

# Efficacy of Varnishes in Preventing Dental Caries – A Systematic Review

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## ABSTRACT

**Background:** There exist a significant divergence and heterogeneity in the reported results regarding efficacy of dental varnishes. Hence it is essential to assess the reports evidence with standardized tool.

**Aim:** To critically examine the effectiveness of dental varnishes in preventing dental caries using the ICDAS scale.

**Methodology:** Searches were done in PubMed, Cochrane and Proquest for articles in the past five years who reported efficacy of dental varnishes in ICDAS scale. Only RCTs were included.

**Results:** At current level of evidence, one method cannot be held superior to other and fluoride varnishes are still efficacious and can be used at required places.

**Conclusion:** Overall, the findings from these studies suggest a trend toward the efficacy of fluoride-based interventions, either alone or in combination with other agents like self-assembling peptides, GIC, and CO2 laser treatments. In future more rigorous study designs and longer follow-up periods would be beneficial to establish clearer guidelines for the use of these interventions in pediatric dental care.

**Keywords:** Dental Caries, ICDAS, Fluoride Varnish, Prevention.

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## INTRODUCTION

Dental caries is a highly prevalent and a very significant public health issue. It also remains one of the most common chronic diseases worldwide, affecting individuals without age predilection. The World Health Organization (WHO) had identified dental caries as a major contributor to the global burden of oral diseases, with untreated caries in permanent teeth being the most prevalent condition across the globe. The WHO Global Oral Health Status Report (2022) has estimated that oral diseases affect close to 3.5 billion people across the globe, with 3 out of 4 people affected living in middle-income countries. Further, globally, an estimated 2 billion people suffer from caries

of permanent teeth and 514 million children suffer from the caries of primary teeth.[1]

The play amongst dietary sugars, oral microbiota, and host factors has a crucial role in the initiation and progression of dental carie, thus making it a multifactorial microbial disease. This also highlights the complexity of its prevention and management. [2-4]

In the search towards clinically effective caries prevention strategies, dental varnishes have always received considerable attention because of their ability to deliver fluoride and other anticariogenic agents, directly to the site of action, the tooth surface.[5] Technically, these varnishes

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form a protective coating on the surface of enamel, enhancing the fluoride uptake and providing long lasting protection against the acid attacks from the oral flora, which is critical for the demineralization-remineralization cycle associated with caries development to occur.[6] Over the years, numerous formulations of dental varnishes, have been developed and clinically tested for their efficacy in caries prevention.

The past decade has witnessed an evergrowing body of research analysing the efficacy of dental varnishes in caries prevention dental caries.[7] Nevertheless, the outcomes of these reported studies have been divergent, with heterogeneity in study design, population characteristics, and assessment criteria contributing to the corresponding heterogeneity in the reported results.[8-11] In order to address these variability issues and also to enhance the standardization of caries assessment, the International Caries Detection and Assessment System (ICDAS) was developed. This ICDAS system provides a not only a comprehensive but also a standardized method for assessing caries, ranging from early enamel lesions to cavitated lesions.[12]

Having eyed on the divergence and heterogeneity in the reported results, it is essential to assess the reported evidence with standardized tool. This systematic review aims to critically examine the effectiveness of dental varnishes in preventing dental caries, specifically focusing on studies published in the past five years that utilize the ICDAS scale to report their outcomes. By restricting the review to recent studies and those employing the ICDAS system, this review aims to provide a contemporary and methodologically rigorous synthesis of the evidence.

## METHODS

**Registration and Research Protocol:** PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 guidelines was adopted and the systematic review was registered in the International Prospective Register of Systematic Reviews (PROSPERO ID: CRD)

### Eligibility Criteria

To conduct this review, we identified and included studies about randomized controlled trials which compared Anticariogenic varnishes of any composition to Fluoride varnish. Studies which were on Children below 10 years and ICDAS below 4 were assessed as relevant to this review. The primary outcome of interest was ICDAS Value.

### Participants

Studies of Children below 10 years or ICDAS below 4 were eligible for this review.

### Interventions

Eligible interventions were: Anticariogenic varnishes of any composition.

### Comparators

We included: Fluoride varnish.

## Outcomes

We included the following primary outcome: ICDAS Value.

### Study design

We included only randomized controlled trials.

