VISTA™ Dental Products

Ultrasonics In Endodontics

SCIENTIFIC DATA

SUMMARY OF SCIENTIFIC LITERATURE

I - Ultrasonic activation of irrigant general information

1. Ahmad M, et al. (1987). **Ultrasonic debridement of root canals: acoustic streaming and its possible role.** J Endod.
   Methods: Analyzed smear layer removal of canals during ultrasonic activation of irrigated sodium hypocholorite
   Conclusions: Ultrasonic activation of irrigant yielded clean canals

2. Plotino G, et al. (2007). **Ultrasonics in endodontics: a review of the literature.** J Endod.
   Methods: Review of many manuscripts
   Conclusions: Ultrasound has efficacious use in many areas of endodontics including root access refinement, removal of intracanal obstructions, increased action of irrigating solutions, condensation of gutta percha, placement of MTA, surgery and root canal preparation

3. Tasdemir T, et al. (2008). **Effect of Passive Ultrasonic Irrigation on Apical Extrusion of Irrigating Solution.** Eur J Dent.
   Methods: Measured amount of NaOCl through the apical foramen when NaOCl was left in the canal versus passive ultrasonic activation of the irrigant
   Conclusions: PUI extruded significantly less irrigant than the control group (2.15 ± 2.73 versus 14 ± 13.03 uL, respectively; $p < 0.05$)
   Low risk of apical extrusion of the irrigating solution when a file is passively ultrasonically activated in the canal

4. Guerisoli D, et al. (2002). **Evaluation of smear layer removal by EDTAC and sodium hypochlorite with ultrasonic agitation.** Int Endod J.
   Methods: Tested smear layer removal using 1.0% NaOCl or water alone, or associated with 15% EDTAC between each file size
   Size 15 file ultrasonically activated in all group
   SEM was used to measure the amount of smear layer
   Conclusions: With ultrasonic agitation, canals irrigated with NaOCl and EDTAC had less smear layer throughout the canal (all thirds) compared to water or NaOCl irrigants

5. Mozo S, et al. (2012). **Review of ultrasonic irrigation in endodontics: increasing action of irrigating solutions.** Med Oral Patol Cir Bucal.
   Methods: Review of existing literature (28 papers)
   Conclusions: The use of ultrasound in the irrigation procedure results in improved canal cleanliness, better irrigant transfer to the canal system, soft tissue debridement, and removal of smear layer and bacteria

General consensus that PUI is more effective than conventional syringe and needle irrigation in eliminating pulp tissue and dentin debris. This differ¬ence may be due to the fact that ultrasound creates a higher speed and flow volume of the irrigant in the canal during irrigation, thereby eliminating more debris, pro¬ducing less apical packing, better access of the chemical product to accessory canals and even the flush effect produced by ultrasound but not manual irrigation

The combination of conventional irrigation together with ultrasonic irrigation facilitates the procedure and improves the elimination of bacteria and the smear layer throughout the canal system thereby contributing to higher success rates for endodontic treatment.

II - Ultrasonic activation of irrigant versus passive irrigation and/or only hand instrumentation

6. Carver K, et al. (2007). **In vivo antibacterial efficacy of ultrasound after hand and rotary instrumentation in human mandibular molars.** J Endod.

Methods: Hand/rotary no irrigation group versus hand/rotary with ultrasonic activation of irrigation

- After instrumentation, canals flushed with 15mL of sodium hypochlorite at a rate of 15mL/min (1 min irrigation)
- Ultrasonic was applied for 1 min at maximal power during irrigation
- Obtained samples from teeth to determine amount of bacteria present (colony forming units) before treatment, after instrumentation, and post ultrasonic irrigation

Conclusions: The use of ultrasonics during irrigation resulted in statistically significantly less bacteria than instrumentation alone

Positives results (less bacteria) were 7 times more likely when using ultrasonic activation during irrigation compared to instrumentation

7. Gutarts R, et al. (2005). **In vivo debridement efficacy of ultrasonic irrigation following hand-rotary instrumentation in human mandibular molars.** J Endod.

