SILVER DIAMINE FLUORIDE APPLICATION WITH AND WITHOUT PREOPERATIVE RADIOGRAPHIC EXAMINATION IN 7–8-YEAR-OLD CHILDREN WITH EXTENSIVE CARIES: A PILOT RANDOMIZED CLINICAL STUDY

Bakhtinur Khudanov
Bekhruz Odilov
Faculty of Dentistry, Tashkent State Medical University, Tashkent, Uzbekistan
https://doi.org/10.5281/zenodo.23204232

Abstract

Background

Silver diamine fluoride (SDF) is a minimally invasive approach for arresting dental caries in children. Although radiographic examination may provide additional information about the depth of a carious lesion and its proximity to the pulp, it is unclear whether preoperative radiography provides a clinically relevant advantage before SDF application in children without clinical signs of pulpitis.

Aim

To evaluate whether preoperative radiographic examination influences the short-term clinical and radiographic outcomes of 38% silver diamine fluoride application in 7–8-year-old children with extensive caries in permanent posterior teeth and no clinical signs of pulpitis.

Materials and Methods

Thirty-two children aged 7–8 years, each with one extensive carious lesion in a permanent posterior tooth, were included in the study. Children presenting with clinical signs suggestive of pulpitis, including severe or spontaneous pain and an abnormal response to cold testing, were excluded. Participants were randomly allocated to two groups of 16 children each. In the radiographic examination group, a preoperative radiograph was obtained before SDF application. In the non-radiographic group, SDF was applied without preoperative radiographic examination. All teeth received 38% SDF according to the standard clinical protocol. At the 3-month follow-up, all participants underwent clinical examination and radiographic assessment. Radiographic proximity to the pulp was defined as less than 1 mm of radiographically visible sound dentin, or absence of clearly visible sound dentin, between the carious lesion and the pulp. This finding was interpreted as close radiographic proximity to the pulp and not as evidence of direct pulp involvement.

Results

At baseline, none of the included children presented with clinical signs of pulpitis. Among the 16 children who underwent preoperative radiographic examination, 3 (18.8%) demonstrated close radiographic proximity of the carious lesion to the pulp, defined as less than 1 mm of radiographically visible sound dentin. At the 3-month follow-up, radiographic proximity to the pulp was observed in 1 child (6.3%) in each group. Clinical signs of pulp involvement were also observed in 1 child (6.3%) in each group. Thus, the observed

frequency of clinical and radiographic findings at 3 months was identical between the two groups.

Conclusion

In this small pilot study of clinically selected 7–8-year-old children without signs of pulpitis, no apparent difference in short-term clinical or radiographic outcomes was observed between SDF treatment performed with and without preoperative radiographic examination. These preliminary findings suggest that clinical assessment may be an important component of patient selection for SDF treatment; however, larger studies with longer follow-up are required before conclusions can be drawn regarding the necessity of routine preoperative radiographic examination.

Keywords: silver diamine fluoride; SDF; dental caries; children; permanent teeth; radiographic examination; pulp; minimally invasive dentistry.

1. Introduction

Dental caries is one of the most common oral diseases in children and can result in extensive destruction of tooth structure when untreated. Management of extensive carious lesions in young permanent teeth can be challenging because lesions may extend deeply into dentin and approach the dental pulp. In these situations, treatment should aim to control caries progression while preserving tooth structure and minimizing the risk of pulpal complications.

Silver diamine fluoride (SDF) has become an important minimally invasive approach for the management of dental caries. A 38% SDF formulation is commonly used for caries arrest, and clinical studies and systematic reviews have demonstrated its ability to arrest dentinal caries in children. SDF is particularly attractive because its application is non-invasive and can be performed relatively quickly, making it useful when conventional restorative treatment is difficult or when a conservative approach is preferred.

However, the management of deep carious lesions requires careful assessment of pulpal status. Clinical examination may identify signs suggestive of irreversible pulpal inflammation, including a history of spontaneous or severe pain and abnormal responses to pulp sensibility testing. Radiographic examination can provide additional information regarding lesion depth and the amount of dentin remaining between the carious lesion and the pulp. This information may be particularly relevant when the lesion appears clinically extensive or when the treatment decision depends on the proximity of the lesion to the pulp.

