caries in Aboriginal children. *Community Dentistry and Oral Epidemiology*, *36*(6), 503-516.

Lee, J. H., Jung, J. Y., Jeong, Y. J., Park, J. H., Yang, K. H., Choi, N. K., Kim, S.H., & Kim, W. J. (2008). Involvement of both mitochondrial-and death receptor-dependent apoptotic pathways regulated by Bcl-2 family in sodium fluoride-induced apoptosis of the human gingival fibroblasts. *Toxicology*, *243*(3), 340-347.

Marinho, V. C., Worthington, H. V., Walsh, T., & Clarkson, J. E. (2013). Fluoride varnishes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev*, *7*(11).

Miller-Keane, O'Toole, M.T. (2005). *Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing, and Allied Health, Seventh Edition*. Saunders, an imprint of Elsevier, Inc.

Milsom, K. M., Blinkhorn, A. S., Walsh, T., Worthington, H. V., Kearney-Mitchell, P., Whitehead, H., & Tickle, M. (2011). A Cluster-randomized Controlled Trial Fluoride Varnish in School Children. *Journal of Dental Research, 90*(11), 1306-1311.

Mohammadi, T. M., Hajizamani, A., Hajizamani, H. R., & Abolghasemi, B. (2015). Fluoride varnish effect on preventing dental caries in a sample of 3-6 years old children. *Journal of International Oral Health: JIOH*, *7*(1), 30.

Moreno, E. C., Kresak, M., & Zahradnik, R. T. (1977). Physicochemical aspects of fluoride-apatite systems relevant to the study of dental caries. *Caries Research*, *11*(Suppl. 1), 142-171.

Pahel, B. T., Rozier, R. G., Stearns, S. C., & Quiñonez, R. B. (2011). Effectiveness of preventive dental treatments by physicians for young Medicaid enrollees. *Pediatrics*, *127*(3), e682-e689.

Shaw, D., Macpherson, L., Conway, D. (2009). Tackling socially determined dental inequalities: ethical aspects of Childsmile, the national child oral health demonstration programme in Scotland. *Bioethics, 23*(2), 131-139.

Silverstone, L. M., & Wefel, J. S. (1981). The effect of remineralization on artificial caries-like lesions and their crystal content. *Journal of Crystal Growth*, *53*(1), 148-159.

Sjöström, S., & Kalfas, S. (1999). Tissue necrosis after subgingival irrigation with fluoride solution. *Journal of Clinical Periodontology*, *26*(4), 257-260.

Spak, C. J., Sjöstedt, S., Eleborg, L., Veress, B., Perbeck, L., & Ekstrand, J. (1990). Studies of human gastric mucosa after application of 0.42% fluoride gel. *Journal of Dental Research*, *69*(2), 426-429.

Twetman, S., & Dhar, V. (2015). Evidence of effectiveness of current therapies to prevent and treat early childhood caries. *Pediatric Dentistry*, *37*(3), 246-253.

Wefel, J. S., & Dodds, M. W. J. (1999). Oral biologic defenses and the demineralization and remineralization of teeth. *Primary Preventive Dentistry, 5th edition.* Stamford: Appleton and Lange, 271-298.

Weyant, R.J., Tracy, S.L., Anselmo, T.T., Beltrán-Aguilar, E.D., Donly, K.J., Frese, W.A., Hujoel, P.P., Iafolla, T., Kohn, W., Kumar, J., Levy, S.M., Tinanoff, N., Wright, J.T., Zero, D., Aravamudhan, K., Frantsve-Hawley, J., Meyer, D.M.; American Dental Association Council on Scientific Affairs Expert Panel on Topical Fluoride Caries Preventive Agents. (2013). Topical fluoride for caries prevention: executive summary of the updated clinical recommendations and supporting systematic review. *J Am Dent Assoc.; 144*(11):1279-91

Legal Aspects of this SOC/SR: Liability by manufacturers and fluoride advocates like the ADA and CDC for negligent misrepresentation of the product and systemic injuries including cytotoxicity, tissue necrosis, permanent alveolar bone loss, increased fluoride content in urine and gastric mucosal injuries.

#

#

Applicant Name: Griffin Cole, DDS NMD FIAOMT		**Office Phone:** 512-472-3565
Mailing Address: 1301 W. 25th Street, Suite 402		**Office FAX:** 512-472-1210
City: Austin		**Home Phone:** 512-330-0267
State of Province: Texas	**Zip code:** 78705	**Home FAX:**
Country: USA		**e-mail:** griffincole@yahoo.com
IAOMT Member #:		**IAOMT Chapter:North America**

#

The IAOMT and Mankind Thanks You!