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working life of instruments.

Introduction: although, there are no reports in the literature about corrosion failure of files, it is likely that pitting or crevice corrosion might occur first and promote fatigue failure altering the fracture mechanism from conventional fatigue failure to corrosion failure. This study focuses the effects of NaOCl on nickel-titanium electropolished and PVD coated rotary instruments and compares these results with those obtained for similar instruments without similar procedures.

Materials and methods: to evaluate the effect of NaOCl cleaning procedures on electropolished and PVD Ni-Ti rotary instruments a total of 54 instruments were tested. A control group of 18 RaCe instruments (which are normally electropolished) without surface treatment was used. EDX and SEM study for each instrument was performed before and after cleaning in NaOCl to determine the aspect of surface areas.

Results: SEM analysis showed that in each sample of the control group more than one type of defects was present in addition to the presence of metal residues. In particular, these instruments showed significant machining marks along the faces of the flutes. It seems that instruments with more irregularity (control group) show more deposits after the NaOCl treatment. After NaOCl treatment, the presence of similar amount of Na and Cl was observed on the surface of all groups of instruments. In addition, contamination of Fe elements is similarly observed. Moreover in the cracks between machining grooves (typically present in non treated instruments) increased quantities of the above mentioned contaminants were observed.

Discussion: in our study, a significantly lower amount of metal defects were observed for electropolished RaCe compared to non-electropolished instruments, suggesting that the electropolishing processes are more efficient in defect removal. After NaOCl cleaning, corrosion occurs on the shaft (the anode) and Fe deposits on the Ni-Ti active part. In particular, the larger amount of deposit was observed on the tip, because it is known that tips induce a higher current density. NaOCl solution determines a widespread chemical oxidation in electropolished and PVD instruments. In the case of non-electropolished instruments the oxidation process is cannot be accurately assessed since oxides contaminant are already present on the surface. However, in these instruments an increased amount of contaminants (NaOCl residues, oxides and metal deposits) can be observed in the structural defects (machines grooves and microcracks). Therefore, it appears that NaOCl attacks more easily the minor structural defects already existing in the files non-surface treated and may weaken the instruments.

Conclusion: electropolishing and PVD procedures positively change the surface composition of the alloy. NaOCl treatment can lead to the increased presence of Fe deposits and oxidation processes and hence reduce the working life of instruments.

References

1. Sattapan B, Nervo G, Palamara J, Messer H. Defect in nickel-titanium endodontic rotary files after clinical usage. *J Endod* 2000; 26:161-5.
2. Rapisarda E, Bonaccorso A, Tripi TR, Condorelli GG, Torrisi L. Wear of nickel-titanium endodontic instruments evaluated by scanning electron microscopy: effect of ion implantation. *J Endod* 2001;27:588-592.
3. Kuhn G, Tavernier B, Jordan L. Influence of structure on nickel-titanium endodontic instruments failure. *J Endod* 2001; 27:516-520.
4. Cheung GSP, Peng B, Bian Z, Shen Y, Darvell W. Defect in ProTaper S1 instruments after clinical use: fractographic examination. *Int Endod J* 2005; 38:802-809.
5. Li Uei-Ming, Lee Bor-Shiunn, Shih Cin-Tsai et al. Cyclic fatigue on endodontic nickel-titanium rotary instruments: static and dynamic tests. *J Endod* 2002;28:448-451.
6. Schäfer E, Dzepina A, Danesh G. Bending properties of rotary nickel-titanium instruments. *Oral Surg Oral Med Oral Pathol Endod* 2003; 96:757-63.
7. Shafer E. Effect of physical vapor deposition on cutting efficiency of nickel-titanium files. *J Endod* 2002;12:800-802.
8. O'Hoy PYZ., Messer HH., Palamara JEA. The effect of cleaning procedures on fractures properties and corrosion of Ni-Ti files. *Int Endod J* 2003;36:724-32.
9. Tripi TR., Bonaccorso A, Condorelli G.G. Cyclic fatigue of different nickel-titanium endodontic rotary instruments. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006 Oct;102(4):e106-14.
10. Berutti E., Angelini A., Rigolone M., Migliaretti G., Pasqualini D. Influence of sodium hypochlorite on fracture properties and corrosion of ProTaper Rotary instruments. *Int Endod J* 2006;39:693-699.

PG06 - *In vitro* and *ex vivo* studies on the antibacterial efficacy of sodium hypochlorite and two new-generation endodontic irrigants, Tetraclean® and MTAD, in comparison with sodium hypochlorite.

