Stannous Fluoride Dentifrice with Sodium Hexametaphosphate: Review of Laboratory, Clinical and Practice-Based Data

By Cynthia Sensenbrough, RDH, MS, Mary Elizabeth Sage, BS, MA

Abstract
Dentifrice was originally used to promote oral hygiene by cleansing teeth. However, with advances in product formulation, it has become a valuable vehicle for the delivery of agents offering health and cosmetic benefits. Stannous fluoride, introduced in 1955 in dentifrice, is one of the longest established of such agents. The well-known anti-caries efficacy of stannous fluoride is based on its impact on the tooth surfaces and on its antibacterial activity.

More recently, the demand for tooth whitening products has increased and sodium hexametaphosphate has been shown to be helpful in whitening surface stains and in controlling calculus. A dentifrice formulation which combines the benefits of stannous fluoride with those of sodium hexametaphosphate is now available. A review of the evidence shows that in addition to effective anti-caries action, this formulation is effective in fighting plaque, gingivitis, and gingival bleeding while inhibiting calculus and extrinsic stain.

A practice-based evaluation including data from over 1,200 dental professionals and 1,000 patients demonstrates the product's benefits and excellent acceptability. Collectively, the research shows this stannous fluoride/sodium hexametaphosphate dentifrice provides multiple benefits to meet the oral health and cosmetic needs of patients.

Key Words: stannous fluoride, dentifrice, gingivitis, caries, sensitivity, calculus

Introduction
Patients today represent one of the most heterogeneous groups in history in terms of age, health status, oral hygiene habits and other factors.

While certain oral health conditions are more prevalent among specific patient groups, such as periodontal disease among diabetic patients, many oral health conditions affect the broad population. According to U.S. surveys, virtually all adult patients have had dental caries, more than half experience gingivitis, and roughly one in three suffer from dental sensitivity. Fortunately, home care products are available to help prevent and treat many common oral health conditions in conjunction with routine professional care.

Dentifrice is one important example. Many years ago, the benefits of dentifrice were limited to the prevention and control of gingivitis and calculus and stain formation on the tooth surfaces. It was common for professionals to tell patients to “use any dentifrice with fluoride and the ADA Seal.” However, formulators today can design dentifrices to provide numerous other benefits, both for health and cosmetic purposes.

In 2005, a stannous fluoride sodium hexametaphosphate (SFSH) formula was introduced offering protection against a broad range of health and cosmetic conditions commonly experienced by patients. The present review reports the laboratory, clinical and practice-based assessments evaluating the efficacy of this dentifrice formulation.

Stabilized stannous fluoride/sodium hexametaphosphate formulation
The SFSH formula combines the therapeutic benefits of a 0.454% stabilized stannous fluoride with the calculus and stain-control characteristics of sodium hexametaphosphate in a low-water formulation dentifrice. Stannous fluoride, which unlike sodium fluoride can be used in combination with calcium-based abrasives, has been incorporated in dentifrices since the 1950s to provide protection against caries, pathogenic bacteria, gingivitis, hypersensitivity, and calculus and plaque. There is considerable evidence for its efficacy as a therapeutic agent with a wide spectrum of beneficial properties. However, its clinical usage was limited because of the potent taste and in some patients its use resulted in extrinsic staining of the teeth. Stannous fluoride was also somewhat unstable in aqueous solution. The latter problem was resolved with the introduction of stabilized stannous fluoride in the 1960s which rendered more available stannous fluoride and resulted in a renewed interest in the wide range of benefits offered by stannous fluoride in dentifrices.

Sodium hexametaphosphate was first introduced in a dentifrice in 1955. It is a chemical whitening agent in the same class as pyrophosphate, which has long been used to inhibit calculus and the molecule is about 10 times longer than that of pyrophosphate. Sodium hexametaphosphate therefore provides better coverage and retention on the tooth surface, thus increasing its ability to inhibit both calculus and stain formation on the enamel surface. Stability of the dentifrice can be an issue with the inclusion of polyphosphates if ingredients are not properly balanced. Like other polyphosphates, sodium hexametaphosphate does not usually show good long-term stability in aqueous dentifrices. However, the novel single-phase SFSH formula, which uses a low-water system in a silica-based formulation, effectively reduces the hydrolysis of sodium hexametaphosphate and helps to maintain effective levels of whitening activity.

The resulting dentifrice has improved esthetic qualities over the original stannous fluoride formulation, and delivers a broad range of therapeutic and cosmetic benefits (Figure 1). The remainder of this paper provides a summary review of research on stannous fluoride, sodium hexametaphosphate and especially, the unique SFSH formulation.

Antibacterial and Anti-inflammatory Action
Most of the oral health benefits of stannous fluoride result from its antibacterial efficacy, particularly against bacteria associated with dental caries, periodontal disease, and oral malodor. Laboratory and clinical studies have shown that stannous fluoride, unlike other fluorides, inhibits bacterial growth by a variety of mechanisms, including interference with metabolic pathways, thus reducing bacterial acid formation, and inhibition of bacterial growth by a variety of mechanisms, including interference with metabolic pathways, thus reducing bacterial acid formation, and inhibition of bacterial growth. In a Live/Dead assay on stannous fluoride, sodium hexametaphosphate dentifrice, green-stained cells are live microbial cells; red-stained cells are dead cells (from Ramji et al.21).
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At 8 weeks, the SFSH showed improvements of 71% and 44% versus the negative control for tactile and thermal measurements, respectively.

