

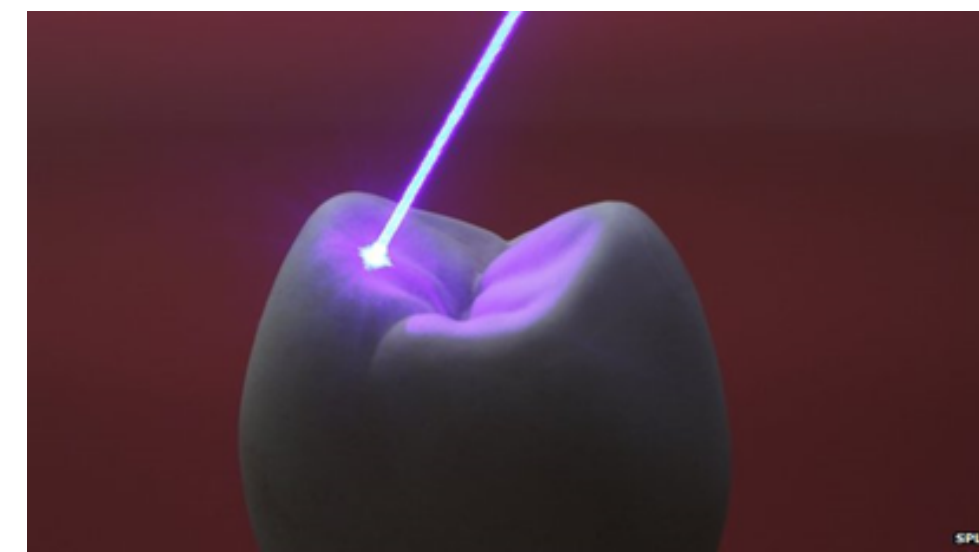


## Research Question

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 has been shown to be optimal for caries removal leaving minimal levels of residual bacteria when preset threshold of 7 or 8 residual units [U].
- No current data of sufficient quality which establish a causative relationship between laser caries removal and irreversible pulpitis.
- 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:**
  - In vivo evaluation of the efficacy of laser 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 laser 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 bleeding
    - Less or no anesthesia required
    - Less anxiety provoking or frightening
    - Patients tend to prefer
  - Although odor, length of visit, and spoon 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.

