

## RATIONALE FOR PLACING TOPICAL FLUORIDE INSIDE CAVITY PREPARATIONS: A REVIEW

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هناك طرق شتى للاستفادة من مادة الفلور منذ أن عرف المجتمع الطبي العلاقة بين هذه المادة ومنع تسوس الأسنان، فتم إضافة الفلور إلى مياه الشرب ومعالجين الأسنان ومواد الأسنان وغيرها، ومن العضلات التي تواجه طبيب الأسنان هو حدوث نكس لنخر حول حشوات الأسنان المختلفة. لذلك جرت عدة أبحاث وطرق لعلاج مكان الحشوة بإدخال الفلور. وهذا المقال محاولة لتغطية بعض هذه المحاولات وكيفية الاستفادة من مادة الفلور في هذا المجال.

### Introduction

Recurrent caries, around dental restorations, has been a major problem facing dental practitioners. In 1949, Healey and Phillips<sup>1</sup> found that 53% of amalgam failure was directly due to recurrent dental caries. Although Richardson et al<sup>2</sup> reported a smaller percentage in 1973, 23% of all amalgam restorations were replaced because of secondary caries. This percentage increased to 54% when new caries were included. In a recent survey in 1987, Klausner and associates<sup>3</sup> found that 54% of 5511 restorations placed by 191 dentists were replacement restorations. Of these replacements, 53% were replaced because of recurrent caries.

Despite the fact that operative procedures have been improved measurably, particularly in regard to the type and design of cavity preparation and in the quality of restorative materials, there is still a need to render the cavity preparation itself less susceptible to recurrent caries. This procedure is especially important because most dental materials are incapable of preventing marginal leakage and do not provide anticariogenic properties. The purpose of this review is to provide evidence showing that fluorides are effective and safe in reducing recurrent caries.

### *Fluorides in Cavity Preparation and Caries Reduction*

The use of fluorides has been proven to be effective in the field of preventive dentistry. Systemic and topical applications of fluorides results in caries reduction. This fact has lead dental researchers to investigate the possibility of reducing recurrent caries by topical fluoride application inside cavity preparations. Gross et al<sup>4</sup> reported that a 50% reduction in secondary caries was achieved by treating the cavity preparations with sodium fluoride. In a laboratory study, a 30-second application of a 10% stannous fluoride solution to prepared cavities was investigated. The result showed a 53 to 75% reduction in enamel solubility in acid.<sup>5</sup> These authors concluded that a topical stannous fluoride treatment should be included as a routine step in cavity preparation. In a controlled two-year clinical trial, Alexander, McDonald, and Stookey<sup>6</sup> used a 30% stannous fluoride solution to treat Class II and Class V cavity preparations in children. Cavity preparations were moistened with stannous fluoride for 15 seconds, air dried, and then restored with amalgam. The control group had cavity preparation with placebo. Children receiving SnF<sub>2</sub> treatment showed a 60.7% and 46.7% reduction in recurrent caries in permanent and primary teeth respectively. Shannon<sup>7</sup> investigated the degree of effectiveness of various SnF<sub>2</sub> concentrations on the acid solubility of walls of freshly prepared cavities. Results indicated that solubility reduction provided by the 30% or 10% SnF<sub>2</sub> is needlessly concentrated

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and that a diluted solution of SnF<sub>2</sub> is a more biologically sound approach.

Several studies investigated the effect of topical fluoride application on carious dentin.<sup>8-9</sup> Radiographic and microradiographic examinations of SnF<sub>2</sub>-treated carious dentin showed a great increase in radiopacity compared to that before treatment. This finding suggests that a 10% SnF<sub>2</sub> solution may cause remineralization.

The above studies clearly indicate the importance of topical fluoride treatment for reducing the incidence of secondary caries and also the possibility of promoting remineralization of small carious tissue accidentally left in the cavity preparations. Freshly cut dentin and enamel should be considered similar to freshly erupted enamel in being highly susceptible to caries because it lacks the fluoride-rich protective layer that forms following exposure to oral fluids. Therefore, any safe means of reducing the dissolution of the susceptible surfaces would be beneficial.<sup>10</sup>

The use of topical fluoride on freshly-cut dentin is not a new concept. Hoyt et al<sup>11</sup> suggested the use of sodium fluoride-kaolin paste as a potential means of reducing hypersensitivity of the dentin.

