

Feature Article

Varnishes

Fluoride Varnishes

Kevin J. Donly, DDS, MS

Kevin J. Donly, DDS, MS, is a professor and postdoctoral program director of the Department of Pediatric Dentistry at the University of Texas Health Science Center at San Antonio Dental School.

Disclosure

Dr. Kevin J. Donly has received grants or research support from the National Institute of Dental and Craniofacial Research, Health Resources and Services Administration, 3M ESPE, Premier, Bisco, GC, Dentsply, Ivoclar, Kerr, Procter and Gamble, Church and Dwight, Philips, Optiva, Oral-B, Enamelon, Atrix Laboratories, and Guidor Companies.

Although he has received grants or research support from these entities, he has no personal financial interests.

Copyright 2003 *Journal of the California Dental Association.*

abstract

Fluoride varnishes are available in the United States, and the Federal Drug Administration has approved a fluoride varnish for use as a cavity preparation lining varnish and as a tooth desensitizing agent. The literature, however, supports the use of fluoride varnishes to inhibit tooth demineralization and enhance remineralization. The purpose of this paper is to present an overview of literature and make recommendations according to the available scientific evidence. Findings support the use of fluoride varnishes as a safe and effective topical fluoride agent.

Fluoride varnishes, although available in Europe for more than two decades, have more recently been introduced to the U.S. marketplace. These fluoride varnishes are recognized by the Federal Drug Administration as a device to be used as a desensitizing agent and a cavity lining varnish.^{1,2} Although fluoridated varnishes are officially recognized as effective cavity varnishes³ and desensitizing agents,^{4,5} research has demonstrated their caries prevention potential. The purpose of this paper is to provide data associated with the caries inhibition effectiveness associated with fluoride varnishes and to make recommendations for clinical use as a preventive dentistry agent.

Fluoride Varnishes Available

There are four fluoridated varnishes marketed in the United States:

- * Duraphat (Colgate Oral Pharmaceuticals, Inc., Canton, Mass). Duraphat is a 5 percent sodium fluoride varnish provided in tubes containing 10 ml of product.
- * Duraflor (Pharmascience, Montreal, Canada). Duraflor is also a 5 percent sodium fluoride varnish, which is provided in 10 ml tubes.
- * Fluor Protector (Ivoclar/Vivadent, Amherst, N.Y.). Fluor Protector is a 1 percent difluorsilane varnish provided in 1 ml ampules and 0.4 ml single dose units.
- * Cavity Shield (OMNII Oral Pharmaceuticals, West Palm Beach, Fla.). Cavity Shield is a 5 percent sodium fluoride varnish but comes in unit-dose packages with an application brush.

Concern has been directed toward the potential settling of sodium fluoride in product packaging. A recent study indicated that the sodium fluoride contained in cavity varnishes was not equally distributed throughout the varnish tube, resulting in varying doses to be obtained when the fluoride varnish was extruded.⁶ Results from the study demonstrated a more uniform fluoride content in Duraphat tubes and Cavity Shield unit-dose packages than in Duraflor tubes. An advertised advantage to Cavity Shield is that the unit dose can be easily mixed and applied to teeth, eliminating the concern of an unknown dose of fluoride.

Caries Prevention Effectiveness

Numerous studies document the caries-preventive effectiveness of fluoride varnish. Further in vivo and in vitro studies have addressed the use of fluoride varnishes on higher caries-risk patients, such as those receiving orthodontic treatment.⁷⁻⁹ Although data varies in reported effectiveness, a significant reduction in caries is noted.¹⁰⁻³¹ Several comparative trials have demonstrated equal or superior caries-prevention benefits of 1.23 percent acidulated phosphate fluoride, the standard professionally applied topical fluoride used in the United States.³²⁻³⁴

Although a majority of clinical trials are associated with caries inhibition in the permanent dentition, there are some studies related to the primary dentition.³⁵⁻⁴² The average caries reduction in the primary dentition, where fluoride varnishes were typically applied twice per year, appears to be less than the caries reduction seen in the permanent dentition; however more clinical trials are necessary, particularly focusing on very young children.

Remineralization

There is minimal information regarding the effectiveness of fluoridated varnishes to enhance remineralization. Preliminary in vitro and in vivo studies, however, indicate that fluoride varnish has the potential to aid in the remineralization of incipient caries.⁴³⁻⁵⁰

Occlusal Caries Prevention

Several studies have compared the use of fluoride varnishes and sealants to prevent occlusal caries. Findings from these studies indicate sealants to be the most effective preventive agent for occlusal tooth surfaces.⁵¹⁻⁵⁴

Fluoride Varnish Application

The application of fluoride varnish is simple. A prophylaxis is not necessary prior to fluoride

varnish application, but brushing with a toothbrush has been recommended.⁵⁵⁻⁵⁶ If there is no evidence of heavy plaque or debris on the teeth, wiping them with cotton gauze is adequate. The teeth can remain moist and the varnish will still adhere to the teeth. A total of 0.3 to 0.6 ml of fluoride varnish is sufficient to cover the dentition. After application, the patient is requested not to brush his or her teeth for the remainder of the day but to return to routine oral hygiene maintenance the following day.

