Dental Caries Prevention Strategies for the Pediatric Dental Patient

Southcentral Foundation Pediatric Dental Service
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Making a cavity

- Tooth
- Bacteria
- Fermentable carbohydrate
Early Childhood Caries

Early childhood caries (ECC) is the presence of 1 or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger.

In children younger than 3 years of age, any sign of smooth-surface caries is indicative of severe early childhood caries (S-ECC).

From ages 3 through 5, 1 or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth, or a decayed, missing, or filled score of >4 (age 3), >5 (age 4), or >6 (age 5) surfaces constitutes S-ECC.
Dental Caries in Children

- ECC (BBTD, Nursing Caries)
  - Related to feeding practices
  - Cultural influences
  - Geographic influences

- Rampant Caries
  - Variation in caries pattern
  - Correlated with carbohydrate consumption
Etiology

- How does the decay process start?
  - Must acquire the bacteria (MS)

- How is MS acquired?
  - Transmission from source
    - Direct vs. Indirect
    - Vertical vs. Horizontal

- Window of infectivity

- Mean age at colonization is 15.7 months
Higher levels of *S. mutans* are associated with untreated tooth decay, thus, infants of mothers with untreated tooth decay are at higher risk of acquiring the bacteria.
Caries Risk Assessment

• Single greatest predictor of future cavities is a past history of cavities
Caries in Primary Teeth

- Primary Teeth Caries progress faster:
  - Lower mineral content
  - Enamel and dentin thinner
  - Large pulp
- Flat contacts make interproximal diagnosis more difficult
- Caries sequence: mand molars, max molars, max anteriors
- Second molars more susceptible than first molars
Fluoride: Mechanisms of action

- **Systemic**
  - Improves crystallinity
  - Reduces acid solubility
  - Improves tooth morphology

- **Topical**
  - Inhibits demineralization
  - Promotes re-mineralization

- **Antibacterial**
  - Concentrates in plaque
  - Disrupts enzyme systems
Re-mineralization equation

\[ \text{Ca}_{10}(\text{PO}_4)_6\text{(OH)}_2 + 20 \text{F}^- \rightarrow 10\text{CaF}_2 + 6\text{PO}_{4-3} + 2\text{H}_2\text{O} \]

Hydroxyapatite + High fluoride \rightarrow Calcium fluoride + phosphate + water

\[ \text{Ca}_{10}(\text{PO}_4)_6\text{(OH)}_2 + 8\text{H}^+ \rightarrow 10\text{Ca}^{+2} + 6\text{HPO}_4^- + 2\text{H}_2\text{O} \]

Hydroxyapatite + Acid \rightarrow Calcium + phosphate + water
“It cannot be assumed that because a person resides in community with nonfluoridated water, he or she is receiving low levels of fluoride.”

An Update on Fluoride and Fluorosis
Steven Levy, DDS, MPH
J Can Dent Assoc 2003; 69(5):286-91
Optimal Fluoride Intake

- Paradigm Shift

- McClure - threshold: 0.10 mg/kg of body weight established in 1943
- Burt – 0.05-0.07 mg/kg as threshold limit
  - To include all sources of fluoride

- Goal:
  - Maximize caries prevention while minimizing fluorosis
Sources of Fluoride (many more than 50 years ago)

- Tap water
- Bottled water
- Milk and Infant formula
- Other dietary sources
- Oral home care products
- Professional applications
- Prescription tablets or drops
Tap Water

- The major source of dietary fluoride in US
- EPA max 4 ppm; secondary limit of 2 ppm
- PHS recommends 0.7-1.2 ppm
- 66% of Americans drink optimally fluoridated water (CDC 2002)
- Water filters
Water Fluoridation in Alaska