Methods: Hand/rotary (no ultrasonics) group versus hand/rotary with ultrasonics

- After instrumentation, canals flushed with 15mL of sodium hypochlorite at a rate of 15mL/min (1 min irrigation)
- Ultrasonic was applied for 1 min (power setting not disclosed) during irrigation
- Teeth fixed and sectioned for imaging analysis

Conclusions: 1 min use of ultrasonics after instrumentation resulted in significantly more tissue dissolution yielding cleaner canals and isthmuses

8. Burleson A, et al. (2007). **The in vivo evaluation of hand/rotary/ultrasound instrumentation in necrotic, human mandibular molars.** J Endod.

Methods: Hand/rotary no ultrasonics group versus hand/rotary with ultrasonics

- After instrumentation, canals flushed with 15mL of sodium hypochlorite at a rate of 15mL/min (1 min irrigation)
- Ultrasonic was applied for 1 min at maximal power during irrigation
- Teeth fixed and sectioned for imaging analysis

Conclusions: 1 min use of ultrasonics after instrumentation resulted in significantly more tissue dissolution yielding cleaner canals and isthmuses

9. Van der Sluis L, et al. (2007). **The evaluation of removal of calcium hydroxide paste from an artificial standardized groove in the apical root canal using different irrigation methodologies** Int Endod J.

Methods: After instrumentation, compared three groups. 1) ultrasonically irrigate 3 min with 50mL 2.0% NaOCl, 2) same as group 1 except water instead of NaOCl, 3) irrigated 50mL of NaOCl using a 27ga syringe

Analyzed remaining calcium hydroxide

Conclusions: Ultrasonic irrigation group was statistically significantly better

10. Van der Sluis L, et al. (2007). **An evaluation of the influence of passive ultrasonic irrigation on the seal of root canal fillings.** Int Endod J.

Methods: Tested leakage of glucose in sealed teeth that were previously hand instrumented and hand-irrigated versus hand instrumented and PUI irrigated

Conclusions: PUI resulted in significantly better sealed teeth

11. Lee S, et al. (2004). **The effectiveness of syringe irrigation and ultrasonics to remove debris from simulated irregularities within prepared root canal walls.** Int Endod J.

Methods: Simulated groove of dental debris and tested ultrasonic irrigation versus syringe irrigation to determine most advantageous approach

Ultrasonic irrigation for 3 min, level 3 Satelac unit, roughly 200mL 2% NaOCl used

Syringe irrigation of 50mL of 2% NaOCl for 7 min

Conclusions: Ultrasonic irrigation was better at removing dentine debris than syringe irrigation

III - Ultrasonic activation of irrigant compared to sonic activation of irrigant

13. Sabins RA, et al. (2003). **A comparison of the cleaning efficacy of short-term sonic and ultrasonic passive irrigation after hand instrumentation in molar root canals.** J Endod.

Methods: Ultrasonic activation versus sonic activation

- 5mL of sodium hypochlorite irrigated during activation
- Imaged the debris in each root for comparison

Conclusions: Sonic and ultrasonic activation showed significantly less root debris than passive activation alone

Ultrasonic activation performed statistically significantly better than sonic activation

30 seconds of ultrasonic activation performed the best

14. Stamos D, et al. (1987). **An in vitro comparison study to quantitate the debridement ability of hand, sonic and ultrasonic instrumentation.** J Endod.

Methods: Five groups

- A- hand instrumentation, B- sonic instrumentation, C- ultrasonic instrumentation ENAC, D- Ultrasonic instrumentation and water irrigation cavi-endo, E- Ultrasonic instrumentation and sodium hypochlorite irrigation cavi-endo

Conclusions: Ultrasonic units performed the best.

15. Van der Sluis LW, et al. (2007). **Passive ultrasonic irrigation of the root canal: a review of the literature.** Int Endod J.