These studies support that the SFSH dentifrice shares the anti-inflammatory characteristics of previous stannous fluoride formulations.

Anti-caries Effects

The anticaries effects of stannous fluoride have been recognized since the 1940s, when the Stannous fluoride-containing dentifrice, Crest® with Fluoristan™, received a Seal of Acceptance by the ADA's Council on Dental Therapeutics. Since then, research has continued to support stannous fluoride as an effective caries prevention aid.

Recent studies have evaluated the anticaries efficacy of SFSH dentifrice.41,42 One such six-month trial found statistical significance of 23% in gingivitis, 57% less bleeding and 7% less plaque relative to a negative control.43 In a second six-month trial with 126 subjects, Mallatt et al. found a 17% reduction in gingivitis (p < 0.001), a 41% reduction in gingival bleeding (p < 0.001) and an 8% reduction in calculus (p < 0.001) with the SFSH dentifrice versus a negative control dentifrice. The SFSH dentifrice also demonstrated statistically significant reductions in gingivitis (26%) and gingival bleeding (27%) relative to a triclosan/cozyme control.44 In a follow-up to this study, Archila et al. chose subjects who had used the triclosan/cozyme dentifrice twice a day but who had proved unresponsive to it, and still had high bleeding scores at the end of the six-month study period.45 After three months use of the 0.76% SFSH dentifrice, the stannous fluoride/hexametaphosphate group (n=45) showed improvements of 77% versus the negative control for tactile sensitivity (Teazel Probe Index) and thermal sensitivity (Schiff Air Index). On all assessments, the SFSH dentifrice produced a significant decrease in sensitivity (p < 0.05) compared to the control dentifrice. In the second study which used essentially the same procedures, results were similar, with the stannous fluoride/sodium hexametaphosphate (n=45) producing significant reduction in sensitivity compared to the control (n=45).46

This action is thought to produce the clinical efficacy of stannous fluoride in the prevention and control of dental caries and gingivitis.

Stannous fluoride has been shown to react with calcium and phosphate complex which coats and protects the surface of the enamel.47 Studies investigating the activity of stannous fluoride, which was discussed above, provides further protection by suppressing of bacteria, particularly Streptococcus mutans, which are one of the primary pathogens associated with dental caries.48,49

The anti-caries benefits of stannous fluoride are therefore due both to physical chemistry and its bacteriocidal effects.

Before the introduction of this SFSH dentifrice, a large number of clinical trials had been carried out that demonstrated the efficacy of stannous fluoride in the control of dental caries.25,27 Many studies have investigated the efficacy of SFSH dentifrice in a dual-phase prototype SFSH dentifrice with a positive control of standard sodium fluoride dentifrice, and also a high-dose (2800 ppm F) and a low-dose (500 ppm F) sodium fluoride dentifrice.25 Visual-tactile examination was supplemented with a radiological examination using Bitewing radiographs after 12 months and at the end of the trial at 24 months. Both examiners found that there was significantly less caries in the SFSH (17% and 25%) and high sodium fluoride (5%) groups as compared to the control group (1100 ppm F) sodium fluoride toothpaste.25 In a recent study, Schulz et al. reported that a dual-phase stannous fluoride/sodium hexametaphosphate dentifrice produced antacaries activity which was

### Table 1. Long-term clinical trials examining the effect of stabilized stannous fluoride on reduction of plaque, gingivitis and gingival bleeding.

