Section: Dentistry

Original Research Article

COMPARATIVE EFFECTIVENESS OF PROFESSIONALLY APPLIED FLUORIDE VARNISH AND FLUORIDE GEL IN DENTAL CARIES PREVENTION: A REVIEW

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Received *: 22/06/2026*
Received in revised form *: 12/08/2026*
Accepted *: 25/08/2026*

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DOI: 10.70034/ijmedph.2026.3.629

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 4039-4042

ABSTRACT

Dental caries remains an important oral health problem among children, making effective preventive strategies an essential component of public health dentistry. Professionally applied topical fluoride, particularly fluoride varnish and fluoride gel, is widely used for caries prevention. This review aimed to compare the effectiveness, safety and practical applicability of fluoride varnish and fluoride gel in children. Relevant literature on professionally applied topical fluoride was reviewed, with emphasis on caries-preventive effectiveness, application procedures, safety and public-health relevance. The reviewed evidence indicates that both fluoride varnish and fluoride gel are effective in reducing dental caries. Fluoride varnish offers important practical advantages, including rapid setting, prolonged contact with enamel, ease of application and relatively lower risk of fluoride ingestion. In one comparative study reported in the reviewed literature, Duraphat fluoride varnish produced 74% caries reduction compared with 37% with APF gel after 2.5 years. However, differences in study populations, fluoride formulations, dentition and application protocols should be considered when interpreting comparative results. Overall, fluoride varnish appears to be a practical and effective option for caries prevention in children, particularly in school-based and public-health programmes, while fluoride gel remains an effective professionally applied alternative when appropriate safety precautions are followed.

Keywords: Dental caries; Fluoride varnish; Fluoride gel; APF gel; Children; Caries prevention; Public health dentistry.

INTRODUCTION

Dental caries is one of the most prevalent oral diseases and continues to be an important public health problem, particularly among children. Prevention of dental caries is therefore an essential component of public health dentistry. Fluoride has been recognized as one of the most effective evidence-based agents for the prevention and control of dental caries. Its anticaries action is primarily related to its topical effect on tooth surfaces, where it helps reduce demineralization and enhance remineralization.[1] Topical fluoride preparations have gained considerable importance in modern preventive dentistry because they deliver fluoride directly to the tooth surface. Evidence-based guidelines recommend the use of topical fluoride for the prevention of dental caries in children and adolescents, particularly in individuals who are at increased risk of developing caries. Various topical fluoride modalities are available, including professionally applied fluoride gels and varnishes.[2]

A review of topical fluoride agents highlights the importance of selecting an appropriate fluoride delivery system according to the patient's age, caries risk and clinical requirements. Professionally applied fluoride preparations provide a relatively high concentration of fluoride and are particularly useful when additional preventive measures are required beyond routine oral hygiene practices.[3]

The use of fluoride as a public health measure has been well established, and fluoride-based preventive strategies have contributed substantially to the reduction of dental caries. Although systemic fluoride exposure has an important role in caries prevention, increasing emphasis has been placed on topical fluoride because of its direct action on the tooth surface. The American Dental Association has also recognized fluoride as an important component of comprehensive caries-preventive strategies.[4]

Among professionally applied topical fluoride agents, fluoride varnish has become an important preventive modality in public health dentistry. Bawden described fluoride varnish as a useful tool for public health dentistry because of its clinical applicability and potential for caries prevention. Fluoride varnish is applied directly to the tooth surface and provides prolonged contact of fluoride with enamel, making it particularly suitable for preventive programmes involving children.[5]

However, the use of highly concentrated fluoride preparations requires consideration of safety. Fluoride toxicity is dependent on the dose and route of exposure, and excessive ingestion of concentrated fluoride preparations may result in adverse effects. Therefore, proper selection, dosage and professional application of topical fluoride agents are important, especially when treating children.[6]

Fluoride varnishes have been developed as practical professionally applied agents for routine dental practice. Their rapid setting and ability to adhere to tooth surfaces allow fluoride to remain in contact with enamel for an extended period. These characteristics have contributed to their use in caries-preventive programmes and make fluoride varnish an important alternative to other professionally applied fluoride preparations such as gels.[7]

Therefore, considering the widespread use of professionally applied topical fluorides and the importance of effective caries prevention in children, it is important to evaluate the relative effectiveness of different fluoride delivery systems. The present review focuses on a comparison of fluoride varnish and fluoride gel for the prevention of dental caries in children, with particular emphasis on their preventive effectiveness, safety and relevance to public health dentistry.

