Micro-CT evaluation of untouched root canal surface after instrumentation with ProTaper Universal, ProTaper Next, and ProTaper Gold: a literature review

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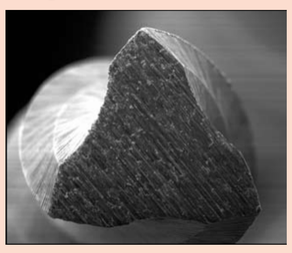
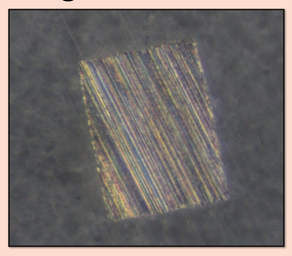
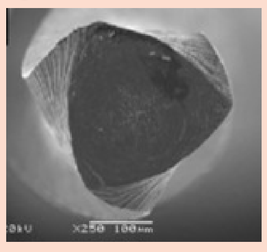
INTRODUCTION

Background: When bacteria infects the root canal, it needs to be treated by eliminating the bacteria through preparing the canal. Multiple NiTi rotary systems have been developed and manufactured to be used for root canal preparation. ProTaper Universal (PTU) ProTaper Next (PTN), and ProTaper Gold (PTG) are systems designed by Dentsply Sirona for endodontic treatment. However, the cleaning and shaping of each file system is variable and isn't able to clean all surfaces of canal completely. Micro-computed tomography (micro-CT) is similar to CBCT except on a smaller scale with much higher resolution. The use of micro-CT allows for nondestructive 3D visualization of an object.

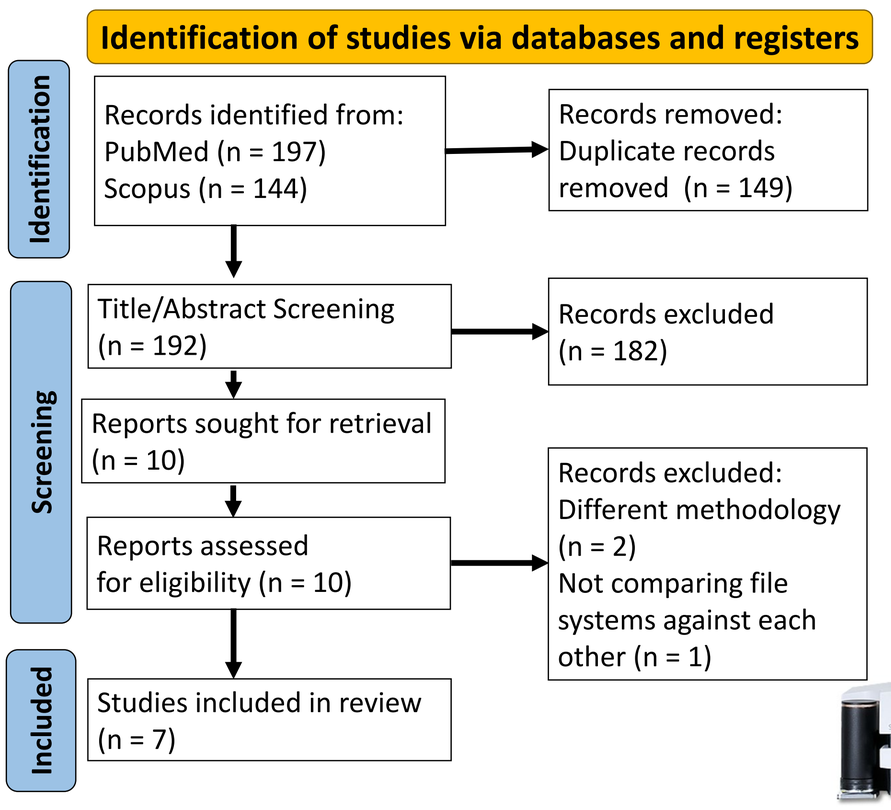
Objective: The purpose of this literature review is to objectively analyze parameters of cleaning and shaping characteristics of canals with the ProTaper Universal (PTU), ProTaper Next (PTN), and ProTaper Gold (PTG) systems.

