Fluorescence-Controlled Er:YAG Laser for Caries Removal in Permanent Mandibular Molars

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Research Question

Do fluorescence-controlled Er:YAG lasers more effectively remove dentinal carious hard tissue on permanent mandibular molars than conventional rotary burs?

Background

- Er:YAG laser energy is readily absorbed by water causing rapid and expansive vaporization within hydrated hard tissues.
- These micro-explosive vaporization events result in destruction and removal of hard tissue.
- Pressure changes cause by the vaporization of water in dentin causes audible “popping” sound which aids in the clinical evaluation of the extent of caries removal.
- Feedback control of the KaVo Key III laser by IGP diode laser feedback control of Er:YAG laser energy is readily absorbed by water causing rapid and expansive vaporization within hydrated hard tissues.
- These micro-explosive vaporization events result in destruction and removal of hard tissue.
- No current data of sufficient quality which establish the optimal for caries removal leaving minimal levels of residual bacteria when preset threshold of 7-8 residual units (UI).
- No current data of sufficient quality which establish the longevity of composite restorations placed after laser caries removal at least 3 years after composite restoration.

Introduction

- Purpose:
  - Goal evaluation of the efficacy of lasers caries removal by IGP diode laser fluorescence-controlled Er:YAG KaVo Key III laser in Class I lesions on permanent first and second mandibular molars.
- Hypothesis:
  - Fluorescence-controlled caries removal will be as effective as conventional rotary bur.
- Rationale of Research Project:
  - Advantages of laser caries removal:
    - Quieter treatment
    - Less collateral damage from vibrations
    - Less blinding
    - Less or no anesthesia required
    - Less anxiety provoking or frightening
  - Patients tend to prefer
    - Although odor, length of visit, and upon excavation accompany laser treatment the benefits may outweigh the limitations/drawbacks.
  - IGP diode laser fluorescence feedback control of Er:YAG laser caries removal may more accurately and objectively appraise dentinal caries by quantifying the presence/extent of carious tissue and more precisely/appropriately adjust the intensity of the laser producing a more conservative preparation.

Experimental Design

- Inclusion Criteria:
  - Age: > 18
  - Patients in good overall health with 2 carious lesions within the established standard.
  - Class I carious lesions within occlusal 1/3 of dentin assessed radiographically using BW and PA radiography on permanent 1st and 2nd mandibular molars selected.
  - Comparable caries states of both lesions, centered, at least 2mm to marginal ridges.
  - Patients without spontaneous, lingering, or purgative pain.
  - No signs, symptoms, or radiographic evidence of pulpal or periradicular involvement.
  - Ideal mark/female ratio: 50/50.
  - 2 preparations needed per patient, split mouth design.
  - Conventional rotary bur prep (control).
  - Fluorescence-Controlled Er:YAG laser prep.
  - 100 total patients, 200 total preps
  - 50 Patients in UNE COM
    - 1 Clinician and 1 Blind Evaluator
  - 50 Patients in Tufts
    - 1 Clinician and 1 Blind Evaluator
- Exclusion Criteria:
  - Caries that extends radiographically beyond the occlusal 1/3 of dentin or only into enamel.
  - Medically compromised patients, not in good general health.
- Clinical and Laboratory Procedures:
  - Initial laser enamel removal to access dentin with Er:YAG laser (λ = 2.94 µm, spot size = 0.63 mm, pulse energy = 250 mJ, pulse repetition = 4 Hz, and No. 2060 KaVo handpiece at distance = 10-20 mm to lesion) and IGP diode laser fluorescence feedback control (λ = 655 nm, relative units [U] calculated and set at 15 [UI]).
  - Control: Conventional rotary preparation and resin composite placement.
  - CBCT (Cavity size difference after caries removal by a fluorescence-controlled Er:YAG laser and by conventional bur treatment).
  - Statistical analysis may be calculated using IBM SPSS statistical software package.

Summary

- By conducting this research we will have a better understanding of how effectively dentinal carious hard tissue of permanent mandibular molars can be removed using fluorescence-controlled Er:YAG lasers and whether it is a viable alternative to conventional rotary techniques.

Reference


Suggested websites:


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