- Population with optimally fluoridated water
  - 1992 – 61%
  - 2000 – 55%

- Ranks 36th among all states

- Cities with optimal fluoridation include:
  - Alakanuk, Barrow, BBAHC – Kanakanak Hospital, Bethel Heights, Bethel City, Craig, Dillingham, Elim, Galena, Fairbanks, Hoonah, Juneau, Kaltag, Kotzebue, Marshall, McGrath, Anchorage (including Girdwood), Nome, Noorvik, Ouzinkie, Palmer, Petersburg, Saint Paul, Selawik, Shaktoolik, Sitka, Tooksook Bay, Unakleet, White Mountain, Yakutat

*all homes may not be on the water system*
Benefits of Fluoridated Water

- Reduced decay in primary teeth 60%
- Reduced decay in permanent teeth 35%
- Current estimates are 15-40%
- Average cost is $0.50 - $3.00 per person/year
- For every $1.00 spent, saves $38 in dental treatment costs
Bottled Water

- 2004 – 23.8 gallons consumed per person in the US
- FDA requirement for testing
- Standards set by the FDA
  - Must label if added; upper limit at 1.7ppm
  - Naturally occurring upper limit set at 2.4 ppm
  - No minimum fluoride concentration
  - Must call manufacturer to get fluoride level information
Milk

- Breast Milk and Cow’s Milk
- Infant formula
  - 1970s – some found to contain very high levels
  - Current range 0.04 – 0.55 ppm
  - Soy based have consistently higher levels
  - Reconstituted with fluoridated water?
    example: powder formula (0.3 ppm) reconstituted with 1 ppm water will give 100-200 times the fluoride of breast or cow’s milk
Other Beverages

- Fluoride content parallels processors water
  - Variation is wide, even from same company

- Pang et al - fluoride intake from beverages (not water or milk) found:
  2-3 yo: 0.36mg/day
  4-6 yo: 0.54mg/day
  7-10 yo: 0.60mg/day

- Tea – raw tea leaves up to 400 ppm fluoride
  - One cup of tea (200 ml) could yield 0.6 mg
Grape Juice

- Highest fluoride beverage (0.05-2.8 ppm)
  - Another report found up to 6.8 ppm

- Cryolite (sodium aluminum fluoride)
  - EPA allows up to 7ppm fluoride
  - More than 30 fruits and vegetables
    - Apricots, blackberries, broccoli, cabbage, cauliflower, cranberries, cucumbers, grapes, lettuce, melons, peaches, peppers, plums, squash, strawberries, tomatoes
    - Level at 2 ppm for potatoes, which are second only to grapes for use of cryolite
Soft Drinks

- Soda: consumption doubled since 1971
- 56% of 8-year-olds drink soft drinks daily
- Sold in 60% of all middle and high schools***
- Heilman - 71% soda contain >0.6 ppm
Soft Drinks in Schools

• Beverage distributors agreement with the Clinton Foundation and the AHA
  – Only water, unsweetened juice, low-fat milk
  – Diet soda to high schools only
  – “the vast majority of schools”
  – When???
    • Depends on school district
    • Goal – 75% by 2008-2009 school year

• Anchorage Obesity Task Force
Other Dietary Sources

- Infant Chicken products – 0.6-10.6 ppm
- Tinned fish – up to 40 ppm
- Dried seafood – 3-290 ppm
- Food generally contributes only 0.3-0.6 mg of the daily intake of fluoride
Fluoride in Toothpaste

- 90% sold in the US contain fluoride
- Fluoride ranges from 1000 to 1500 ppm (1mg/g or 0.1%)
- 2-5 year olds ingest 30-59% dispensed
- Toothpaste amount should equal a grain of rice or a “smear”
- Caries prevention = 30-50%
Fluoride Toothpaste

- Fluoride toothpastes for preventing dental caries in children and adolescents (Cochrane Review 2005)
  - 74 studies involving 42,300 children
  - Children 5 to 16 who used a fluoridated toothpaste had fewer DMFT after 3 years
  - Twice a day use increases the benefit
  - The benefits of fluoride toothpastes are firmly established
Fluoride Rinses

