

Surface Integrity of Dental Ceramics Post Resin-Cement Removal by Burning Technique

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INTRODUCTION

The necessity to remove resin-cement from the intaglio surface of dental crowns before re-cementation is a common clinical challenge. The burning technique, which involves burning off the cement, has been suggested for this purpose. However, the impact of this technique on the surface properties of ceramics remains unclear [1].

AIM

This study aimed to evaluate the effects of the burning cements off on the surface properties of zirconia and lithium disilicate dental ceramics, particularly analyzing mechanical properties, including hardness and elastic modulus.

MATERIAL AND METHOD

Ceramic Samples



n = 8 samples / group
3.4 mm x 3.4 mm x 1.3 mm thickness

Universal Resin-Cement



Ceramic Sample Preparation



Burning Technique

Table 1. Re-Cementing Surface Preparation Steps for Ceramic Samples Using the Burning Technique		
STEPS	ZIRCONIA	LITHIUM DISILICATE
Surface Preparation	Air abraded with 150µ aluminum oxide at 60 PSI.	Cleaned in ultrasonic cleaner for 5 minutes, etched with 9.6% hydrofluoric acid (Purident, Watertown, Massachusetts, United States) for 20 seconds, rinsed for 1 minute, then cleaned for 3 minutes in ultrasonic.
Adhesive Application	Perforated template with glass slab used to apply 0.2 mm adhesive layer.	Clearfil ceramic primer plus applied with microbrush after etching.
Cement Application	Cement bleed, applied to sample surface, glass slab placed to spread cement evenly, light-cured for 20 seconds.	Cement bleed, applied to sample surface, glass slab placed to spread cement evenly, light-cured for 20 seconds.
Storage	Samples were individually placed in tubes filled with distilled water (maintaining 100% humidity) and stored at 36°C for 15 days.	Samples were individually placed in tubes filled with distilled water (maintaining 100% humidity) and stored at 36°C for 15 days.
Burning Technique	Post-cementation, the samples were subjected to the burning technique. Heated to +150°C, gradually increased to 400°C, held for 1 minute, cooled, cement removed with metal instruments.	Post-cementation, the samples were subjected to the burning technique. Heated to +150°C, gradually increased to 400°C, held for 1 minute, cooled, cement removed with metal instruments.

ATR-FTIR Analyses

- Samples were analyzed before and after cementation;
- An analysis of the surface chemical composition and the effectiveness of resin-cement removal was conducted;
- Attenuated Total Reflection (ATR) was performed using the Thermo Scientific Nicolet™ 6700 over a range of 750–4000 cm⁻¹. A resolution of 2 cm⁻¹ was used, and 120 scans were co-added to improve the signal-to-noise ratio;
- ATR-FTIR spectra were analyzed using OMNIC™ software for peak and band identification, both before and after cementation.

Hardness and Elastic Modulus Analyses

- Samples were analyzed before and after cementation;
- A Berkovich tip (100mN) was used to assess the hardness and elastic modulus of the ceramic surface;
- A minimum of four series of six indentations, with a 5 µm spacing between indentations, were performed in different areas of the surface for each sample;
- Statistical Analyses: Two-Way ANOVA with post hoc Tukey test ($\alpha = 0.05$).

SEM Analyses

- Samples were analyzed before surface preparation, after burnout process, and after repeating the burnout process post-burnout to assess the surface quality.

RESULTS

The burning technique effectively removed residual resin-cement from the ceramic samples. FTIR analysis confirmed no significant chemical residue post-treatment (Figure 7). Additionally, no significant differences in the hardness and elastic modulus of the ceramic surfaces were observed before and after the burning technique (Graphs 1 and 2).

SEM images revealed differences in surface quality between lithium disilicate (LS) and zirconia samples post-burnout. The LS surfaces appeared smoother, potentially due to residual cement, but changed after hydrofluoric acid and silane primer treatment, showing a micro-retentive surface. In contrast, the zirconia samples displayed a rougher surface, suggesting more complete resin-cement removal during burnout, exposing the air-abraded layer underneath (Figures 8 and 9).