<table>
<thead>
<tr>
<th>Reference</th>
<th>No. of Subjects</th>
<th>% St.</th>
<th>Mode of Delivery</th>
<th>Treatment Duration</th>
<th>Length of Trial</th>
<th>Plaque Reduction</th>
<th>% Reduction Gingival Bleeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archila et al.</td>
<td>186 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily</td>
<td>6 months</td>
<td>ND</td>
<td>25.8%**</td>
<td>27.4%**</td>
</tr>
<tr>
<td>Archila et al.</td>
<td>38 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily</td>
<td>12 weeks</td>
<td>ND</td>
<td>54%**</td>
<td>59%**</td>
</tr>
<tr>
<td>Boyd et al.</td>
<td>23 adolescent</td>
<td>0.4 Brush-on gel</td>
<td>Twice daily</td>
<td>18 months</td>
<td>50%**</td>
<td>55%**</td>
<td>50%**</td>
</tr>
<tr>
<td>Balwanger et al.</td>
<td>16 adults</td>
<td>0.4 Dentifrice</td>
<td>Twice daily</td>
<td>6 months</td>
<td>5% ns</td>
<td>19%**</td>
<td>31% ns</td>
</tr>
<tr>
<td>Clarion et al.</td>
<td>28 adults</td>
<td>0.1 Mouth rinse</td>
<td>Twice daily</td>
<td>3 weeks</td>
<td>28%**</td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td>Chithole et al.</td>
<td>26 handpicked children</td>
<td>0.2 Syrup</td>
<td>Twice daily</td>
<td>3 weeks</td>
<td>48%*</td>
<td>52%*</td>
<td></td>
</tr>
<tr>
<td>Mallatt et al.</td>
<td>128 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily</td>
<td>6 months</td>
<td>8%*</td>
<td>17%*</td>
<td>41%**</td>
</tr>
<tr>
<td>Mankvich et al.</td>
<td>104 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily</td>
<td>6 months</td>
<td>20%*</td>
<td>21%*</td>
<td></td>
</tr>
<tr>
<td>Grant et al.</td>
<td>10 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily</td>
<td>6 months</td>
<td>32%**</td>
<td>29%**</td>
<td></td>
</tr>
<tr>
<td>Perlman et al.</td>
<td>154 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily</td>
<td>6 months</td>
<td>5% ns</td>
<td>21%*</td>
<td>33%*</td>
</tr>
<tr>
<td>Finanor et al.</td>
<td>31 adults, partial</td>
<td>0.4 Brush-on gel</td>
<td>Twice daily</td>
<td>6 months</td>
<td>55%**</td>
<td>48%**</td>
<td>69%**</td>
</tr>
<tr>
<td>Williams et al.</td>
<td>112 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily</td>
<td>6 months</td>
<td>23%**</td>
<td>22%*</td>
<td></td>
</tr>
</tbody>
</table>

All reductions are versus control except for Archila and Chithole which were relative to baseline values.

*Significant difference for abutment level.
**p < 0.05

< p 0.01
ND no significant
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*ON ENAMEL PLAQUE AND ENAMEL EROSION VS ORDINARY TOOTHPASTE

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A series of in vitro studies evaluated the anticipated potential of the SFSH formulation have been reported in one publication14 and some clinical trials.15 In a study of fluoride uptake into demineralized enamel, it exhibits no uptake compared to a clinically proven stannous fluoride and silica dentifrice.15 In a second in vitro study, plaque cycling experiment the stannous fluoride/sodium hexametaphosphate provides almost complete protection against lesion initiation and progression; it would appear to be a clinically proven clinically proven dentifrices.16 These studies indicate that this SFSH dentifrice is as effective as clinically proven fluoride dentifrices both in its mode of action and in its clinical benefits.

Anticaries Effects Dental calculus results from the mineralization of bacterial plaque formed on the surfaces of teeth. Agents that inhibit calculus growth, particularly condensed phosphates, have been found to be effective in the prevention of calculus development. In this class of phosphates, sodium hexametaphosphate dentifrice was shown to be particularly effective. In vitro studies by White et al.17,18 have demonstrated that reductions in hydroxyapatite crystal growth and mineralization of plaque components of sodium hexametaphosphate either in aqueous solution or in a dentifrice.19 These agents are significantly greater than for a conventional anti-caries dentifrice containing pyrophosphate. This finding has been supported by four 6-month clinical trials in which sodium hexametaphosphate produced significant reductions in calculus formation — when compared to stannous fluoride or stannous fluoride — as compared to a regular sodium fluoride dentifrice or a triclosan/ cloxymethyl ether.20 A total of 866 subjects participated in the four 6-month clinical trials. Efficacy was assessed using a standard clinical method (Volpe-Manhold Index). A series of supragingival calculus coverages on the lingual surfaces of the 6 anterior teeth. In the 2 studies evaluating SFSH formulations, clinical reductions of 55% and 56% were observed across the selective controls at 6 months.20

Whitening Effects There is an increasing demand for tooth whitening products and also for oral care products that sustain whitening effects. Peroxide is a successful bleaching agent when delivered via whitening strips or in tray-based systems, but it is not particularly effective in dentifrices because of the brief contact time with the tooth surface.21 Peroxphosphates, on the other hand, help maintain whitening and control staining because they have a strong affinity for the minerals in teeth. Sodium hexametaphosphate has been shown to have important effects on the chemical mechanisms of chromogen adsorption and desorption.21,22 It appears that the polymer chains interact with pellicle films to lift stain material out of the pellicle and to prevent the adsorption of new chromogens. Gerlach et al. reported a 29% reduction in composite stain relative to a negative control following 6 weeks of use of a sodium fluoride dentifrice containing 7% sodium hexametaphosphate.23 Clinical studies providing evidence for the efficacy of sodium hexametaphosphate in the removal of extrinsic stain have been reviewed by Baig et al.24 A number of recent clinical trials have assessed the extrinsic stain removal efficacy of the SFSH dentifrice in its 6-month study of anti-calcus effects, Schiff et al.25 also assessed extrinsic stain, using the Lobene Stain Index on the facial surface of U-shaped anterior teeth; at another 5 nor 6 months did subjects in the SFSH group show signs of developing any such stain. Four recent clinical trials, which were summarized in two publications, have used similar methods to compare the extrinsic stain removal efficacy of the SFSH dentifrice with that of a positive control whitening dentifrice.26 All 4 were randomized, double-blind, controlled studies in which efficacy was measured using a modified Lobene Stain Index. Two studies assessed whitening at baseline and 2 weeks27 and the other 2 studies measured stain at baseline, 5 and 6 weeks.28 In all cases, there was highly significant stain removal in the experimental groups and also in the positive control groups. There were no significant differences in the effects of the SFSH and positive control dentifrices.

