

*** ENDOACTIVATOR RESEARCH ADDENDUM ***

SUMMARY OF SUPPORTING REFERENCES

ONGOING CLINICAL STUDIES & PUBLICATIONS

1. **Oscillatory pattern of sonically powered endodontic files** (Lumley PJ, et. al, *Int Endod J*, 22:3, pp. 125-132, 1989)

Result & Conclusion:

Sonically powered endodontic files are particularly efficient and are largely unaffected by loading. This study demonstrated that a longitudinal oscillatory pattern of sonic energy was particularly efficient.

2. **Streaming patterns produced around endosonic files** (Lumley PJ, et. al, *Int Endod J* 24:6, pp. 290-297, 1991)

Result & Conclusion:

Sonic devices produce a large disturbance around freely oscillating tips. Importantly, sonically driven tips are unaffected by dentinal wall constraints.

3. **Determination of the minimum instrumentation size for penetration of irrigants to the apical third of root canal systems** (Isfahan Medical University, Iran: Khademi A, et al, *J Endod* 32:5, pp. 417-420, 2006)

Result & Conclusion:

This paper showed the interrelationship and importance between apical diameter and apical taper in curved canals on removing the smear layer and related debris. This paper also supports the need to prepare canals on the order of 25/07 (Baumgartner) and 40/06 (Wallace) to facilitate the EA tip producing 2 alpha.

4. **Comparative safety of various intracanal irrigation systems** (University of Tennessee: Himel V, et al, *J Endod* 35:4, pp. 545-549, 2009)

Result & Conclusion:

This study showed the “EndoActivator extruded statistically significantly less irrigant than manual, ultrasonics, and RinsEndo groups.”

AND/OR

“Manual, ultrasonics, and RinsEndo groups had significantly greater amount of extrusion compared with EndoVac and EndoActivator.”

5. **Representative images demonstrating the efficacy of the EndoActivator in curved mesial canals in mandibular molar teeth** (Nova SE University: Kuttler S, *Personal Correspondence*, 2009)

Conclusion:

Sonic agitation with the EndoActivator in highly curved canals of mandibular molars demonstrated a high level of cleanliness as evidenced by no smear layer and open, patent tubules.

6. **The synergistic antimicrobial effect by mechanical agitation and two chlorhexidine preparations on biofilm bacteria** (University of British Columbia, Canada: Haapasalo M, et al, *J Endod* 36:1, pp. 100-104, 2010)

Result & Conclusion:

“Sonic activation (EndoActivator) showed the highest levels of bactericidal activity with CHX-plus after both exposure times.”

“The low-intensity ultrasonic or sonic agitation improves the action of disinfectants against biofilm bacteria.”

7. **An ex vivo evaluation of the efficacy of dynamic irrigation using the EndoActivator** (UCL Eastman Dental Institute, University College London, UK: Gulabivala K, et al, Poster Presentation, *British Endodontic Society Spring Scientific Meeting*, Institute of Civil Engineers, London, March 2010)

Conclusion:

Automated dynamic irrigation using the EndoActivator System was significantly more effective in removing stained collagen from the root canal than manual dynamic and static irrigation. The efficacy of the EndoActivator was increased with tip size and power setting.

8. **Analyzing endosonic root canal file oscillations: an in vitro evaluation** (University of Birmingham, UK: Lumley PJ, et al, *J Endod* 36:5, pp. 880-883, 2010)

Result:

Ultrasonic energy produces a series of nodes/antinodes along the length of an activated tip. Because of this mode of action, when an ultrasonically vibrating tip or canula contacts the surface of a prepared canal, then the displacement amplitudes and the biophysical forces necessary to maximize cleaning are undesirably reduced.

Conclusion:

Sonic energy produces a single node/antinode along the length of a nonmetal polymer tip. Sonically-activated polymer tips do not dampen upon canal wall constraint.

9. **Effectiveness of different final irrigant protocols on smear layer removal in curved canals** (Paris 7 – Denis Diderot University, France: Caron G, et. al, *J Endod* 36:8, pp. 1361-1366, 2010)

Result & Conclusion:

“The Sonic Activation Group (final rinse 17% EDTA / 3% NaOCl and EndoActivator) showed statistically significantly better smear layer removal ($P<0.05$) in comparison with the No Activation Group and other Test Groups in the apical third.”