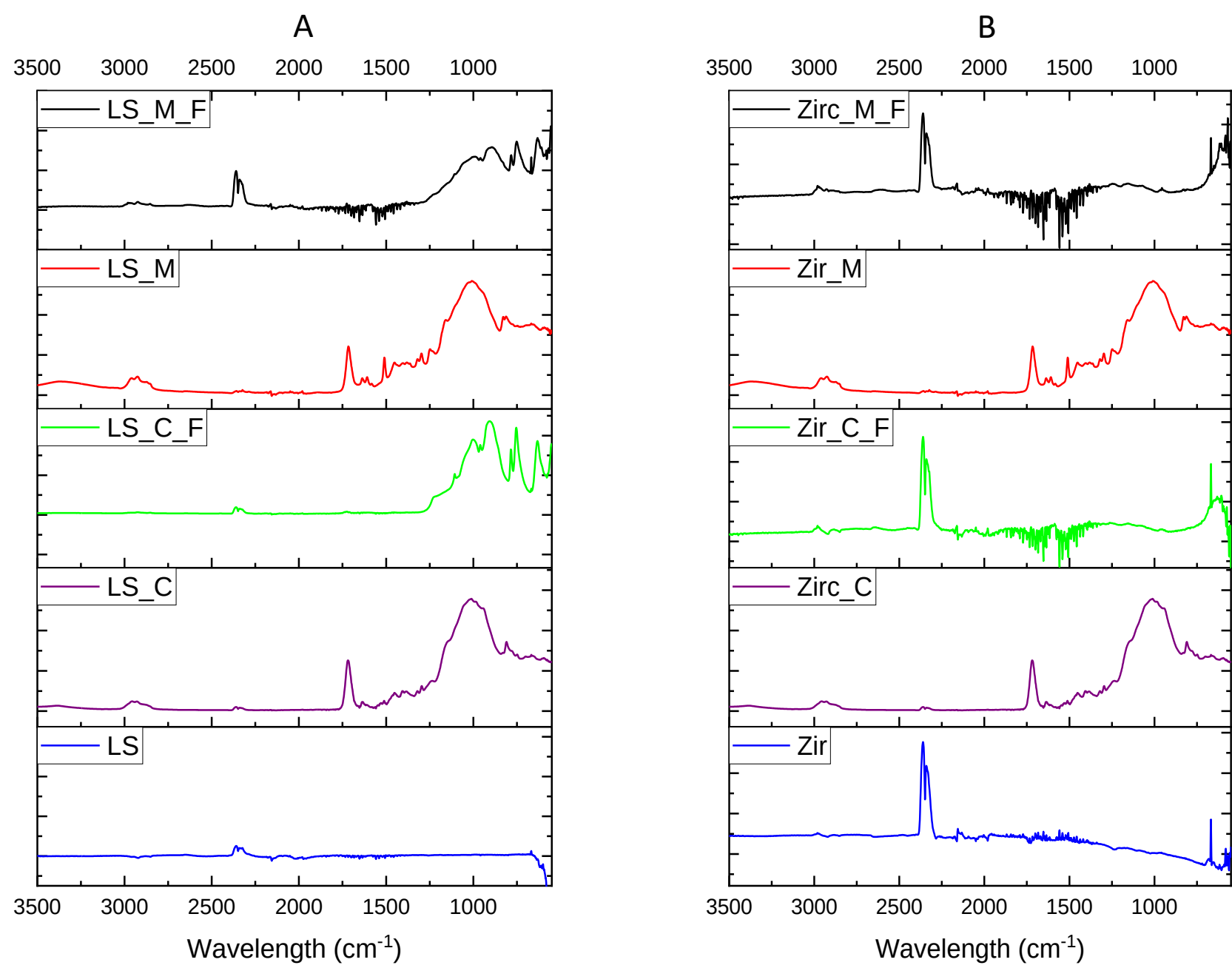