In reviewing these data, it appears that combining sodium hexametaphosphate with stannous fluoride in the dentifrice inhibits extrinsic stain formation and that the SFSH dentifrice is as effective as positive control whitening dentifrices.

Practice-Based Evaluation The efficacy and safety of dentifrices with stannous fluoride or a combination of stannous fluoride and sodium hexametaphosphate is supported by an extensive body of evidence. However, its success ultimately depends on its acceptability to users when used at home by consumers as part of their own personal oral hygiene routine. In order to assess the acceptability of the SFSH dentifrice, a practice-based assessment was undertaken involving dental professionals and their patients.29 Dentists and hygienists across the USA participated in the study, and samples of the SFSH formulation were offered to a group of patients for 5–6 months.29,30 The patients' oral health was assessed at the beginning and after 6 months. Responses analyzed were those in which dentists or hygienists provided both pre- and post-oral health assessments and gave answers to questions. Sixty-eight percent of all respondents reported improvements in their patients' oral health, including improvements in gingival bleeding and inflammation and reduction in calculus formation. Reductions in the sensitivity were reported by 61% of professionals and in staining by 57%. Eighty percent report ed they would recommend the SFSH dentifrice; this rose to 91% among those professionals who observed improvements. A total of 1,078 questionnaires were returned by patients. Of these, 88% reported positive assessments of the SFSH dentifrice (Excellent/Very Good/Good) and two-thirds of all patients stated that they intended to continue to use the product; this percentage rose to 77% when patients reported noticeable improvements in their oral health. In terms of rating specific effects, roughly 9 out of 10 patients rated the product positively for "keeping mouth healthy", "cleaning teeth thoroughly", being "a more effective "make-up gams healthier" and "freshening breath" (Figure 6). Eighty-three percent rated it positively for reducing surface stains and 77% for reducing gingival bleeding.

It is important to differentiate between practice-based evaluations from randomized, controlled clinical studies. For example, clinical trials typically need calibrated examiners who use standardized indices to assess the status of a specific oral condition or concern. Often the examiner and subject are blind to treatment. In this practice-based evaluation assessing practicing professionals and their patients assessed oral conditions using a questionnaire. Calibration was not done across offices and the product identity was known. This type of evaluation is similar to their assessments of practicing professionals do on a routine basis. They recommend a home care product, and then use their experience and clinical judgment to determine the effect it has on their patients' oral health. This large, practice-based assessment with the SFSH dentifrice confirms findings of the controlled clinical trials. The major outcome is that it provides evidence of excellent professional acceptance and an equal level of acceptance among patients, expressions of confidence in an intention to continue using the SFSH dentifrice.

Conclusions Extensive laboratory and clinical research add to the body of research supporting the value of stannous fluoride as a multi-benefit dental ingredient.31 Stannous fluoride reduces bacterial growth, bacterial activity, and inflammatory markers as well as protects against plaque, gingivitis and gingival bleeding, hyperplasia, and caries. Research also suggests the efficacy of sodium hexametaphosphate in the control of calculus and extrinsic staining. Seventeen published clinical and laboratory papers demonstrate the efficacy of these dentifrice ingredients.32–34 When all these effects are combined, this formulation, which is therefore able to provide a wide combination of health and customer benefits,35 results from a large practice-based assessment involving over 1,200 dental professionals and over 1,000 patients further support the product is widely acceptable and beneficial for improving oral health.35

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References

9. 46
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Extrinsic tooth discoloration, an updated review

By Dr. Kasio Cynthia DIBS, DECSO, D.D.S.B.D, director of Esthetic and Restorative Dentistry – Saint Joseph University – Saint Joseph Tyatia, DDS, R.O.I. Imaging Center, OMF-IMPATH research group, Department of Maxillofacial Medicine, University of Leuven and Oral & Maxillofacial Surgery, University of Leuven. Prof. Mehnah Carina DIBS, CESDA, Ph.D, FICD, Director of Esthetic and Restorative Dentistry Postgraduate Program Saint Joseph University, President of the continuing education committee - Lebanese Dental Association

Abstract

The appearance of the tooth’s external color is of particular cosmetic importance. Discolored teeth are seen frequently in the dental practice, an important challenge to the dentist. The causes of tooth discoloration are many and complex. Basically, there are two types of tooth discolorations: those caused by extrinsic factors and those caused by an intrinsic congenital or systemic influence. The maj- ority of tooth discolorations are extrinsic in nature and appear as brown inclusions. Dental treatments are designed to identify, involve the etiology of the discoloration, and implement a therapy. An overview of the extrinsic etiol- ogy and the clinical appearance of tooth discoloration are discussed in this review.

Key-words: Discoloration, stains, etiology, whitening, chromogenic protein.

