

1. Introduction

Oxymetazoline (OXY), is an effective medicament used for controlling bleeding during otolaryngology surgery.¹ More recently, over-the-counter OXY formulations containing benzalkonium chloride (BKC; *commercially available as Afrin*) have demonstrated significant antimicrobial activity against common oral commensals implicated in pulpal infections, including *Streptococcus mutans* and *Rothia dentocariosa*.² This proof-of-concept was further supported by a retrospective clinical study in which MTA-based pulpotomies pretreated with an off-label 0.05% OXY hemostatic solution applied directly to the pulp demonstrated greater success in preventing radiographic pathosis than 20% ferric sulfate (FS)-based pulpotomies.³ Additional research on the interaction of OXY with NeoPUTTY's structure-function relationship may provide a better understanding of its pharmacological and mechanistic actions in pulpal management.

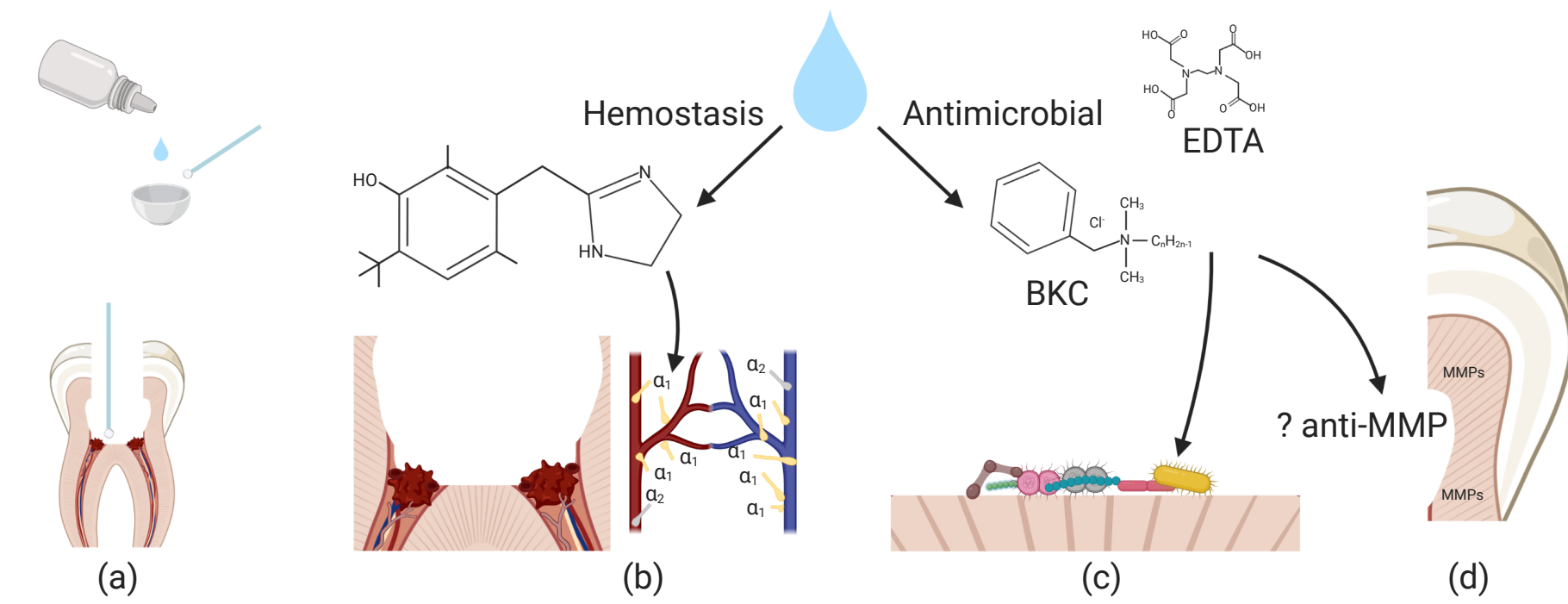


Fig. 1: Conceptual Model of Imidazoline Activity showing dual function on application to exposed pulp chambers, showing sympathetic innervation dominated by post synaptic α -1 adrenoceptors.*⁴

2. Purpose

This study evaluated the effect of a pulpotomy medicament, 0.05% oxymetazoline solution (OXY), on the morphology, elemental composition, and mechanical properties of calcium silicates (NeoPUTTY). Comparisons were made with the following treatments: artificial saliva (AS), 17% EDTA, and 5.25% Sodium Hypochlorite (NaOCl).

