Black is Back
Remineralization in the 21st Century

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CHICAGO DENTAL SOCIETY
In 1853, the first known reference to silver nitrate was published in a dental textbook. In 1965, Dr. Mizuho Nishino did her PhD thesis on silver diamine fluoride. Why has it taken 53 years for this to come to American dentistry? Throughout history, mankind has constantly searched for better ways to do things. This program focuses on the innovations and advancements in remineralization products and technologies that will influence and change the delivery of care we provide our patients tomorrow.

After this course, you will be able to:

- Compare the latest products engineered to deliver calcium and phosphate and how they interact
- Review protocols and techniques for SDF placement
Course Outline

I. The New Paradigm in Preventive Dentistry
   a. Shift from a “repair model” to a “health-oriented model”
   b. Why do we resist change? How can we accomplish new protocols and gain staff acceptance?
   c. 80% of all dental caries occurs in only 20% of the U.S. Population
   d. Economic Burden: mean spending in dental care in adults ages 55-64
      i. Spent est. 108 billion dollars in dental – half of this was treating dental caries
      ii. Projection to $180 billion within next 10 years.
   e. Balancing the “ethical” treatment decisions with “third party payment” choices?
      i. ADA center for evidence-based decisions: www.ebd.ada.org/
   f. Achieving the goals set by “Healthy People 2010 and 2020” – U.S. Surgeon General Report
   g. AAPD guideline for starting a dental home: Within 6 months of first tooth erupting.
      “In order to prevent dental problems, your child should see a pediatric dentist when the first tooth appears, or no later than his/her first birthday.”

II. The CARIES BALANCE CHART
   Proposed by Featherstone in 1999 - Recognized the caries process as:
   • Multifactorial
   • Balance between factors (BAD) Pathological and (SAFE) Protective factors
   • Balance is delicate and swings either way several times daily in most people
   • If Pathological factors outweigh the Protective factors, the risk is greater that caries will initiate/progress
   • The RISK FACTORS tell us “HOW” it happened?
      • Additional reading: https://www.cda.org/Portals/0/journal/journal_102007.pdf
   
Adapted by Doug Young et el, 2012 Community Dental Oral Epidemiology. Added SAFER

a. Caries is a multi-factorial disease “process” that involves:
   i. Time, Microflora, Host and Diet
      • Current attention focused on 3 other dynamics in this model: Salivary flow, saliva buffering capacity and fluoride exposure
   ii. Role of Saliva:
      • Buffering capacity
      • Preserves integrity of dental and oral tissues
      • Antimicrobial activity
      • Immune surveillance
      • Natural reservoir for fluoride, calcium and phosphate ions
a. Fluoride is LESS effective in the absence of CA and P ions in saliva

iii. Impact of Fluoride:
- Supports natural remineralization
- Inhibits bacterial metabolism
- Inhibits demineralization
- Promotes remineralization
- Fluoridated drinking water adds a strong “protective value” on CAMBRA
- Some bottled waters now contain fluoride – check bottles for labeling
  a. Reference: Nelson T. “Consequences of Convenience” Dimensions of Dental Hygiene, Feb 2012: (10)2; 31-34. Chart on page 32 of all bottled water

- Fluoride Concentration
  a. Silver Diamine Fluoride 44,800 ppm
  b. Varnish 22,600 ppm
  c. APF (in office) 12,300 ppm
  d. NaF (Rx) 9,000 ppm
  e. Rinse (Rx) 3,300 ppm
  f. MI Paste w/F 900 ppm
  g. SnF w/ACP (Enamalon) 970 ppm
  h. Act Fluoride Rinse 200 ppm

- Fluoride Options
  a. Color – White or clear
  b. Fluoride content - .25ml, .30ml, .40ml?
  c. Other special ingredients? Xylitol? ACP? CHX?
  d. Pine tree sap (Rosin or Colophony?) vs Shellac?
  e. Dispenser/Delivery system?
  f. Wet vs. Dry application?
  g. Uptake? (30 min., 2, 4 or 6 hours?)
  h. Taste

- Considerations
  a. Medicament and brush sold separate or connected
  b. Environmental issues/Waste
  c. Cost
  d. Ease of opening some of the containers
  e. Ease of spreading the medicament (wet vs dry)
  f. Restrictions after application (eating and drinking and time)
  g. Flavor options-Consider trying the ones you use.
**JADA Reprint on Professionally-applied Topical Fluoride:**
Executive Summary of Evidence-based Clinical Recommendations
(http://www.ada.org/~/media/ADA/Science%20and%20Research/Files/report_fluoride.ashx)

