Use of (Er,Cr:YSGG) Laser for Debonding of Cement Retained Zirconia Implant Restorations

School of Dental Medicine
UNIVERSITY OF COLORADO ANSCHUTZ MEDICAL CAMPUS
DENTAL. INTEGRATED FOR HEALTH.

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Graduate Periodontics Program University of Colorado

Introduction:

- Prevalence of peri-implantitis is estimated around 22% and is managed by a combination of non-surgical and surgical management.
- During surgical management, removal of the implant crown is critical to provide adequate access and ensure sufficient debridement.
- Retrieval can be challenging in the cases of cemented restorations and commonly necessitates sectioning of the crowns using rotary instruments which is time consuming, has increased risk of structural damage to the prosthetic and possible increased heat production.
- Prosthetic complications: abutment screw loosening and porcelain fracture range from 5 to 45%.
- Erbium lasers has been employed to remove orthodontic brackets, crowns and veneers from natural teeth. However, the evidence on the use of lasers to remove cement retained implant crowns is limited.

Figure 1: Image of Er,Cr:YSGG Laser being using on zirconia veneer restorations

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Aim:

- The purpose of this cadaveric study is to compare the efficacy of Erbium, Chromium-Doped-Yttrium-Scandium-Gallium Garnet (Er,Cr:YSGG) Laser with conventional rotary instruments for the removal of cement-retained zirconia implant crowns by evaluating the time needed for retrieval and the temperature changes at the bone implant interface.

- The study further aims to assess if the type of cement has an influence on the retrieval capacity of Er,Cr:YSGG Laser.