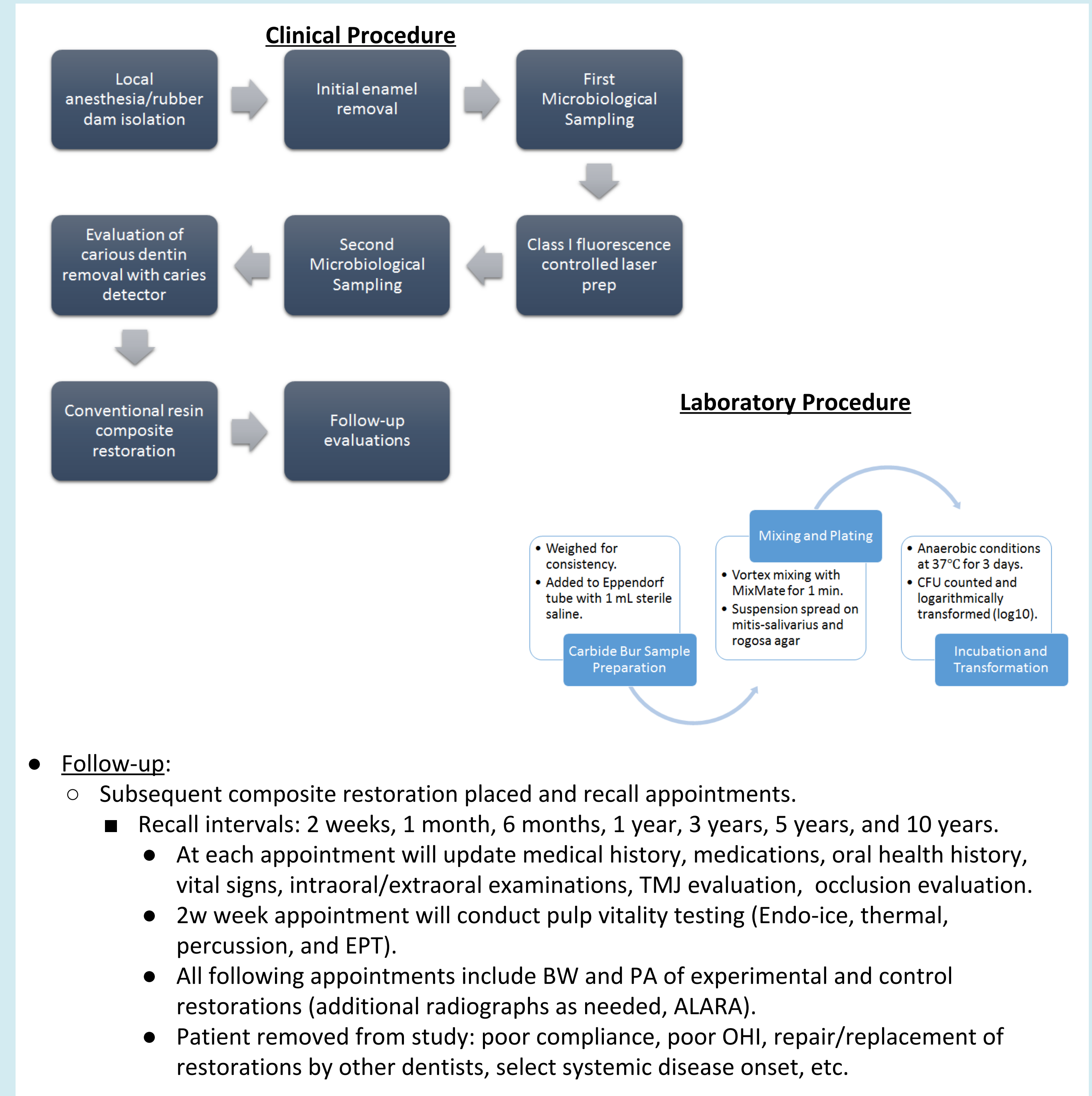


## Experimental Design

- Inclusion Criteria:**
  - Age: 18+
  - Patients in good overall health with 2 carious lesions within the established standard.
  - Class I carious lesions within occlusal 2/3 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 percussive pain.
  - No signs, symptoms, or radiographic evidence of pulpal or periapical/periradicular involvement
  - Ideal male/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 CDM
      - 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 2/3 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 ( $\lambda = 2.94 \mu\text{m}$ , 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 ( $\lambda = 655 \text{ nm}$ , relative units [U] calculated and set at 15 [U]).
  - Control: Conventional rotary preparation and resin composite placement.
  - CRT Biological Testing (Ivoclar Vivadent).
  - Statistical analysis may be calculated using IBM SPSS statistical software package.



## Er:YAG Laser



## 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:**
  - Domisch, H., Peus, K., Kneist, S., Krause, F., Braun, A., Hedderich, J., Jepsen, S. and Eberhard, J. (2008). Fluorescence-controlled Er:YAG laser for caries removal in permanent teeth: a randomized clinical trial. *European Journal of Oral Sciences*, 116: 170-176. doi: 10.1111/j.1600-0722.2008.00521.x.
  - Eberhard J. Cavity size difference after caries removal by a fluorescence-controlled Er:YAG laser and by conventional bur treatment. *Clinical oral investigations*. 2008;12:12:311-318.
  - Eberhard J. Evaluation of selective caries removal by a fluorescence feedback-controlled Er:YAG laser in vitro. *Caries research*. 2005;11:39:496-504.
  - Hosein, Tasleem and Hasan, Arshad. "Efficacy of Chemo-Mechanical Caries Removal with Carisolv." *Journal of the College of Physicians and Surgeons Pakistan* Volume 18.4. (2008); 222-225.
  - Jacobsen T, Norlund A, Englund G, Tranæus S. Application of laser technology for removal of caries: A systematic review of controlled clinical trials. *Acta Odontologica Scandinavica* [serial online]. March 2013;69(2):165-74. Available from: Dentistry & Oral Sciences Source, Ipswich, MA.
  - Jepsen S. Biochemical and morphological analysis of dentin following selective caries removal with a fluorescence-controlled Er:YAG laser. *Lasers in surgery and medicine*. 2008;07:40: 350-357.
  - Krause F. Evaluation of selective caries removal in deciduous teeth by a fluorescence feedback-controlled Er:YAG laser in vivo. *Clinical oral investigations*. 2008;09:12:209-215.
  - Schwass B. Evaluation of the efficiency of caries removal using an Er:YAG laser driven by fluorescence feedback control. *Archives of oral biology*. 2013;58:603-610.
- Suggested websites:**
  - <http://www.kavo.com/Products/Dental-Instruments/Dental-laser/2063.aspx>
  - <https://www.youtube.com/watch?v=x369jS7Ctto>
  - [http://downloads.ivoclarvivadent.com/zoolu-website/media/document/478/CRT+bacteria?\\_ga=1.170222560.1182148736.1415060928](http://downloads.ivoclarvivadent.com/zoolu-website/media/document/478/CRT+bacteria?_ga=1.170222560.1182148736.1415060928)

## Acknowledgements

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