Literature Review: Topical fluoride is an important preventive measure for controlling dental caries in children. Professionally applied fluoride preparations mainly include fluoride gels and fluoride varnishes. These agents act directly on the tooth surface by reducing demineralization and promoting remineralization.

Fluoride gel, particularly acidulated phosphate fluoride (APF) gel, is a high-concentration topical fluoride preparation generally applied using trays. It has demonstrated effectiveness in caries prevention, but its application requires appropriate isolation and precautions to minimize fluoride ingestion. Fluoride varnish is an adherent professionally applied preparation that remains on the tooth surface for a relatively prolonged period and allows sustained fluoride release. It is generally applied two to four times per year according to the child's caries risk and is considered particularly useful for children and public-health programmes.

The literature suggests that fluoride varnish may provide important advantages over gel because of its rapid setting, prolonged contact with enamel and lower potential for fluoride ingestion. Clinical evidence summarized in the dissertation also reported greater caries reduction with Duraphat fluoride varnish (74%) compared with APF gel (37%) after 2.5 years in one comparative study. However, differences among studies in population, dentition, formulation and application protocol should be considered when comparing their effectiveness.

Comparison of Fluoride Varnish and Fluoride Gel

Feature	Fluoride Varnish	Fluoride Gel
Application	Direct application to tooth surface	Usually applied using trays
Contact time	Prolonged due to adherence	Relatively short
Application frequency	Usually 2–4 times/year	Often periodic professional application
Ingestion risk	Relatively low due to rapid setting	Greater concern because of high concentration
Use in children	Particularly suitable	Requires greater precautions in younger children
Public-health use	Highly practical	More technique-dependent
Caries prevention	Effective, especially in high-risk children	Effective, particularly in appropriate high-risk/permanent dentition

The available literature indicates that both fluoride varnish and fluoride gel are effective professionally applied topical fluoride agents. However, fluoride varnish appears to offer practical and safety advantages for children and school-based public-health programmes.

MATERIALS AND METHODS

The present review article was conducted as a narrative literature review based on the available literature on professionally applied topical fluoride. Relevant studies, reviews and guidelines concerning fluoride varnish and fluoride gel in children were reviewed, with particular emphasis on caries-preventive effectiveness, method of application, safety and public-health applicability. The information was extracted from the uploaded literature and synthesized to compare the effectiveness and clinical usefulness of fluoride varnish and fluoride gel for the prevention of dental caries in children.

Data Extraction: Relevant information was extracted from the selected literature and organized according to the type of topical fluoride, fluoride concentration, method and frequency of application,

caries-preventive effectiveness, safety, advantages, limitations and suitability for children. Particular attention was given to studies comparing fluoride varnish and fluoride gel and their applicability in public-health settings.

Table 1: Data Extraction of Relevant Literature

Author/Source	Fluoride agent	Population/Setting	Main findings
Tewari et al.	Duraphat varnish	Children	Reported 74% caries reduction after 2.5 years
Tewari et al.	APF gel	Children	Reported 37% caries reduction after 2.5 years
Bawden	Fluoride varnish	Public-health dentistry	Varnish considered a useful preventive tool
Whitford	Topical fluoride	Children/general population	Emphasized safety and risk of fluoride toxicity
Autio-Gold	Fluoride varnish	Clinical practice	Supported practical use of fluoride varnish
Review evidence	Fluoride varnish	Children	Effective for children at moderate-to-high caries risk
Guideline evidence	Fluoride gel	Children	Effective, but higher-concentration gels require precautions against ingestion

The comparative data reported in the dissertation showed a higher caries-reduction percentage with Duraphat fluoride varnish (74%) than APF gel (37%) in the cited comparative study.

