

Comparative Effects of Bioelectric and Manual Toothbrushing on Acrylic Denture Teeth: Surface Integrity and Wear Analysis.

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Introduction

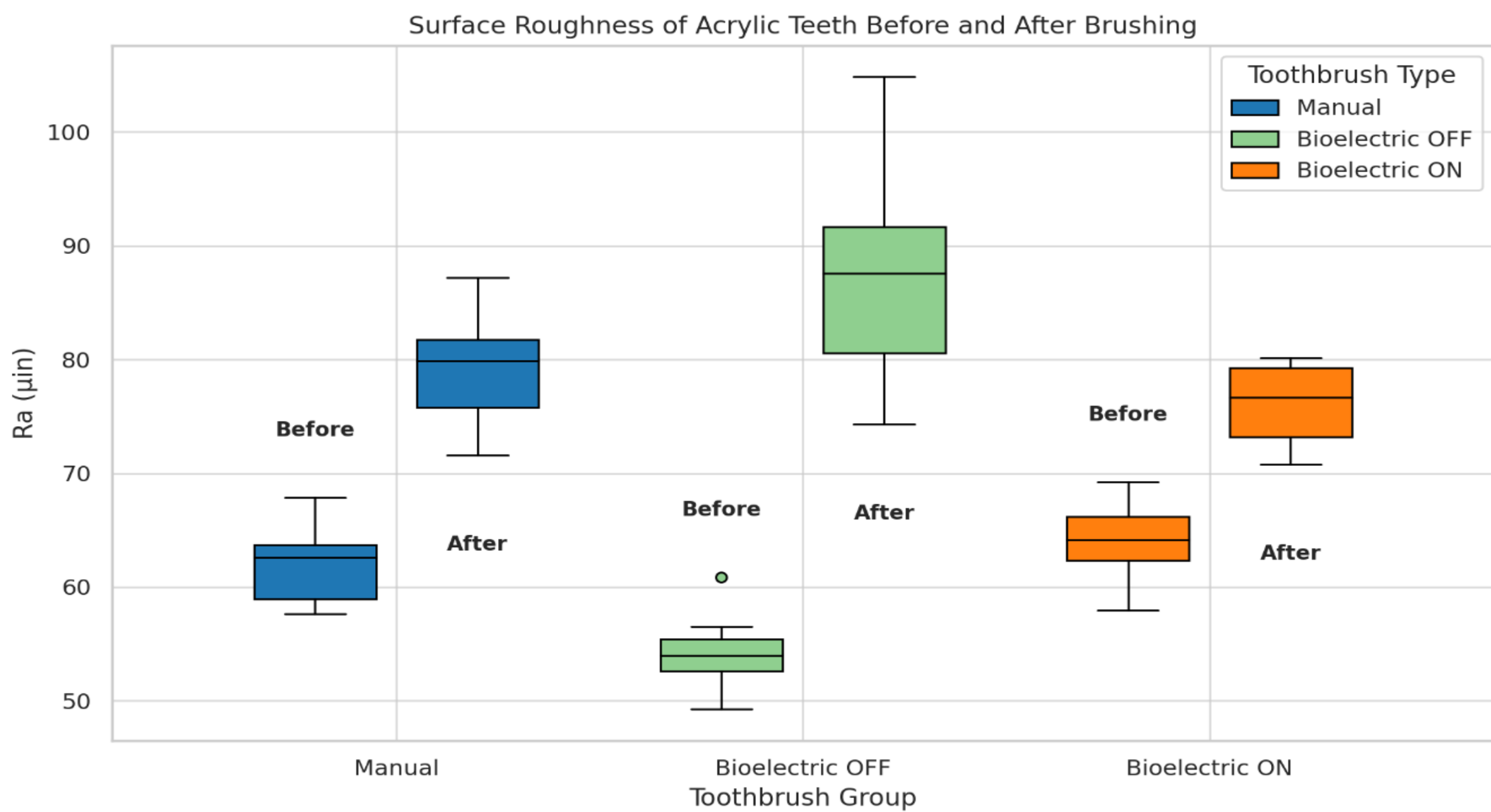
Toothbrushing is essential for plaque control, however brushes can also cause abrasion on teeth and prostheses (1). Sonic toothbrushes using bristle contact and fluid motion (2). Bioelectric toothbrushes emit DC microcurrents to alter the permeability of biofilm, promoting detachment of biofilm with minimal mechanical force (3). A roughened surfaces significantly increase bacterial adhesion, leading to denture stomatitis and compromising long-term prosthesis performance (4). The aim of this study was to evaluate the effect of bioelectric toothbrush usage on acrylic denture teeth.



