AN INVESTIGATION ON THE EFFICACY OF A UNIVERSAL DENTAL BUR WITH NOVEL COATING FOR VARIOUS RECONSTRUCTION MATERIALS

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Introduction and Objectives

Removal of fixed dental reconstructions may require cutting/drilling of the material for easy removal for the subsequent restoration. Such procedures require time as a function of the hardness of the material that adds to chairside time.[1-3] Recent developments in coatings used on diamond burs aim to reduce the time required during cutting of materials and make it more versatile for all restorative materials.[4]

This study investigated the efficacy of dental burs with different surface coatings on various reconstruction materials and evaluated surface changes microscopically after use.

Materials and Methods

Specimen Preparation

(PMMA, Nano-hybrid resin composite, Lithium Disilicate, CAD/CAM resin composite, Zirconia)

(12x4x4 mm^3)

(N=30, n=6 per group)

Burs

Bur 1: (Intensiv FG307CB)
Bur 2: (Komet 6881.314.016)
Bur 3: (Intensiv FG 307C)
Bur 4: (Komet ZR6881.314.016)
Bur 5: (Intensiv Prototype 1)
Bur 6: (Intensiv Prototype 2)
Bur 7: (Intensiv Prototype 3)

Cutting efficacy measurement

Custom-made device (Fig. 1)

(rpm=120'000, water coolant (50 ml/l) Pressure: 750 g, working length: 3 mm; one bur for 6 times) (Fig. 2)

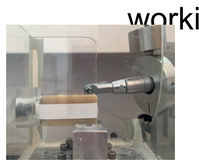


Fig. 1. Custom-made device for testing cutting efficacy of the tested burs.

Time recording

Microscopic Evaluation

Digital microscope (Keyence, Japan)

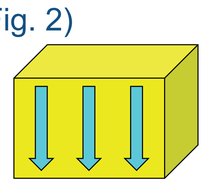


Fig. 2. Cutting direction of the tested burs on blocks of restorative material.

Cleaning

Ultrasonic Cleaning (10 min, distilled water)

