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RESONANCE COMPATIBILITY BETWEEN ENDOSONIC TIPS AND ULTRASONIC DEVICES OF DIFFERENT BRANDS

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SUMMARY:

The **aim** of the study was to determine the compatibility of 6 piezoelectric scalers - Mini Piezon (EMS), Pyon 2 LED (W&H), Woodpecker HW-3H (GWMI), Varios 550 (NSK), P5 Newtron (Satelec-Acteon) and DTE HD-7H (GWMI) with 8 types of endosonic tips for separated instruments removal - K-files # 20 and 25 (EMS), ET25 (Satelec), Redo 2 (VDW), CPR-tips 6,7,8 (Obtura Spartan), Proultra Endo tips 6,7,8 (Dentsply-Maillefer), RT3 (EMS), Endo E3 (W&H), E7 (NSK).

Methods: Examined and measured was the change in the tips' displacement amplitude with the power increase of the scalers under total magnification 80x with an optical microscope (Leica MZ6) and an image-measuring software (Klonk Image Measurement).

Results: Ultrasonic devices' compatibility with the examined tips was as follows: Woodpecker – 76,9%, Mini Piezon – 61,5%, Pyon 2 LED - 30,7%, Varios 550 – 83,3%, P5 Newtron – 83,3%, DTE – 33,3%. Lack of compatibility was found in 40,35% of all cases. In 29,82% of the cases of lack of compatibility it was demonstrated as a non-effective vibration, and in the rest of the cases – 10,53% - uncontrolled over-powerful vibration, which was dangerous to use.

Conclusion: Endosonic tips should be carefully chosen in accordance with the ultrasonic scaler used.

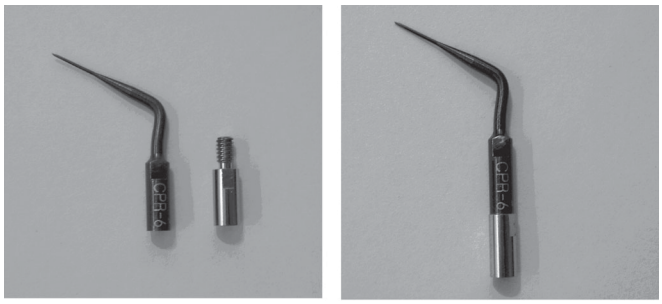
Key words: endodontic ultrasonic tips, separated instruments removal, piezoelectric ultrasonic scalers,

INTRODUCTION

Currently there isn't any information regarding compatibility between endodontic ultrasonic (endosonic) tips for separated instruments removal and ultrasonic devices of different brands. The producers themselves claim that resonance frequencies of the tips match the working frequency of the devices of the same brand, but in their product catalogues there is not any information about possibilities to use the tips with scalers of a different producer [1, 2, 3, 4, 5]. These answers are also missing in the scientific literature, as the studies are mostly discussing success rates and complications during removing of fragments with different locations in the root canal [6, 7, 8, 9, 10, 11, 12].

Currently there are two standards of the thread which is used to assemble the ultrasonic tip to the scaler – "EMS"-type (metric) – M3x0.5-3.5 and "Satelec"-type (in inches)– M3x0.6-3.6. Ultrasonic tips from the first type can not be combined with ultrasonic devices from the second, and vice versa. Lately the so called euro-adaptors (San Diego Swiss, figure 1) have been introduced, and they allow a Satelec-type ultrasonic tip to be attached to an EMS-type scaler. For the present, adaptors in the other direction don't exist – so EMS-type tips can not be used with Satelec-type ultrasonic devices.

Fig. 1. Euro-adaptor (San Diego Swiss) for attachment of Satelec-type tips to EMS-type scalers



Apart from the thread-problem, the main reason for lack of compatibility between ultrasonic tips and scalers is the difference in resonant frequencies [13]. To be able to vibrate efficiently, the piezoelectric crystal of the ultrasonic device (this is the generator of vibration) must be in resonance. Attaching an ultrasonic tip to the device creates a completely new vibrating system, which may have a resonance frequency, different from that of the piezoelectric crystal. This results in ineffective vibration, which can not be used [13]. So, in order to vibrate efficiently, ultrasonic tips must have a resonance frequency, matching that of the respective device. The contact between the tip and the object of friction (for example some tooth structure), as well as the alteration of the power settings of the device, can also change the frequency of vibration. That's why most of the devices vibrate in a broad frequency range (for example 28-36kHz, 28±3 kHz, 30±3kHz [1, 2, 3, 4, 5] and have a built-in software of the negative-feedback type for constant alteration of the working frequency of the device to keep it in resonance. As it was explained, compatibility between scalers and tips is a multifactor dependence, and the only way to verify it is to make an experiment. We think a study is necessary, verifying resonance compatibility between each combination of ultrasonic devices and endosonic instruments on the market today.

