Micro-CT investigation of the adaptation and porosity of MTA dental root canal filling material
- a pilot study:

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Introduction and aim:

Endodontic treatment aims to eliminate the majority of intra-canal bacteria and to fill the space three-dimensionally to avoid re-infection. Long term success mostly depends on the ability of both the coronal and the root canal fillings to provide a fluid-tight seal, which is negatively influenced by the presence of voids. Mineral trioxide aggregate (MTA) has been used very recently as a root-canal filling material, as an alternative to *gutta percha*. The latter has been studied by micro CT [1]. However, MTA adaptation to root-canal walls, and the amount of both inner and outer voids, has not previously been investigated in 3-D by a non-destructive method. Therefore, the aim of this pilot study was to use Micro-CT scanning to determine: (i) the volume of voids and (ii) gap-incidence at material/tissue interfaces in root canals obturated with: (a) MTA (test material) and (b) *gutta percha* (control).

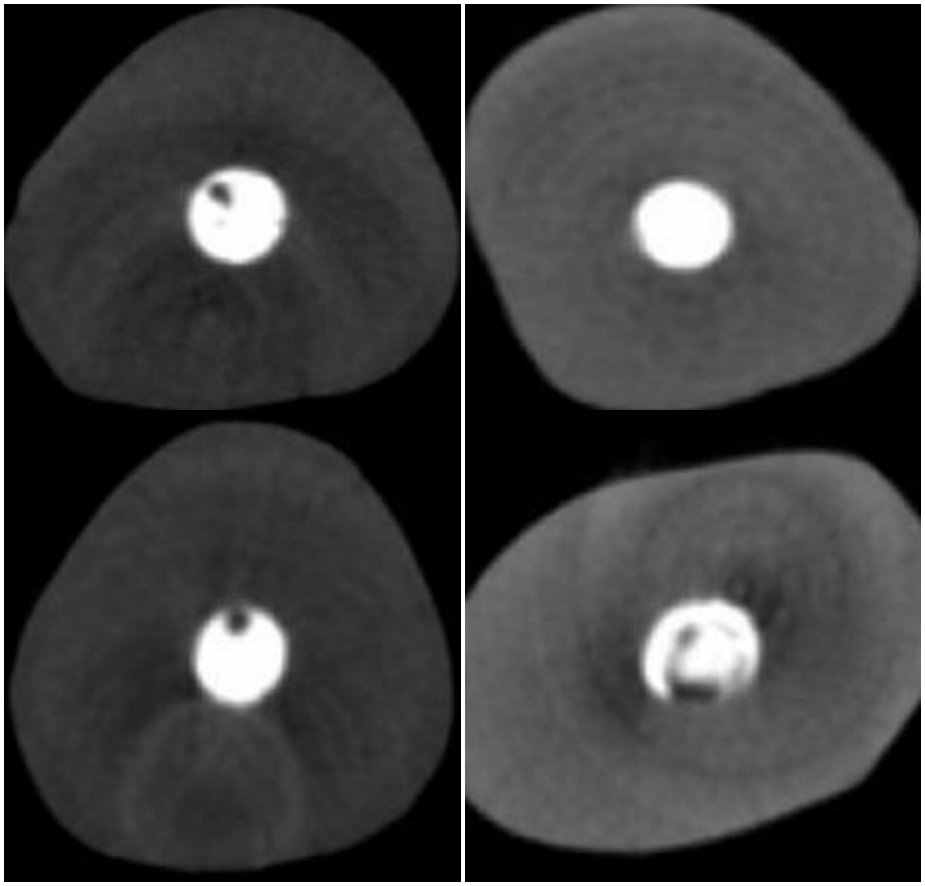

Figure1: Canal cross-sections showing dense fillings, inner voids and outer (interfacial) voids.

Methods:

Six straight, single-rooted sound extracted teeth were prepared and randomly allocated to one of two groups; MTA or *gutta percha*.

Micro-CT was used to obtain 2-D cross-section images of the inner structure of the roots and to create a 3-D model for each root. A Skyscan 1072 micro-CT scanner was used to scan the samples with a pixel size of 15.19 µm, rotation angle: 180°, rotation step: 0.9° and an exposure time of 3.1 s.

NRecon software was used to reconstruct the samples and **CTan** software was used for the final analysis. The percentage volumes of voids were determined and data were statistically analyzed using a Mann-Whitney U test.

Results:

Means and standard deviations of void-percentages are tabulated below. There was no statistically significant differences between the two material groups ($p>0.05$) as indicated in Table 1.

Group	***Variable***	***Inner voids %***	***Outer voids %***	***Total voids %***
Gutta percha	**Mean**	0.88 %	1.17 %	2.06 %
	S.D.	1.35	1.25	1.45
MTA	**Mean**	0.07 %	0.88 %	0.88 %
	S.D.	0.13	0.80	0.81
p-value		*0.26*	*0.83*	*0.28*

Table1: Void-percentages in each material group.

Conclusion:

Micro-CT proved to be a useful and non-destructive tool for measuring voids within root-filling materials and at the interface with root-canal walls. Both materials showed similar void-percentages, suggesting that MTA is as effective as the control. However, these results - based on a small sample size - are not yet definitive and so the subject merits further investigation.

Reference

1. Hammad, M., A. Qualtrough, and N. Silikas, *Evaluation of root canal obturation: a three-dimensional in vitro study.* J Endod, 2009. **35**(4): p. 541-4.