Materials and Methods

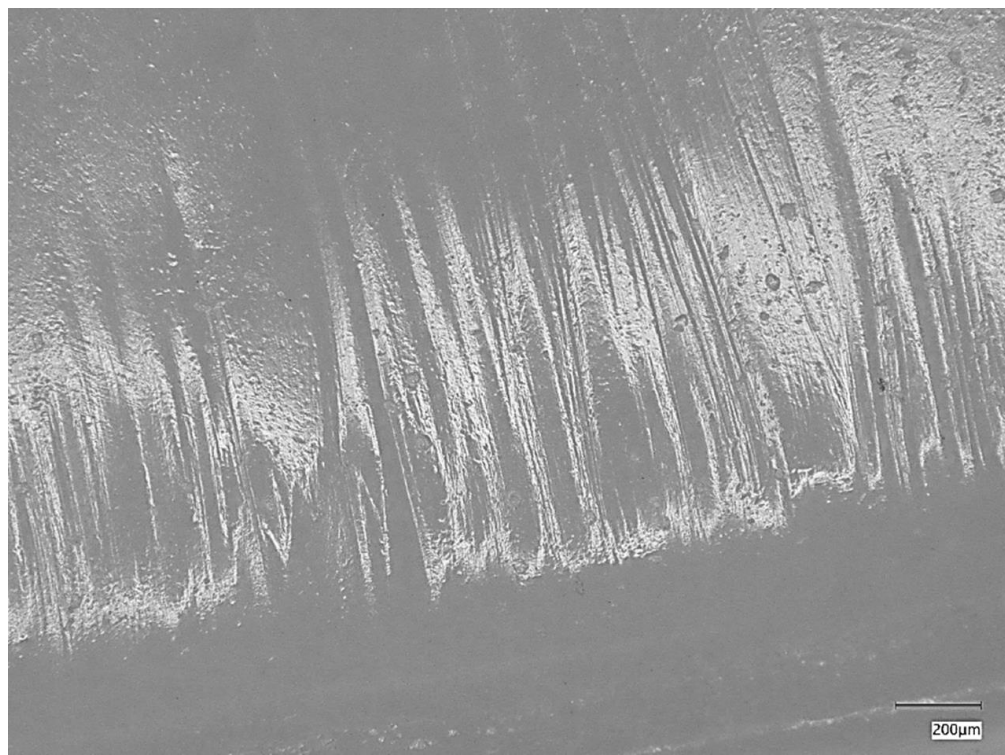
Specimens: 36 heat-cured PMMA incisors (Dentsply Portrait IPN).
Groups (n = 12):
Manual soft-bristle brush
Bioelectric brush OFF
Bioelectric brush ON

Protocol: 20,000 strokes under 200 g load in 1:1 dentifrice/water slurry using brushing simulator.
Measurements:
Surface roughness (Ra, μm) with profilometer
Weight (g) with 0.0001 g precision balance
Microscopic evaluation with digital microscope
Statistics: One-way ANOVA + Tukey’s post-hoc ($\alpha = 0.05$).

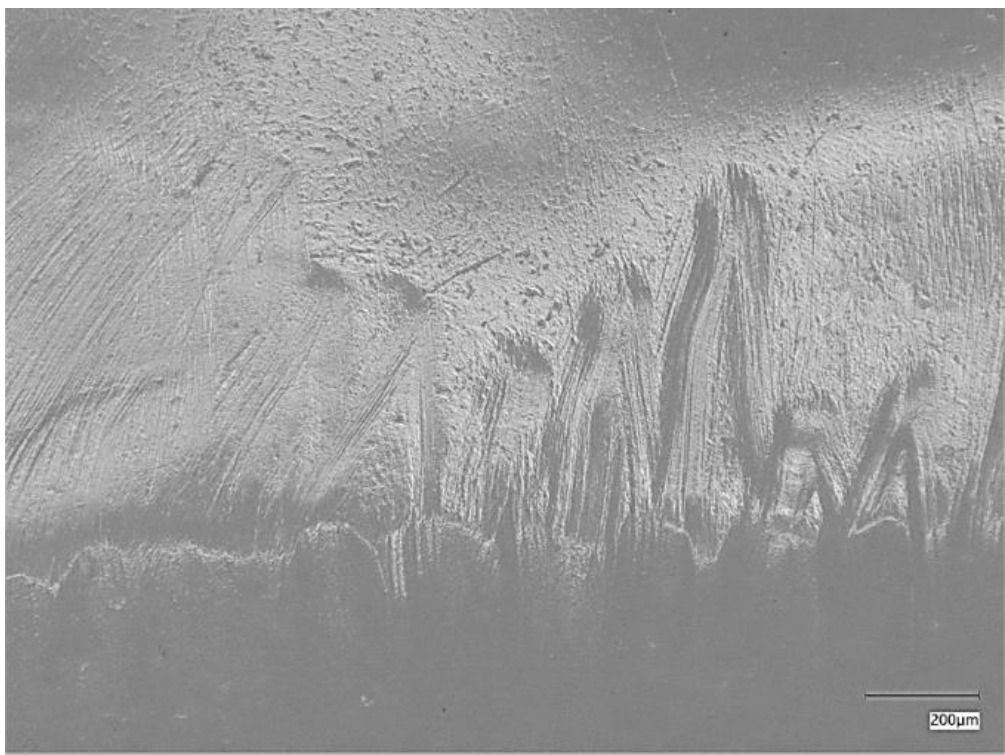


Results

Surface Roughness:
Manual: $1.54 \pm 0.22 \rightarrow 2.23 \pm 0.37 \mu\text{m}$ (significant increase)
BE-OFF: $1.48 \pm 0.20 \rightarrow 2.16 \pm 0.40 \mu\text{m}$ (significant increase)
BE-ON: $1.55 \pm 0.25 \rightarrow 1.84 \pm 0.20 \mu\text{m}$ (non-significant increase)
Weight Loss: No significant weight changes detected across all groups ($p = 0.71$).
Microscopy: Manual and BE-OFF specimens showed deeper, grooves and scratches. BE-ON specimens showed shallower, more uniform surfaces with fewer scratches.



Manual Control



Bioelectric-ON

Discussion

This study demonstrates that bioelectric activation significantly reduced the abrasive effects of simulated toothbrushing on acrylic denture teeth. Triboelectric effects and altered bristle-surface interaction may explain the reduced abrasion observed (5). Limitations include the in vitro design, absence of salivary and thermal cycling conditions, use of a single denture tooth material and one toothpaste, and lack of direct biofilm removal testing. These findings offer early evidence of protective effects that warrant further investigation.

Conclusion

- Bioelectric toothbrushes significantly minimized surface roughness increase versus manual and BE-OFF groups.
- Minimal material loss observed.
- Represents a less abrasive cleaning option for dentures.
- May extend denture lifespan and improve oral hygiene in prosthetic patients.

References