The criterion for compatibility, which has been

accepted, is as follows – the increase of the power of the ultrasonic device should result in increase of the amplitude of vibration of the ultrasonic tip [14, 15, 16].

The **aim** of this study is to verify the resonance compatibility between 8 types of endodontic ultrasonic tips for separated instruments removal and 6 piezoelectric ultrasonic devices of different brands.

MATERIALS AND METHODS

The endosonic instruments (figure 2) and piezoelectric devices used in the study are listed in table 1.

Fig. 2. – ultrasonic tips used in the study

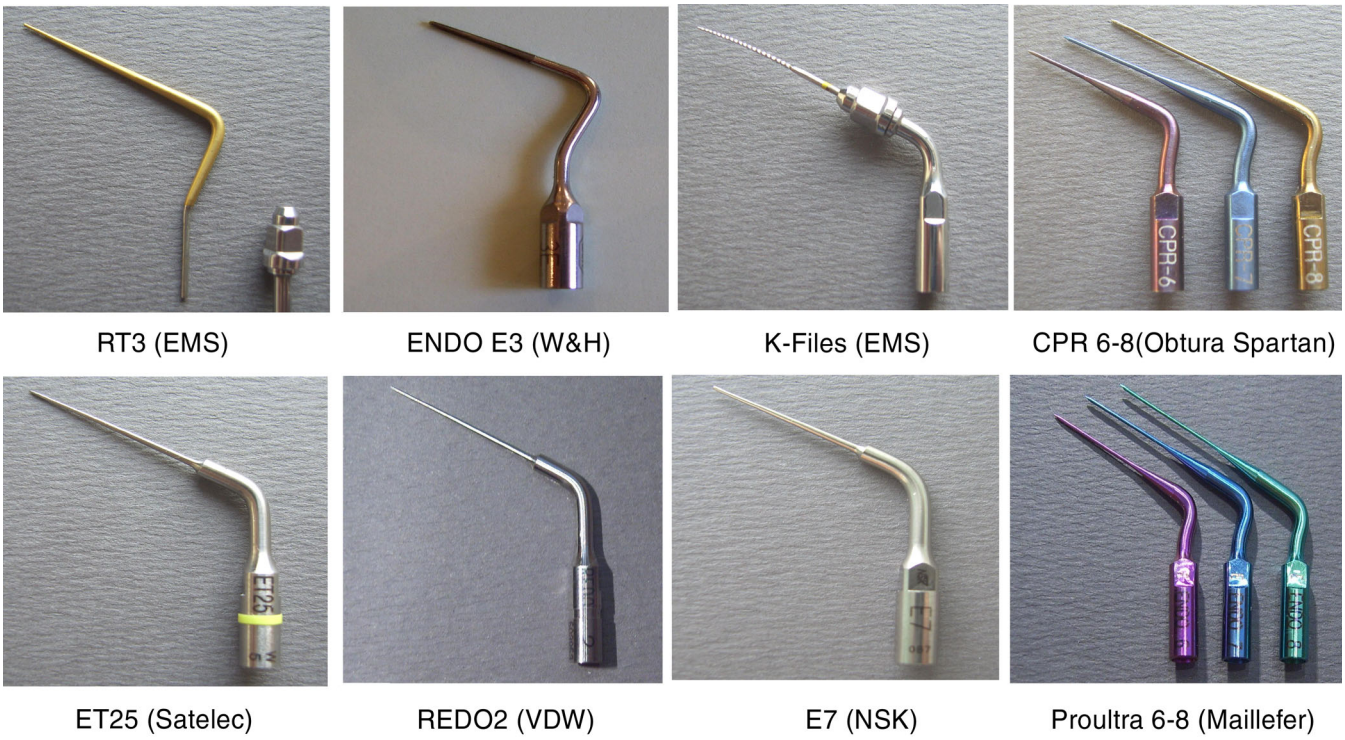


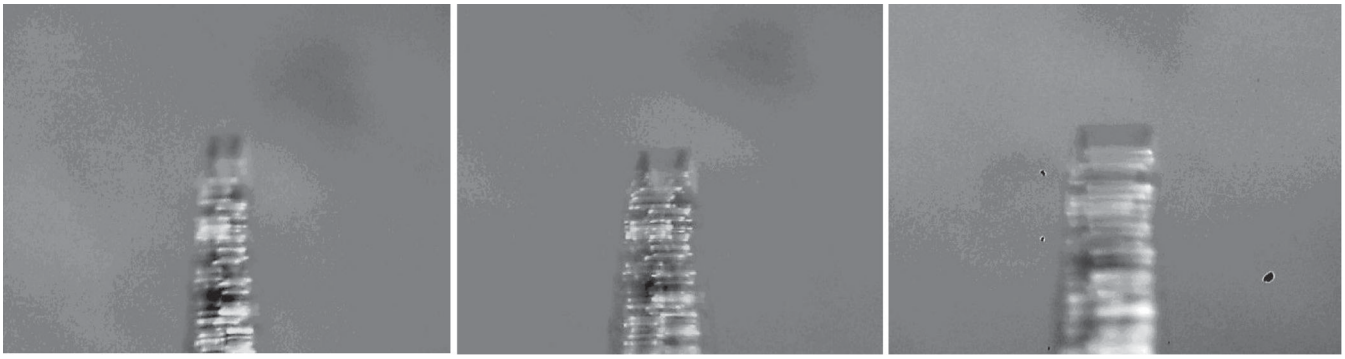
Table 1.

	Mini Piezon (EMS)	Woodpecker HW-3H (GWMI)	Pyon 2 LED (W&H)	Varios 550 (NSK)	P5 Newtron (Acteon-Satelec)	DTE HD-7H (GWMI)
	EMS-type	EMS-type	EMS-type	Satelec-type	Satelec-type	Satelec-type
RT3 (EMS)EMS-type	YES	YES	NO	—	—	—
ENDO E3 EMS-type	YES	YES	YES	—	—	—
K-files 20EMS-type	YES	YES	YES	—	—	—
K-files 25EMS-type	YES	YES	YES	—	—	—
Proultra 6 EMS-typE	NO	YES	NO	—	—	—
Proultra 7EMS-type	NO	YES	NO	—	—	—
Proultra 8EMS-type	YES	YES	NO	—	—	—
CPR 6 Satelec-type	YES*	NO*	NO*	YES	YES	NO
CPR 7 Satelec-type	YES*	NO*	NO*	NO	YES	NO
CPR 8 Satelec-type	NO*	YES*	YES*	YES	YES	YES
ET25 Satelec-type	NO*	YES*	NO*	YES	YES	NO
Redo 2Satelec-type	YES*	YES*	NO*	YES	YES	NO
E7Satelec-type	NO*	NO*	NO*	YES	NO	YES

* - the instrument was attached to the scaler using Euro-adaptor (San Diego Swiss)

