Backscattered electron SEM of early childhood caries

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No conflicts of interest to disclose
Objectives and Methods

- Early childhood caries is a major health problem
- We looked for structural and compositional changes in primary molar decay
- Deciduous molars preserved in 70% ethanol, obtained from anonymised collection. Age at extraction estimated from remaining root lengths in the range 4 to 8 years. Photographed
- Reason for extraction most likely pulpitis - in every case there was a deep penetrating carious lesion
- Further dehydration to 100% ethanol, then xylene, and embedding in PMMA from monomer
- Teeth bisected and vertical section surfaces polished flat. Photographed
- Compositional contrast = mineral concentration dependent imaging using 20kV backscattered electron scanning electron microscopy,
  - uncoated [means we can examine number of polishing levels with no further preparation],
  - 50Pa chamber pressure
  - Fields montaged to cover entire specimen & higher magnifications for detail
- Blocks later stained with iodine vapour to study residual organic matrix and invading microbiota.
Invasive spread in dentine parallel with incremental layering of collagen during its development.

? Motile invasive species
Carious attack in enamel from EDJ; prominent cross-striations and mineral deposition within the prism boundary discontinuity spaces.

Interproximal carious lesion in enamel & pseudocoloured.
Mineralisation of interglobular dentine. Peritubular dentine most mineralised.
Mineralisation of interglobular dentine
Prominent neonatal lines in enamel and dentine – neonatal hypoplasia seen at approximal surface and cusp tip.

numerous enamel tubules
Fissure caries

Two more cases of neonatal hypoplasia
We studied disease which must have spread rapidly through dentine
Much destruction of enamel occurred from within, attacking enamel from the EDJ
Neonatal enamel hypoplasia an important factor in several cases
Even most demineralised carious dentine showed hyperdense ‘peritubular dentine’ (PTD)
  • or locally expanded tubules, probably fungal invasion (e.g., Candida spp.)
  • or multiple fine tubes crossing the tubule axis in the collagen fibre direction of the dentine matrix, a hallmark of motile invasive species (e.g. Capnocytophaga spp.)
Patches of interglobular dentine (IGD), normally unmineralised, sometimes more densely calcified than surrounding carious matrix
  • This is the first report of addition of mineral to IGD in association with remineralisation phenomena in caries
Calcospheritic de-mineralisation pattern indicates different state of intra- vs. inter-collagen mineral
Caries involves many microbial species which cannot be identified by morphology alone
but there are many morphological types of dentine caries.
In future work, it might be possible to reach some spp. identification, with, e.g., Matrix Assisted Laser Desorption/Ionization Time Of Flight {MALDI-TOF} mass spectrometry

Results and Conclusions and THANKS