- a. Recommendations based on patient risk level
- b. Patients classified as “low risk” receive no additional benefit with routine 2x/year fluoride applications (in-office)
- c. **4 Minute fluoride application** is only acceptable therapy when gel/foam is used (1 minute is NOT recommended any longer)
- d. Fluoride varnish is highly effective in caries prevention and suggested every 6 months (or less) for higher risk children

**ADA Professional Product Review**

A service Provided by the council on Scientific Affairs for the members of ADA

Fluoride Varnish & SDF: Fluoride Analysis & Clinical Guidance 11/2017

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<table>
<thead>
<tr>
<th>Fluoride</th>
<th>Treatment Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Fluoride (NaF) Most common</td>
<td>Caries</td>
</tr>
<tr>
<td>Monofluorophosphate (MFP)</td>
<td>Caries</td>
</tr>
<tr>
<td>Stannous Fluoride (SnF₂) cariostatic and antimicrobial <em>Staining issues</em></td>
<td>Caries, Hypersensitivity, Plaque/Gingivitis</td>
</tr>
</tbody>
</table>
**LAB REPORT**

Fluoride Release and Availability

### Products tested for fluoride release

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
<th>Fluoride Source</th>
<th>Carrier (% by wt.)</th>
<th>Solvent (% by wt.)</th>
<th>Ca-P</th>
<th>Component</th>
<th>Other Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duraphat</td>
<td>Colgate</td>
<td>5% NaF</td>
<td>Colophonium</td>
<td>30 - 60</td>
<td>Ethanol</td>
<td>TCP* (&lt; 5%)</td>
<td>n-Hexane (10-15%), flavor enhancer (1-5%), thickener (1-5%)</td>
</tr>
<tr>
<td>Vanish White Varnish</td>
<td>3M ESPE</td>
<td>5% NaF</td>
<td>Pentauryltyl glycerol ester of collophory resin</td>
<td>30 - 75</td>
<td>Ethanol</td>
<td>TCP* (&lt; 5%)</td>
<td>Polyvinyl acetate (30-50%), silicon dioxide (1-5%), flavoring</td>
</tr>
<tr>
<td>MI Varnish</td>
<td>GC America</td>
<td>5% NaF</td>
<td>Hydrogenated rosin</td>
<td>10 - 30</td>
<td>Ethanol</td>
<td>CPP-ACP*</td>
<td>Polyvinyl acetate (30-50%), silicon dioxide (1-5%), flavoring</td>
</tr>
<tr>
<td>Prevident</td>
<td>Colgate</td>
<td>5% NaF</td>
<td>Methylhydrogenated rosinate</td>
<td>Ethanol</td>
<td>Ethanol</td>
<td>Xylitol (sweetener)</td>
<td></td>
</tr>
<tr>
<td>NuPho White Varnish</td>
<td>Dentsply</td>
<td>5% NaF</td>
<td>Urethane dimethacrylate resin* and hydrogenated rosin</td>
<td>30 - 40</td>
<td>Isopropl alcohol</td>
<td>Titanium dioxide; natural and artificial flavors</td>
<td></td>
</tr>
<tr>
<td>Duraflor Halo</td>
<td>Medcom</td>
<td>5% NaF</td>
<td>Synthetic resin</td>
<td>50 - 70</td>
<td>Ethanol</td>
<td>Ethanol</td>
<td>Xylitol (sweetener)</td>
</tr>
<tr>
<td>SDF</td>
<td>Elevate</td>
<td>38% SDF</td>
<td>DI Water</td>
<td>≤ 62.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*TCP = tri-calcium phosphate; CPP-ACP = Casein phosphopeptide-amorphous calcium phosphate.

▲ Table 1. List of materials included in the experiment, along with their components (as compiled from publicly-available sources, including published studies, informational product package inserts, and product safety data sheets).

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**Evidence-Based Clinical Practice Guideline on Nonrestorative Treatments for Carious Lesions: A Report from the American Dental Association**

### Clinical Pathway for the Nonrestorative Treatment of Carious Lesions on Permanent Teeth

#### Occlusal

- Noncavitated
  - Sealants + 5% NaF Varnish*, or
  - Sealants Alone

  **If not feasible**
  - 5% NaF Varnish*, or
  - 1.23% APF Gel®, or
  - 0.2% NaF Mouthrinse®

- Cavity
  - 1.23% APF Gel®, or
  - 5% NaF Varnish*

#### Facial or Lingual

- Noncavitated
  - 5% NaF Varnish*, or
  - Resin Infiltration Alone, or
  - Resin Infiltration + 5% NaF Varnish*, or
  - Sealants Alone

- Cavity
  - 5,000 ppm F (1.1% NaF) Toothpaste or Gel®

**If not feasible**

- 5% NaF Varnish*, or
- 38% SDF**, or
- Potassium Iodide Solution®
- 38% SDF Solution Alone** or
- 1% Chlorhexidine + 1% Thymol Varnish®

Lesions should be monitored (e.g., hardness, texture, color, radiograph) periodically throughout the course of treatment.

