Comparative Study of Two Different Tooth Restorative and Finishing/Polishing Techniques, and the Post-Restorative Impact

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Introduction

Dental caries is a common multifactorial disease around the world and is regarded as the leading cause of oral pain and tooth loss [1]. Treatment of the disease includes restorative intervention using methods such as amalgam, resin, porcelain, gold, endodontic therapy, and extraction. The use of composite resin has grown in popularity due to esthetic properties, however the longevity of composite resin restorations is approximately 2-6 years [2]. Factors influencing this longevity may include iatrogenic damage introduced by use of inappropriate restorative and finishing/polishing techniques by the dental provider. Studies analyzing the impact of preparation design and finishing/polishing techniques on resin failure rate and post-restorative biofilm colonization is minimal. Both factors may significantly influence the longevity and success of direct composite resin restorations. Analyzing the post-restorative impact of traditional and modern restorative techniques may be imperative for developing more favorable and long-lasting resins.

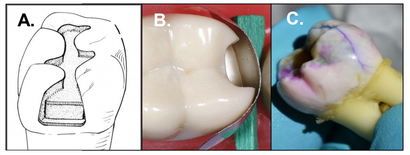

Figure 1. A) Artist-rendering of a G.V. Black (traditional) restorative preparation. B) Occlusal view of Traditional slot preparation. C) Fracture evaluation using Bioclear Disclosing Solution.

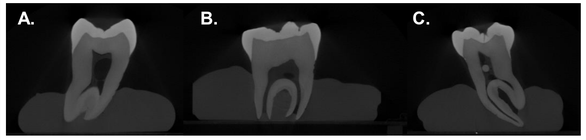

Figure 2. Pre-preparation analysis of samples by MicroCT for detection of non-visible fractures. A) Cross-section of tooth sample labelled #45. B) Cross-section of tooth sample labelled #51. C) Cross-section of tooth sample labelled #10.

Objectives

This study aimed to improve patient oral health by illustrating the impact that rotary instruments have on composite during the preparation and finishing/polishing procedures involved in traditional and modern restorative techniques. Demonstration of improper instrumentation was assessed with the goal of improving composite resin failure rates and increasing the longevity of dental restorations.

Table 1. Experimental design based on group (n=20).

Group	A	B	C	D
Preparation Design	G.V. Black	G.V. Black	Modern	Modern
Finishing Technique	Carbide Bur	Diamond Bur	Carbide Bur	Diamond Bur
Polishing Technique	Jiffy Polish	Jazz Polish	Jiffy Polish	Jazz Polish

Methods

Extracted human molars were initially evaluated for fractures and microfractures using Bioclear Disclosing Solution (Figure 1) and UV-light. Samples with detectable fracture lines were not included in this study. Eighty (80) teeth were selected based on this criteria. Teeth were mounted using PVS and analyzed by X-Ray Microtomography scanning (Micro-CT) to record baseline fracture levels (Figure 2). Teeth were grouped (n=20) and prepared based on experimental design (Table 1). All samples were evaluated post-preparation by Micro-CT for fractures inflicted during the preparatory phase. Teeth were then restored, polished, and evaluated a third time for additional fractures inflicted. All data was compared to control values and statistically analyzed for significant fracture differences.

Results

A significant difference was found between traditional preparations and modern preparations; traditionally prepared teeth exhibited more total fractures ($p < 0.05$) (Fig. 3a). Traditionally prepared teeth undergoing either finishing/polishing technique did not yield significant differences (Fig. 3b), while Modern prepared teeth illustrated a statistically significant difference of fractures inflicted from the control group to the final polish for carbide + Jiffy polish (p=0.0034) (Fig. 3c) and diamond + Rockstar polish (p=0.0003) (Fig. 3d).