Another rationale for placing topical fluoride inside cavity preparation is its effectiveness as an indirect pulp-capping material. Nordstrom and co-workers<sup>12</sup> compared a 10% SnF<sub>2</sub> solution to calcium hydroxide for indirect pulp capping in human primary and permanent teeth. The SnF<sub>2</sub> solution was applied for five minutes. Results showed no significant difference between the failure rates of teeth treated by both means. However, teeth treated with SnF<sub>2</sub> showed harder dentin and greater radiodensity than teeth treated with calcium hydroxide.

It is well known that fluoride in small quantities is an enzyme inhibitor whereas in large concentration it actually kills microorganism. Therefore, application of topical fluoride inside cavity preparations may have an antibacterial effect. Furthermore, fluoride decreases the free energy of tooth surfaces. This may render cavity margins less susceptible to plaque accumulation. A long term *in vivo* study has indicated that plaque formed on silicate restorations differs in composition from plaque formed on resin or amalgam restorations. Carbohydrate/nitrogen and nitrogen/calcium ratios were generally lower in plaque associated with sili-

cate cement. This suggests that either the carbohydrates are metabolized less or there is less bacteria in the plaque.<sup>13</sup>

#### *The effect of fluorides on dental pulp*

The biocompatibility of topical fluoride, when applied to freshly-cut dentin, has been addressed in numerous studies. Andres et al<sup>14</sup> studied the effect of 30% SnF<sub>2</sub> solution applied to deep cavities prepared in dog teeth. They found no adverse pulp response. Weiss et al<sup>15</sup> also reported a very slight, if any, inflammation in pulpal tissue in human teeth when a 10% SnF<sub>2</sub> solution was applied to freshly cut cavities. In another study by Weiss and associates,<sup>16</sup> Class V cavities were prepared in young premolar teeth. The prepared cavities were then treated with 10% SnF<sub>2</sub>, 2% NaF, or 1.23% AFP. Histologic examinations showed no significant effects of any of these fluoride solutions on the underlying pulp. However, Branstrom et al<sup>17</sup> stated that in deep cavities, where pulp could be exposed, 8% SnF<sub>2</sub> should not be applied more than 30 seconds. These studies indicate that application of topical fluoride to cavity preparations in moderate concentration and for a short period of time is a safe procedure.

#### *Fluoride application procedures in cavity preparation*

Fresh stannous fluoride solution is the topical fluoride of choice. Many studies have shown that SnF<sub>2</sub> offered a higher degree of protection and resistance to acid dissolution.<sup>7,18,19</sup> Although some studies have shown that aged SnF<sub>2</sub> solution can be more effective than fresh solution, the aged solution has a lowered pH value which may cause an adverse effect on the pulp.<sup>10</sup>

1. Cavity preparation is completed in the usual manner with rubber dam.
2. In a deep cavity, the placement of a base is recommended for pulp protection and thermal insulation. Although fluoride has been proven to be non-irritant to the pulp, possible microscopic exposure in a deep cavity necessitates pulpal protection. However, maximum benefit will be achieved from fluoride treatment of the cavity walls.<sup>10</sup>
3. Cavity varnish should not be applied before fluoride because this will prevent the beneficial

interaction between cavity walls and the topical fluoride.

4. A 5-8% fresh stannous fluoride is applied directly with plastic dispenser or with a cotton pellet for 30 seconds. The cavity preparation is then air-dried and the restoration is completed in the usual manner.

The application of topical SnF<sub>2</sub> is indicated before placement of dental amalgam, direct gold, and cast restoration. However, its use is contra-indicated with composite resin because it will interfere with acid etch procedure. Furthermore, Stookey<sup>20</sup> stated that stannous fluoride treatment may stain or pigment the underlying enamel and thus, may cause an undesirable esthetic problem. Instead, 2% sodium fluoride solution is applied after composite restoration is completed. It is not necessary to use topical fluoride with glass ionomer restorations since they contain fluoride.<sup>21</sup>

#### Summary and recommendations

Numerous research projects have shown fluoride to be useful as anticariogenic agent, anti-bacterial agent, pulp capping material and desensitizing solution. Accordingly, the application of fluoride solutions to cavity preparations has been suggested as beneficial. The use of topical fluorides is not required on all cavity preparations. If one elects to use a topical fluoride, the following are recommended:

1. Under amalgam, direct gold, and castings use 8–10% stannous fluoride.
2. With resins, do not apply fluoride to the cavity preparation since it will interfere with acid etching. Instead, apply the fluoride after the restoration is completed and use the sodium instead of the stannous fluoride to prevent possible staining.
3. It is not necessary to use topical fluoride with glass ionomer restorations since they contain fluoride.

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