### Search strategy

The following components were included in the search string mesh or other subject terms: ("dental varnish" OR "fluoride varnish" OR "varnishes") AND ("dental caries" OR "tooth decay" OR "caries prevention" OR "caries control" OR "cavity prevention") AND ("efficacy" OR "effectiveness" OR "preventive effect" OR "prevention") AND ("ICDAS") NOT ("Adult" OR "Orthodontic")(Figure 1).

The following trial registries were searched Cochrane CENTRAL, PubMed and Proquest . Searches were run for the past five years until 30th August 2024. We restricted our search to only include the following languages: English. To maximise our chances of identifying all relevant studies, as well as searching databases we also manually checked the reference lists of the included studies and used the similar articles feature of a database.

## Study Selection and Screening

### Screening

Articles were screened by title and abstract, by 3 authors independently. Three review authors retrieved the full-text for inclusion. Discrepancies were resolved by consensus. The selection process was recorded in sufficient detail to complete a PRISMA flow diagram (Figure 2).

### Data extraction and assessment of Risk of Bias

A standardised form was used for data extraction of characteristics of studies, outcomes and risk of bias. 3 review authors independently assessed the risk of bias for each study using the Cochrane Risk of Bias 2 tool (Figure 3). Their mean value was used as bias for every study.

## RESULTS:

A total of 233 records were identified from databases (n = 2) and registers (n=1). Of which, 85 duplicate records were removed and hence only 220 records screened. Of the 220 records, only 13 reports were sought for retrieval, 207 were records excluded by reading title. Only 11 reports were finally reviewed as 2 records were excluded due to non-eligibility (Reason 1: Did not use varnish throughout (n = 1), Reason 2 Non reporting of final ICDAS (n = 1)). The risk of bias is depicted in figure 2. PICO Table depicts the data about the Population, Intervention, Control, and Outcome (Table 1).

## DISCUSSION

Based on the results from the systematic review, it is evident that various interventions for the prevention and treatment of caries in children demonstrate varying degrees of effectiveness and bias concerns. Comparison of SAP P11-4 with Fluoride Varnish, Doberdoli et al. (2020)[13] found no significant difference between using

SAP P11-4 alone and SAP P11-4 combined with fluoride varnish in children aged 6-15 years, with an ICDAS score of 2-3. Both these interventions had similar effectiveness against caries. This suggested that adding fluoride varnish to SAP P11-4 might not provide additional benefits in this context. This study had a bias level categorized as "Some Concerns,"

Brandão et al. (2020)[14] have compared CO2 laser application alone to the use of APF combined with CO2 laser and fluoride varnish in children aged 6-8 years. The results suggested no significant difference in the short term; however, the combined intervention proved more effective over the long term. This study also had a bias level marked as "Some Concerns," highlighting possible methodological issues or biases that could affect the reliability of the results. In case of comparing GIC with Fluoride Varnish, Ying Lam et al. (2021)[15] studied in 4-year-old children with an ICDAS score of less than 4. Their findings showed that quarterly applications of sodium fluoride varnish and a single placement of GIC were equal in effectiveness in preventing caries. This study had a "Low" bias level, suggesting that the findings are relatively robust and reliable. While comparing RMGIC Sealant and Fluoride Varnish, Rodrigues et al. (2021)[16] assessed the effectiveness of resin-modified glass ionomer cement (RMGIC) sealant versus fluoride varnish in children aged 5-11 years with an ICDAS score of less than 4. They concluded that sealing is more effective than fluoride varnish for arresting occlusal enamel carious lesions in erupting permanent molars. The study was marked with "Some Concerns" regarding bias, which may influence the interpretation of the results. On looking at Other Protocols Combined with Fluoride Varnish, Anderson et al. (2021)[17] compared the use of other caries management protocols with and without fluoride varnish in children aged 1-7 years and have shown that addition of fluoride varnish failed to improve caries prevention in this age group. This study's bias level was categorized as "Some Concerns," potentially affecting the reliability of these findings.

Olgen et al. (2022)[18] compared fluoride varnish with casein phosphopeptide-amorphous calcium phosphate, along with motivational strategies in children aged 6-9 years. This study showed that fluoride varnish was less effective than casein phosphopeptide-amorphous calcium phosphate in the short term, with a "Low" bias level, suggesting reliable results.

Agarwal et al. (2022)[19] and Uchil et al. (2022)[20] showed the effectiveness of fluoride varnish alone and compared with resin-modified glass ionomer (RMGI) varnish and GIC sealant, respectively. In both these studies, it was found that fluoride varnish was effective with a "Low" bias level.