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Abstract

The aim of this work was to compare the efficacy of two endodontic irrigants of new ge-

neration, Tetraclean® and MTAD. Their antimicrobial effectiveness was assessed by *in vitro* and *ex vivo* studies. Sodium hypochlorite was included as standard reference irrigant. It was found that all the irrigants displayed bactericidal activity *in vitro* after only 5' contact with the bacteria and that sodium hypochlorite was effective till 1:4 dilutions, whereas both Tetraclean® and MTAD could be still effective when diluted 1:1024. Furthermore the *ex vivo* model employing experimentally infected and irrigated human teeth showed that only Tetraclean® and MTAD were capable of eradicating the infection (100% and 93% efficacy respectively), while 70% of the teeth irrigated with sodium hypochlorite showed gradual microbial recolonization. These data suggest that the new generation irrigants may represent novel tools, crucial to the success of the endodontic therapy.

Introduction: the main objective of endodontic therapy is the removal of the bacteria present in the root canal system (RCS) and in the dentinal tubules. Mechanical debridement of infected root canals grants a significant reduction in bacterial contamination (1). Nevertheless, the instrumentation techniques currently employed leave many areas of RCS unaffected. Therefore, the use of a root canal irrigant, in addition to mechanical instrumentation, is warranted for the disinfection of RCS (2). Recently, Torabinejad et al. (3) described a new endodontic irrigant, MTAD, made up of an antibiotic, an acid and a detergent. MTAD has been shown to efficiently remove the smear layer and to efficiently kill *Enterococcus faecalis*, the most commonly isolated species from root canals of teeth with post-treatment disease (4, 5). In line with these findings, a similar endodontic irrigant, made up of doxycycline, citric acid, cetrimide and polypropylene glycole, was introduced by Giardino et al. (6) and the developing of the researches about its action was recently described (7). The aim of this study is to compare the bactericidal activity of new generation endodontic irrigants, Tetraclean® and MTAD, by *in vitro* and *ex vivo* studies. Sodium hypochlorite was included as reference irrigant.

Materials and methods: the bactericidal activity was measured according to the European Standards prEN 1276:1997 (8).

According to the microbiological standard procedures (9), studies on the dilution effects of the irrigants were conducted employing 54 clinical isolates of *E. faecalis* and 8 reference ATCC microorganisms.

The *ex vivo* model included 48 single-root upper incisor and lower premolar teeth. After crown remotion, the teeth were instrumented, treated with EDTA/sodium hypochlorite and sterilized. After this step, they were handled in a strictly sterile way. Subsequent-

PREMIO RICCARDO GARBEROGLIO

tly the teeth were infected with *E. faecalis* ATCC 29212 and then irrigated as previously described (7, 10). The groups consisted of 5 teeth irrigated with Brain Heart Infusion (BHI) broth (positive controls), 15 teeth with MTAD, 15 teeth with Tetraclean® and 10 teeth with 5.25% sodium hypochlorite. After treatment, teeth were immersed in BHI broth and kept at 37°C. Three uninfected teeth, used as negative controls, were incubated in BHI broth and kept at 37°C. The bacterial growth was evaluated, at time-points before and after irrigation, by plating 100 µL of broth where the teeth were immersed onto Bile Aesculin Agar (BAA) plates and by counting the number of colonies 24 hours later.

Results: all the irrigants display a strong and similar bactericidal activity (> 5 logarithms reduction in microbial counts) and the effect is evident after only 5' contact with the bacteria.

Nevertheless, serial dilution assays show complete loss in efficacy for sodium hypochlorite at 1:8 dilution, whereas both Tetraclean® and MTAD are still 100% effective when diluted 1:1024.

Furthermore the *ex vivo* model shows that only in the teeth irrigated with Tetraclean® and MTAD the bacterial burden drops by the time to undetectable values (100% and 93% efficacy for Tetraclean® and MTAD respectively). Differently, in the teeth irrigated with sodium hypochlorite there is a rapid but temporary drop in bacterial burden and many (70%) of the teeth are recolonized by 24 hours post irrigation.

Discussion: the *in vitro* data provide the first comparative analysis on the bactericidal properties of the new irrigants and indicate the 5 minutes as a time span sufficient to achieve the optimal antibacterial effects. Unexpectedly, the *ex vivo* data reveal major differences among hypochlorite and the other irrigants. Only the latter allow total clearance of the microorganisms from the infected teeth. If these *in vitro* data will have a clinical counterpart, we can assume that the use of new generation irrigants will allow full success in endodontic therapy. Moreover, the observation that Tetraclean® and MTAD are effective up to very high and comparable dilutions is likely to be ascribed to the doxycycline included in their formulations. Yet, it is worth noting that the antibiotic content in Tetraclean® is 3-fold less. This implies that other parameters (i.e. additional effects by cetrimide and surface tension) have to account for its optimal performance. Given the complexity of the endodontic anatomy and the persistence of bacteria inside the dentinal tubules, it is very likely that the efficacy of an irrigant strictly depends also on its penetration capability. Ongoing studies will address these issues.