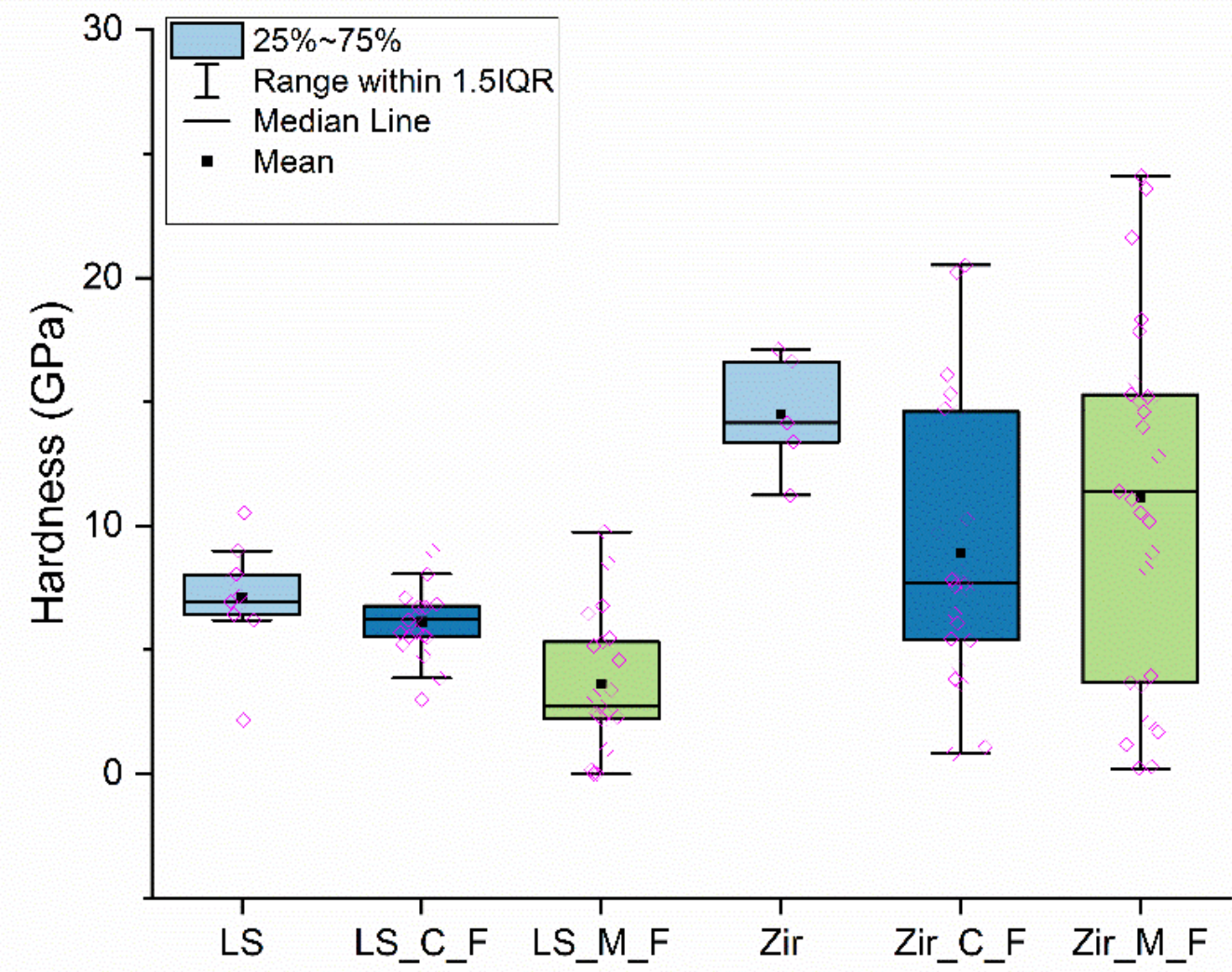