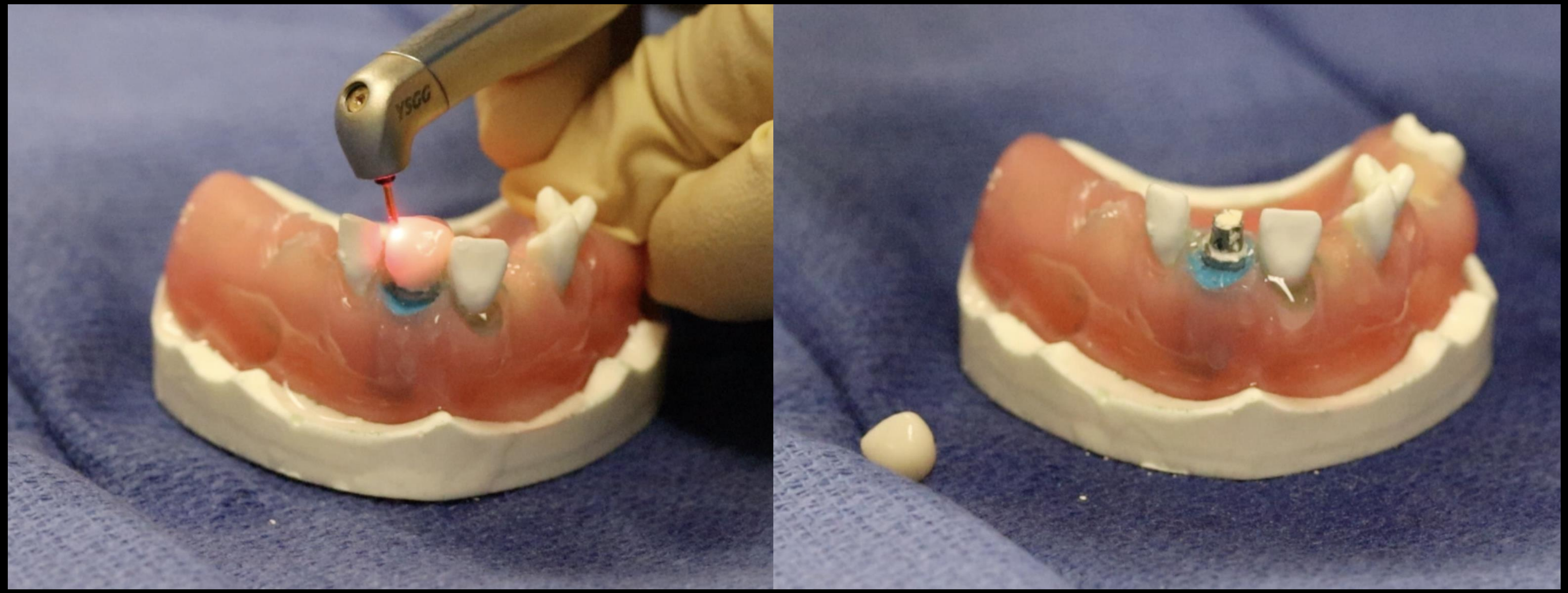

Figure 2: Image of Er,Cr:YSGG Laser being used to remove implant supported cement zirconia crowns.

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Materials and Methods:

- 30 implants were placed into three human cadaver tibias
- Using digital impressions, central incisor shaped zirconia crowns of 2 mm thickness were milled and cemented onto stock abutments and placed into saline water bath.
- Three different cements with different water sorption rates were used; Resin Cement, Resin Modified Glass Ionomer cement and Zinc Oxide Temporary Cement.
- In the Laser Group, (Er,Cr:YSGG laser -Biolase) irradiation at the standardized settings was used to remove the cement retained prosthesis.
- Time for retrieval was recorded from the start of the irradiation to the completed removal of crown was measured in minutes.
- Using a digital pyrometer, the temperature changes (In Celsius) at the bone implant interface were recorded from the start of the irradiation to the complete crown removal of the crown.
- The crowns were then thoroughly cleaned and debrided of cement, evaluation for any structural damage was completed followed by re-cementation to the stock abutments.
- In Rotary Group the cemented crowns were removed using a hand piece and diamond bur. The time and temperature changes were recorded similarly to the laser group.

Statistical Analysis:

- Two-Way ANOVA Models were employed to compare elapsed time and temperature changes between the groups for each cement.
- Tukey's honestly significant difference test was used for pairwise post-hoc analysis.

Figure 3: Three human cadaver tibias with 30 implants placed, 10 implants in each tibia.

Figure 4: Three humans cadaver tibias placed with cement zirconia crowns in saline water bath at 37 degrees Celsius.