The ultrasonic tips were photographed during vibration under magnification 40x (using Leica MZ6 stereomicroscope), at three different power settings of the ultrasonic devices – minimum power, 10% of the maximum power and 20% of the maximum power, figure 3 (suggested by Walmsley et al., 16).

Fig. 3. example of visually detectable increasing amplitude of vibration at magnification 80x when compatibility is present



After that, using an image measuring software (Klonk-Image Measurement), images were additionally magnified to 80x and the displacement amplitudes for the three power settings for each endosonic tip were compared. Ten different activations of the ultrasonic device for each power setting were photographed, so that ten comparisons per combination endosonic tip–ultrasonic scaler were performed. Visually detectable increase of the amplitude of vibration at magnification 80x was searched for.

It was accepted in the study, that the increase of the amplitude of vibration of the tip, following the increase of the power of the scaler, is a sign for compatibility (figure 3). Lack of compatibility is present when the amplitude does not increase, when there is not any detectable vibration at magnification 80x, or when the vibration at minimum power is extremely strong and is impossible to be adequately used, as it jeopardizes the integrity of the instrument itself.

RESULTS

Compatibility of the scalers with the examined endosonic tips is as follows: Mini Piezon (EMS) is compatible with 8 of 13 examined tips (61,5%), Woodpecker (GWMI) – 10 of 13 tips (76,9%), Pyon 2 led (W&H) – 4 of 13 tips (30,7%), Varios 550 (NSK) and P5 Newtron (Satelec) – 5 of 6 tips each (83,3%), DTE (GWMI) – 2 of 6 tips (33,3%) (tables 1 and 3).