Introduction

Ever since the ancient times, mankind has been questing for beauty through the perfection of the human body. White and ivory colored, for example, used to be the ideal for women and men. In today's society, where most people place tooth color high. The common occurrence of tooth discoloration is a key challenge to the dentist. The causes of tooth discoloration are many and complex. Basically, there are two types of tooth discolorations: those caused by extrinsic factors and those caused by an intrinsic congenital or systemic influence. The maj- ority of tooth discolorations are extrinsic in nature and appear as brown inclusions. Dental treatments are designed to identify, involve the etiology of the discoloration, and implement a therapy. An overview of the extrinsic etiol- ogy and the clinical appearance of tooth discoloration are discussed in this review.

Teeth discolorations are associ- ated with many clinical and esthetical challenges. They can have an impact on a person's self-esteem and confidence in today's society, where most people place tooth color high. The common occurrence of tooth discoloration is a key challenge to the dentist. The causes of tooth discoloration are many and complex. Basically, there are two types of tooth discolorations: those caused by extrinsic factors and those caused by an intrinsic congenital or systemic influence. The maj- ority of tooth discolorations are extrinsic in nature and appear as brown inclusions. Dental treatments are designed to identify, involve the etiology of the discoloration, and implement a therapy. An overview of the extrinsic etiol- ogy and the clinical appearance of tooth discoloration are discussed in this review.

A variety of colors can typically be seen in one tooth and even from the gingival margin to the incisal edge of the tooth a gradation of the color is observed. Many variations of tooth structure is likely to cause an alteration in outward appearance of the tooth caused by changes of light transmitting and reflecting properties. Some discolorations are located on the outer surface of the tooth structure, others are caused by intrinsically acquired color due to periodontal diseases and in- fections. This is true of cigaretes, which are incorporated into the pellicle, and some occur dur- ing tooth development and result in an alteration of the light transmitting properties of the tooth structures. Tooth discol- orations are caused by many factors: medications, genetic defects, diseases, trauma, caries and metal dental procedures. Some examples are it is important to understand what staining is in the tooth. There are two types of tooth discolor- excretion: extrinsic which affects the teeth from outside and intrinsic which affects the tooth from the inside.

Extrinsic discoloration lies on the tooth surface or in the acquired pellicle. The majority of tooth discolorations are extrinsic in nature and appear as brown inclusions. Extrinsic staining of a single tooth is unus- ual. The distribution is usually generalized. Extrinsic discoloration usually found on surfaces with poor tooth brush accessibility. Smok- ing, tea or coffee consumption and increasing age are pro- moting factors and such dis- colorations are frequently seen in connection with oral use of antibacterial plaque-inhibiting mouthwash. Chemical altera- tion of the acquired pellicle ap- pears to be the major reason for these brown inclusions.7

The causes of extrinsic staining can be divided into two catego- ries: those compounds which are incorporated into the pellicle and produce a stain as a result of their basic color 2 or those which lead to staining caused by chemical interaction at the tooth surface.4

Direct staining has a multi-fa- torial etiology with chromosomes derived from dietary sources or substances habitually placed in the mouth. The human body's ability to cause discoloration is impor- tant as it has a profound effect on treatment outcomes.

Normal enamel is colorless and transparent. Dental caries and dentin is mainly responsible for the color of the tooth. The dentin has a yellowish brown color where it consists of thick layers and where the enamel layer is thin (cervical margin). Teeth discolorations are associ- ated with many clinical and esthetical challenges. They can have an impact on a person's self-esteem and confidence in today's society, where most people place tooth color high. The common occurrence of tooth discoloration is a key challenge to the dentist. The causes of tooth discoloration are many and complex. Basically, there are two types of tooth discolorations: those caused by extrinsic factors and those caused by an intrinsic congenital or systemic influence. The maj- ority of tooth discolorations are extrinsic in nature and appear as brown inclusions. Dental treatments are designed to identify, involve the etiology of the discoloration, and implement a therapy. An overview of the extrinsic etiol- ogy and the clinical appearance of tooth discoloration are discussed in this review.

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Ultra-low abrasion for your patients who need sensitivity relief and seek gentle whitening

- Clinically proven relief from the pain of sensitivity\(^{1,4}\)
- Gently lifts stains and help prevent new stains from forming\(^{5,7}\)
- Ultra-low abrasive formulation appropriate for your patients with exposed dentine\(^{a}\)

Recommend Sensodyne – specialist expertise for patients with dentine hypersensitivity

\(^{a}\)With twice-daily brushing

Other articles found greater
enamel dissolution occurring in
flavored and energy (sports) drinks
than in cola drinks.

The influence of coffee, tea,
cola, and red wine staining on
the color of teeth after home
bleaching has been evaluated. A
total of 45 samples were ob-
tained from 45 sound maxillary
central incisors. The samples
were immersed in four staining
solutions (coffee, tea, cola, and
red wine) or artificial salivafollow-
ing 15 min and 6 h of immer-
sion on the first day and next day
of all the staining solutions, the
lowest ΔE values were observed
with coffee staining versus arti-
ficial saliva (control group), for
all time intervals evaluated after
whitening. There were statisti-
cally significant differences be-
tween the red wine, cola, and tea
solutions.