3. Material and methods

In this in vitro study, NeoPutty was placed in resin molds and immersed in 30 μ l test samples (n=5) containing: AS, 17% EDTA, OXY (Afrin), and 5.25% NaOCl for 1min. Treated samples were incubated in artificial saliva (AS) for 7 days at 37°C. SEM-EDX was used to analyze the microstructure and elemental composition of hydrated calcium silicate. Mechanical properties (hardness and modulus) were assessed using Hysitron TriboIndenter nanoindentation.

4. Results: SEM

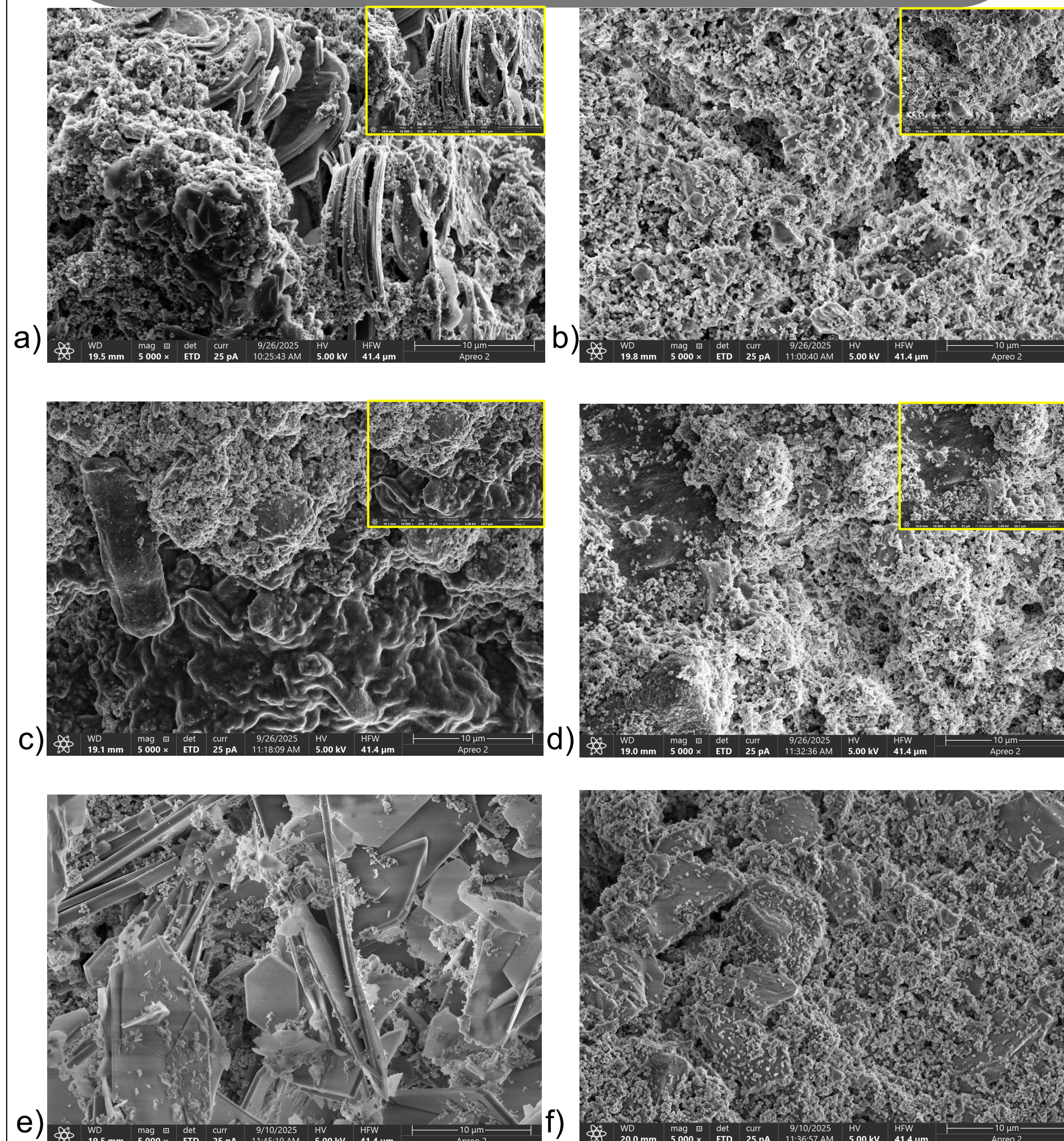


Fig. 2: SEM images of NeoPUTTY blocks at 5000x magnification. The blocks were treated with a) artificial saliva only (AS), b) 17% EDTA, c) 0.05% OXY, and d) 5.25% Sodium Hypochlorite (NaOCl). Figures e) and f) show NeoPUTTY incubation in DW only and its unhydrated form. Treatment groups showed a difference in particle size, shape and distribution. EDTA and NaOCl-treated samples (b and d respectively) depict a more eroded surface. Insets (yellow) depict magnified images of the corresponding areas.