Microscopic Evaluation

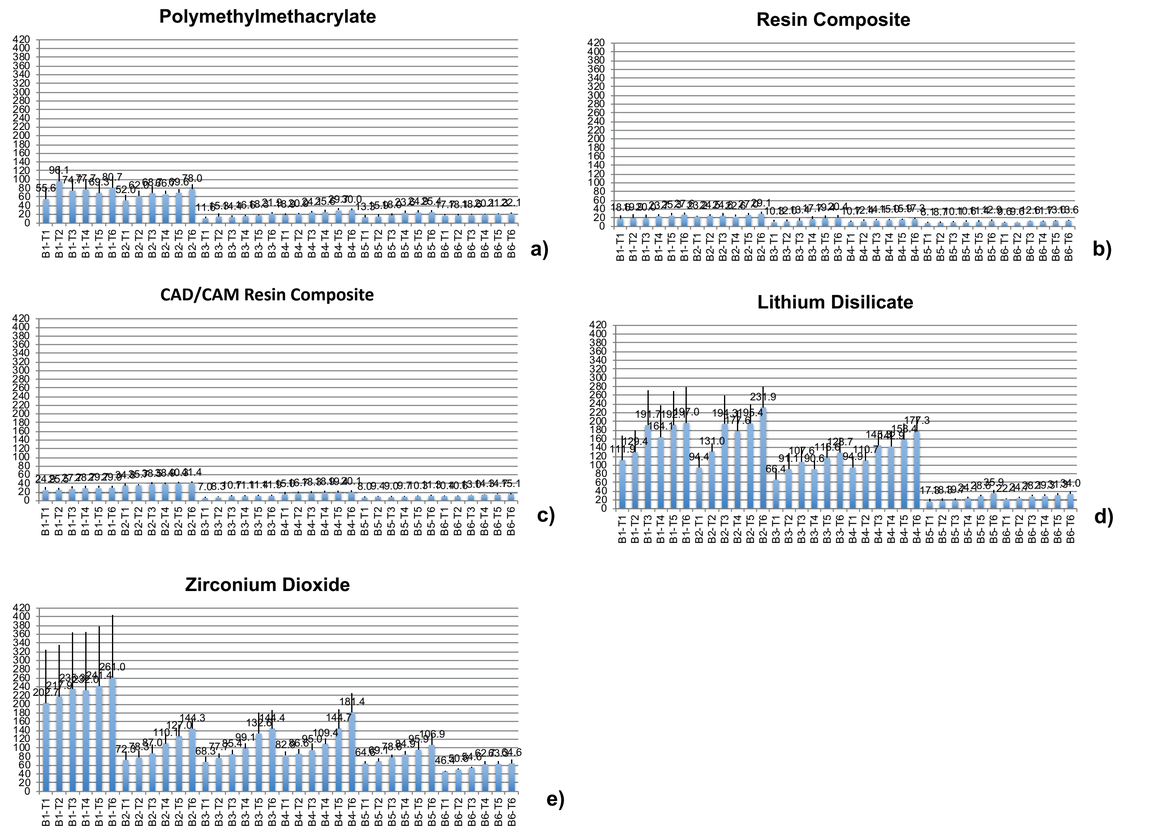
Digital microscope

Statistical Analysis

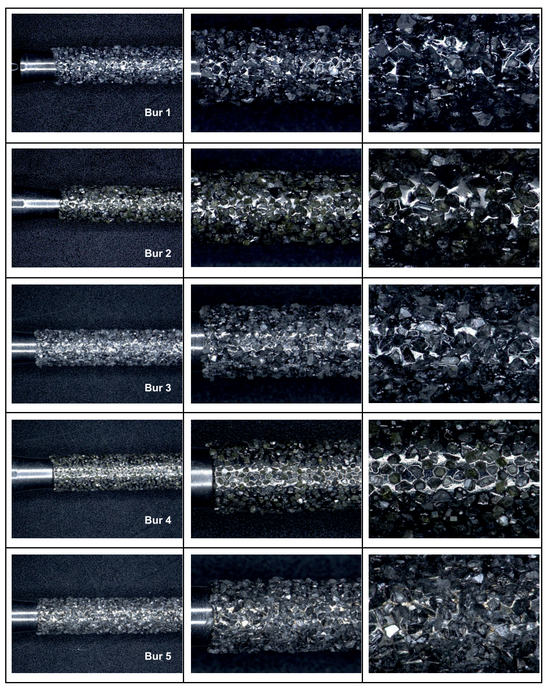
Two-way ANOVA and Tukey's HSD tests (alpha = 0.05) (SPSS Software)

Results

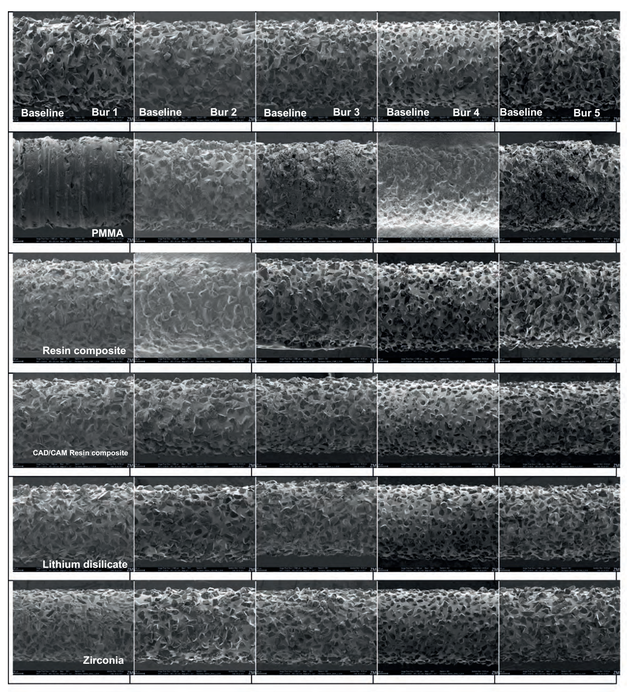
Both the material ($p<0.05$) and the bur system ($p<0.05$) significantly affected the cutting efficacy results (s). Bur 6 significantly showed the highest efficacy with all materials tested (composite: 12±1; PMMA: 20±2; CAD CAM composite: 13±1; lithium disilicate: 28±3; zirconia: 57±5) ($p<0.05$) followed by Bur 5 (10±3 - 83±11), Bur 3, (10±2 - 101±22), Bur 4 (14±2 - 138±30), Bur 2 (25±4 - 171±41) and Bur 1(23±6 - 232±130) in descending order (Figs. 3a-e). Among all materials tested, zirconia and lithium disilicate significantly required more cutting time compared to those of other materials tested. Ultrasonic cleaning did not completely remove the smear layer for PMMA on all bur surfaces (Figs. 4a-b).



Figs. 3a-e. Mean and standard deviation of time (seconds) required for cutting 3 mm depth in **a)** Polymethylmethacrylate, **b)** Nano-hybrid resin composite, **c)** CAD/CAM resin composite, **d)** Lithium Disilicate, **e)** Zirconium dioxide. Note that each bur was used 3 times for each reconstruction material and measurements were repeated 3 times. Note that zirconium dioxide required more time to cut compared to other materials. B: Bur; T: Time.



Figs. 4a. Digital microscope images of unused tested Burs (1-5) at different magnifications (x50; x100; x200). Note different dispersion of diamonds although all selected burs presented similar roughness.



Figs. 4b. SEM images of unused (Top row) and used Burs 1 to 5 (x200) after testing on polymethylmethacrylate, nano-hybrid resin composite, CAD/CAM resin composite, lithium disilicate, zirconium dioxide. Note that some resin material smear adhered to the diamond particles when used on PMMA and Bur 5 sustained less damage after use on all materials tested.

Conclusions

From this study, the following conclusions were made:

- Zirconia and lithium disilicate required significantly more time of drilling compared to other materials tested.
- Cutting efficacy of prototype Bur 6 was better especially for zirconia and lithium disilicate.
- The burs tested are recommended to be used 6 times in order to retain maximum cutting efficacy.

Clinical Relevance

- Bur 6 could be considered as a "universal bur" for both the ceramic and polymeric materials tested.
- Bur 6 was the most efficient bur for cutting zirconia.

References:

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4- Al-Haj Husain N, Özcan M. A study on topographical properties and surface wettability of monolithic zirconia after use of diverse polishing instruments with different surface coatings. J Prosthodont. 2017 (in press).