- OTC rinses have 0.05% NaF for daily use
  - = 0.022% F ion or 220 ppm
- Indications:
  - High risk rampant caries, who can expectorate (usually over 6 y.o.)
  - Orthodontics
  - Radiation
  - Prosthetics
- Risks – alcohol in some; fluoride ingestion
- Benefit of .2% weekly rinse is about 34%
Combinations of Home Care Products

- **Combinations of topical fluoride (toothpastes, mouthrinses, gels, varnishes) versus single topical fluoride for preventing dental caries in children and adolescents** (Cochrane Review 2005)
  - 12 studies involving 4026 children
  - Topical fluorides (mouthrinses, gels, or varnishes) used in addition to fluoride toothpaste achieve a modest reduction in caries compared to toothpaste used alone
**Prescription Supplements**

<table>
<thead>
<tr>
<th>TABLE 1. Recommended dietary fluoride supplement* schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoride concentration in community drinking water†</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>0–6 months</td>
</tr>
<tr>
<td>6 months–3 years</td>
</tr>
<tr>
<td>3–6 years</td>
</tr>
<tr>
<td>6–16 years</td>
</tr>
</tbody>
</table>

* Sodium fluoride (2.2 mg sodium fluoride contains 1 mg fluoride ion).
† 1.0 parts per million (ppm) = 1 mg/L.

**Sources:**
Fluoride Supplements

• Which children?
• Indicated as the major risk factor for fluorosis in a number of studies
• Topical Benefit
• Compliance
Fluoride Gel Ingestion

- Typically contains 12,300 ppm for APF gel
- Ingested amount averages 10-35 mg when not using suction and 2-7 mg with suction
- Clearly exceed optimal levels, however these applications are infrequent
- Fluorosis risk is unclear
- Study of home gel application in 7-13 yo
  - ingested 30-98% of amount used (mean 67%)
Fluorosis

- Hypo-calcification of enamel due to excessive fluoride during tooth development
Fluoride Foam/gel

**Foam advantages**
- Limited ingestion potential
- Equal cost
- Compact storage
- Equal efficacy
- Patient acceptance
History of Fluoride Varnish

• Developed in the 1960’s as an alternative to conventional topical fluoride
• By the mid 70’s the benefits of FV’s were accepted in Europe and used extensively
• By early 1990’s almost 93% of all professionally applied topical fluoride in Scandinavia were varnishes.
• FV became available in the U.S. in 1991 when the FDA approved durafluor as a cavity liner.
Varnish vs Gel

- **Ease of application**
  - Less than 1 minute vs 4 minutes
  - No suction required
  - No trays required

- **Safety**
  - Concentration of varnish is 2x gel but amt is 10x less
  - APF gets swallowed as a bolus, varnish is “time released”
  - Toxic dose is 10x normal dose, gel toxic dose is 2x normal dose.

- **Effectiveness**
  - Uptake is similar to gel
  - Caries reduction of up to 40% (comp to APF)
  - More effective on occlusal fissures
Original Recipe
Advantages of Duraflor

- Effectiveness substantiated by many studies
- Available in the US
- Quick, easy administration
- Substantivity
- No sour taste, less acute ingestion risk
- No wait to drink (pop)
- No trays to cause patients to gag
- Fluoride levels remain low because varnish wears off over a matter of days rather than minutes
Current Recommendations

- Children 1-7 yo: goal to provide repeated addition of small amounts of fluoride to the oral fluids
- Delay use of fluoride supplements until after the 1st permanent tooth is erupted – use lozenges or chewable tablets
- Continue and extend community water fluoridation
- Fluoride supplements given to children 5 or younger only after establishing intake from all sources is < 0.25 mg/d
- Fluoride tabs or lozenges can be used as a topical; advise to suck on them slowly and not swallow immediately after application
- Counsel parents on toothpaste use in young children
- Canadian Dental Association