4. Results: EDX

EDX elemental color maps of treated sample

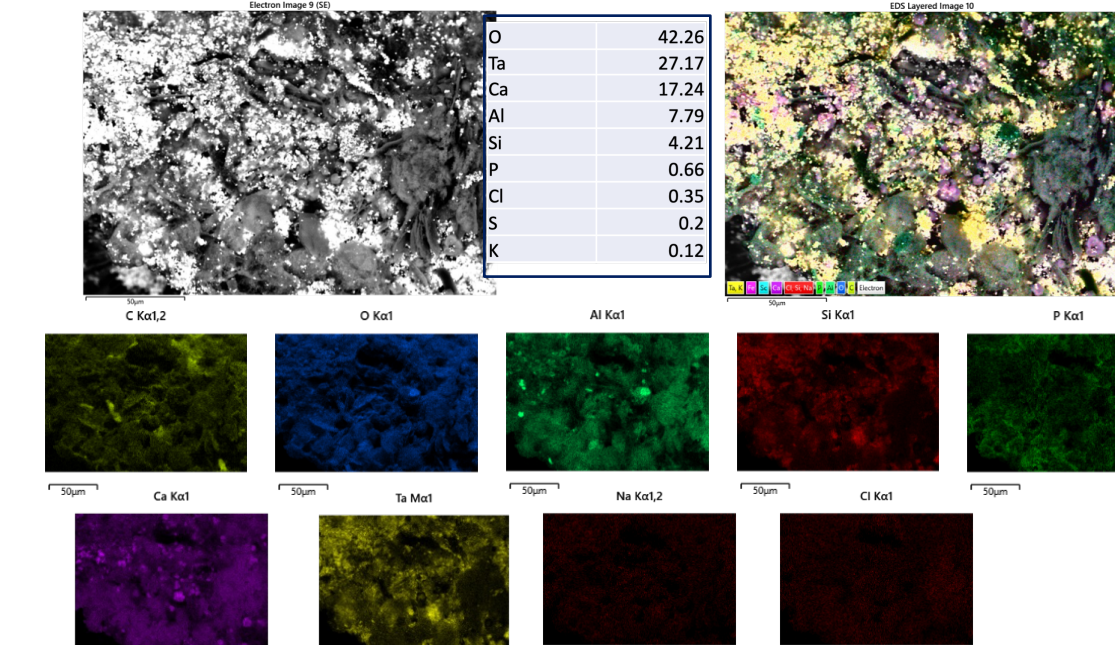


Fig. 3: Backscattered electron (BSE) image of NeoPUTTY blocks treated with OXY along with the corresponding elemental color map. O, Ca, Ta, Si, Al were the predominant elements found in all samples.

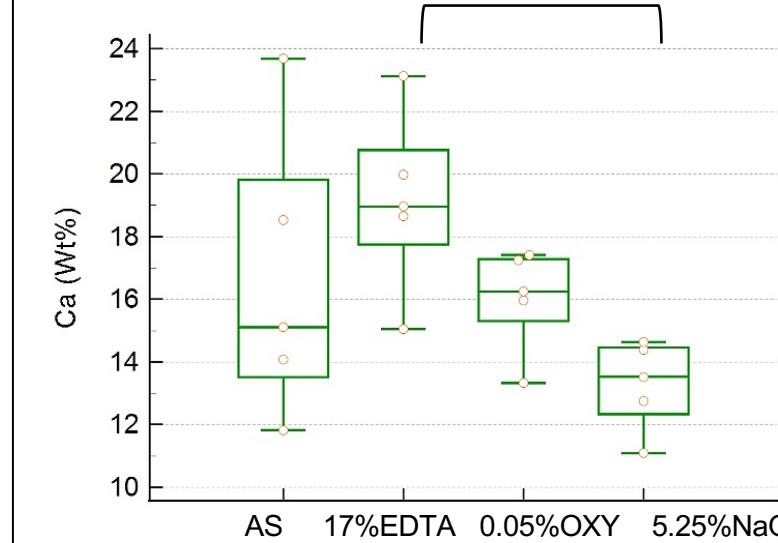


Fig. 4: Ca (Wt%) for NeoPUTTY treated samples (n=5). One way ANOVA + Kruskal Wallis test (non-parametric) tests used for comparison ($p=0.03$). *AS-artificial saliva, 0.05% OXY (Afrin), and 5.25% NaOCl.