Nevertheless, radiographic proximity to the pulp should not be equated with actual pulpal involvement. A carious lesion with less than 1 mm of radiographically visible sound dentin, or with no clearly visible sound dentin, may be considered to be in close radiographic proximity to the pulp, but this finding alone does not establish direct pulp exposure or pulpal disease. The remaining dentin may include affected or infected dentin, and the absence of clinical signs of pulpitis may indicate that the pulp remains clinically asymptomatic.

This raises an important clinical question regarding the role of routine preoperative radiographic examination before SDF application. If children with clinical signs of pulpitis are excluded on the basis of clinical examination and pulp sensibility testing, it remains uncertain whether additional preoperative radiographic information changes the short-term outcome of SDF treatment. Existing literature supports the effectiveness of SDF for caries arrest, but evidence specifically addressing whether preoperative radiographic examination

influences the outcome of SDF treatment in clinically asymptomatic children with extensive caries is limited.

Therefore, the aim of this pilot randomized clinical study was to evaluate whether preoperative radiographic examination influences the short-term clinical and radiographic outcomes of 38% SDF application in 7–8-year-old children with extensive caries in permanent posterior teeth and no clinical signs of pulpitis.

We hypothesized that the absence of preoperative radiographic examination would not result in worse short-term clinical or radiographic outcomes in carefully selected children without clinical signs of pulpitis.

2. Materials and Methods

2.1 Study design and participants

This pilot randomized clinical study included 32 children aged 7–8 years. Each participant had one permanent posterior tooth with an extensive carious lesion.

Children were eligible for inclusion when an extensive carious lesion was present in a permanent posterior tooth and there were no clinical signs suggestive of pulpitis.

Children presenting with signs suggestive of pulpitis were excluded. These included a history of severe or spontaneous dental pain and an abnormal response during cold testing.

2.2 Randomization and study groups

The 32 participants were randomly allocated to two groups of 16 children each.

The **preoperative radiographic examination group** underwent radiographic examination before SDF application.

The **non-radiographic group** received SDF application without a preoperative radiographic examination.

The purpose of this allocation was to determine whether information obtained from a preoperative radiograph influenced the subsequent short-term clinical and radiographic outcomes of SDF treatment.

2.3 Clinical examination

Before treatment, all children underwent clinical examination and assessment of symptoms relevant to pulpal status. Children with severe or spontaneous pain or an abnormal response to cold testing were excluded from the study.

Thus, the study population consisted of children without clinical signs suggestive of pulpitis at baseline.

2.4 Radiographic assessment

In the radiographic examination group, a preoperative radiograph was obtained before SDF treatment. The radiograph was evaluated for the depth of the carious lesion and its proximity to the pulp.

Close radiographic proximity to the pulp was defined as **less than 1 mm of radiographically visible sound dentin between the carious lesion and the pulp, or the absence of clearly visible sound dentin**.

Importantly, this radiographic criterion was not interpreted as direct pulp involvement or pulp exposure. Rather, it represented the radiographic proximity of the carious lesion to the pulp.

At the 3-month follow-up, all participants underwent radiographic examination using the same assessment criterion.

2.5 SDF treatment

All participants received **38% silver diamine fluoride** according to the standard clinical application protocol.

2.6 Follow-up assessment

Three months after SDF application, all children were reassessed clinically and radiographically.

Clinical assessment focused on the development of signs suggestive of pulpal involvement.

Radiographic assessment focused on the relationship between the carious lesion and the pulp, using the predefined criterion of less than 1 mm of radiographically visible sound dentin or absence of clearly visible sound dentin.

2.7 Statistical analysis

Descriptive statistics were used to summarize the clinical and radiographic findings. Categorical variables were expressed as frequencies and percentages.

Because of the small sample size, the results were interpreted primarily as preliminary descriptive findings.

3. Results

3.1 Study population

Thirty-two children aged 7–8 years were included in the study. Each child contributed one permanent posterior tooth with an extensive carious lesion. The participants were randomly allocated to the preoperative radiographic examination group (n = 16) or the non-radiographic group (n = 16).

No participant included in the study presented with clinical signs suggestive of pulpitis at baseline.

3.2 Baseline radiographic findings

Among the 16 children who underwent preoperative radiographic examination, 3 children (18.8%) demonstrated close radiographic proximity of the carious lesion to the pulp, defined as less than 1 mm of radiographically visible sound dentin or absence of clearly visible sound dentin.

The remaining 13 children (81.3%) had more than 1 mm of radiographically visible sound dentin between the carious lesion and the pulp.