Table 2.

RT3 (EMS) EMS-type	Endo E3 (W&H) EMS-type	K-files # 20 (EMS) EMS-type	K-files # 25 (EMS) EMS-type	Proultra 6 (Maillefer) EMS-type	Proultra 7 (Maillefer) EMS-type	Proultra 8 (Maillefer) EMS-type	CPR 6 (Obtura Spartan) Satelec-type	CPR 7 (Obtura Spartan) Satelec-type	CPR 8 (Obtura Spartan) Satelec-type	ET25 (Satelec) Satelec-type	Redo 2 (VDW) Satelec-type	E7 (NSK) Satelec-type
66,6%	100%	100%	100%	33,3%	33,3%	66,6%	50%	33,3%	83,3%	50%	66,6%	33,3%
2 of 3	3 of 3	3 of 3	3 of 3	1 of 3	1 of 3	2 of 3	3 of 6	2 of 6	5 of 6	3 of 6	4 of 6	2 of 6

Table 3.

Mini Piezon (EMS)	Woodpecker HW-3H (GWMI)	Pyon 2 LED (W&H)	Varios 550 (NSK)	P5 Newtron (Acteon-Satelec)	DTE HD-7H (GWMI)
EMS-type	EMS-type	EMS-type	Satelec-type	Satelec-type	Satelec-type
61,5 %	76,9 %	30,7 %	83,3 %	83,3 %	33,3 %
8 of 13	10 of 13	4 of 13	5 of 6	5 of 6	2 of 6

Lack of compatibility was found in 40,35% of all cases. In 29,82% of the cases of lack of compatibility it was demonstrated as a non-effective vibration, and in the rest of the cases – 10,53% - uncontrolled over-powerful vibration, which was dangerous to use.

Compatibility of the endosonic tips with the

ultrasonic devices is displayed in tables 1 and 2.

Because of the variety of possible combinations and the relatively small numbers in some subgroups, no statistical analysis was possible.

DISCUSSION

In the present study, the ultrasonic devices with highest percentage of compatibility are Varios 550 (NSK) and P5 Newtron (Satelec) – 83,3% each, followed by Woodpecker (GWMI) – 76,9% of compatibility with the examined endosonic tips. When interpreting the results we should take into consideration the fact that the ultrasonic devices of EMS-type, because of the existence of the euro-adaptor, were combined with a larger number of tips (13 tip types), compared to the Satelec-type scalers (6 tip types). On the other hand, the adaptor itself increases the length of the studied tips thus increasing the risk for the working frequency to change and get out of resonance [13]. The adaptor was used in 18 combinations (see table 1), and lack of compatibility was observed in 11 of these cases (61,1%). We think adding the length of the adaptor (8,5 mm) to the resonance system tip-scaler leads to shifting the resonance frequency outside of the working range of the piezoelectric crystal.

Lack of compatibility was found in 40,35% of all cases (23 of 57 examined combinations). Only in 10,53% of all the cases (6 of 57 combinations) lack of compatibility was due to a rather powerful vibration of the instrument at minimum power setting of the scaler and impossibility to decrease the vibration to safe to use levels. We think the reason for that is in the negative-feedback software not being able to control the vibration. In the combination of DTE scaler (GWMI) and CPR-6 tip (Obtura Spartan) vibration was so powerful that it caused a spontaneous fracture of the instrument. The same amplitude would probably be suitable for periodontological purposes, but for the super fine endosonic tips it is destructive.

In the remaining 29,82% of the cases of lack of compatibility, no visible vibration could be detected at magnification 80x even at maximum power of the device. We think this is due to the piezoelectric crystal of the ultrasonic device going completely out of resonance.

No other studies on resonance compatibility between endosonic tips and ultrasonic devices of different brands currently exist, so we can not compare our results to such of similar investigations. Lea et al [17, 18, 19] examined periodontal ultrasonic tips without adaptors, and these are the only studies currently available. We think it would be beneficial if endosonic instruments could be standardized and all production complied with the standard, as it is so for the endodontic instruments for root canal enlargement and decontamination.

CONCLUSION

Endosonic tips should be carefully chosen in accordance with the ultrasonic scaler used. Combinations between different brands of instruments and ultrasonic devices are possible, but information regarding resonance compatibility should be observed. In our opinion more studies on compatibility are necessary.

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