4. Results: Nanoindentation and Ex-vivo

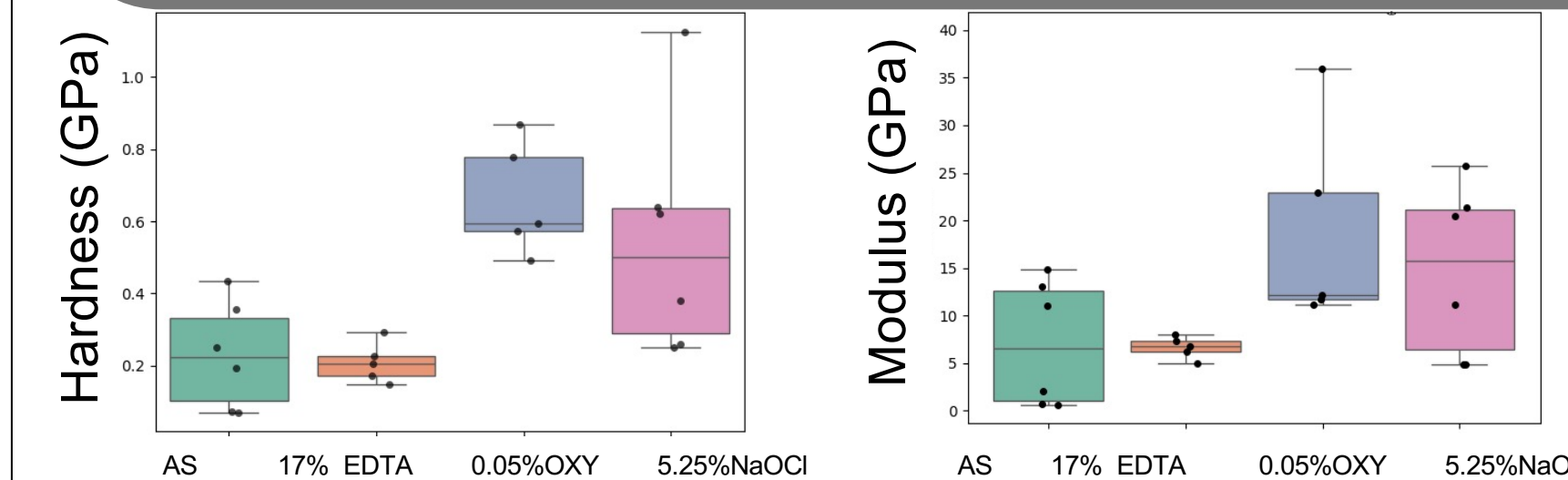


Fig. 4: Nanoindentation test showing hardness and modulus for the treated NeoPUTTY samples incubated in AS for 7 days at 37°C. OXY- and NaOCl-treated samples showed significantly higher hardness than AS- and EDTA-treated samples. $p<0.05$; $n\sim 6$).

Ex-vivo Experiments:

