

Influence of different techniques for removing intracanal medications based on bioceramics and calcium hydroxide compounds

Considerations:

After 7 days, the intracanal medication becomes brittle inside the root canals, confirmed by the images obtained by microcomputed tomography.

It is also observed that the intracanal medication does not easily flow into the polar areas of the root canal, and this may be related to the physicochemical property of flow.

The removal of Bio-C Temp had better results compared to Ultracal XS. Such fact may be related to the brittle characteristic of these intracanal medication.

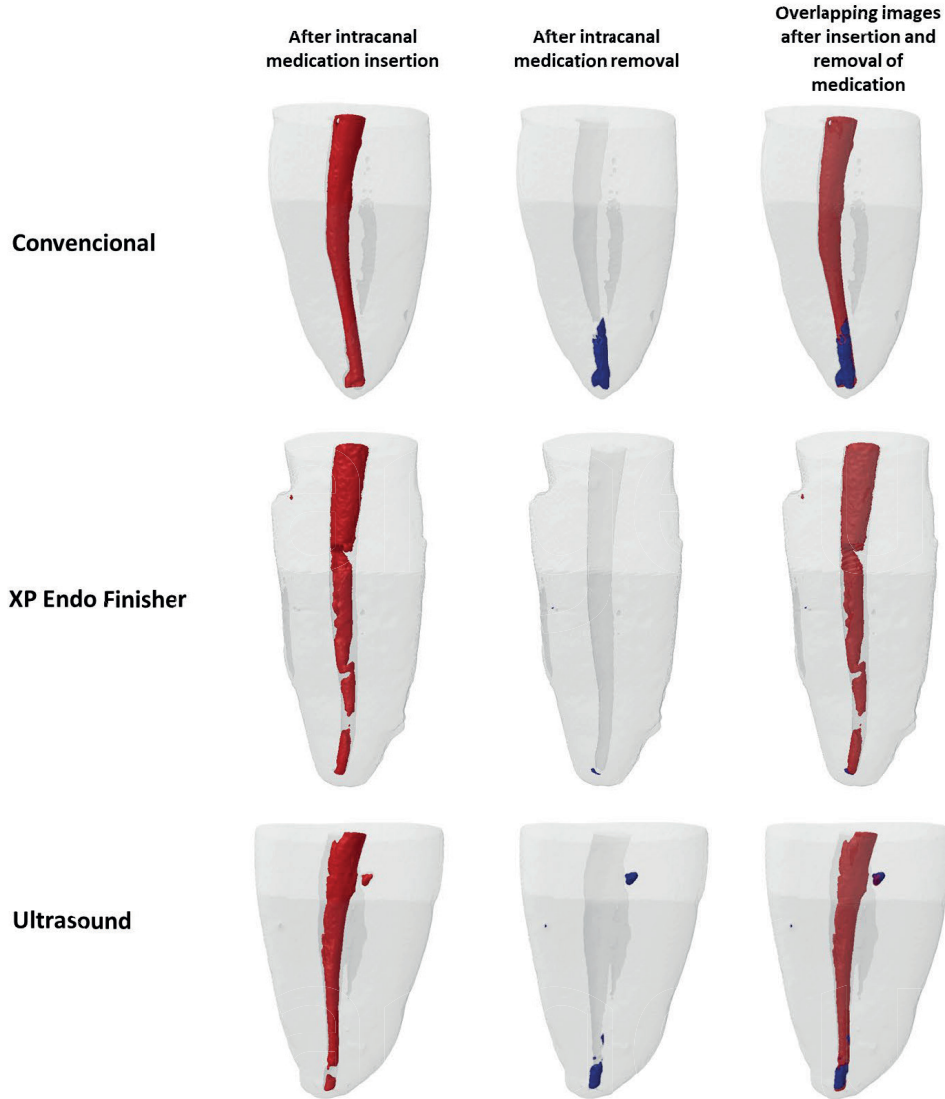
The teeth filled after intracanal medication with Bio-C Temp showed the best bond strength values.

Table I. Microcomputed tomography analysis of the percentage (%) of the volume of material removed (mm³) after the use of different intracanal medication removal techniques Bio-C Temp (Angelus) and Ultra Cal XS (Ultradent).

	Bio-C Temp (Angelus)			UltraCal XS (Ultradent)		
	Conv	XP	US	Conv	XP	US
% of removal material (mm ³)	86.90 ± 1.11	98.60 ± 1.39	94.70 ± 0.36	82.65 ± 2.43	94.54 ± 1.23	90.32 ± 1.34

Conv: conventional syringe and needle technique; XP: conventional technique associated with XP Endo Finisher instrument; US: conventional technique associated with ultrasonic inserts.