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**Notes:**
- *Eild and nF = fluoride
- APF = acidulated phosphate fluoride
- SDF = stannous fluoride
- F = fluoride
- DCI = Decayed, Carious, and Inflamed
- *Defined as International Caries Detection and Assessment System (ICDAS) 1 and 2 lesions.
- **Defined as ICDAS 5 and 6 lesions.
- †Application every 2-6 months.
- The order of treatments included in this recommendation represents a ranking of priority defined by the potential for successful noninvasive, nonrestorative treatment, taking into account the patient's preferences, medical needs, or insurance status.
- **Intragranular lytic and don't offer if patient is sensitive to fluoride treatments or if patient has a history of fluoride intolerance.
- †Indicated for patients who will not comply with oral hygiene instructions.
- **Administered once per week.
- †Intermittent application.
- **Intragranular lytic and don’t offer if patient is sensitive to fluoride treatments or if patient has a history of fluoride intolerance.
- †Indicated for patients who will not comply with oral hygiene instructions.
- **Administered once per week.
- †Intermittent application.

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**ICDAS** (International Caries Detection & Assessment System)

**ADA – Caries Classification System**

<table>
<thead>
<tr>
<th>I</th>
<th>Visible only after drying</th>
<th>No enamel breakdown</th>
<th>1 Caries with Or</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Visible wet</td>
<td>No enamel breakdown</td>
<td>Without Drying</td>
</tr>
<tr>
<td>III</td>
<td>Breakdown into dentine</td>
<td>Dentine initial caries</td>
<td>2 Moderate Enamel</td>
</tr>
<tr>
<td>IV</td>
<td>Gray area showing through</td>
<td>Dentine involved Only 5%</td>
<td>Caries</td>
</tr>
<tr>
<td>V</td>
<td>Cavitation into dentine</td>
<td>Dentinal caries</td>
<td>3 Distinct Cavitation</td>
</tr>
<tr>
<td>IV</td>
<td>Cavitation and breakdown</td>
<td>Severe breakdown</td>
<td>Extensive</td>
</tr>
</tbody>
</table>
III. **Remineralization Technologies:**  
**ATTACHED CHART:** Products formulated to strengthen enamel using Ca/P and Fluoride

- a. ACP: Amorphous Calcium Phosphate (ADA patented ACP)  
- b. CPP-ACP: Casein Phosphopeptide; amorphous calcium phosphate (Recaldent)  
- c. CSPS: Calcium Sodium Phosphosilicate (Novamin)  
- d. Arg: Arginine Bicarbonate (Pro Argin)  
- e. TCP: Beta Tri-Calcium Phosphate

Classified by:  Mechanism of Action, Solubility/Bioavailability and Professional Brand  
Products utilizing the technology

VI. **ADA recommendations: OTC fluoride toothpaste**

- *Smear* (0.125 g) as soon as first tooth erupts until age 3  
- *Pea-sized amount* (0.25 g) from age 3 to age 6  
- *Age 6 onwards:* Strip of toothpaste

*Consider spitting out. NOT rinsing. Dilutes the Fluoride.*
### Product information - see my web site at JudyBendit.com

http://judybendit.com/additionalproductlinks.htm

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>ACP</th>
<th>CPP-ACP</th>
<th>CSPS</th>
<th>TCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amorphous Calcium Phosphate</td>
<td>Casein Phosphopeptide - Amorphous Calcium Phosphate</td>
<td>Calcium Sodium Phosphosilicate</td>
<td>Beta Tri-calcium Phosphate</td>
<td></td>
</tr>
<tr>
<td>ADA licensed ACP</td>
<td>(Recaldent®)</td>
<td>(Novamin®)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Mechanism of Action