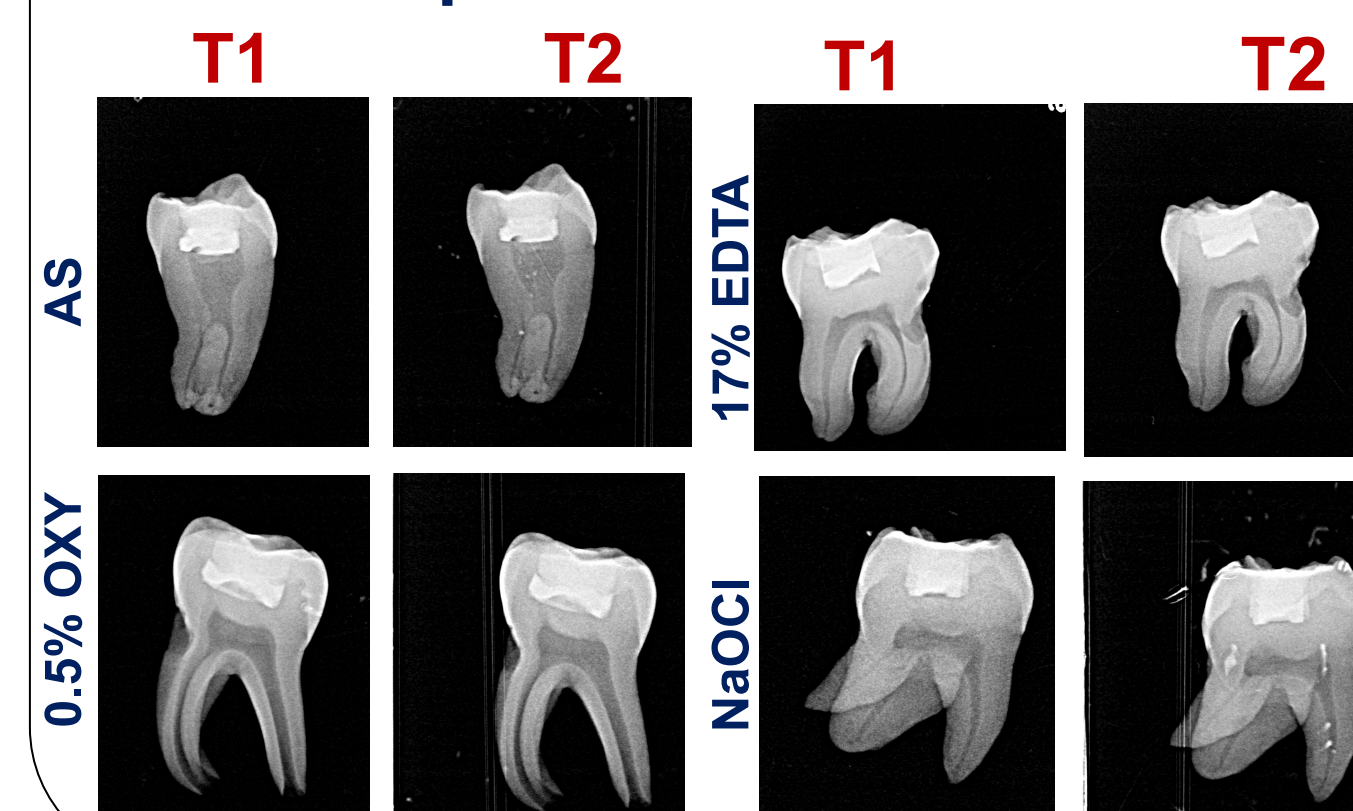


Fig. 5: Radiographs of permanent molars treated with the 4 groups and restored with NeoPUTTY base and RMGI in AS seen at time points **T1-start and T2= 8 months**. No changes in the restoration structure or seal noted clinically, radiographically after incubation.

5. Discussion

- SEM revealed that AS and OXY-treated NeoPUTTY exhibited larger amorphous, granular-globular deposits with distinct plate-like crystals. EDTA and NaOCl-treated samples showed roughened surfaces with porosities and leaching of white hydration products, indicating disruption of the hydration matrix.
- EDX data for all groups displayed similar elemental composition. Ca (Wt %) of OXY-treated NeoPUTTY was comparable to all groups.
- 0.05% OXY-treated NeoPUTTY demonstrates a higher modulus and hardness value.
- In the ex vivo experiments, deep Class I cavity preps (4mm depth) on molars were treated and restored with NeoPUTTY/RMGI and showed i) an intact surface restoration and ii) a sound marginal integrity clinically and radiographically after 8 months of incubation in artificial saliva.

6. Conclusion

0.05% OXY as a pulpotomy agent does not alter the *surface morphology, elemental compositional framework or mechanical properties* of NeoPUTTY significantly. It can be used as an effective pulpotomy medicament with its dual benefits of being an anti-microbial and a hemostatic agent.

7. References

- Cartabuke, R.S., Anderson, B.J., Elmaraghy, C., Rice, J., Tumin, D. and Tobias, J.D., 2019. Hemodynamic and pharmacokinetic analysis of oxymetazoline use during nasal surgery in children. *The Laryngoscope*, 129 (12), pp.2775-2781.
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- * Fig.1- designed in Biorender.com