Safety

A 5 percent sodium fluoride preparation is 50,000 ppm sodium fluoride. Although this is a relatively high-dose fluoride preparation, a minimal amount is applied (0.3 to 0.6 ml).⁵⁷ This can be converted to a range of approximately 5 to 12 mg fluoride. The fluoride varnish slowly breaks away from the tooth surface, and research has demonstrated that a negligible amount is ingested. Ekstrand and colleagues reported a low plasma fluoride level following placement of a 5 percent fluoride varnish, which was comparable to plasma fluoride levels experienced after toothbrushing with a fluoridated dentifrice.⁵⁸ This level is significantly lower than plasma fluoride levels seen after a professionally applied 1.23 percent acidulated phosphate fluoride.⁵⁹ The acidulated phosphate fluoride, even when delivered in trays, dissipates throughout the mouth with subsequent swallowing of the fluoride.

Due to the difficulty of placing topical fluoride delivery trays in children younger than 5, difficulty in obtaining the cooperation of these young children to use a slow-speed suction to remove excess fluoride from the mouth as it dissipates from the delivery tray, and the inability to keep young children from swallowing the acidulated phosphate fluoride in the delivery tray, this young population could benefit from the fluoridated varnishes. Ease of varnish application, safety, and efficacy comparable to 1.23% acidulated phosphate fluoride makes the use of fluoride varnish on young children rational.

Summary

There is overwhelming evidence that fluoride varnish is effective at inhibiting tooth demineralization. Fluoride varnish is as effective in caries reduction as other professionally applied topical fluoride regimens currently used. The following lists of indications and contraindications summarizes recommendations:

Indications

- * Biannual professionally applied topical fluoride agent on moderate and high-risk patients, particularly children younger than 5.
- * Root desensitizing agent.
- * Cavity varnish, in place of a nonfluoridated cavity varnish.
- * Institutionalized patients.
- * Exposed root surfaces.
- * Patients receiving orthodontic therapy.

Contraindications

- * Treatment of cavitated lesions.
- * Low risk, caries-free patients, living in a fluoridated community.
- * Circumstances where post-fluoride treatment esthetics is a concern.

References

1. Bawden, JW, Fluoride varnish: A useful new tool for public health dentistry. *J Public Health Dent* 58:266-69, 1998.
2. Beltran-Aguilar ED, Goldstein JW, Lockwood SA, Fluoride varnishes: A review of their clinical use, cariostatic mechanism, efficacy and safety. *J Am Dent Assoc* 131:589-96, 2000.
3. McComb D, Ben-Amar A, Brown J, Sealing efficacy of therapeutic varnishes used with silver amalgam restorations. *Oper Dent* 15:122-28, 1990.
4. Arends J, Duschner H, Ruben JL, Penetration of varnishes into demineralized root dentine in vitro. *Caries Res* 31:201-05, 1997.
5. Tveit AB, Tötdal B, et al, Fluoride uptake by dentin surfaces following topical applications of TiF, NaF and fluoride varnishes in vivo. *Caries Res* 19:240-47, 1985.
6. Shen C, Autio-Gold J, Assessing fluoride concentration uniformity and fluoride release from three varnishes. *J Am Dent Assoc* 133:176-82, 2002.
7. Seppä L, Tuutti H, Luoma H, Post-treatment effect of fluoride varnishes in children with a high prevalence of dental caries in a community with fluoridated water. *J Dent Res* 63:1221-22, 1984.
8. Todd MA, Staley RN, et al, Effect of a fluoride varnish on demineralization adjacent to orthodontic brackets. *Am J Orthod Dentofacial Orthop* 116:159-67, 1999.
9. Seppä L, Tuutti H, Luoma H, Three-year report on caries prevention using fluoride varnishes for caries risk children in a community with fluoridated water. *Scand J Dent Res* 90:89-94, 1982.
10. Clark D, A review on fluoride varnishes: An alternative topical fluoride treatment. *Community Dent Oral Epidemiol* 10:117-23, 1982.
11. de Bruyn H, Arends J, Fluoride varnishes -- a review. *J Biol Buccale* 15:71-82, 1987.
12. Haugejorden O, Nord A, Caries incidence after topical application of varnishes containing different concentrations of sodium fluoride: 3-year results. *Scand J Dent Res* 99:295-300, 1991.
13. Helfenstein U, Steiner J, Fluoride varnishes (Duraphat): A meta-analysis. *Community Dent Oral Epidemiol* 22:1-5, 1994.
14. Kirkegaard E, Petersen G, et al, Caries-preventive effect of Duraphat varnish applications versus fluoride mouthrinses: 5-year data. *Caries Res* 1986:20:548-55, 1986.
15. Koch G, Petersson L, Caries preventive effect of a fluoride-containing varnish (Duraphat)

after 1 year's study. *Community Dent Oral Epidemiol* 3:262-66, 1975.