Recent studies by Natchiyar et al. (2023)[21] and Yassin et al. (2023)[22] explored novel interventions such as P11-4 self-assembling peptide with fluoride varnish and SDF with NaF varnish, respectively, reporting no significant

difference among control and test groups. The levels of bias ranged from low to some concerns. Finally, Abdellatif et al. (2023)[23] reported that the combination of 8% silver diamine fluoride with 5% NaF varnish showed a higher caries arrest rate than 38% SDF alone. This study had a "Low" bias level, indicating robust and reliable results.

In this systematic review few significant points were observed. All studies failed to report mean ICDAS scores pre and post treatment groups, instead they reported only a frequency table of number of cases in every interval of time. This basically compromises the critical assessment of every technique and authors have to rely upon their conclusion and make additional mathematical calculations for assessment. Secondly, bias level was concerning in some studies, reducing the overall effectiveness of conclusion of this review.

On comparing previous systematic reviews, Li et al., (2020)[24] have reported that there was no significant difference between sealant and varnish. Kashbour et al., (2020)[25] have also been unable to prove the superiority of sealants vs varnishes due to inadequate quality of the included studies. Therefore, it should be inferred that at current level of evidence, one method cannot be held superior to other and fluoride varnishes are still efficacious and can be used at required places.

## CONCLUSION

Overall, the findings from these studies suggest a trend toward the efficacy of fluoride-based interventions, either alone or in combination with other agents like self-assembling peptides, GIC, and CO2 laser treatments. However, the presence of some concerns regarding bias in several studies calls for careful interpretation of the results. Future research with more rigorous study designs and longer follow-up periods would be beneficial to establish clearer guidelines for the use of these interventions in pediatric dental care.

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**Table 1: PICO**

| Author                                | Population          | Intervention                               | Control                                                | Outcome                                                                                                                                |
|---------------------------------------|---------------------|--------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Doberdoli et al., (2020)(13)</b>   | 6-15 yrs, ICDAS 2-3 | SAP P11-4 & Fluoride Varnish and SAP P11-4 | Fluoride Varnish                                       | SAP P11-4 is similar to SAPp11-4 with fluoride varnish                                                                                 |
| <b>Brandão et al., (2020)(14)</b>     | 6-8 yrs             | CO2 Laser; APF with CO2 Laser              | Fluoride Varnish                                       | No difference; Intervention was better in long term                                                                                    |
| <b>Ying Lam et al., (2021)(15)</b>    | 4, ICDAS< 4         | GIC                                        | Fluoride Varnish                                       | Quarterly NaFV application and single GIS placement showed similar effectiveness                                                       |
| <b>Rodrigues et al., (2021)(16)</b>   | 5-11 ICDAS<4        | RMGIC Sealent                              | Fluoride Varnish                                       | Sealing is a more effective approach than fluoride varnish for arresting occlusal enamel carious lesions in erupting permanent molars. |
| <b>Anderson et al., (2021)(17)</b>    | 1-7 years           | Other Protocols + Fluoride varnish         | Other protocols                                        | No effect by fluoride varnish in the selected age group                                                                                |
| <b>Olgenet et al., (2022)(18)</b>     | 6-9 yrs             | Fluoride Varnish and CPP-ACP; CPP-ACPF     | Motivation                                             | Fluoride varnish less effective than APF in short term                                                                                 |
| <b>Agarwal et al., (2022)(19)</b>     | 3-4 yrs             | Fluoride Varnish                           | Nil                                                    | Fluoride varnish is effective                                                                                                          |
| <b>Uchilet al., (2022)(20)</b>        | 6-8 yrs             | RMGI-F varnish                             | GIC Sealent                                            | No difference                                                                                                                          |
| <b>Natchiyaret et al., (2023)(21)</b> | 3-5                 | P11-4 self-assembling peptide              | fluoride varnish with xylitol-coated calcium phosphate | No difference                                                                                                                          |
| <b>Yassin et al., (2023)(22)</b>      | < 4 yrs; ICDAS>3    | SDF                                        | NaF varnish                                            | No difference                                                                                                                          |
| <b>Abdellatif et al., (2023)(23)</b>  | < 4 years           | 8% SDF with 5% NaF varnish                 | 38% SDF                                                | SDF + NaF had a higher arrest rate than SDF alone                                                                                      |