Giornale Italiano di Endodonzia (2015) **29**, 65—69

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journal homepage: www.elsevier.com/locate/gie

ORIGINAL ARTICLE/ARTICOLO ORIGINALE

The activation of irrigation solutions in Endodontics: a perfected technique

L'attivazione degli irriganti in Endodonzia: una tecnica perfezionata

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Received 22 July 2015; accepted 28 July 2015
Available online 3 September 2015

KEYWORDS
Irrigation solutions;
Activation;
Microscope;
Sodium hypochlorite.

Abstract
Aim: In endodontics a complete chemo mechanical cleansing of the complex root canal system is essential in order to achieve a theraupetic success.
Methodology: Sodium hypoclorite due to its antimicrobial and proteolytic characteristic, is an efficient endodontic irrigant and it is the most commonly used.

The following article introduces a refined technique in order to increase the degree of cleansing during endodontic treatment.

The technique involves intracanal heating of the irrigants through a heat source.
Results: The described technique is able to enhance simply and considerably the use of sodium hypochlorite, making it easily accessible even to generic operators.
Conclusions: To confirm the validity of this improved technique, further research and scientific studies are needed, although at the clinical level, the results by using it are very satisfactory.

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Peer review under responsibility of Società Italiana di Endodonzia.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.gien.2015.08.005

PAROLE CHIAVE
Soluzioni irriganti;
Attivazione;
Microscopio;
Ipoclorito di sodio.

Riassunto
Obiettivo: In Endodonzia una completa detersione chemio-meccanica del complesso sistema dei canali radicolari è fondamentale per il raggiungimento del successo terapeutico.
Materiali e metodi: L'ipoclorito di sodio, grazie alle sue proprietà antimicrobiche e proteolitiche, è un irrigante endodontico efficiente ed efficace ed è il più comunemente utilizzato.

L'articolo che segue introduce una tecnica perfezionata per incrementare il grado di detersione durante il trattamento endodontico. La tecnica prevede il riscaldamento intracanalare della soluzione mediante una fonte di calore.
Risultati: La tecnica descritta riesce a potenziare in modo semplice e considerevole l'uso dell'ipoclorito di sodio, rendendola facilmente fruibile anche agli operatori generici.
Conclusioni: Per confermare la validità di questa tecnica perfezionata occorrono ulteriori ricerche e studi scientifici, anche se a livello clinico i risultati che si stanno ottenendo utilizzandola sono davvero soddisfacenti.

Introduction

The long-term success of endodontic treatment is closely linked to adequate cleansing of the endodontic space after root canal shaping, and then proceed to a complete obturation of the complex root canal system.[1—3] Probably, a significant percentage of failures is caused by the presence of residual pulp tissue.[4] The endodontic space is composed by spaces easily accessible to hand and rotary instruments (main canals) and, as confirmed by many clinical and histological studies, by not easily accessible or inaccessible spaces (isthmus, delta, loop, lateral and accessory canals and dentinal tubules)[5] (Figs. 1—3). Root canal shaping is not able to reach all areas of the root canal system, regardless of the technique used; then a part of canal is not treated. It is therefore necessary to carry out the endodontic biochemistry cleansing (accessible and not accessible spaces); once cleaned, it can be filled and obtured with guttapercha and cement during obturation.[6] It is important to use proper care and diligence in the diagnosis and treatment of endodontic disease and make treatment plan, record data of pre-treatment and treatment itself and save them.[7] These are tips, useful to gather documents that can, in case of necessity, prove the correctness of the diagnostic, therapeutic and ethics behavior held by the dentist. Particularly important is recording and storage the informed consent, as in a non-negligible percentage of cases the complaint raised to the dentist is right in the defect information to the patient.[8] Bacteria are

