Remineralization of enamel lesions proximal to dentin cavitated lesions restored with resin modified glass ionomer in the primary dentition.

Christina McCann, David Velek, Dzhuliya Servetnik, Nicholas Wentworth

Hypothesis

This *in vivo* study proposes to evaluate dental hard tissue remineralization proximal to glass ionomer restorations. It is hypothesized that glass ionomer used in class II restorations will provide significantly more bioavailable fluoride and hard tissue remineralization on the proximal surface of adjacent teeth as compared to the same restoration completed using resin composite materials.

Introduction

- Resin composites and glass ionomer have been developed as more aesthetic alternatives to traditional dental amalgam.
- Physical properties of each material differ markedly. While resin composites exhibit better resistance to occlusal wear due to bulk filler material, glass ionomers generally exhibit decreased marginal leakage due to the ionic bond formed between polyalkenoic acids and the dentin-enamel hard tissues.
- The fluoride properties of glass ionomers are superior to those of resin composites:
  - Fluoride release by glass ionomers have been shown to be five times higher than fluoride-enriched resin composites.
  - Fluoride uptake by dental hard tissues adjacent to glass ionomer is twice as great as uptake by dental hard tissues adjacent to resin composites.
  - Dental remineralization is superior in hard tissues adjacent to glass ionomer.
- Fluoride-containing dental materials are able to release fluoride ions for a long period of time. However, fluoride release diminishes rapidly after an initial high fluoride release.
- Resin modified glass ionomer is a dental restorative material that combines composite resin and glass ionomer.
- Bond strength of RMGI to enamel and dentin is 8-12 MPa, significantly lower than that of composite to enamel and dentin, 11-25 MPa.
- Remineralization occurs by deposition of calcium and phosphate ions by odontoblast processes and through diffusion of ions from glass ionomer restorative materials.
- It is postulated that enamel lesions on the interproximal surface of a tooth adjacent to a dentinal lesion may be remineralized when a glass ionomer restoration is placed in that dentinal lesion.

Inclusion Criteria

- Pediatric patients at UNE CDM Oral Health Center of moderate to low caries risk.
- Systemically healthy.
- Initial, active dentin cavitated lesion on the distal surface of a primary first molar or mesial surface of a primary second molar without pulpal involvement adjacent to a posterior tooth with a radiographically evident enamel lesion on the interproximal surface.
- The base of the radiographic carious lesion must be situated within the middle 1/3 of the dentin.
- The bucco-lingual width of the carious lesion must be no greater than 1/3 of the intercuspal width and not extend beyond the proximal line angles.
- The definitive restoration shall have supragingival margins.
- Both teeth are expected to exfoliate within the next 6-18 months.
- Patients' primary water source falls within a fluoridation level of 0.7-1.2 mg/L.
- Informed consent must be obtained from parent.

Exclusion Criteria

- Patients of high caries risk or severe early childhood caries.
- Patients unwilling or unable to return their exfoliated teeth.
- Teeth not in contact or with developmental or morphological anomalies.

Materials & Methods

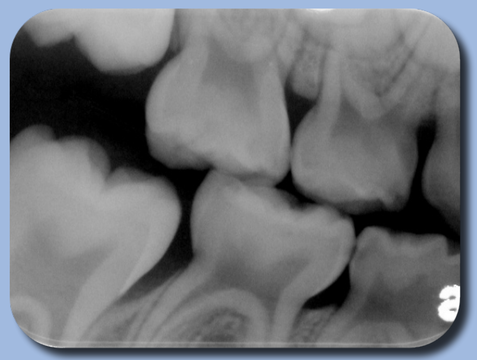

Fig. 1: Dentin decay in tooth #S adjacent to enamel lesion in tooth #T

Patients with initial class II carious lesions will be identified through radiographic (Fig. 1) and intra-oral examination with informed consent obtained. A total of 44 patients will be randomly assigned to a control group (N=22) or experimental group (N=22).

Restorations:
Patients in the control group will have class II restorations completed using Filtek Supreme resin composite. Resin composite shall be placed incrementally and cured per manufacturer instructions.

The control group will have Class II preparations restored with 3M ESPE Filtek Supreme composite. The experimental group will have Class II preparations restored with GP Fuji IX GP Glass Ionomer.

All class II preparations and restorations will be performed by one clinician to decrease the chance for variability. Enamel lesions will be examined with Quantitative Light-induced Fluorescence (QLF) prior to the placement of adjacent restorations (Fig 2A&B) to to obtain a pre-interventional measurement of demineralization. QLF is a highly sensitive method for determining short-term changes in lesions in the mouth. This method works on accessible surfaces of teeth. The QLF produces a strong beam of harmless blue light, and passes it down a short cable and into a person's mouth. An intra-oral camera fitted with a filter captures the resulting fluorescent images.

Home Care:
Patients will be instructed to brush and floss regularly, with parental assistance or supervision. Parents will be provided with a Hanks Balanced Salt Solution into which exfoliated teeth may be placed prior to delivery to the clinic. Recall appointments will be at three-month intervals until exfoliation of the tooth with enamel lesion of interest.

Assessment of Remineralization:
After exfoliation, teeth will be examined using three methods to assess remineralization.
1. Post-intervention QLF
2. Compressive load testing.
3. Transverse microradiography

QLF: Light fluorescence measurements will be obtained on whole exfoliated teeth to provide a quantitative analysis of demineralization of the enamel lesion and compared to pre-intervention measurements.

Compressive Load Testing: The tooth with the enamel only lesion will be analyzed. Teeth will be sectioned into 1.5 mm segments of enamel at the site of the interproximal enamel lesion. Each segment will be analyzed using the Instron compressive strength testing apparatus (Fig. 3) to quantify the degree of remineralization. Enamel strength, as a measure of remineralization, will be measured by applying a compressive load using an Instron universal testing machine at a crosshead speed of 1 mm/min.

Transverse microradiography (TMR): TMR will be employed to quantify and compare mineral loss/gain of the enamel lesions in the experimental and control groups. A section of tooth as previously described Will be cut into thin 80-150 µm planoparallel slices. A microradiograph image is made of the sections together with a calibration stepwedge. The mineralization can be calculated from the gray levels of the images. The parameters of interest will be mineral content in the enamel lesion area, the mineral volume by percent of the lesion body.

Figure 3: Instron compressive load testing apparatus

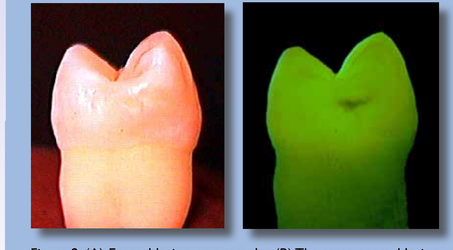

Figure 2: (A) Enamel lesion on premolar, (B) The same enamel lesion viewed with quantitative light-induced fluorescence

Statistical Analysis:
Data will be analyzed in conjunction with the UNE Department of Mathematical Sciences.

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College of Dental Medicine