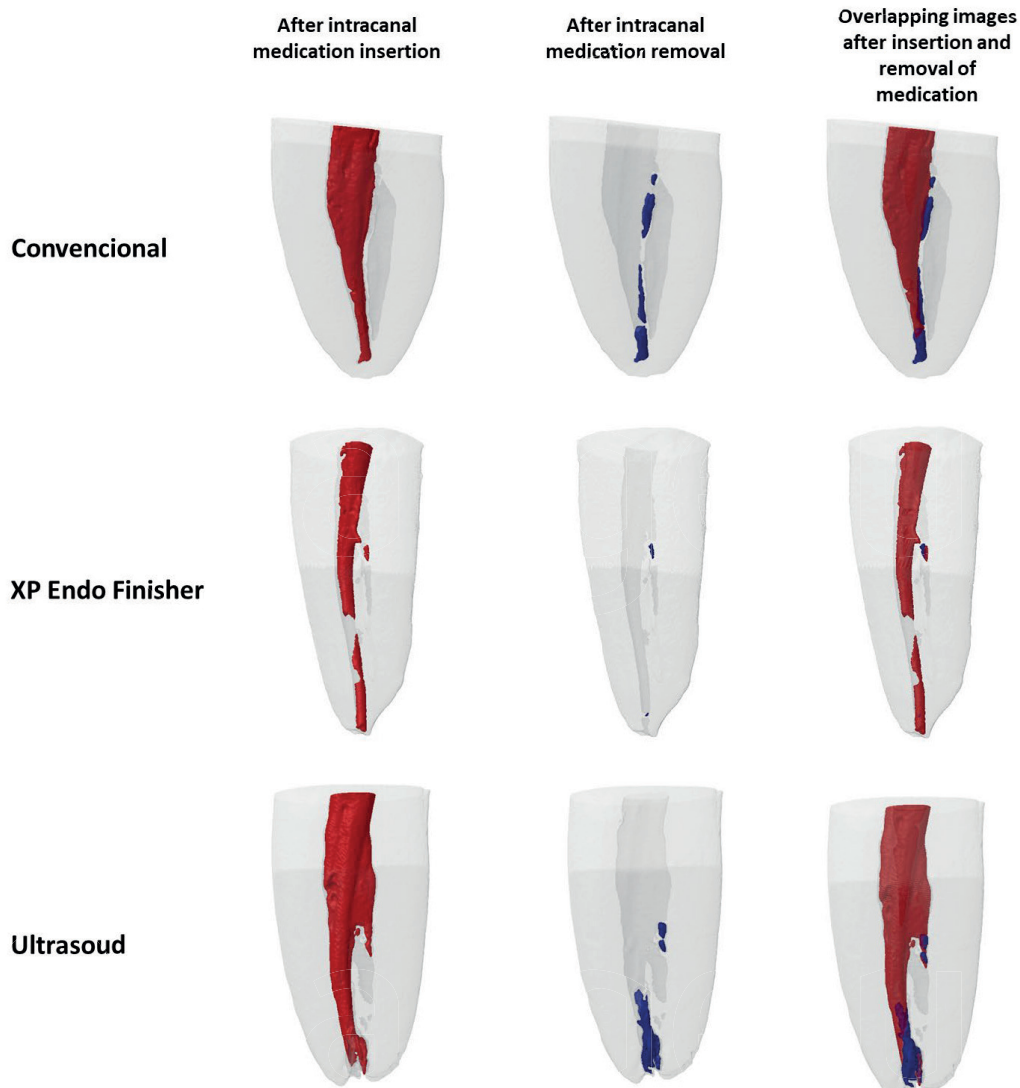
Note: The Bio-C Temp removal was better compared to Ultracal XS removal.



In 3D models it is observed:
 In red: Root canal filling with intracanal medication Bio-C Temp (Angelus).
 In blue: remnant of intracanal medication after removal with different techniques (conventional, conventional + ultrasound, conventional + XP-endo Finisher).

It is noteworthy that the teeth were scanned one day after the insertion of the intracanal medication, and probably that this medication should present some polymerization reaction or prey, which makes it brittle, making the flow difficult, as observed in 3D models.

Figure I. Representative images of three-dimensional models obtained in microcomputed tomography after insertion and removal of intracanal medication with different techniques. In red it is observed the filling of the root canal with intracanal medication Bio-C Temp (Angelus) and in blue the volume of intracanal medication remaining after removal with different techniques, as follows: conventional technique: with syringe and needle; XP Endo Finisher technique: conventional technique associated with XP Endo Finisher instrument; Ultrasound technique: conventional technique associated with complementation with ultrasonic insert.



In 3D models it is observed:

In red: Root canal filling with intracanal medication UltraCal XS (Ultradent).