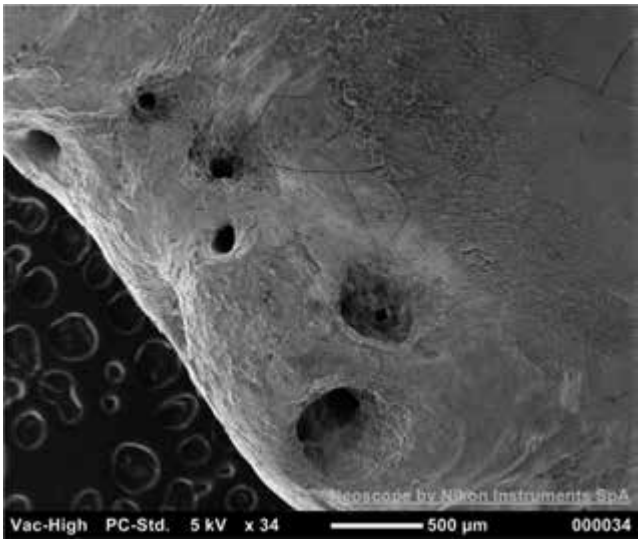

Figure 1 Root apex of the mesial root of a lower first molar SEM photographed: the number of many exits are shown.

Figure 2 Diaphanization of a lower central incisor: an isthmus between the two root canals is shown.

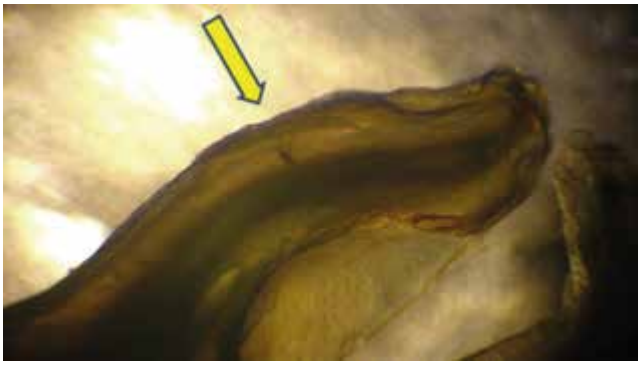

Figure 3 Diaphanization of a lower first molar: a lateral canal in the middle third of the distal root is shown.

the main causative agents of periapical pulp infection.[9] A not treated canal, so do not cleansed, shaped and obtured, can lead to the development or persistence of a periapical lesion. In the literature a lot of authors showed various techniques to improve the effectiveness of sodium hypochlorite as irrigant, including the use of greater amounts of irrigant and preheating of the same.[10,11] Cunningham and Joseph have shown that a sodium hypochlorite solution at body temperature allows to carry out the sterilization in considerably less time compared to the same solution at room temperature (22 °C).[12] Preheated sodium hypochlorite solution has greater ability to dissolve pulp tissue and cleanse the canal.[11–13] Abou Rass and Oglesby[11] have compared the timing of the dissolution of the connective tissues of rat using sodium hypochlorite solutions at 2.6% and 5.25% at the temperature of 23 °C and 60 °C. Timing of the dissolution of the tissues significantly decreased with increasing of concentration and temperature. The speed at which a chemical reaction occurs increases with the increase of temperature, pressure, excitement and concentration. Since the pressure inside the root canal system cannot be increased, it is possible to accelerate the cleansing increasing the concentration and the temperature of the detergent shaking it once irrigated the endodontic space. The excitement is easily achieved by sonic or ultrasonic sources. Currently are available solutions of sodium hypochlorite with a concentration not exceeding 6% to prevent possible stinging reactions.[14,15] In everyday practice, sodium hypochlorite solution is preheated outside of the tooth to a temperature of 50 °C.[16–17] Preheated solutions have limited utility, since they rapidly stabilize at a temperature included between body and the ambient temperature.[13] Woodmansey[18] has shown that hypochlorite at boiling temperature is able to disintegrate the pulp tissue at a speed 210 times higher compared to the solution at room temperature (2 min against 420 min). For this reason in 2005 Woodmansey proposed a technique of intracanal heating of sodium hypochlorite using a heat source, System-B (Sybron Endo).[18] The technique was as follows: after completing chemo-mechanical preparation of the root canal system, a System-B plugger was chosen that fit passively to 3 mm from the working length. The heat source was at 200 °C with power equal to 10. Then the canal

Figure 4 Temperatures of the outer surface of the root measured during the heating cycle of the irrigant.