10. **Comparative evaluation of the antimicrobial efficacy of a 5% sodium hypochlorite subsonic-activated solution** (University of Turin, Italy: Berutti E, et al, *J Endod* 36:8, pp. 1358-1360, 2010)

Results:

“The results show a significant improvement of root canal disinfection in the EA 30 group in which 30 seconds of agitation was applied compared with irrigation alone.”

11. **Effectiveness of different irrigant agitation techniques on debris and smear layer removal in curved root canals: a scanning electron microscopy study** (Hülsmann M, et al, *J Endod* 36:12, pp.1983-1987, 2010)

Results:

“EndoActivator was significantly more effective than ultrasonic agitation and CanalBrush.”

12. **Effect of EndoActivator System on Antibacterial Efficacy of MTAD** (Loma Linda University: Harhash AI, Shabahang S, Torabinejad M, *Personal Correspondence*, 2010)

Conclusion:

Activation of MTAD with the EndoActivator System completely inhibited the growth of *E. faecali* in 1.5 minutes, as compared to using the evidence-based 5-minute protocol.

13. **A quantitative and qualitative analysis of ultrasonic versus sonic endodontic systems on canal cleanliness and obturation** (University of Florida: Kanter V, Weldon E, et al, *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 112:6, pp. 809-813, 2011)

Result & Conclusion:

- Loose Debris 3mm from Radiographic Terminus: EndoActivator was statistically significantly better than Ultrasonics and the control group.
- Opened Dentinal Tubules 3mm from Radiographic Terminus: EndoActivator was statistically significantly better than the Ultrasonic group.
- EndoActivator provided better obturation of lateral and accessory canals ($P<0.01$)

14. **Qualitative analysis of the removal of the smear layer in the apical third of curved roots: convention irrigation versus activated systems** (Blank-Gonçalves LM, Machado ME, et. al, *J Endod* 37:9, pp. 1268-1271, 2011)

Conclusion:

“Sonic and ultrasonic irrigation produced better removal of the smear layer in the apical third of curved roots compared to conventional irrigation.”

15. **Assessment of smear layer removal protocols in curved root canals** (University of Manitoba, Canada: Mello I, et al, *Aust Endod J* 40:2, pp. 66-71, August 2014)

Results:

The EndoActivator was superior for removal of smear layer from the apical area of curved roots when compared to the other experimental protocols tested.

16. **Efficacy of 3 different irrigation systems on removal of calcium hydroxide from the root canal: a scanning electron microscopic study** (Ahlquist, M, et. al, *J Endod* 41:1, pp. 97-101, 2015)

Conclusion:

The EndoActivator System showed better results in removing $\text{Ca}(\text{OH})_2$ in each third of the root canal in comparison with the EndoVac, ProUltra and a master apical file.

17. **Comparison of smear layer removal ability of QMix with different activation techniques** (Arslan D, Guneser MB, et al, *J Endod* 42:8, pp. 1279-1285, 2016)

Results:

The various thirds of prepared canals were evaluated for cleanliness using the EndoActivator, Er:YAG 2490 nm (flat tip), and Er:YAG 2940 nm (PIPS tip). All the groups studied showed superior cleaning versus the control group.

18. **Antibacterial efficacy of a new sonic irrigation device for root canal disinfection** (Neuhaus KW, et. al, *J Endod* 42:12, pp. 1799-1803, 2016)

Results & Conclusion:

Sonically-driven polymer tips, like the EndoActivator and EDDY, clean root canal systems as well as or better than ultrasonically-driven metal insert tips. Strategically, polymer tips have an amplitude 30 times greater than ultrasonic tips, and sonically-driven polymer tips do not cut dentin or risk changing root canal morphology.

19. **Effect of sonic and ultrasonic activation on organic tissue dissolution from simulated grooves in root canals using sodium hypochlorite and EDTA** (Conde AJ, Estevez R, Loroño G, Valencia de Pablo Ó, Rossi-Fedele G, Cisneros R, *Int Endod J* 50:10, pp. 976-982, 2017)

Conclusion:

The EndoActivator increased the tissue-dissolving activity of irrigants from artificial grooves in root canals of maxillary central incisors.

20. **The efficacy of supplementary sonic irrigation using the EndoActivator system determined by removal of a collagen film from an ex vivo model** (Bryce G, MacBeth N, Gulabivala K, Ng YL, *Int Endod J* [Epub ahead of print], November 2017)

Conclusion:

Supplementary sonic irrigation using the EndoActivator system resulted in significantly more effective removal of stained collagen from the canal surface ($P < 0.0001$) compared with syringe irrigation only.