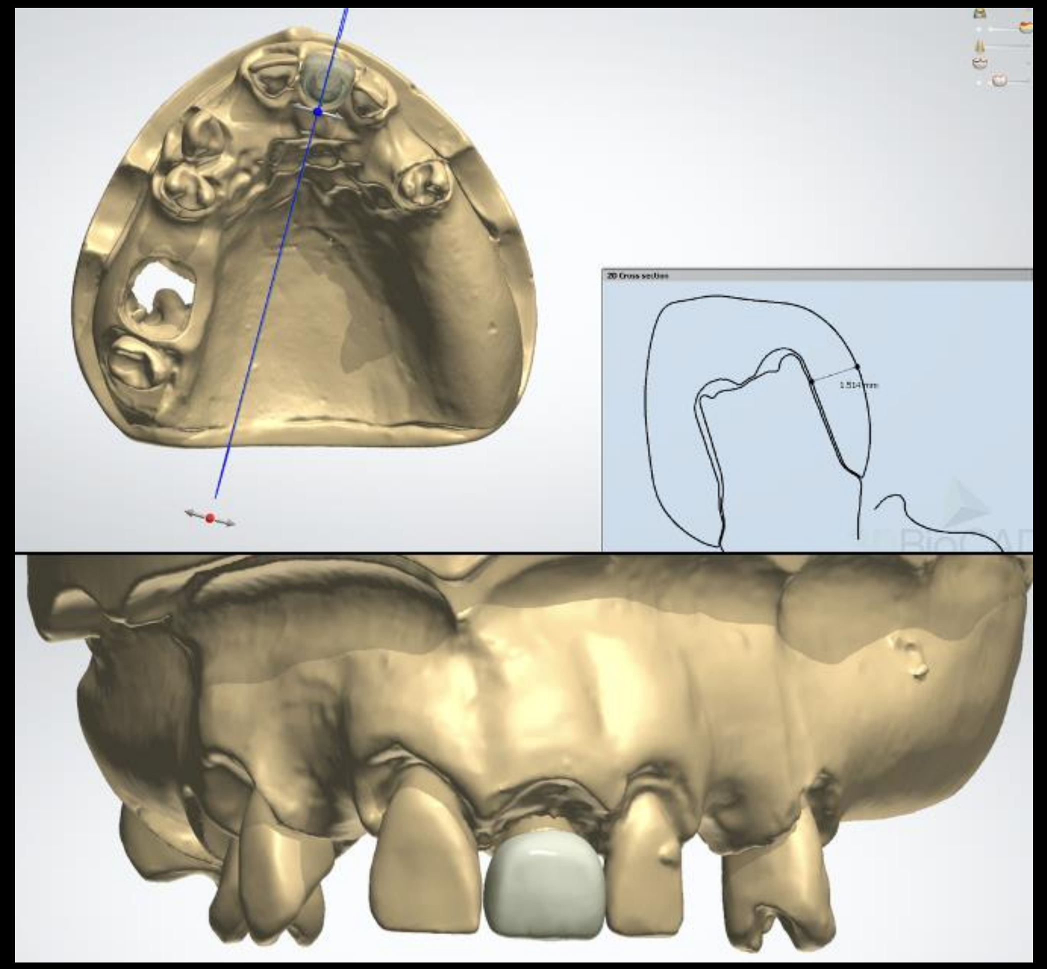

Figure 5: Uniform 2mm central incisor zirconia crowns designed on digital software.

Figure 6: Cemented zirconia crowns onto stock abutments on human cadaver tibia

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Results:

- Average time for Er,Cr:YSGG laser to remove the crowns was 2:38 minutes vs 0:30 seconds for the rotary, which was statistically significant.
- Average time for Er,Cr:YSGG laser group to remove the prosthesis using resin cement, resin modified glass ionomer, and zinc oxide temporary cement was 5:45 minutes, 2:38 minutes, and 0:39 seconds respectively which was statistically significance.
- Average time for rotary group to remove the prosthesis using resin cement, resin modified glass ionomer, and zinc eugenol cement was 0:36 seconds, 0.27 seconds, and 0:28 seconds respectively which is not statistically significance.

