The Medical Management of Dental Caries Using Silver Nitrate and Silver Diammine Fluoride

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Iowa Primary Care Association
2015 Annual Conference

A drop of ammoniacal silver nitrate was applied to each lesion, followed by a drop of eugenol to reduce and precipitate the silver.

Silver diammine fluoride 38% (Fluoroplant) was applied to the dried surface for 3 min using a cotton pellet in a gentle rubbing manner.

Silver fluoride 40% solution (AGF Silver fluoride) was applied for 60 sec with a cotton pellet to the dry surface, followed by a layer of 10% stannous fluoride spot application paste (Floran) flowed over the treatment site.

Chlorhexidine gel (5% in 2.5% methylhydroxyethylcellulose) was applied to the dried surface for 3 min and the excess gently washed away with sterile water.

Isotonic saline was applied for 60 sec with a gentle rubbing manner on the dried surface.
Silver Nitrate (AgNO3)

- First medicinal use dates to 1,000 B.C. when it was used for storing potable water
- Antibacterial effect
- Various medical treatments for many years
- Commonly used for:
  - Wart removal
  - Water purification

Conclusion

The use of chemotherapeutic agents to reduce caries progression shows promise. In this in vitro study, single applications of either AgF/5mF, or AgNO proved to be successful methods of reducing carious lesion progression over a six-week period of time. Compared to a control group, reduction in lesion depth progression for these two treatment regimens was 29% and 19%, respectively. Both treatments were significantly better (P<0.05) that the other groups, although not significantly different from each other.
U.S. Food and Drug Administration

- Silver nitrate is approved as an antimicrobial agent
- When used to treat cavities = "off label" use

Silver Nitrate

- First dental use in mid 1800s
- Silver reacts with organic material of dentin and forms a protective layer and is more resistant to acid (Hill & Arnold, JDR, 1937)
- Effective in arresting initial lesions, repeat @ 12 months (Hyde, JCDA, 1973)
- Irritating to pulp, will stain decay and skin

Howe’s Silver Nitrate Method

- Introduced in 1917
- Initially used to sterilize root canals
- Later applied to deep enamel pits and dentine to prevent the spread of caries
Silver Nitrate Fell Out of Favor by 1960’s
- Largely due to advances in dentistry
- Air Turbine Handpiece (1950’s and 60’s)
- Effective local anesthetics (Lidocaine 1948)
- Improved filling materials
  - Porcelain fused to metal crowns (1950’s)
  - Acid Etch Composite (Buonocore – 1955)
- Dental Insurance (1960’s/early 70’s)

Silver Nitrate Fell Out of Favor by 1960’s
- Turns teeth black
- Stains clothes, skin, countertops, etc.

Renewed Interest in Silver Nitrate
- Traditional preventive and restorative approaches often fail with certain high risk groups
  - Native America population
  - Early childhood caries
  - Medicaid population
- Funding mechanisms (capitation) can change dentists’ incentive to treat
Dr. Steve Duffin

- General Dentist in Oregon
- 100 children per week
- 70% have caries into dentine at initial visit
- 60% clinic reimbursement is capitation

Dr. Steve Duffin

- Using Silver Nitrate since 2011
- 25% Silver Nitrate
- Fluoride Varnish
- Other dentists in Oregon have largely stopped restoring caries in the primary dentition

- Oregon Dental Association Journal
- May 2013
Product Information

• 25% vs. 50%
Steve Duffin’s Original Protocol

- 5 applications Silver Nitrate at times:
  - Zero
  - 2 weeks
  - 4 weeks
  - 8 weeks
  - 12 weeks

Modified Protocol

- 3 applications 1 month apart
How could Silver Nitrate be used in Clinical Practice in Iowa?

- ECC – delaying definitive treatment
- Case example
  - 3 y.o. with ECC from Ukraine
How could SN be used in Clinical Practice in Iowa?

- Older patients – delaying definitive treatment
- Case example
  - 8 y.o. with OR appointment 4 months post-initial exam
How could SN be used in Clinical Practice in Iowa?