A study assessed the influence of
surface sealant on the color sta-
bility of composite resins.

Red wine resulted in the highest
discoloration. Intermedi-
ate values were found for orange
juice, and the cola soft drink.

Some drinks may be rela-
tively good for health may not
be so good for teeth in terms of
staining them. Cranberry juice,
grape juice and other dark-
colored fruit juices are very
good at staining teeth because
they contain pigments—and lots
of them—that can yellow teeth,
probably the same way they
stain composite resin.

Cranberry juice contains po-
tential anticaries agents (high-
molecular-weight polyphenols)
that inhibit the production of or-
ganic acids and the formation of
biofilms by cariogenic bacteria.

The polyphenols of cranberries
interfere with various activities
(including formation of bio-
film and adhesion) of Porphy-
rromonas gingivalis, the main
etiologic agent in chronic peri-
odontitis.

In order to avoid these stains,
straws should be used and
mouthwash followed by tooth
brushing should be done.

Iron-fortified foods can help
prevent iron deficiency so can
iron-fortified soy sauce due to
the relatively high iron absorp-
tion from soy sauce. But soy
sauce sticks to teeth, and the
dark-colored pigments can cause
very bad stains. In a study done
by Chan K.C, the discoloration
of enamel exceeded that of
cementum. Discoloration
factors was found to be super-
ior and ingressive for dentin
and cementum. Discoloration
of cementum exceeded that of
dentin, and dentin stained more
than enamel. Coffee and soy
sauce stained the calcified den-
tal tissues more than the cola
beverage and tea. The longer
the staining time, the deeper
was the discoloration.

Iron-fortified beverages can con-
tribute to iron deficiency. Soy
sauce contains moderate levels
of iron, but the high amount
of sodium and potassium in
the soy sauce can cause high
levels of sodium in the body,
resulting in water retention
and swelling.

Balsamic vinegar is deeply pig-
mented causing teeth discolora-
tion. The polyphenols in balsamic
vinegar have antioxidant proper-
ties, both in vitro and in vivo.

Wild blueberries are rich in
polyphenols and have several
health benefits. For example,
blueberry extracts may reduce
the decline of cogni-
tive and behavioral function
in the aging process. Antioxy-
radicals in blueberries have
teeth-protective properties,
both in vitro and in vivo.

Even if the deep berry blue color
can cause deep staining, aren’t
all the benefits cited above
worth staining teeth?

3. Betel leaf: India, Pakistan

The betel (Piper betle or Paan)
is the leaf of a vine belonging
to the Piperaceae family, which
includes pepper and kava. Ex-
ploratively the leaves of Pi-
er betel, an evergreen perennial
vine, are a reservoir of phenolics
with antioxidant and antiinflammatory
activities. It is a compound of natural substances
chewed for its psychoactive
effects. Studies showed that
oral feasting of betel leaf extract
(BLE) significantly inhibited the
growth of human prostate.

It is believed that chewing be-
tel quid could reduce stress,
strengthens teeth and maintains
oral hygiene.

Approximately 200 million
persons chew betel regularly
throughout the western Pacific
basin and south Asia. There is
copious production of a blood-
dered saliva that can stain oral
structures. After years of chew-
ing, the teeth may become red-
from nearly black.

4. Liquorice

It is a uniquely tasting herb de-
gived from Glycyrrhiza glabra,
and has been used in medicine

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Conservative Care and Treatment of TMJ Dysfunction in Dental Patients

By Shivani Sarthi, Physical Therapist (TMJ Specialist)

Each year, the number of reported cases of TMJ dysfunction patients in- increases, with factors ranging from stress, trauma to the jaw, post-dental procedures, or other facial surgeries. TMJ suffers growing. TMJ dysfunc- tion is defined as a term covering a high number of muscles of mastication and the temporomandibular joints.

The symptomatic picture of a TMJ patient does vary signifi- cantly, and can include muscle spasms, joint pain, an inability to fully close the mouth, and difficulty chewing. Recent studies show that more females than males suffer from TMJ symptoms, most of which, are in their childbearing years.

The conventional methods used to treat TMJ dysfunction include: Botox to relax specific muscle groups (masseters), or- thodontics (braces, retainers, mouth guards), and in some cases, surgery. There exist options in the field of physical therapy for patients looking for an alternative health approach. Specialized treatment that soft tissue release and joint mobilization, alone, has had a profound affect on the re- sults and outcomes of TMJ suffers. Application of intra-oral technique to release the laryngeal pterygoid and myo- fascial release to the anterior neck component are two exam- ples of treatment goals. Both techniques increase circulation pres- sure on the jaw caused by hyper- toned muscle groups.

There is a demand placed on oral surgeons and dentists, to be more aware of the com- plexity of treatment, specifically after oral surgery, and dental procedures in which the jaw is open and overstretched (beyond normal range), for a long period of time. A patient may experience trauma is- sues that derived mainly from tobacco contents rather than just liquorice. Adjacent re- gard to tooth staining derives mainly from added dyes to tooth- tooth staining. Interestingly, oxy- genating agents or CHX may reduce this staining. A review done by Van Maaalen-Schakel NW, searched the literature for data concern- ing the effect of an oxygenating agent (O3) on CHX- containing toothpastes. There was moderate evidence that a combination of CHX and an OA reduces tooth staining without interfering with plaque growth inhibition.