16. Koch G, Petersson L, Rydén H, Effect of fluoride varnish (Duraphat) treatment every six months compared with weekly mouthrinses with 0.2 percent NaF solution on dental caries. *Swed Dent J* 3:39-44, 1979.
17. Modéer T, Twetman S, Bergstrand F, Three-year study of the effect of fluoride varnish (Duraphat) on proximal caries progression in teenagers. *Scand J Dent Res* 92:400-07, 1984.
18. Petersson L, Arthursson L, et al, Caries-inhibiting effects of different modes of Duraphat varnish reapplication: A 3-year radiographic study. *Caries Res* 25:70-73, 1991.
19. Primosch R, A report on the efficacy of fluoridated varnishes in dental caries prevention. *Clin Prev Dent* 7:12-22, 1985.
20. Seppä L, Tuutti H, Luoma H, A 2-year report on caries prevention by fluoride varnishes in a community with fluoridated water. *Scand J Dent Res* 89:143-48, 1981.
21. Seppä L, Pöllänen L, Caries preventive effect of two fluoride varnishes and a fluoride mouthrinse. *Caries Res* 21:375-79, 1987.
22. Seppä L, Tolonen T, Caries preventive effect of fluoride varnish applications performed two or four times a year. *Scand J Dent Res* 98:102-05, 1990.
23. Seppä L, Pöllänen L, Hausen H, Caries-preventive effect of fluoride varnish with different fluoride concentrations. *Caries Res* 28:64-67, 1994.
24. Sköld L, Sundquist B, et al, Four-year study of caries inhibition of intensive Duraphat application in 11-15-year-old children. *Community Dent Oral Epidemiol* 22:8-12, 1994.
25. Wegner H, The clinical effect of application of fluoride varnish. *Caries Res* 10:318-20, 1976.
26. Petersson LG, Fluoride mouthrinses and fluoride varnishes. *Caries Res* 27(suppl 1):35-42, 1993.
27. Axelsson P, Paulander J, et al, Effect of fluoride containing dentifrice, mouthrinsing, and varnish on approximal dental caries in a 3-year clinical trial. *Community Dent Oral Epidemiol* 15:177-80, 1987.
28. Bruun C, Bille J, et al, Three-year caries increments after fluoride rinses or topical applications with a fluoride varnish. *Community Dent Oral Epidemiol* 13:299-303, 1985.
29. Petersson LG, Westerberg I, Intensive fluoride varnish program in Swedish adolescents: Economic assessment of a 7-year follow-up study on proximal caries incidence. *Caries Res* 28:59-63, 1994.
30. Seppä L, Luoma H, Hausen H, Fluoride content in enamel after repeated applications of fluoride varnishes in a community with fluoridated water. *Caries Res* 16:7-11, 1982.
31. Petersson LG, Magnusson K, et al, Effect of quarterly treatments with a chlorhexidine and a fluoride varnish on approximal caries in caries-susceptible teenagers: A 3-year clinical study.

Caries Res 34:140-143, 2000.