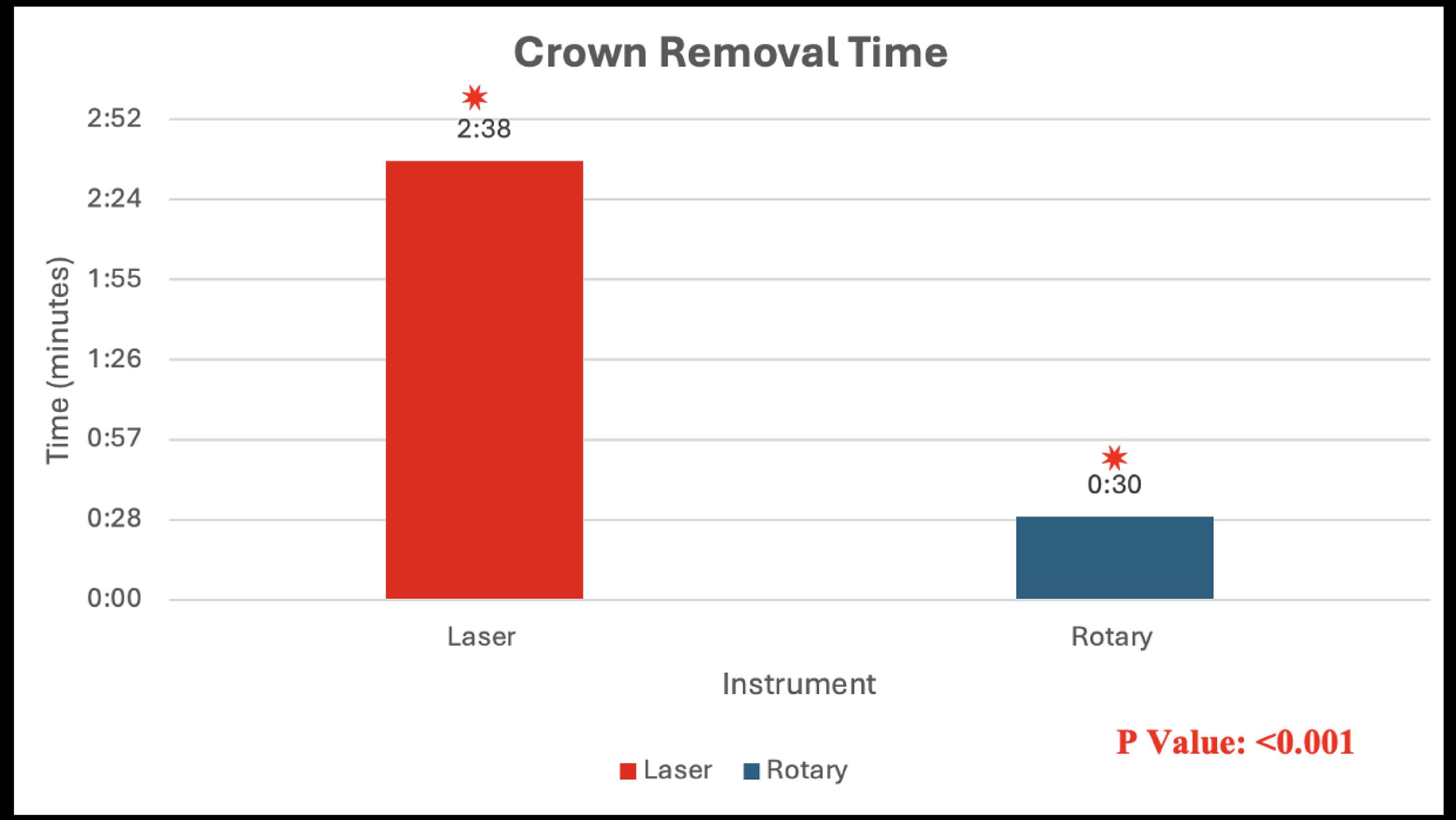

Figure 7: Graph demonstrating difference in crown time removal between laser and rotary instrumentation.