“Fluoride supplements need only be considered for patients at high risk for dental caries and even then may be unnecessary if patients are receiving adequate fluoride from other sources.”
Toxicity

- Probable Toxic Dose: 5 mg/kg of body weight
  - Average 5 year old would equal about \( \frac{1}{2} \) 8-oz tube
- Certainly Lethal Dose: 16-32 mg/kg
- Nausea, abdominal pain, and vomiting almost always accompany acute fluoride toxicity
- Diarrhea, excessive salivation and tearing, sweating, and generalized weakness may also occur
- No more than 120 mg of fluoride (224 mg of sodium fluoride) should be dispensed at one time
Treatment of Fluoride Toxicity

- Determine child’s weight and estimate ingestion
- If less than 8mg/kg – give milk and monitor for at least 6 hours
- If more than 8mg/kg – give milk, induce vomiting, ED
- If unknown dose – look for symptoms to determine treatment
Fluoride Varnish

- Both are 5% NaF
- Vanish - .50 mL
- Cavity Shield – .25 ml or .40 ml
- 22,600 ppm fluoride
- Recommend no other fluoride products that day
- 5% NaF = 225% F ion = 22,500 ppm or 22.5 mg/L = 11.25 mg/pkg
Technique

• Brush varnish from foil and mix in well
• teeth: ideally toothbrush clean, blot dry
• paint on varnish
• avoid hard foods, brushing, and alcohol for 4 hrs. minimum
• thorough brushing and flossing will remove varnish from dentition
Technique
Knee to Knee Exam
Fluoride Varnish

1. Open the foil package and stir
2. Dry the teeth with 2X2 gauze
3. Apply the varnish with the enclosed brush
4. Allow to air dry
5. POI
Contraindications

- Ulcerative gingivitis and stomatitis
- Colophony/colophonium allergy
Interactions

- Discontinue other gels and rinses for 24 hrs. after application
- Discontinue fluoride supplements for several days after application
Adverse reactions

- Edematous swelling and nausea are possible following extensive applications.
- Some patients complain of the appearance (color) Now available in white.
## Professionally applied Fluoride protocol

<table>
<thead>
<tr>
<th>Water F level</th>
<th>Caries status</th>
<th>Active caries (moderate risk)</th>
<th>Rampant caries (high and very high risk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deficient (&lt;0.7ppm)</td>
<td>None</td>
<td>Apply topical 2x per year</td>
<td>Consider topical 4x per year</td>
</tr>
<tr>
<td>Optimal</td>
<td>None</td>
<td>Apply topical 2x per year</td>
<td>Consider topical 4x per year</td>
</tr>
</tbody>
</table>
Specific Indications

- Newly erupted first permanent molars that cannot be properly sealed
- In conjunction with ART for pre-cooperative patients with ECC
- Adult special needs patients who cannot manage secretions
- After vital bleaching procedures
- In conjunction with OHI for Orthodontic patients
Caries Incidence in Relation to Salivary Mutans Streptococci and Fluoride Varnish Applications in Preschool Children From Low- and Optimal-Fluoride Areas.

Twetman S, Petersson LG, et al:
CARIES RES 1996; 30 (September/October): 347-353

- Fluoride varnish is effective even in fluoridated areas
- Application of fluoride varnish significantly reduces Streptococcus Mutans Levels
Michael Kanellis, DDS, MS

Guest Presentation

- **Fluoride Varnish:** Fluoride varnish can also play an important role in controlling the caries process until children are old enough to cooperate for traditional treatment. Clinical studies have demonstrated fluoride varnish to be a safe and highly effective means of preventing decay. The caries reduction rate ranges from 25% to 75% with the use of fluoride varnish. Applications of fluoride varnish applied at frequent recall appointments after ART can effectively "recharge" the glass ionomer restorations.
References


Thanks for your attention

Any questions?????