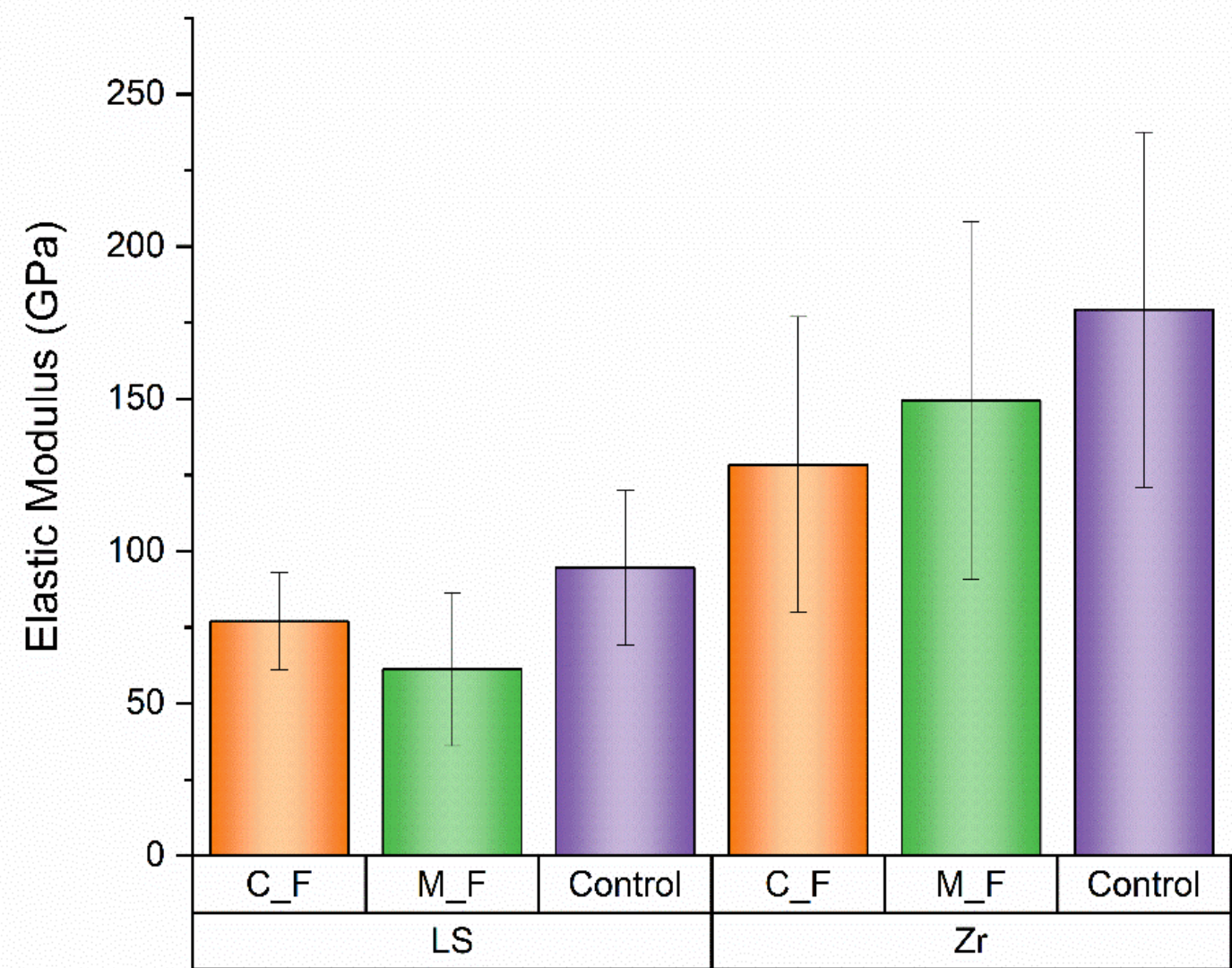