These radiographic findings indicated the depth and proximity of the carious lesions but were not interpreted as evidence of direct pulpal involvement.

3.3 Three-month clinical and radiographic outcomes

At the 3-month follow-up, all 32 children underwent both clinical and radiographic examination.

In the preoperative radiographic examination group, 1 of 16 children (6.3%) demonstrated a radiographic finding indicating close proximity of the carious lesion to the pulp. The same finding was observed in 1 of 16 children (6.3%) in the non-radiographic group.

Clinical signs suggestive of pulp involvement were observed in 1 child (6.3%) in the preoperative radiographic group and in 1 child (6.3%) in the non-radiographic group.

Thus, the observed frequency of both clinical and radiographic findings at the 3-month follow-up was identical in the two study groups.

Because of the small sample size, these findings should be considered preliminary and should not be interpreted as evidence of equivalence between the two approaches.

4. Discussion

The present pilot study investigated whether obtaining a preoperative radiograph influenced the short-term clinical and radiographic outcomes of 38% SDF treatment in 7–8-year-old children with extensive caries in permanent posterior teeth who had no clinical signs of pulpitis.

The principal finding was that the observed 3-month clinical and radiographic outcomes were similar in the two groups. One child (6.3%) in each group demonstrated clinical signs suggestive of pulp involvement, and one child (6.3%) in each group demonstrated close radiographic proximity to the pulp at follow-up.

An important finding at baseline was that 3 of 16 children (18.8%) in the preoperative radiographic group had lesions with less than 1 mm of radiographically visible sound dentin or no clearly visible sound dentin between the carious lesion and the pulp. Importantly, none of these children had clinical signs suggestive of pulpitis. This finding illustrates the difference between radiographic lesion depth and actual pulpal disease. A lesion may be radiographically very close to the pulp without necessarily indicating direct pulp involvement.

The use of SDF in this context is clinically relevant because SDF provides a non-invasive approach to caries management. Previous clinical studies and systematic reviews have demonstrated the effectiveness of 38% SDF in arresting caries in children, although much of the evidence has historically focused on primary teeth. Evidence concerning permanent teeth is comparatively more limited.

More recent evidence continues to support SDF as an effective minimally invasive approach to caries management in children and adolescents, while emphasizing the need for monitoring and further well-designed clinical studies.

The present findings may have practical implications for the selection of children for SDF treatment. If a child has no history of severe or spontaneous pain and demonstrates no clinical signs suggestive of pulpitis, the additional information obtained from a preoperative radiograph may not necessarily translate into a different short-term clinical outcome. However, this interpretation must remain cautious. Radiographs provide information that cannot be obtained through clinical examination alone, and the present study was not

sufficiently large to establish that preoperative radiographic examination can safely be omitted in all children with extensive caries.

Another important consideration is the distinction between **radiographic proximity to the pulp** and **pulpal involvement**. In this study, a lesion was considered radiographically close to the pulp when less than 1 mm of radiographically visible sound dentin remained, or when sound dentin could not be clearly identified. This criterion should not be interpreted as a diagnosis of pulpitis, pulp necrosis, or direct pulp exposure. The clinical status of the pulp must be assessed independently.

The study has several limitations. First, the sample size was small, with only 16 children in each group. Therefore, the study had limited statistical power to detect potentially meaningful differences between groups. Second, the follow-up period was only 3 months and therefore does not provide information about the longer-term success or safety of SDF treatment. Third, only children without clinical signs suggestive of pulpitis were included. Consequently, the findings cannot be generalized to children presenting with spontaneous pain, severe pain, or other signs of pulpal disease. Finally, the study focused on permanent posterior teeth in children aged 7–8 years, and the results may not be applicable to primary teeth or older age groups.

Despite these limitations, the study provides preliminary clinical information regarding the role of preoperative radiographic examination before SDF application in deep carious lesions. Larger randomized studies with longer follow-up are needed to determine whether preoperative radiographic examination provides a measurable clinical benefit and to establish which clinical and radiographic characteristics are most useful for patient selection.

5. Conclusion

Within the limitations of this pilot randomized clinical study, no apparent difference in 3-month clinical or radiographic outcomes was observed between children who received 38% SDF treatment with and without preoperative radiographic examination.

In clinically selected 7–8-year-old children with extensive caries in permanent posterior teeth and no clinical signs of pulpitis, preoperative radiographic examination did not result in an apparent difference in the short-term outcomes observed in this small sample.

