Removal of Prefabricated Zirconia Crowns from Primary Anterior Teeth with Er,Cr:YSGG Laser Compared to a High-Speed Handpiece: an *in-vitro* study

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Introduction

Zirconia Crowns are the newest restoration being implemented to treat pediatric patients, with less plaque accumulation, better gingival health, and vastly better esthetics compared to stainless steel crowns. The removal of a zirconia crown can sometimes be indicated due to recurrent decay, fractured ceramic, inaccurate cementation or need for replacement. Crown removal with an air-rotary handpiece can be challenging and unpleasant experience for both the patient and provider. One of the advantages of prefabricated zirconia crown is the ability to remove them with an Erbium, chromium-doped yttrium, scandium, gallium garnet (Er,Cr:YSGG) laser in an atraumatic manner. The aim of this *in-vitro* study is to analyze and compare the removal time required, pulpal temperature changes, and differences in ceramic and tooth structure integrity for removal of prefabricated zirconia crowns from primary anterior teeth using an Er,Cr:YSGG laser and air rotary handpiece.

Methods

1. Extracted teeth were collected in VCU Pediatric Dental clinics and stored in isotonic saline solution.
2. A total of 18 primary anterior teeth were prepared with a 1–2 mm occlusal reduction and approximately 20–30% overall clinical crown reduction into dentin using a highspeed rotary handpiece and diamond burs.
3. Size 4 and 5 prefabricated zirconia crowns were cemented using resin modified glass ionomer (RMGI) cement.
4. All teeth were stored in moist containers for 24-48 hours before retrieval was initiated.
5. To measure pulpal temperature changes during crown removal, a 3-4mm diameter hole was drilled through the furcation. Temperature probe (Sper Scientific® 800008, Scottsdale, AZ, USA) was inserted through the access hole into the pulp chamber to record pulpal temperature in 30 second intervals
6. Eighteen crowns were irradiated using the following Er,Cr:YSGG laser parameters: 5.0 Watts, 15 Hertz, 50 Water and 50 Air; 5 Watts, 15 Hertz, 50 Air, and 50 Water with the Turbo Mx9 handpiece. The crowns were irradiated on the buccal, lingual and occlusal surfaces for 30 sec. in continuous motion. The interproximal surfaces were not irradiated directly to mimic adjacent teeth being present in the mouth.
7. Crown retrieval was attempted by digital manipulation and hemostat every 30 seconds. Temperature was recorded every 30 seconds during the retrieval process. Tooth was subjected to additional 30 s intervals of laser irradiation and additional attempts of crown removal until the crown could be retrieved and the time was stopped.
8. The experiment was repeated fro rotary handpiece retrieval using 17 zirconia crowns using Adec TG-97L air-driven highspeed handpiece and flame diamond bur
9. **One specimen from each group was sent to SEM analysis**

Statistical Analysis: Differences in time and temperature were compared based on the method of removal (laser vs. drill) with equal and unequal variance t-tests, as appropriate. The significance level was set at 0.05 level. SAS EG v.8.2 (SAS Institute, Cary NC) was used for all analyses

Results

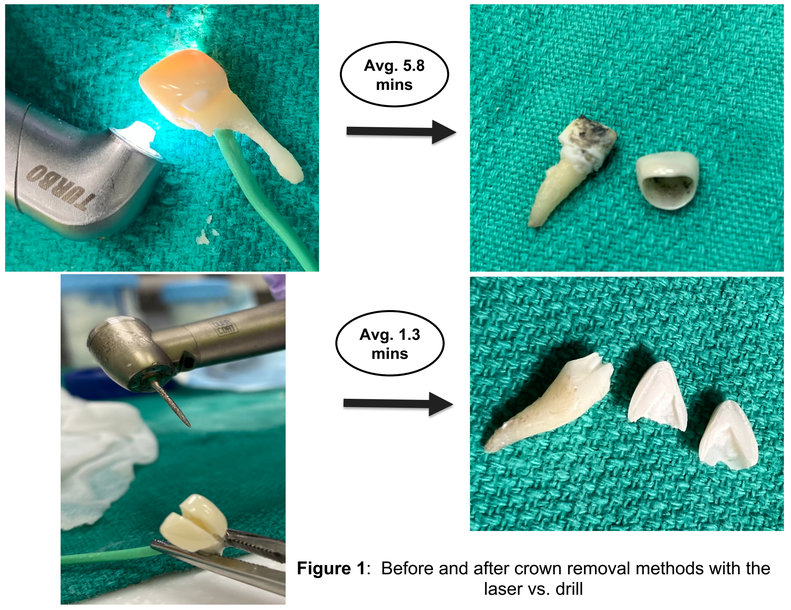

Figure 1: Before and after crown removal methods with the laser vs. drill

		Mean (SD)	
		Laser (n=18)	Drill (n=17)
Debonding Time (seconds)		**353.3 (110.61)**	**80.9 (19.36)**
	Size 4	337.5 (120.76)	83.1 (14.91)
	Size 5	385 (87.81)	79 (23.37)
Maximum Temperature Recorded (°C)		**27.7 (1.59)**	**22.2 (0.85)**
Change in Temperature from Baseline (°C)		**2.9 (1.86)**	**0.2 (1.16)**

Table 1: Summary of Time to Debond and Changes in Temperature for Debonding with Laser and Drill

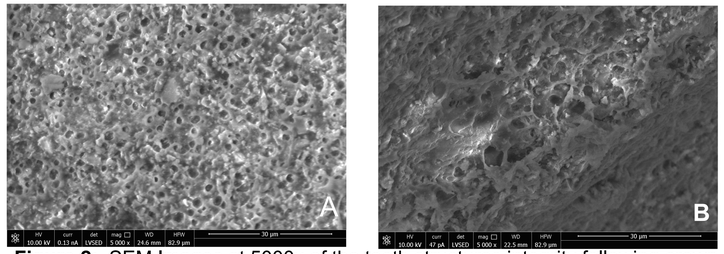

Figure 2: SEM Images at 5000x of the tooth structures integrity following crown removal of the drill (A) and laser (B)

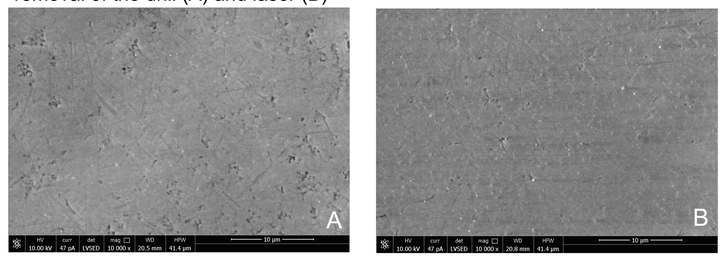

Figure 3: SEM Images at 10,000x of the zirconia crown structure integrity following removal with the drill (A) and laser (B)

Discussion

Prefabricated zirconia crowns can be removed using laser irradiation. Laser assisted crown removal does not damage the tooth or crown as does air rotary removal. While laser-assisted crown removal took significantly longer compared to air rotary handpiece removal, laser irradiation can be performed without the need of needle injected local anesthetic, a major benefit over air rotary removal. Both crown removal methods can safely remove crowns without increasing pulpal temperature that could result in irreversible pulpal damage to primary anterior teeth.

Conclusion

Anterior prefabricated zirconia crowns can be removed by Er,Cr:YSGG laser irradiationwhich takes longer time then air rotary handpiece removal, but renders prefabricated zirconia crown reusable following retrieval. The laser settings in this study were able to successfully and safely remove anterior prefabricated zirconia crowns without compromising tooth structure integrity.

References

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