Conclusions: these data provide insights on the antimicrobial features of two new generation irrigants, strongly warranting clinical studies aimed at promoting their use in endodontic clinical practice.

References

1. Siqueira JF Jr, Lima KC, Magalhaes FA, Lopes HP, de Uzeda M. Mechanical reduction of the bacterial population in the root canal by three instrumentation techniques. *J Endod* 1999;25:332-5.
2. Dalton BC, Orstavik D, Phillips C, Pettiette M, Trope M. Bacterial reduction with nickel-titanium rotary instrumentation. *J Endod* 1998;24:763-7.
3. Torabinejad M, Khademi AA, Babagoli J, Cho Y, Johnson WB, Bozhilov K, Kim J, Shabahang S. A new solution for the removal of the smear layer. *J Endod* 2003;29:170-5.
4. Hancock HH III, Sigurdsson A, Trope M, Moiseiwitsch J. Bacteria isolated after unsuccessful endodontic treatment in a North American population. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics* 2001;91:579-86.
5. Stuart CH, Schwartz SA, Beeson TJ, Owatz CB. *Enterococcus faecalis*: its role in root canal treatment failure and current concepts in retreatment. *Journal of Endodontics* 2006;32:93-8.
6. Giardino L, Savoldi E, Pontieri F. Azione detergente e battericida di un irrigante canalare sperimentale. *25° Congresso Nazionale della Società Italiana di Endodonzia*, Verona, Italy, 2004.
7. Neglia R, Ardizzoni A, Giardino L, Ambu E, Grazi S, Calignano S, Rimoldi C, Righi E, Blasi E. Potent antimicrobial efficacy of Tetraclean®, a new generation endodontic irrigant, in comparison with sodium hypochlorite. *Submitted to journal*.
8. CEN (European Committee for Standardization). Chemical disinfectants and antiseptics - quantitative suspension test for the evaluation of bactericidal activity of chemical disinfectants and antiseptics used in food, industrial, domestic, and institutional areas - test method and requirements (phase 2 step 1). prEN 1276:1997; <http://www.cenorm.be/cenorm/index.htm>
9. National Committee for Clinical Laboratory Standards. Methods for dilutions antimicrobial susceptibility tests for bacteria that grow aerobically. Approved Standard M7-A4. *National Committee for Clinical Laboratory Standards*, Wayne, Pa, USA.
10. Shabahang S, Torabinejad M. Effect of MTAD on *Enterococcus faecalis*-contaminated root canals of extracted human teeth. *J Endod* 2003;29:576-9.

PG07 - Ni-Ti Shaper 1-ProTaper effects on canal volume measurement and variations: a microtomographic comparative study

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Abstract

The aim of the study is to evaluate the root canal volume variation achieved by S1 ProTa-

per instrument on the third coronal canal surface.

Ten distal root canals of ten freshly extracted first premolar teeth have been selected and instrumented as follows:

1. instrumentation with K file 20 (as control);
2. instrumentation with S1 ProTaper as manufacturer protocol;
3. Instrumentation with S1 ProTaper used with brushing.

Microtomographic canal scanning (pQCT) and measurements were obtained after each instrumentation phase.

We found a no statistically significant difference between the volumes of K 20 file and S1 ProTaper as protocol instrumented canals. However there was a statistically significant difference between the K 20 file and S1 ProTaper with brushing instrumented canals, and between the S1 ProTaper as protocol and S1 ProTaper with brushing.

In conclusion S1 ProTaper used as protocol do not change root canal volume; moreover pQCT could be considered a valid quantitative method in endodontics.

Introduction: precise morphological mapping of the root canal system is a prerequisite for obtaining the best possible results in endodontic therapy. However, because of limitations in previously applied methods, is very difficult to evaluate the effects of different instruments on the same root canal, because of the need of processing the specimen (e.g. histologic sections).

Microtomographic technique (pQCT) has proven to be useful as a non-destructive technique for 3D reconstruction of teeth *in vitro*, at an high-resolution quality (1).

The aim of our study is to evaluate the root canal volume variation achieved by S1 ProTaper instrument on the third coronal canal surface through pQCT.

Materials and methods: ten distal root canals of ten upper first premolars freshly extracted were selected for this study. After having prepared standard access cavities, the canals were passively negotiated with sizes 0.10, 0.20 K-type hand files and used until the apical foramen; the working length was determined visually. Preparations were made by a single operator using a Technica.

First phase: S1 ProTaper was used until 1 mm of the working length, centering and avoiding any lateral movement (as protocol).

Second phase: S1 ProTaper was used until 1 mm of the working length, applying lateral movement (brushing).

Microtomographic canal scanning and measurements were obtained after each instrumentation phase.

A pQCT scanner was used for the measurements (Stratec Research SA+ pQCT, Stratec Medizintechnik GmbH, Pforzheim, Ger-