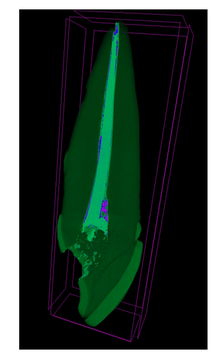
ProTaper Universal (PTU)	ProTaper Next (PTN)	ProTaper Gold (PTG)
2006	2013	2014
Progressive taper (Variable taper)		
Triangular cross-section	Rectangular cross-section	Triangular cross-section

METHODS

Analysis was performed following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.
A PubMed search was conducted to find studies comparing at least one ProTaper system with other rotary systems. Search terms included: ProTaper Universal (PTU), ProTaper Next (PTN), and ProTaper Gold (PTG) , structural model index (SMI), change in canal volume, untouched walls, micro-CT. Studies were included if they studied at least one ProTaper system and had roots with < 30° curvature. Only micro-CT studies were included in this review.
Out of the studies found, a total of seven studies were included.





Micro-CT

RESULTS

Authors	Type and Amount of Teeth	Files used for micro-CT analysis	Results
Gagliardi et al. (2015)	24 mandibular first molars with two separate mesial canals	PTG, PTU, and PTN (*n*=16)	Untouched canal wall: PTN (11.7%) > PTU (2.7%), PTG (3.6%) Surface area in coronal third: PTU (63.8%) > PTN (23.0%), PTG (42.7%) Structure Model Index (SMI): No significant difference Roundness: No statistical differences among 3 groups. Canal Volume Increase: PTU (coronal: 200.78%, middle: 276.35%) > PTG (coronal: 134.60%, middle: 169.72%) > PTN (coronal: 94.69%, middle: 160.35%)
Nehme et al. (2021)	32 mandibular first molars with two separate mesial canals	PTG and 2Shape (*n*=32)	Untouched canal wall: No significant difference Amount of dentin removed: No significant difference
Silva et al. (2020)	16 three-rooted maxillary first molars and a single root canal within each root	PTU, PTG, NeoNiti, and HyFlex EDM (*n*=12)	Untouched canal wall: No significant difference SMI: No significant difference Canal volume after preparation: No significant difference Surface area after preparation: No significant difference
Sivakumar et al. (2023)	33 maxillary molars	PTU, PTG, and Twisted Files (*n*=11)	Untouched canal wall: No significant difference Change in canal volume: PTU (2.67 mm^3) > PTG (1.98 mm^3) >Twisted Files (0.74 mm^3)
Yalniz et al. (2021)	30 maxillary first premolars with two separate root canals	PTU, PTG, and One-Curve (*n*=10)	Untouched canal wall: No significant difference Canal Volume Increase: No significant difference SMI: No significant difference
Cerqueira et al. (2021)	16 mandibular premolars with radicular grooves and one canal that divides into two canals (Vertucci's V configuration)	PTN and XP-endo shaper (*n*=8)	Untouched canal wall: No significant difference Change in canal volume: PTN (3.90 mm^3) > XP-endo shaper (1.79 mm^3)
Velozo et al. (2020)	20 single rooted mandibular incisors with long oval-shaped canals and fully formed root apices	PTN and XP-endo shaper (*n*=10)	Untouched canal wall: No significant difference Canal Volume Increase: No significant difference

CONCLUSION

- PTU might remove more dentin and increase canal volume more than PTG and PTN according to some studies
- Many studies found no or few differences between the systems they used
- The variability of the types of teeth used in the studies could lead to incomparable results between the studies
- More studies needed directly comparing PTU, PTN and PTG against each other

Acknowledgments

Dr. Shizuko Yamauchi Endodontics Graduate Student Award
Ms. Emily Jones (UNC-CH Library), Dr. Miki Furusho (UConn: Graphics)

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