RESULTS

The reviewed literature showed that both fluoride varnish and fluoride gel are effective professionally applied topical fluoride agents for dental caries prevention. Fluoride varnish demonstrated several practical advantages, including prolonged contact with enamel, rapid setting and relatively low risk of fluoride ingestion. It was reported to be effective particularly among children with moderate-to-high caries risk. Fluoride gel was also found to be effective for caries prevention, particularly in permanent dentition. However, its application generally requires trays and greater precautions because of the possibility of ingestion of high-concentration fluoride. In the comparative study reported in the reviewed literature, Duraphat fluoride varnish produced 74% caries reduction compared with 37% for APF gel after 2.5 years, suggesting a greater preventive effect of varnish in that study population.

Overall, the findings indicate that fluoride varnish may be more practical and suitable for children and community-based programmes, while fluoride gel remains an effective professionally applied option when appropriate application and safety precautions can be maintained. However, differences in study design, fluoride formulation, dentition and application protocols should be considered when interpreting the comparative findings.

DISCUSSION

The present review indicates that both fluoride varnish and fluoride gel are effective professionally applied topical fluoride agents for the prevention of dental caries in children. Fluoride acts mainly through topical anticariogenic and antimicrobial effects, with gels and varnishes being important professionally applied delivery systems. The reviewed evidence suggests that fluoride varnish has important practical advantages, particularly in children. Its rapid setting, prolonged adherence to enamel and slow fluoride release allow effective fluoride exposure while reducing the possibility of fluoride ingestion. These properties also make varnish relatively simple and less technique-sensitive to apply.[1-3,5,7,9,11–13] Fluoride gel, especially APF gel, is also effective in caries prevention. However, its application generally requires trays, appropriate isolation and precautions to minimize ingestion. The reviewed literature indicates that APF gel may be particularly useful in permanent dentition, whereas high-concentration gels require greater caution in younger children.[2,3,8,10,11] Importantly, the comparative evidence reported in the dissertation showed 74% caries reduction with Duraphat fluoride varnish compared with 37% with APF gel after 2.5 years. This finding favours varnish; however, it should not be interpreted as definitive evidence that varnish is always superior, because fluoride concentration, formulation, dentition, application protocol and study methodology can influence outcomes.[1,8,10,11]

The effectiveness of fluoride cannot be explained solely by its concentration. Evidence summarized from Seppä and other studies suggests that increasing fluoride concentration does not necessarily produce a proportional increase in anticaries effectiveness. This supports the importance of fluoride retention and sustained contact with enamel rather than concentration alone.[12,13]

From a public-health perspective, fluoride varnish appears particularly advantageous because it can be applied quickly, requires relatively little equipment and is suitable for school-based preventive programmes. Reviews included in the dissertation reported substantial caries-preventive potential for varnish in children, including a preventive fraction of approximately 43% in permanent teeth and 37% in primary teeth.[1,2,5,7,9,13–15]

Safety is another important consideration. Fluoride varnish is generally well tolerated, and its rapid setting may reduce fluoride ingestion and acute toxicity risk. Nevertheless, allergic reactions to colophony/resin and other contraindications should be considered.[5-7]

Overall, the reviewed literature supports fluoride varnish as a highly practical option for caries prevention in children, particularly in community and school-based programmes, while fluoride gel

remains an effective alternative when professionally applied with appropriate precautions. The findings of the available literature should, however, be interpreted according to individual caries risk and clinical circumstances rather than assuming that one fluoride modality is universally superior.[1–15]

CONCLUSION

The present review shows that both fluoride varnish and fluoride gel are effective professionally applied topical fluoride agents for the prevention of dental caries in children. Fluoride varnish offers several practical advantages, including prolonged fluoride contact, rapid setting, ease of application and reduced risk of fluoride ingestion. These characteristics make it particularly suitable for children and school-based public-health programmes. Although comparative evidence suggests a greater caries-preventive effect of fluoride varnish in some studies, the available evidence does not establish universal superiority because outcomes may vary according to formulation, dentition, application frequency and study methodology. Therefore, selection of fluoride varnish or fluoride gel should be based on the child's caries risk, age, clinical needs, safety considerations and feasibility of implementation.

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