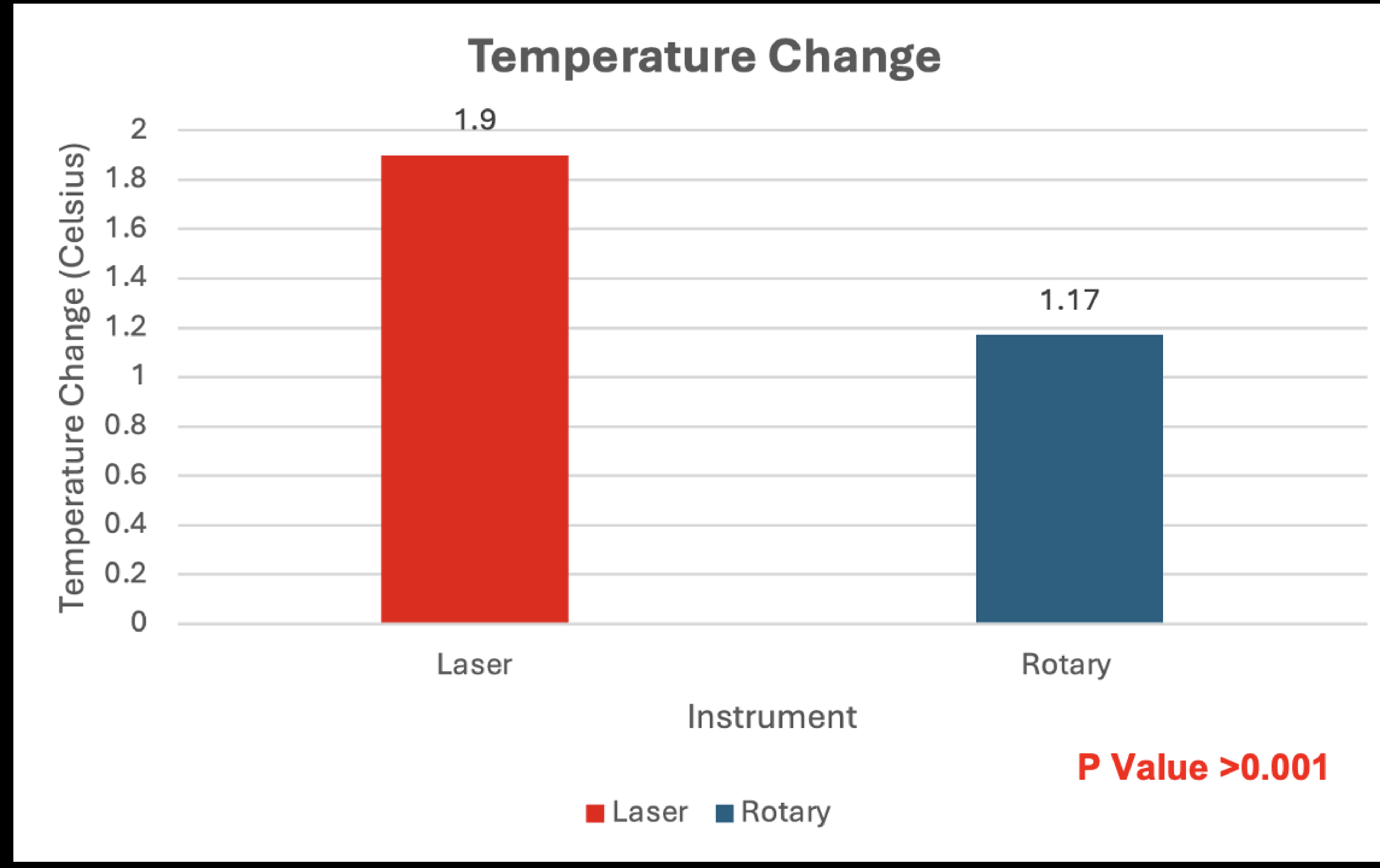

Figure 8: Graph demonstrating difference in temperature changes between laser and rotary crown removal.

Results:

- Mean temperature recorded at the bone implant interface for the laser was 1.90 °C vs 1.17 °C for the rotary. The difference was not statistically significant.
- Water sorption rate correlates with solubility of the cement.
- Solubility increases as water sorption increases.
- Lasers work by the transmission of energy that is absorbed by water and monomer molecule causing them to be activated and release energy that breaks down the polymerized cement structure.