- Older uncooperative patients when treatment is essential but can’t be provided
How could SN be used in Clinical Practice in Iowa?

- Dependent adults in long-term care facilities
- Dry mouth
- Root caries
How could SN be used in Clinical Practice in Iowa?

- Carious crown margins that are difficult to restore, or can’t be restored

- Patients with interproximal incipiencies
  - Case example
    - Young adult with multiple interproximal incipiencies
Protocol for interproximal application

Interproximal application
• Keep silver nitrate contained to avoid spilling

• Place rubber dam to avoid leakage of silver nitrate to gingival tissue

• Use disposable pipette to draw up small amount of silver nitrate
• Place drop of silver nitrate in disposable dappen dish

• Floss “superfloss” through contact in question

• As “fuzzy” portion of superfloss is ready to be flossed through contact, apply a drop of silver nitrate to the floss
• Carefully floss the wetted portion of superfloss into the contact, making efforts to maximize contact with affected surfaces.

• Apply fluoride varnish to entire contact area that has been treated to seal in silver nitrate.

• Rinse fluoride varnish to "set" the varnish.
Stretch and cut the rubber dam to remove from patient, to avoid splatter.
Where do we go from here?

Amish Silver Nitrate Clinical Trial:
Study Design and Subject Recruitment
Funding

• Delta Dental of Iowa Foundation
• Dow’s Institute for Dental Research
• Department of Pediatric Dentistry

Purpose of the Study

To compare the conventional approach of restoring caries in the primary dentition, to medically managing caries using silver nitrate and fluoride varnish.

Study Population

• Amish children living in Kalona, IA.
  – High caries rate
  – Low exposure to fluoride
  – Limited access and utilization of regular dental care
  – Culturally less sensitive to black discoloration of primary teeth
Kalona Amish

- Old order Amish settlement in Kalona established 1845
- Growing population
- ~1,600
- Average family has 8 children
- Other Anabaptist groups
- New order Amish
- Beachy Amish
- Mennonite

Study Design

- Randomized controlled clinical trial.
- Inclusion Criteria:
  - Healthy children (2-11 years of age) with at least one primary tooth with caries into dentine.
- Random assignment to one of two groups:
  - Conventional restorative group
  - Silver nitrate / fluoride varnish group
- Subjects to be followed for a minimum of two years

Study Teeth

- Prior to random assignment, a clinical exam was done to determine which teeth would receive treatment
- Decision to Treat – if conventional treatment without pulp therapy was not an option for a carious primary tooth, the tooth was excluded from the study
  - Tooth going to exfoliate soon
  - Signs or symptoms of irreversible pulpitis indicating caries into pulp needing pulp therapy or extraction
Conventional Group
- Exams and radiographs
- Oral Health Education
- Prophy
- Fluoride Varnish application
- Restorations for caries into dentine
  - Composites
  - Stainless Steel Crowns
  - No amalgams
- 6-month recall schedule with BW radiographs

Silver Nitrate Group
- Exams and radiographs
- Oral Health Education
- Prophy
- 3 Silver Nitrate applications, 1 month apart
- Fluoride Varnish application
- 6-month recall schedule with BW radiographs

Silver Nitrate Application
- 5 second application per carious lesion
- Immediately cover with fluoride varnish
- Nothing to eat or drink for 30 minutes
- Accessible lesions (open cavities and facial/lingual smooth surface lesions
  - Apply silver nitrate with microfiber brush
- Interproximal lesions
  - Apply silver nitrate with super-floss or G.U.M soft-pick

Outcome Measures
- Caries incidence and progression (arresting)
  - Patient level
  - Tooth level
- Major and minor failures (study teeth)
- Patient quality of life
- Cost-effectiveness
- Acceptability of treatment strategies to patients, and parents.
Subject Recruitment

- IRB requirements for cultural competency
- Letter of support from Amish Community
- All written materials to be reviewed and deemed appropriate/acceptable by someone with Amish ties

Letter to Bishop Yoder

Dear Bishop Yoder:

Your letter of support was received, and we are grateful for your thoughts and encouragement. Our goal is to ensure that the project is carried out with respect and sensitivity to the Amish community. We are committed to involving local Amish leaders in all stages of the research process, and we assure you that your support is appreciated.