Figure 7. A) Lithium Silicate Glass-Ceramics (LS) with the different experimental conditions, LS_C: with Calibra, LS_C_F: with Calibra after the furnace step, LS_M: with multiink, LS_M_F: with multiink after the furnace step. B) Zirconia (Zir) with the different experimental conditions, Zir_C: with Calibra, Zir_C_F: with Calibra after the furnace step, Zir_M: with multiink, Zir_M_F: with multiink after the furnace step.



Graph 1. Hardness results of the experimental condition (Calibra = C_F; Multiink = M_F) compared with the control (Lithium Silicate glass-ceramics = LS; Zirconia = Zir). The small diamonds represent the data dispersion.



Graph 2. Elastic Modulus results of the experimental condition (Calibra = C_F; Multiink = M_F) compared with the control.

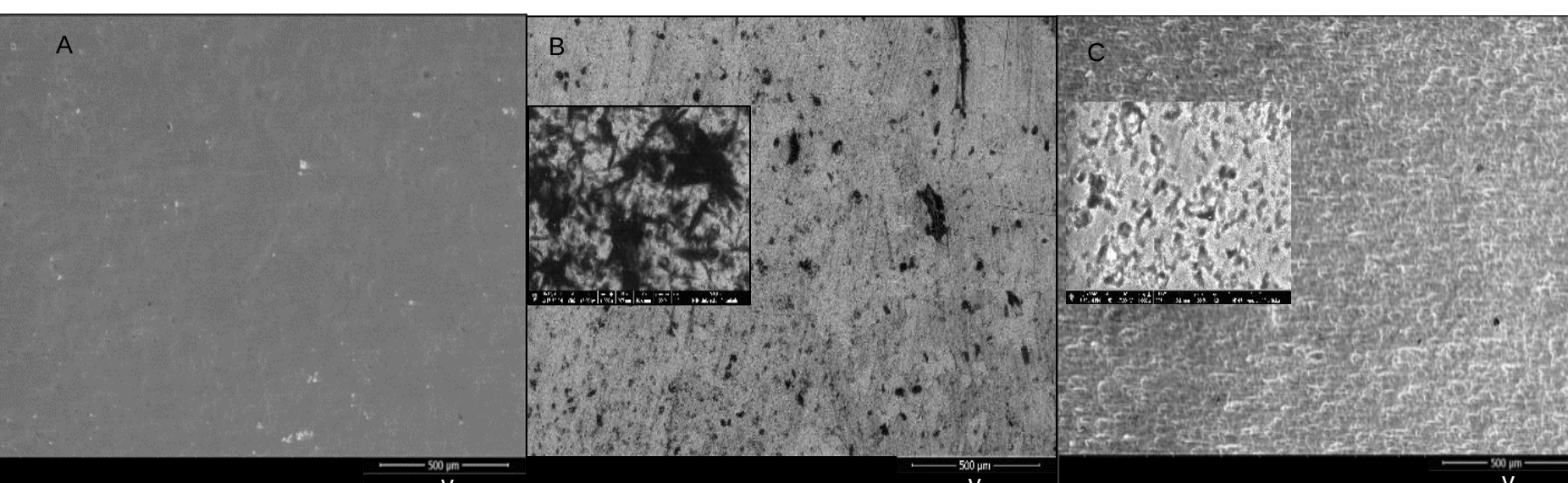


Figure 8. SEM images of LD samples, A) before any surface treatments (control), B) after the furnace step, and C) after repeating the surface treatments post-burnout.

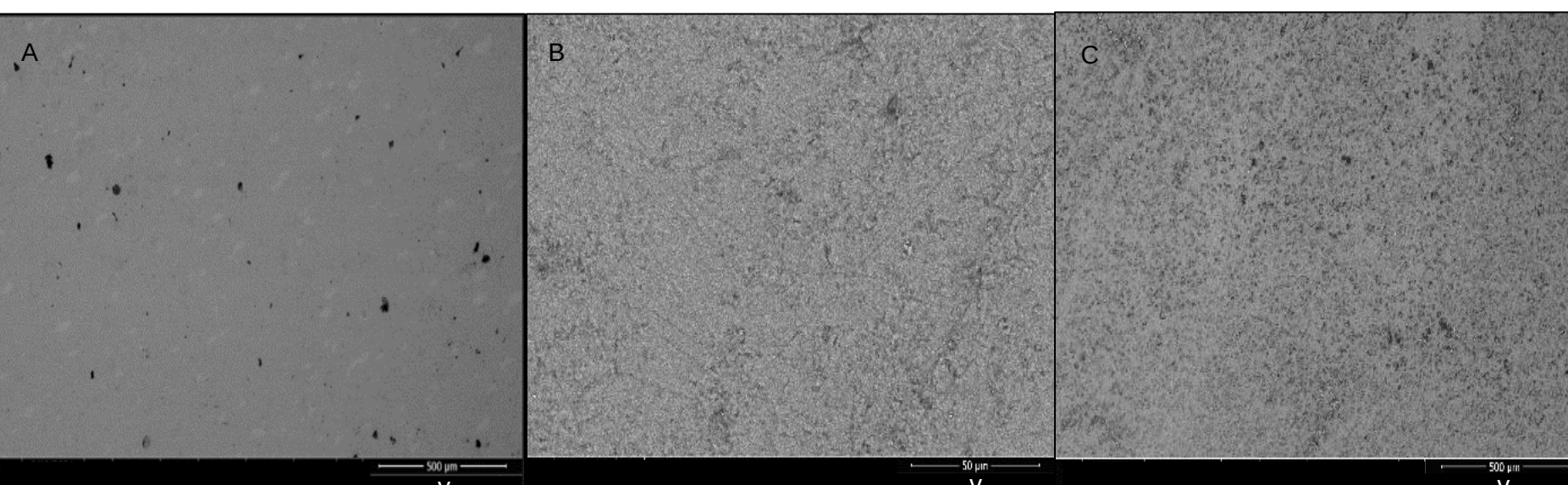


Figure 9. SEM images of zirconia sample, A) before surface treatments (control), B) after the furnace step, and C) after repeating the surface treatments post-burnout.

CONCLUSION

The study concludes that the burning technique is an effective and viable clinical method for removing resin-cement from dental ceramic surfaces without compromising their mechanical properties, making it a suitable option for re-cementation procedures.

REFERENCES

- Silva GC. A straightforward technique for removing titanium bases from screw-retained monolithic implant-supported prostheses. *J Prosthet Dent.* 2022; **128**(4): 837-838.