<table>
<thead>
<tr>
<th>Specialized salt compounds binds Ca/P ions until delivery</th>
<th>Casein binds to tooth surface &amp; plaque until pH is lowered (acidic) This creates Ca/P ions to become available</th>
<th>Silica binds Ca/P until sodium elevates pH to free CA/P ions</th>
<th>Blended beta tri-calcium phosphate encapsulates the Ca/P ions until reactive with saliva</th>
</tr>
</thead>
<tbody>
<tr>
<td>(amorphous) No defined or crystalline structure</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Solubility & Bioavailability

<table>
<thead>
<tr>
<th>Rapid delivery</th>
<th>Becomes soluble only during lowered pH/acidity</th>
<th>Becomes soluble when sodium buffers pH to release Ca/P ions</th>
<th>Low to moderate rate of solubility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly soluble &amp; Bioavailable</td>
<td>More effective with inclusion of Fluoride</td>
<td></td>
<td>Highly structured crystalline form</td>
</tr>
<tr>
<td>Greatest fluoride uptake</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Professional Products

<table>
<thead>
<tr>
<th>Premier Dental</th>
<th>GC America</th>
<th>DENTSPLY</th>
<th>3M</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENAMEL PRO</td>
<td>MI Paste</td>
<td>MI Paste Plus</td>
<td>Vanish F</td>
</tr>
<tr>
<td>5% F Varnish/ACP</td>
<td>MI Fluoride Varnish</td>
<td>MI paste ONE</td>
<td>varnish/TCP</td>
</tr>
<tr>
<td>Pro Paste/ACP</td>
<td>MI paste ONE</td>
<td>NuSolutions</td>
<td>Clinpro 950/TCP</td>
</tr>
<tr>
<td>Na F Gel /ACP</td>
<td></td>
<td>5,000ppm</td>
<td>Clinpro 5000/TCP</td>
</tr>
<tr>
<td>Discus (Philips)</td>
<td>Cadbury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day/Nite</td>
<td>Trident chewing gum w/ Recaldent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/ACP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relief Oral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gel/ACP</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Arm & Hammer® | | | |
| Truly Radiant™/ACP | | | |
| Enamel Care in Canada | | | |

<table>
<thead>
<tr>
<th>Cadbury</th>
<th>Discus (Philips)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Newest products: Black is Back...


Code:

- **D1354** - Interim caries arresting medicament application ($19.52 - Medicaid reimbursement)**
- D1208 - Topical application of fluoride
- D9910 - Application of a desensitizing medicament, per visit
- D1999 - Unspecified preventive procedure by report
- **Note**: The ADA Code Revision Committee approved in March 2017 the change from “per application” to “per tooth” beginning January 1, 2018.

Descriptor: Conservative treatment of an active, non-symptomatic carious lesion by topical application of a caries-inhibiting medicament and without mechanical removal of sound tooth structure.

The procedure:

1. Wear standard personal protective equipment (PPE), and make sure the patient is wearing safety glasses and plastic-lined bib.
2. Dispense one to two drops of silver diamine fluoride into a plastic dappen dish, depending on how many teeth you are treating. One drop will treat five surfaces.
3. Apply scented lip balm to the patient's lips to help mask the smell of the silver diamine fluoride as it is placed in the mouth.
4. Use a saliva ejector when possible.
5. Isolate the tongue and cheek from the affected teeth using gauze or cotton rolls. Absorbent triangles work well.

6. Consider applying petroleum jelly to proximal gingival tissue with a cotton applicator for safety. This could help to prevent staining of the gingiva if the silver diamine fluoride touches it.

7. Dry affected tooth surfaces with a cotton swab.

8. Immerse a microbrush into the solution in your dappen dish and remove any excess on the side of the well. This is best done with a dental assistant to avoid spilling. Don’t use glass dappen dish/solution will etch glass.

9. Apply it directly onto the affected tooth surface(s) with the microbrush.

10. Allow the silver diamine fluoride to absorb for at least one minute.

*** Consider adding Fluoride varnish over the SDF to keep it contained on surface***

11. Invert all used cotton, the microbrush, and the dappen dish into a glove so it can't drip on any surface or skin. Dispose of it in a trash can.

Silver diamine fluoride became available in the United States in 2015. It is indicated as a treatment of tooth sensitivity but has been used to treat and prevent caries in young children, in some parts of the world. In two controlled trials, application of silver diamine fluoride was reported to "arrest" caries lesions in ≥96 percent of cases

Elevate Oral care http://www.elevateoralcare.com

https://www.youtube.com/watch?v=_NhymbuWyjM  DR. Graham Craig MDS, PhD on Riva Star

References


8. https://www.pbs.org/newshour/show/this-new-treatment-could-make-your-next-trip-to-the-dentist-more-bearable


Notes: