Micro-CT Analysis of Volumetric Changes of Root-End Filling Materials

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OBJECTIVE

The purpose of this study was to evaluate the volumetric changes of root-end filling materials according to different immersion conditions using a micro-CT.

METHODS & MATERIAL

Forty-eight extracted human single-rooted premolars were obturated with gutta percha. After root-end resection, root-end preparation was performed with a diamond bur.

The tooth specimens were randomly allocated to three groups according to the tested materials (ProRoot MTA, Biodentine, or RetroMTA), and each group was divided into two subgroups (saline or blood condition).

Table 1. Calcium silicate-based materials used in this study

Material (Lot number)	Composition	Manufacturer
ProRoot MTA (0000293709)	Powder: Tricalcium silicate, dicalcium silicate, bismuth oxide, tricalcium aluminate, calcium sulfate dehydrate, or gypsum. Liquid: Distilled water	Dentsply Tulsa Dental, John son city, USA
Biodentine (B27276)	Powder: Tri-calcium silicate, di-calcium silicate, calcium carbonate, calcium oxide, iron oxide, zirconium oxide Liquid: Calcium chloride, a hydrosoluble polymer, water	Septodont Ltd., Saint Maur-des-Faussés, France
RetroMTA (RMBJ09D02)	Powder: Calcium carbonate, silicon dioxide, aluminum oxide, calcium zirconia complex Liquid: Distilled water	BioMTA, Seoul, Korea

After root-end filling of tested materials, the tooth specimens were immersed in saline or blood for 5 days in a 37°C incubator.

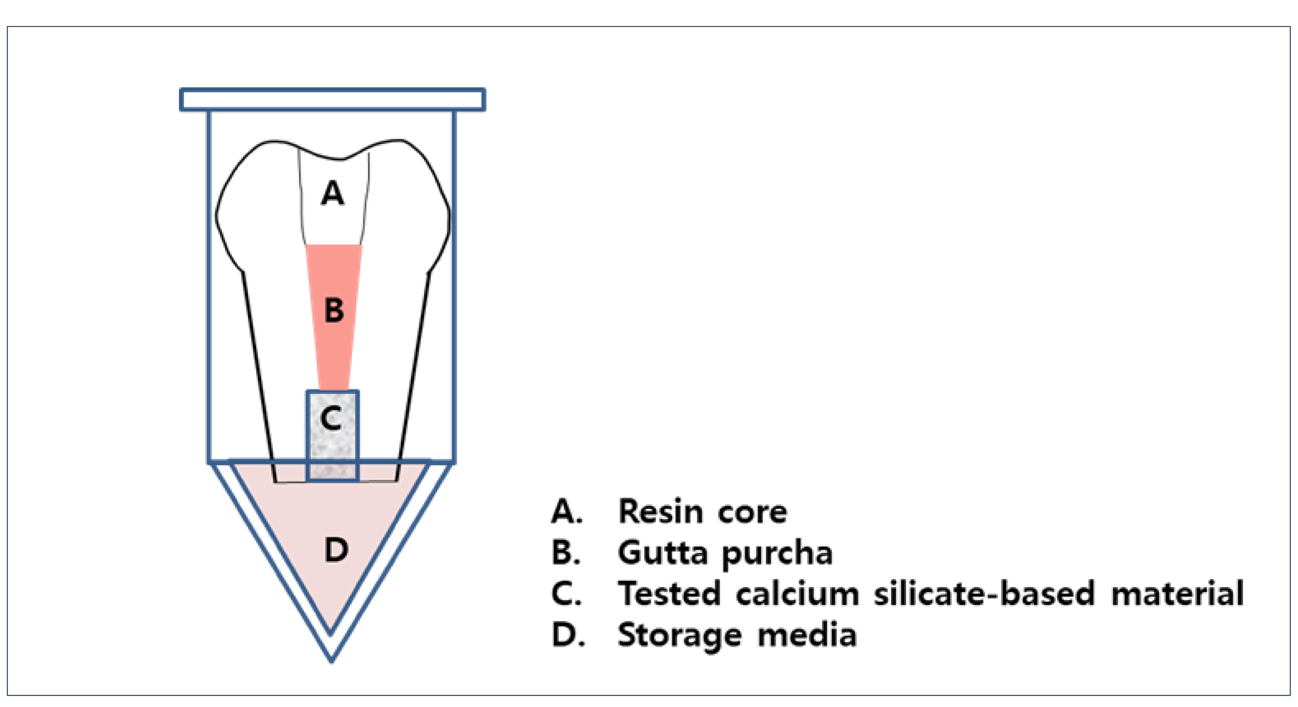

Figure 1. Schematic diagram of the experimental design representing the tooth specimen in a sealed 1.5 ml Eppendorf tube

Micro-CT scans were performed immediately after root-end filling and 5 days after immersion. The volume loss (%) was obtained from difference in the percentage of defects of materials through micro-CT analysis between before and after immersion.

Data were analyzed using the Kruskal-Wallis and Mann-Whitney U test (α=0.05).

RESULTS

Biodentine showed the highest volume loss (%) among different materials in both environments (P<0.05). The volume loss (%) of Biodentine and RetroMTA did not differ between saline and blood (P>0.05). ProRoot MTA represented singnificantly lower volume loss (%) in blood than saline (P<0.05).

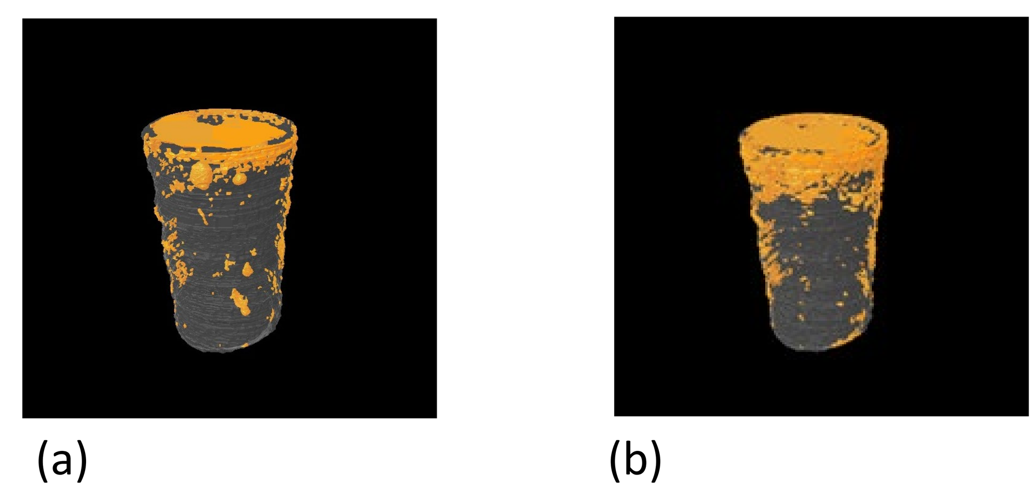

Figure 2. Representative of 3D reconstructions of Biodentine evaluated (a) before and (b) after exposure to blood. The gray cylinder shapes represent the filling materials, and the orange dots represent the overall defects of the root-end fillings.

Table 2. Total volume loss (%) of calcium silicate-based materials with different environments (saline or blood)

Environments	ProRoot MTA median (25%/75%)	Biodentine median (25%/75%)	RetroMTA median (25%/75%)
Saline	0.25 [b*] (0.13/0.41)	1.87 [a] (1.22/2.60)	0.23 [b] (0.10/0.39)
Blood	0.06 [b] (-0.01/0.12)	2.64 [a] (0.73/4.15)	0.11 [b] (-0.01/0.27)

Different superscript lower case letters indicate statistical differences among different calcium silicate-based materials in the same row (*p*<0.05).

Asterisks (*) indicate a significant difference between saline and blood environments in the same column (*p*<0.05).

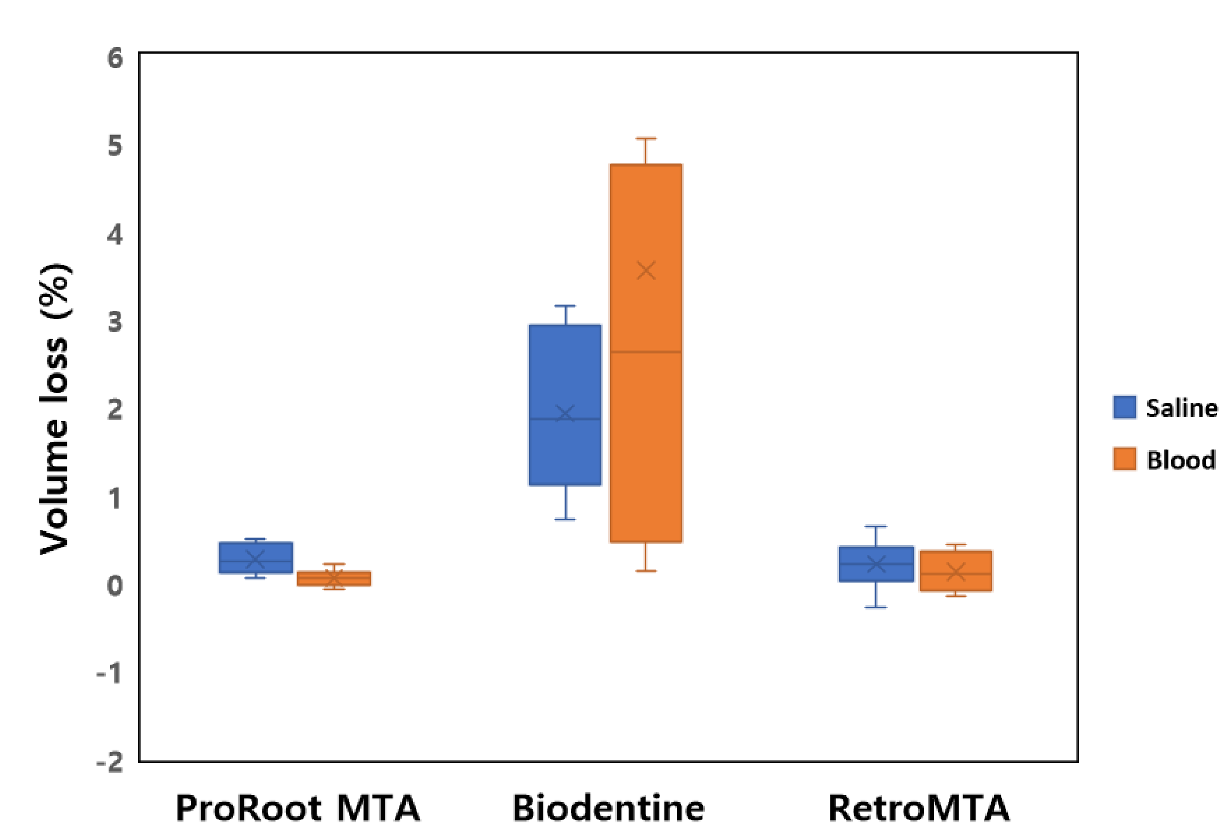

Figure 3. Box plots of total volume loss (%) with different environments (saline or blood)

CONCLUSION

From the micro-CT analysis, ProRoot MTA and RetroMTA showed less volumetric changes than Biodentine in both environments. In particular, ProRoot MTA had volumetric stability even in the blood environment.

Presented at the 99th Annual Session of the Greater New York Dental Meeting in 2023.