However, these findings should be considered preliminary. The study does not establish that preoperative radiographic examination is unnecessary. Larger studies with adequate statistical power and longer follow-up are required to determine whether radiographic examination can safely be omitted in selected children undergoing SDF treatment.

References

1. Gao SS, Zhao IS, Hiraishi N, Duangthip D, Mei ML, Lo ECM, Chu CH. Clinical trials of silver diamine fluoride in arresting caries among children: a systematic review. JDR Clinical & Translational Research. 2016
2. Jabin Z, Vishnupriya V, Agarwal N, Nasim I, Jain M, Sharma A. Effect of 38% silver diamine fluoride on control of dental caries in primary dentition: a systematic review. Journal of Family Medicine and Primary Care. 2020

3. Contreras V, Toro MJ, Elías-Boneta AR, Encarnación-Burgos A. Effectiveness of silver diamine fluoride in caries prevention and arrest: a systematic literature review. General Dentistry. 2017
4. Muntean A, Mzoughi SM, Pacurar M, et al. Silver diamine fluoride in pediatric dentistry: effectiveness in preventing and arresting dental caries—a systematic review. Children
5. Vishwanathaiah S, Maganur PC, Syed AA, et al. Effectiveness of silver diamine fluoride (SDF) in arresting coronal dental caries in children and adolescents: a systematic review. Journal of Clinical Pediatric Dentistry. 2024
6. Horst, J. A., Ellenikiotis, H., & Milgrom, P. L. (2016). UCSF Protocol for Caries Arrest Using Silver Diamine Fluoride: Rationale, Indications and Consent. Journal of the California Dental Association
7. Crystal, Y. O., Marghalani, A. A., Ureles, S. D., Wright, J. T., Sulyanto, R., Divaris, K., Fontana, M., & Graham, L. (2017). Use of Silver Diamine Fluoride for Dental Caries Management in Children and Adolescents, Including Those with Special Health Care Needs. Pediatric Dentistry
8. Slayton, R. L., Urquhart, O., Araujo, M. W. B., et al. (2018). Evidence-based clinical practice guideline on nonrestorative treatments for carious lesions: A report from the American Dental Association. Journal of the American Dental Association
9. Zhao, I. S., Gao, S. S., Hiraishi, N., Burrow, M. F., Duangthip, D., Mei, M. L., Lo, E. C., & Chu, C. H. (2018). Mechanisms of silver diamine fluoride on arresting caries: A literature review. International Dental Journal, 68(2), 67–76. Phantumvanit, P., Makkes, S., Duangthip, D., et al. (2018). Consensus Recommendations on the Use of Silver Diamine Fluoride Stomatology Caries Management. Journal of Dental Research
10. Alshammarih, A. F., Almuhaiza, M. A., & Almalik, M. A. (2022). Twelve-month randomized controlled trial of 38% silver diamine fluoride with or without potassium iodide in indirect pulp capping of young permanent molars. Journal of the American Dental Association
11. Crystal, Y. O., & Niederman, R. (2016). Silver Diamine Fluoride Treatment Considerations in Children's Caries Management. Pediatric Dentistry
12. Mei, M. L., Chu, C. H., Low, K. H., Cheak, C. F., & Lo, E. C. (2013). Caries arresting effect of silver diamine fluoride on dentine carious lesion with S. mutans and L. acidophilus dual-species biofilm. Journal of Dentistry
13. Oliveira, B. H., Chhabra, N., Silva, T. C., et al. (2019). The inhibitory effect of silver diamine fluoride on dentin demineralization and collagen degradation. Journal of Dentistry
14. Guedes, R. S., Yamada, L. C., Luppino Massucato, E. M., et al. (2016). Random clinical trial of the effectiveness of silver diamine fluoride in arresting caries treatment in primary teeth. Journal of Dentistry
15. Milgrom, P., Horst, J. A., & Ludwig, S. (2018). Topical silver diamine fluoride for dental caries arrest. Caries Research, 52(4), 263–272.Seifo, N., Cassie, H., Radford, J. R., & Innes, N. P. (2019). Silver diamine fluoride for managing carious lesions: An umbrella review. BMC Oral Health
16. Horst, J. A., Heima, M. (2019). Prevention of Dental Caries Driven by Silver Diamine Fluoride. Journal of Dental Research