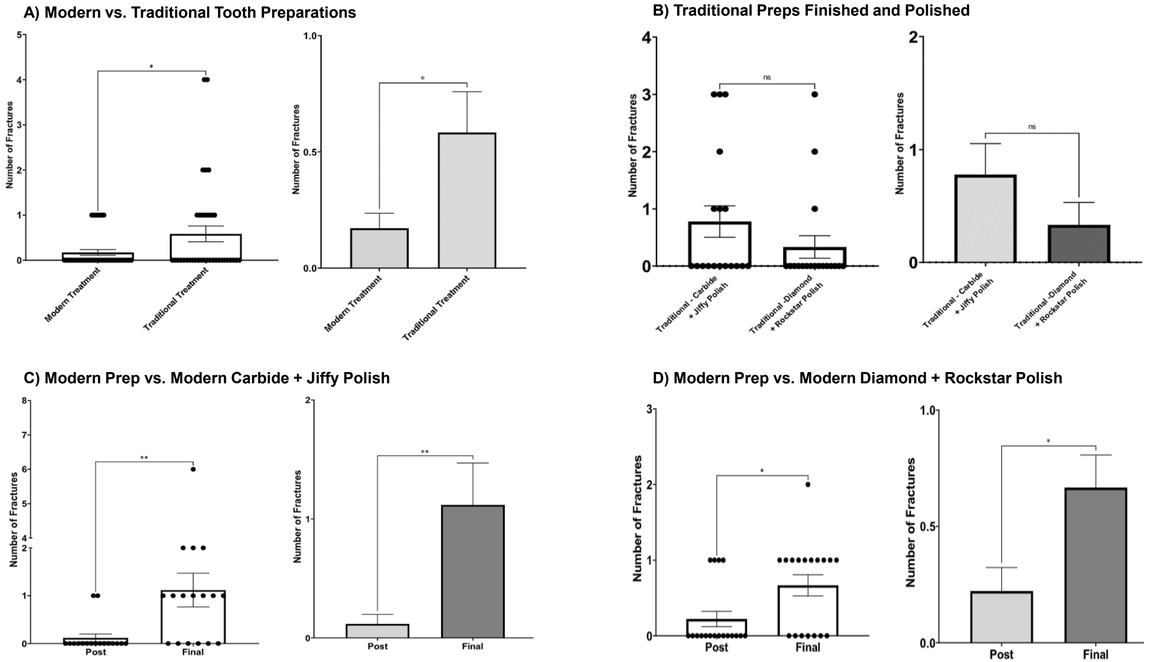

Figure 3. A) Modern vs. Traditional tooth preparations; first graph represents the total number of fractures and the second represents the average number of fractures per tooth after the preparatory phase (p=0.0327). B) Traditionally prepped teeth finished and polished with Carbide + Jiffy polishers and Diamond + Rockstar polishers, respectively (p=0.198). C) Number of fractures produced by Modern tooth preparations vs. fractures produced by Modern Carbide + Jiffy polish (p=0.0034). D) Number of fractures produced by Modern tooth preparations vs. fractures produced by Modern Diamond + Rockstar polish (p=0.0003). All results were analyzed with independent T-test analysis. The first graph for each dataset represents the total number of fractures per tooth and the second graph of each dataset represents the average number of fractures per tooth after respective treatments.

Conclusion

This study was performed to illustrate the impact that rotary instruments have on composite during the preparation and finishing/polishing procedures involved in traditional and modern restorative techniques. Our data illustrates that Traditional restorative preparation techniques inflict more fractures on a human tooth than Modern preparation techniques. While these data suggest that Modern preparations are superior to Traditional preparations in terms of reducing iatrogenic damage produced by rotary instruments, the finishing and polishing of Modern restorations yields a higher propensity for microfracture (traditionally polished teeth produce <1 fracture per tooth, while modern polished teeth produce >1 fracture per tooth). Additional analysis will be necessary to determine whether a specific location is prone to rotary-insult in Modern finishing and polishing (such as infinity margins) or whether the affect is from over-heating due to insufficient lubrication and cooling in the process, or some other phenomenon. Increased beveling and exposure of enamel rods may lead to thinner composite resins along infinity margins and produce an area of the tooth susceptible to rotary-insult and fracture. Understanding the reason for and location of fractures will be necessary for improving composite resin failure rates and increasing the longevity of dental restorations.

Future Direction

Data yielded from Phase 1 of this study will now be utilized throughout Phase 2: the post-restorative impact of finishing and polishing techniques and biofilm colonization. Teeth prepared according to the experimental design outlined in Phase 1 (Table 1) will undergo biofilm colonization in order to begin understanding additional factors that may impact the longevity of dental resin restorations. Phase 2 will attempt to discover a restorative technique that is beneficial in preventing recurrent colonization and promotes long-term restoration success.

Figure 3. Staining and biofilm accumulation along the DO margins of a composite resin restoration. Phase 2 of this study will analyze biofilm colonization on traditional and modern restorations with the intent on discovering how biofilm may impact resin failure rates.

References

1. https://www.ncbi.nlm.nih.gov/pubmed/11218479
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5513465/

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