Methods: Review of the existing literature, so many different materials and methods

Conclusions: Ultrasonic irrigation is better than sonic at removing dentine debris

Passive ultrasonic irrigation removes more organic tissue, planktonic bacteria and dentin debris compared to traditional syringe irrigation

16. Paragliola R, et al. (2009). **Final rinse optimization: influence of difference agitation protocols.** J Endod.

Methods: Canals shaped with rotary instruments and smear layer removed with 3mL EDTA for 2 minutes

Seven groups to analyze best method of final rinsing after smear layer removal 1) no agitation, 2) hand file for ~7 seconds OR gutta percha cone, 3) EndoActivator®* for 20 seconds, 4) Plastic Endo (sonic) for 30 seconds, 5) Satelac passive ultrasonic irrisafe for 20 seconds, 6) EMS passive ultrasonic ESI file for 20 seconds

Conclusions: Ultrasonic is most effective at cleaning the apical third of canals

Ultrasonic units provided statistically significantly better cleaning than the EndoActivator®* at locations 1mm, 3mm and 5mm from the root apex

17. Wiseman A, et al. (2011). **Efficacy of sonic and ultrasonic activation for removal of calcium hydroxide from mesial canals of mandibular molars: a microtomographic study.** J Endod.

Methods: Sonic activation for 20 seconds between 3 irrigants (17mL 6% NaOCl, 3mL 14% EDTA, and 3mL 6% NaOCl), 15/0.02 tip, 10,000 cycles

Ultrasonic activation, same as above, power setting 10 on P5 Satelac Booster unit

Total activation 60 seconds for each paper

Conclusions: Ultrasonic irrigation removed statistically significantly more calcium hydroxide than sonic irrigation

18. Jiang L, et al. (2010). **Evaluation of a sonic device designed to activate irrigant in the root canal.** J Endod.

Methods: EndoActivator®* for sonic testing and Irrisafe by Satelac, power setting 4 for ultrasonic testing

Total irrigation volume of 6mL and time of 1 min for both groups

Conclusions: Ultrasonic activated group performed better than EndoActivator®*

EndoActivator®* results in a large amplitude, causing a lot of wall contact, and no cavitation of irrigant

Amplitude of EndoActivator®* in water is ~1mm, apical root canal is less than 0.5mm so much wall contact occurs

Ultrasonic driven file at 30kHz with an oscillation amplitude of 75um reaches velocities above cavitation threshold (threshold is ~14m/s to cause cavitation)

*Not a registered trademark of Vista Dental Products.

19. Capar I, et al. (2014). **Effect of different final irrigation methods on the removal of calcium hydroxide from an artificial standardized groove in the apical third of root canals.** J Endod.

Methods: Compared standard syringe irrigation, self-adjusting file (SAF; sonic), EndoVac®*, passive ultrasonic irrigation (Satelac P5 Newtron XS)

Syringe irrigation- 10mL irrigant

SAF- 2 min, 5k movements/min, 10mL irrigant at 5mL/min

EndoVac®* - first irrigation of 5 mL of irrigant for 1 min, followed by a second irrigation of 5mL of irrigant for 30 seconds

PUI- power 6, 1 minute activation, 10mL/min irrigant

Conclusions: PUI removed significantly more calcium hydroxide than the other techniques

Sonic activation did not perform as well as syringe irrigation or EndoVac®* when using NaOCl as an irrigant

IV - Literature refuting the EndoActivator®*

20. Uroz Torres D, et al. (2010) **Effectiveness of the EndoActivator®* system in removing the smear layer after root canal instrumentation.** J Endod.

Methods: Compared standard needle irrigation of sodium hypochlorite and EDTA, to EndoActivator®* activation of sodium hypochlorite and EDTA

- EndoActivator®* activated 4% sodium hypochlorite solution for 1 min then EDTA for 1 min, followed by a rinse of 3mL of sodium hypochlorite
- Same procedure above but needle irrigation for control group

Conclusions: EndoActivator®* did not increase smear layer removal

V - Other publications

21. Peters O, et al. (2001). **Effects of four Ni-Ti preparation techniques on root canal geometry assessed by micro CT.** Int Endod J.

Methods: Used uCT scans before and after preparation (Ni-Ti K files, Light speed instruments, ProFile 0.04, and GT rotarty instruments) to analyze and quantify dentine volume removed.

NO ultrasonics tested

Conclusions: Instrumentation of canals increased volume and surface area

Prepared canals were more rounded, had greater diameters and were straighter than unprepared canals

All instrumentation left 35% or more of the canals' surface area unchanged (demonstrating the need for ultrasonic activation)

*Not a registered trademark of Vista Dental Products.