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Influence of Surface Treatments on Retention of Cement-Retained Implant Prostheses: An In Vitro Study

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KEYWORDS

Dental implants, Cement-retained prosthesis, Surface treatment, Abutment retention, Implant abutments, In vitro study, Tensile strength

ABSTRACT:

Introduction ;To evaluate and compare the effect of different surface treatments on the retention strength of cement-retained crowns supported by stock implant abutments under simulated clinical conditions.

Materials and Methods:

Sixty-nine titanium stock abutments were divided into three groups (n = 23). Group I received no surface treatment (control), Group II underwent circumferential grooving followed by sandblasting, and Group III received dimpled bur modifications. Nickel-chromium copings were fabricated and luted using zinc phosphate cement. Retention was tested using a universal testing machine under tensile load. Statistical analysis included one-way ANOVA and post hoc comparisons.

Results:

Group II demonstrated significantly higher tensile strength (166.06 ± 0.23 N) compared to both the control group (66.09 ± 0.08 N) and Group III (66.78 ± 0.22 N) ($p < 0.001$). Group I and Group III showed comparable retention values, indicating minimal impact from dimpled surface modifications alone.

Conclusion:

A combination of circumferential grooves and sandblasting significantly improves the retention of cement-retained prostheses to stock implant abutments. This technique may enhance clinical success, particularly in cases with short abutments or limited interocclusal space.

1. Introduction

Cement-retained prostheses are widely used in implant-supported restorations due to their superior esthetics, passive fit, and favorable load distribution. However, challenges remain in achieving adequate retention, especially in cases involving short or prefabricated abutments.

Mechanical modifications of the abutment surface, such as sandblasting or grooving, are proven techniques to improve micromechanical retention. This study

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compares the effects of two such surface treatments on the retention of cemented Ni-Cr copings.

2.Materials and Methods

Sample Preparation: Sixty-nine straight titanium abutments (4.3 mm diameter, 4 mm height) were divided into three groups:

- Group I: Control (no treatment)
- Group II: Circumferential groove + sandblasting
- Group III: Bur-created dimples

All abutments were embedded in heat-cured acrylic resin. Copings were cast using a standardized wax pattern (0.5 mm thickness) and Ni-Cr alloy.

Abutment mounted in lab analog and surface modification techniques applied.

Figure 2A–C. *Groups I–III: Control, Circumferential Grooving + Sandblasting, and Bur Modification*

3.Cementation and Testing: Zinc phosphate cement was used to lute the copings. Excess cement was removed, and samples were tested for tensile strength using a universal testing machine (5 mm/min crosshead speed).

Figure 3. *Zinc phosphate cement used for luting copings.*

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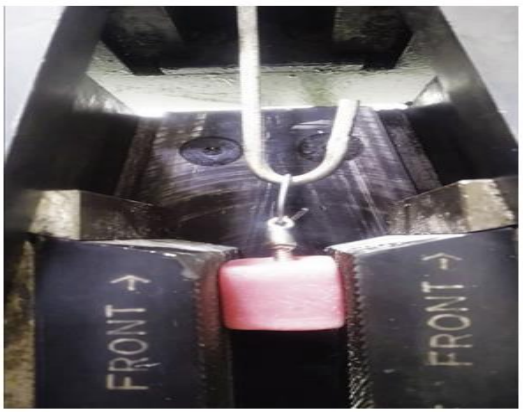
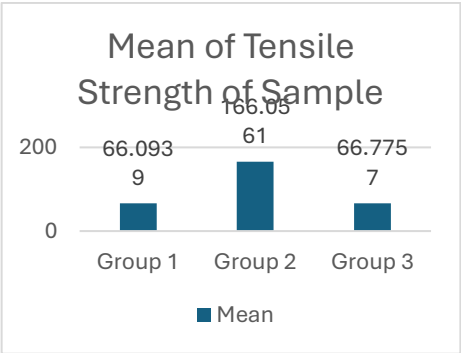


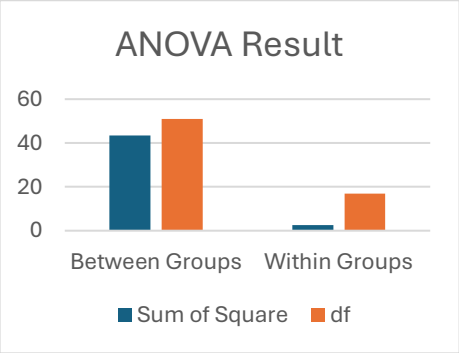
Figure 4. *Universal testing machine performing tensile test.*

4.Results

- Group I (Control): 66.09 ± 0.09 N
- Group II (Groove + Sandblast): 166.06 ± 0.23 N
- Group III (Bur Modification): 66.78 ± 0.22 N



Graph 1. *Mean tensile strength among three groups*



Graph 2. *ANOVA result showing statistical significance among groups*

5.Statistical Analysis: One-way ANOVA revealed significant differences between groups ($p < 0.001$). Group II showed statistically higher retention compared to others.

Discussion

The superior performance of Group II can be attributed to increased micromechanical retention from the combined groove and sandblasting treatment. While Group III introduced surface irregularities, the dimple pattern failed to create sufficient mechanical interlocking. These findings support the use of surface treatment to compensate for anatomical or prosthetic limitations.

Conclusion

Circumferential grooves followed by sandblasting significantly enhance the tensile strength of cement-retained implant crowns. Clinicians should consider these modifications in cases where abutment geometry limits mechanical retention.

Clinical Significance

Incorporating surface modifications like grooving and sandblasting into abutment preparation protocols can improve retention outcomes and long-term success of cement-retained implant prostheses.

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