32. Seppä L, Leppänen T, Hausen H, Fluoride varnish versus acidulated phosphate fluoride gel: A 3-year clinical trial. *Caries Res* 29:327-30, 1995.
33. Shobha T, Nandlal B, et al, Fluoride varnish versus acidulated phosphate fluoride for school children in Manipal. *J Indian Dent Assoc* 59:157-60, 1987.
34. Tewari A, Chawla H, Utreja A, Comparative evaluation of the role of NaF, APF & Duraphat topical fluoride applications in the prevention of dental caries -- a 2 1/2 year study. *J Indian Soc Pedod Prev Dent* 8:28-35, 1990.
35. Frostell G, Birkhed D, et al, Effect of partial substitution of invert sugar for sucrose in combination with Duraphat treatment on caries development in preschool children: The Malmö study. *Caries Res* 25:304-10, 1991.
36. Grodzka K, Augustyniak L, et al, Caries increment in primary teeth after application of Duraphat fluoride varnish. *Community Dent Oral Epidemiol* 10:55-59, 1982.
37. Holm A-K, Effect of fluoride varnish (Duraphat) in preschool children. *Community Dent Oral Epidemiol* 7:241-45, 1979.
38. Kerebel L, LeCabellec M, et al., Report on caries reduction in French schoolchildren 3 years after the introduction of a preventive program. *Community Dent Oral Epidemiol* 13:201-04, 1985.
39. Murray J, Winter G, Hurst C, Duraphat fluoride varnish. A 2-year clinical trial in 5-year old children. *Br Dent J* 143:11-17, 1977.
40. Paunio P, Effect of a fluoride varnish on primary dentition. Dental research in Finland 1982. *Proc Finn Dent Soc* 78:114, 1982.
41. Twetman S, Petersson LG, Pakhomov GN, Caries incidence in relation to salivary mutans streptococci and fluoride varnish applications in preschool children from low- and optimal-fluoride areas. *Caries Res* 30:347-53, 1996.
42. Petersson LG, Twetman S, Pakhomov GN, The efficiency of semiannual silane varnish applications: A two-year clinical study in preschool children. *J Public Health Dent* 58:57-60, 1998.
43. Seppä L, Hausen H, et al, Effect of a sodium fluoride varnish on the progress of initial caries lesions. *Scand J Dent Res* 91:96-98, 1983.
44. Ögaard B, Rölla G, Helgeland K, Fluoride retention in sound and demineralized enamel in vivo after treatment with a fluoride varnish (Duraphat). *Scand J Dent Res* 92:190-97, 1984.
45. Seppä L, Effects of a sodium fluoride solution and a varnish with different fluoride concentrations on enamel remineralization in vitro. *Scand J Dent Res* 96:304-09, 1988.
46. Holmen L, Ögaard B, et al, A polarized light and scanning electron microscope study of the effect of Duraphat treatment on in vivo caries. *Scand J Dent Res* 94:521-29, 1986.

47. Ögaard B, Duschner H, et al, Microradiography and confocal laser scanning microscopy applied to enamel lesions formed in vivo with and without fluoride varnish treatment. *Eur J Oral Sci* 104:378-83, 1996.
48. Weinstein P, Domoto P, BB Tooth Decay. Results of a promising open trial to prevent baby bottle tooth decay: A fluoride varnish study. *J Dent Child* 61:338-41, 1994.
49. Attin T, Hartman O, et al, Fluoride retention of incipient enamel lesions after treatment with a calcium fluoride varnish in vivo. *Arch Oral Biol* 40:169-74, 1995.
50. Castellano JB, Donly KJ, In vitro remineralization using different fluoride varnish application techniques. *J Dent Res* 81:A352 (Abst #2816), 2002.
51. Holm G-B, Holst K, Mejåre I, The caries-preventive effect of a fluoride varnish in the fissures of the first permanent molar. *ACTA Odontol Scand* 42:193-97, 1984.
52. Bravo M, Llodra JC, et al, Effectiveness of visible light fissure sealant (Delton) versus fluoride varnish (Duraphat): 24-month clinical trial. *Community Dent Oral Epidemiol* 24:42-46, 1996.
53. Bravo M, Baca P, et al, A 24-month study comparing sealant and fluoride varnish in caries reduction on different permanent first molar surfaces. *J Public Health Dent* 57:184-86, 1997.
54. Bravo M, Garcia-Anllo I, et al, A 48-month survival analysis comparing sealant (Delton) with fluoride varnish (Duraphat) in 6- to 8-year-old children. *Community Dent Oral Epidemiol* 25:247-50, 1997.
55. Seppä L, Effect of dental plaque on fluoride uptake by enamel from a sodium fluoride varnish in vivo. *Caries Res* 17:71-75, 1983.
56. Vaikuntam J, Fluoride varnishes: Should we be using them? *Pediatr Dent* 22:513-16, 2000.
57. Roberts JF, Longhurst P, A clinical estimation of the fluoride used during application of a fluoride varnish. *Br Dent J* 162:463-66, 1987.
58. Ekstrand J, Koch G, Petersson LG. Plasma fluoride concentration and urinary fluoride excretion in children following application of the fluoride-containing varnish Duraphat. *Caries Res* 14:185-89, 1980.
59. Ekstrand J, Koch G, Petersson LG. Plasma fluoride concentration in pre-school children after ingestion of fluoride tablets and toothpaste. *Caries Res* 17:379-84, 1983.

To request a printed copy of this article, please contact: Kevin J Donly, DDS, MS, Department of Pediatric Dentistry, Dental School, University of Texas Health Science Center at San Antonio, 7703 Floyd Curl Drive, San Antonio, TX 78229-3900, or at donly@uthscsa.edu.