In blue: remnant of intracanal medication after removal with different techniques (conventional, conventional + ultrasound, conventional + XP-endo Finisher).

Figure II. Representative images of three-dimensional models obtained in microcomputed tomography after insertion and removal of intracanal medication with different techniques. In red there is the filling of the root canal with UltraCal XS (Ultradent) intracanal medication and in blue the remaining intracanal medication volume after removal with different techniques: conventional technique: with syringe and needle; XP Endo Finisher technique: Conventional technique associated with XP Endo Finisher instrument; Ultrasound technique: conventional technique associated with complementation with ultrasonic insert.

Sample 01



Sample 02



Sample 03



In 3D models it is observed:

In red: Root canal filling with intracanal medication.

In blue: root canal after 7 days of intracanal medication.

* It is noteworthy that the teeth were scanned immediately after the insertion of the intracanal medication, and 7 days after, and that this medication should probably present some polymerization reaction or prey, which makes it brittle, making the flow difficult, as observed in 3D models.

Figure III. Representative images of three-dimensional models obtained by microcomputed tomography after initial and 7 days after the insertion of intracanal medication. In red, the images immediately after filling the root canal with intracanal medication Bio-C Temp (Angelus) and, in blue, the images is observed 7 days after filling the medication. It can be noted that the medication after 7 days becomes brittle, which hinders its flow within the root canal system.

Table II. Mean \pm standard deviation values of bond strength after removal of intracanal medication by different techniques.

	Bio-C Temp (Angelus)			UltraCal XS (Ultradent)		
	Conv	XP	US	Conv	XP	US
Thirds						
Cervical	24.78 \pm 3.14	26.74 \pm 1.12	23.06 \pm 2.65	24.69 \pm 0.79	15.41 \pm 0.75	20.97 \pm 1.04
Middle	17.31 \pm 2.47	20.83 \pm 2.28	16.45 \pm 1.21	20.02 \pm 1.99	10.40 \pm 0.64	17.02 \pm 1.43
Apical	8.57 \pm 1.89	16.76 \pm 1.81	12.64 \pm 1.03	19.32 \pm 0.98	6.39 \pm 0.93	12.62 \pm 2.04

Conv: conventional syringe and needle technique; XP: conventional technique associated with XP Endo Finisher instrument; US: conventional technique associated with ultrasonic inserts.

Note: It is observed that the greater the removal of Bio-C Temp, the greater the bond strength in the three root thirds evaluated.

Table III. Analysis of the percentage (%) of the failure pattern by digital stereomicroscopy after the bond strength test, after the use of different intracanal medication removal techniques of Bio-C Temp (Angelus) and UltraCal XS (Ultradent).

Failures	Terço	Bio-C Temp (Angelus)			UltraCal XS (Ultradent)		
		Conv	XP	US	Conv	XP	US
Ad	Cervical	25	25	25	0	25	0
	Middle	0	25	0	0	0	0
	Apical	0	25	25	0	0	0
Am	Cervical	75	75	75	100	50	100
	Middle	100	75	100	100	75	100
	Apical	100	75	75	100	100	100
C	Cervical	0	0	0	0	25	0
	Middle	0	0	0	0	25	0
	Apical	0	0	0	0	0	0

Conv: conventional syringe and needle technique; XP: conventional technique associated with XP Endo Finisher instrument; US: conventional technique associated with ultrasonic inserts. Ad: dentin adhesive; Am: mixed adhesive; C: cohesive.



Figure III. Representative images of the failure pattern analysis by digital stereomicroscopy after the bond strength test, after the use of different intracanal medication removal techniques of Bio-C Temp (Angelus) and Ultra Cal XS (Ultradent). (A) Dentin adhesive failure; (B) Mixed adhesive failure; and (C) Cohesive failure.

Note: The teeth filled after removal of Bio-C Temp showed higher frequency of mixed failures, confirming the highest bond strength.

Table IV. Mean \pm standard deviation values of bond strength after removal of intracanal medication Bio-C Temp (Angelus) by different techniques without application of EDTA before the root canal filling.

	Bio-C Temp (Angelus)		
	Convencional	XP	Ultrasound
Thirds			
Cervical	8.59 \pm 2.59	11.27 \pm 5.64	12.3 \pm 3.13
Middle	5.98 \pm 2.28	6.75 \pm 4.15	10.58 \pm 2.79
Apical	6.23 \pm 1.01	7.57 \pm 1.56	9.20 \pm 4.38

Conv: conventional syringe and needle technique; XP: conventional technique associated with XP Endo Finisher instrument; US: conventional technique associated with ultrasonic inserts.

Note: When you removed Bio-C Temp and did not further treat with EDTA solution, the bond strength values were considerably lower.