Most of the search into stain for- mation has been carried out on chlorhexidine, although there are other anitplaque which cause staining to a lesser extent and factors mechanisms present could be applicable to stain- ing found with poyvalent met- als. The characterising stain of the tongue and teeth noted by Flotra is not peculiar to chlorhexidine, it has been re- ported in other cationic antiseptics,

An essential oil/phenolic product may cause staining. To help maintain optimal TMJ functioning and help manage pain and discomfort. Treatment and management of TMJ is a joint effort between pa- tients and dental professionals and can be effectively treated through specialized physical therapy modalities used in extrin- sic stain accumulation after six weeks, with increased accu- mulation after 12 weeks versus brushing alone.

Polyvinylpyrrolidone (PVP) (a polymer used as a synthetic blood plasma substitute and in the cosmetic, drug, and food- processing industries) was shown in vitro to reduce chlo- rhexidine mouthrinses, dietary stain- ing without affecting the uptake of the antiseptic to the test sub- strate. A study in vivo aimed to determine whether PVP affected plaque and dietary staining by a low concentration chlorhex- idine rinse. Tooth stain areas were comparable for placebo, 0.05% and 0.006% chlorhexidine rinses, but significantly reduced with the PVP/chlorhexidine rinses, but at the expense of some loss of plaque inhibition.}

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for thousands of years, Glycy- rhrina is 50 times sweeter than sucrose. It retains, when sapid, a singular liquorice flavour. The liquorice sweetness has a slow- er onset than sugar and lingers. Unlike artificial sweeteners like aspartame, satchfez, and packets of sugar, liquorice, it contains no sulfur molecul.

For the treatment of bronchial asthma, the root of liquorice (Glycyrrhiza glabra) has been used as a traditional medicine in the East and West. Licorhicalone A is the predominant, character- istic chalcone in liquorice root which might be involved in the pathogenesis of virus-exacerbat-

Liquorice is used as a flavorant in a variety of edibles, medi-
cine, and tobacco, and is often incurred as consumed in vast amounts without any regard or only with vague concepts of side effects.70 Liquorice taste is called hyperadrenocorti- cism which presents with typical symptoms including high blood pressure, low blood potassium, muscle pain, and weakness.

Liquorice may induce hyperten-
sion71 because excessive licorice consumption can precipitate a severe hypertensive event through activation of renal min-
eralocorticoid receptors.72

Besides the hypertension prob-
lem, liquorice may cause teeth and tongue staining. Glycyrrhizin by itself does not stain teeth, but when combined with dark food dyes, tobacco and/or cur-
ries, liquorice is associated with tooth staining. Tobacco stained, black liquorice is known, but the tooth staining derives mainly from added dyes to liquorice confections and from liquorice-flavoured tobacco. Liquorice staining with dark caramel and leaves from chewing tobacco, experience dramatic change in the teeth. Tooth staining, in the form of extrinsic or internal tooth staining which leaves a surface brownish/black tongue stain. This tongue staining is usu-
ally and disappear after a few hours.

Health care workers, including all in the dental team, discover-
ing new hygiene techniques help to relieve pres- sure on the jaw caused by hyper- toned muscle groups.

Recent studies show a link be- tween stress and the jaw, to TMJ. Specific triggers such as stress, intake and smoking, for exam-
ple, have an effect on sleep qual-
ity, and therefore, may promote bruism at night. Bruism, is a neurologic, sleep movement disorder characterized by grind- ing or clenching of the teeth in our sleep. This disorder is very damaging to the teeth and the jaw, and also causes fa-
tigue and pain to the facial mus-
cles. Lifestyle changes and sleep hygiene techniques can be enforced by the physical therapist, to help maintain optimal TMJ functioning and help manage pain and discomfort. Treatment and management of TMJ is a joint effort between pa-
tients and dental professionals and can be effectively treated through specialized physical therapy modalities used in extrin-
sic stain accumulation after six weeks, with increased accu-
mulation after 12 weeks versus brushing alone.73

Polyvinylpyrrolidone (PVP) (a polymer used as a synthetic blood plasma substitute and in the cosmetic, drug, and food-processing industries) was shown in vitro to reduce chlo-

ered. A study showed that CHX mouthwash was more effective than a control and than chlorhexidine containing toothpaste but caused greatest depopulation of extrinsic stains. Supragingival calculus deposition was least in tricosan Na’s group followed by CHX + tricosan + Na+ + ZnCl2. CHX, more than half of the sub-
jects reported adverse events during the experimental phase.74

Thus although chlorhexidine di- glucanote (CHX) is currently the most effective mouthwash for reducing plaque and gingivitis than chlorhexidine con-}
cantly increased compared to the other 3 rinses. The antiadhesive/chlorhexidine rinse demonstrated the highest antiadhesive, antiplaque, or anti-water rinse.