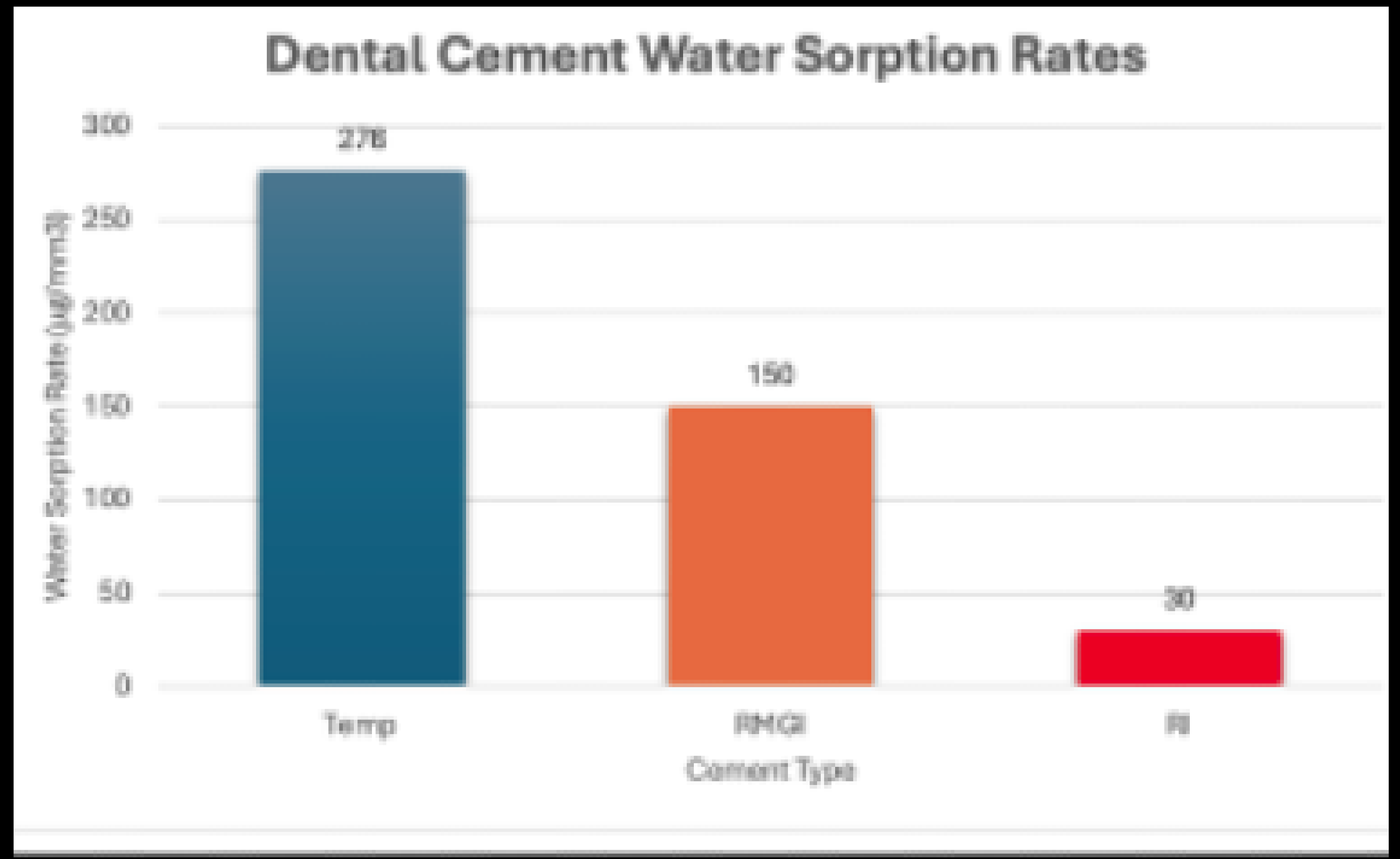

Figure 9: Graph demonstrating different water sorption rates for the three different cements used in the study.