Sincerely,

[Signature]

[University or Institutional Information]

Letter of Support from Bishop

Kesler, J.

June 20, 2020

Dear Team:

I am grateful for your efforts in reaching out to the Amish community and for your commitment to cultural competency in research. Your support is invaluable, and we are confident that your wisdom and guidance will help us in carrying out this important work.

Sincerely,

[Signature]

[University or Institutional Information]
Study Location

Current Progress of the Study

- Oct, 2014 – IRB approval (201406792)
- Oct & Nov, 2014 – Informational sessions
- July, 2015 – Recalls will begin

Diagram showing the progress of the study with percentages and numbers.
Next Steps

• Would like to have 90 children enrolled in study
• Have already completed treatment interventions on several children

Acknowledgements

• Dr. John Maxwell
• Kalona Amish
Silver Diamine Fluoride

UCSF Protocol for Arresting Carious Lesions with SDF
1. Plastic-lined cover for counter, plastic-lined bib for patient.
2. Standard Personal Protective Equipment (PPE) for provider and patient.
3. 1 drop of SDF into the deep end of a glass or plastic dappen dish.
4. Remove bulk saliva with saliva ejector.
5. Isolate tongue and cheek from affected teeth with “2x2” gauze or cotton rolls.
6. Apply petroleum jelly to gingiva near affected areas with a cotton applicator.
7. Dry affected tooth surfaces with triple syringe, or if not feasible dry with cotton.
8. Bend microsponge, immerse into SDF, remove excess on side of dappen dish.
9. Apply directly onto the affected tooth surface(s) with microsponge.
10. Allow to absorb for 1 minute, then remove excess with gauze or cotton roll.
11. Rinse with water.
12. Place gloves, cotton, and microbrushes into plastic waste bags.

Silver Documentation and Billing

- D1354
- Interim caries arresting medication application
- Code is effective January 1, 2016
- Code definition: Conservative treatment of an active, non-symptomatic carious lesion by topical application of a caries arresting or inhibiting medicament and without mechanical removal of sound tooth structure.

Elements of Informed Consent

- Expected change in color of the demineralized enamel and dentin as the decay arrests
- Likelihood of reapplication
- Contraindications: silver allergy and stomatitis.
SDF Studies

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<tr>
<th>Arrested Caries</th>
<th>Prevented Caries</th>
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Lessons learned
Lessons learned

• Food impaction is an issue
• Interproximal application is an issue
• Leaving large open lesions is an issue

Lessons learned

• Not a cure for caries in pits of permanent teeth
• SN on adjacent tooth is no guarantee adjacent tooth won’t decay
Questions remaining

- Will SN and SDF show up radiopaque?
Are SN, SDF radiopaque? Yes

Major Failures
490995 (#A) 491796 (#L)

How this changes tx planning
What should we do about tooth #T?

Options

• DO restoration
  – Amalgam, composite, glass ionomer
• SSC
  – Conventional, Hall
• Medical management
  – Silver nitrate, Silver Diamine Fluoride
How to Handle SN and SDF in the Clinic

Basic tray setup

• Metal tray
• Metal pan (make sure you use it)
• Silver tackle Box

What does the silver tackle Box contain

• Silver Solution (Silver Nitrate or SDF)
• Approximal aids
• Microbrushes
• Dapen dishes
• Extra brush (in case you will apply fluoride varnish to other teeth)
Pan set up

- Silver nitrate/ Silver diamine fluoride solution
- Dapen dish
- Microbrush
- Fluoride varnish and extra brush
- Soft-pick
- Micropippete

What if I touched the gingiva or cheeks?

- Have salt always available in case you touched the gingiva or the cheeks
- Wipe the area with a saturated gauze of the salt water solution

Approximal Application Aids

- Super floss
- Soft-Picks (X-mas tree)
One drop Only will do the Job

Make sure you do not spill Silver on the clinic surfaces

What's In It For Me?

WIIFM?
Questions?