However, the parallel plaque regrowth study suggested this inhibition of staining resulted from the oral hygiene activity by the anti-adhesive.  

b - Cetylpyridinium chloride: Cetylpyridinium chloride (CPC) is a cationic quaternary ammonium compound that is used in many types of mouthwashes, toothpastes, cough pastes, throat sprays, gargles, and eye drops. It is an antiseptic that kills bacteria and other microorganisms. It is used in toothpaste in preventing dental plaque and reducing gingivitis.

It has also been used as an ingredient in certain pesticides. Cetylpyridinium chloride may cause burning of the mouth and throat and on their surfaces. However, these stains can be easily removed by toothpaste and rinsing during a routine check up.

As known, Cationic antiseptics such as chlorhexidine (CHX) and cetylpyridinium chloride (CPC) are often used to inhibit plaques due to their capacity to produce extrinsic stain, and can be used as a main ingredient for the fabrication of toothpastes. A study was done in vitro to determine if toothpaste influenced the inhibitory effect of CHX and CPC as a predictor of action in vivo. Little staining was seen when CPC was mixed to CHX toothpastes, and CPC combination was used immediately after the antiseptics. The results have shown the concept of separating the use of antiseptics until sometime after the use of toothpaste, and the idea of developing mouthwash friendly toothpastess.

8 - Chromogenic Bacteria Chromogenic Bacteria: Chromogenic bacteria cause stainless discoloration and are received liquid Amoxicillini for a prolonged period of time. Chromogenic bacteria are the staining role of extrinsic stains of the teeth which can be seen in children and can sometimes be insinuate if the bacteria affect the tooth during development stage. The black stain in the cervical region are due to the Actinomyces species bacteria. The bacteria produces color of the teeth responsible for oral malodour, which react with iron in the saliva to produce a dark brown form a bacterial plaque that is usually black or has black discoloration to it.8 Green stains are attributed to fluorescein bacteria and fungi such as Penicillium and Aspergillus species.

A recent study has investigated the effect of the blacks pigmented bacteria Prevotella nigrescens and Prevotella intermedia on the caries process in the experimental induced periodontal disease in rabbits. The results showed that the extrinsic stain coincide with the color of the sulphide of the metal component.46 Even the margins of the gums, at the base of the teeth, can present stains. A technique to measure this stain was the Burmanto line which is a clinical sign found in patients with lead poisoning.

Drug-induced tooth discoloration can be avoided by prescribers of well-known offending drugs known to cause tooth discoloration. This is particularly true of antibiotics in the dental biofilm of patients with or without black extrinsic tooth stains, using the multiplex polymerase chain reaction (PCR) technique. The result showed that the similar bacterial composition of dental biofilms of black tooth stains and severely discolored surfaces that black tooth stains are not free of cariogenic bacteria.

9 - PROFESSIONAL INTOXICATION: Iron dust Copper sulfate

Iron deficiency is estimated to be the most common nutritional deficiency in both developed and underdeveloped nations.  

Iron supplements are generally consumed as a result of growth or drops for children. Besides its undesirable taste, one of its main problems is that iron is not easily absorbed by the body after consumption.

The quality of the consumed drinking water may also affect oral health. For example, the post-treatment of tap water may cause aesthetic problems in the dental enamel color.17 The availability of extrinsic stains of the teeth in our society today because of the presence of numerous chromogenic products on the market as well as environmental chemicals. In addition to that, esthetics has become a top priority for patients, because a bright smile is now a must for social integration and strengthened self-esteem.

References


5 Suryaprath, H., Rajesh, V., and K. C. Z. C. S. S. Brushing teeth before consuming iron supplements is effective on decreasing iron stain ing and a simple scaling by the dentist is sufficient to remove these stains.4 Adcock et al. Copper causes a green stain in mouthstains containing iron.49,50 Even the margins of the gums, at the base of the teeth, can present stains. A technique to measure this stain was the Burmanto line which is a clinical sign found in patients with lead poisoning.

Drug-induced tooth discoloration can be avoided by prescribers of well-known offending drugs known to cause tooth discoloration. This is particularly true of antibiotics in the cervical region which is a clinical sign found in patients with lead poisoning.

Conclusion

The etiology of tooth staining is important in making a proper diagnosis and the elimination of caus e of discoloration to the patient and, in some instances, in help ing the dentist establish a treatment plan. He may even refuse to perform the whitening pro cedure in cases of rapid relapse risk such as in heavy smokers.

Different clinical indices and photometric techniques have been used in order to evaluate extrinsic stains. Several parameters are used to identifying the extent of stain, and two major factors are included:

In order to differentiate between extrinsic and intrinsic discoloration, the degree of stain is used with a dental explorer or scaler instrument over discoloration that cannot be removed by a clear adhesive plaque will be removed by a light scratching. Tenacious stains are removed with a sharp dental scaler. Intrinsic discoloration cannot be removed by using the scratch test. Tooth discoloration is a major concern in our society today because of the presence of numerous chromogenic products on the market as well as environmental chemicals. In addition to that, esthetics has become a top priority for patients, because a bright smile is now a must for social integration and strengthened self-esteem.