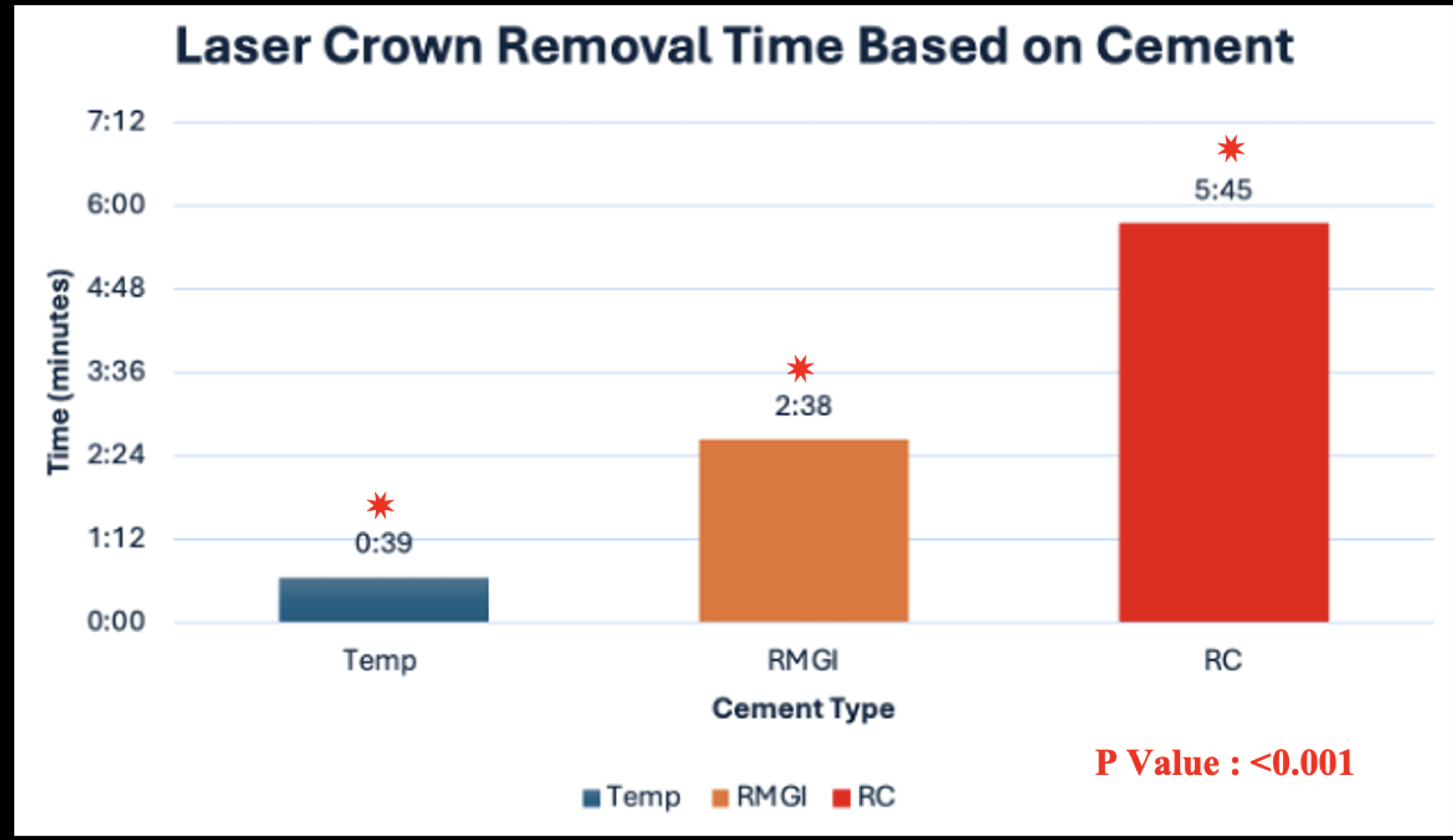

Figure 10: Graph demonstrating laser crown removal times times based on the three different cements used in the study.

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Conclusion:

- This cadaveric study showed that Er,Cr:YSGG laser irradiation can be used to retrieve cement retained zirconia implant crowns with no structural damage to prosthesis compared to conventional rotary methods.
- Average time for Er,Cr:YSGG laser to remove cement retained implant supported crowns was slightly higher when compared to rotary.
- There is an indirect correlation between crown removal time and water sorption rates of the luting cement. The higher the water sorption rate the less time taken to remove the prosthesis.
- The mean temperature changes during retrieval were relatively low for the laser and rotary group respectfully.

Clinical Implications:

- Atraumatic removal of implant crown.
- No damage to prosthetic abutment
- Minimal temperature change
- More cost effective for patient

Laser Crown Removal Classification

Class	Cement	Time Removal
Class I	TC	0-2 min
Class II	RMGI	2-4 min
Class III	RC	5 + min

Figure 11: Laser Crown Removal Classification System.

Figure 12: Image Comparing Er,Cr:YSGG Laser Crown Removal vs Rotary Crown Removal.

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