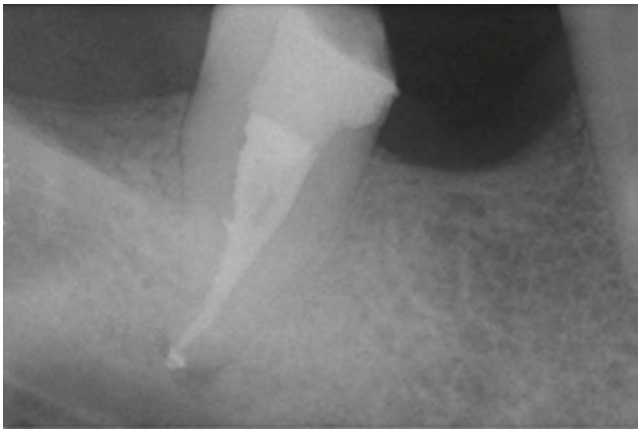

Figure 5 Post-operative radiograph of 4.7. Obturation with thermo-plasticized guttapercha after activation and heating of irrigants: a complex endodontic anatomy is shown.

was irrigated with sodium hypochlorite introducing the heat-carrier activated for 3/5 s. The cycle should be repeated every 5 s until the complete irrigant evaporation. During the irrigant heating a pipe draw vapors of chlorine.

Materials and methods

This study proposes a revision and improvement of Woodmansey technique with a careful analysis of the benefits and improvements.

Figure 6 Post-operative radiograph of 2.1. Obturation with thermo-plasticized guttapercha after activation and heating of irrigants: several lateral canals are shown.

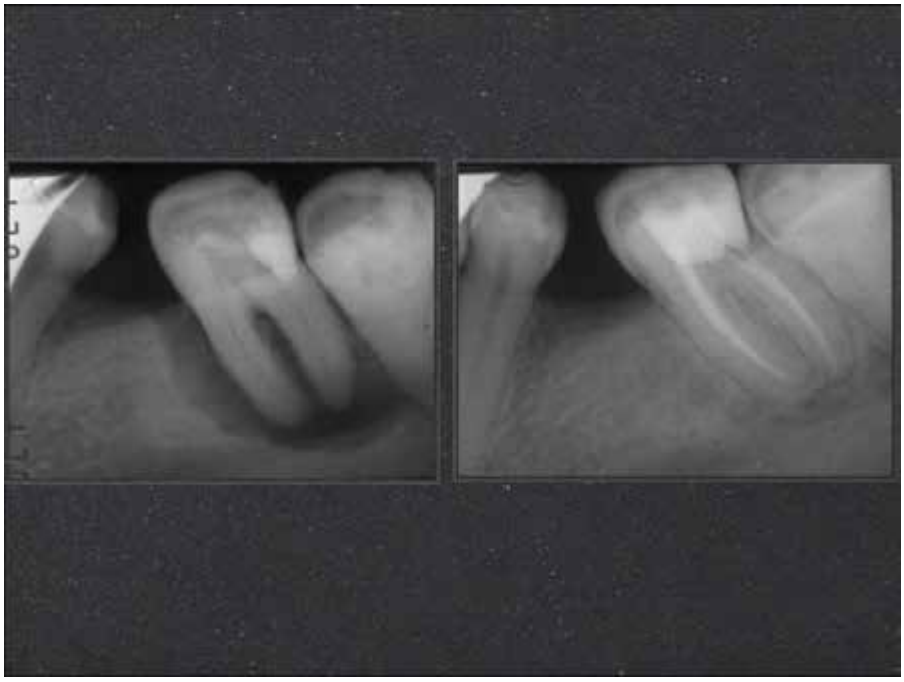

Figure 7 Endodontic treatment of 4.7 with severe osteolytic lesion. Treatment with activation and heating of irrigants. 24 months control: complete restitutio ad integrum of bone tissue is shown.

Perfected technique: operating protocol

Sodium hypochlorite has a boiling temperature included between 96 °C and 120 °C. Moreover, with temperature increasing more chlorine is released, so there is a reduction of the title.

Based on these characteristics Woodmansey technique has been revised and improved. First of all the temperature of the heat carrier has been changed, from 200 °C to 150 °C. Since the boiling temperature of sodium hypochlorite is between 96 °C and 120 °C it is worthless to use the heat carrier at 200 °C. Keeping it at 150 °C the boiling point will be reached, the irrigant will act more with less lost of chlorine. It will increase the safety for the periodontal ligament too. The smaller heat carrier in 2005 was the fine (50/06), then to bring it to 3 mm from the working length, the canal must be abundantly prepared. Today, however, there are several tools such as 30/04, then the passive 3 mm from the working length can be easily achieved without excessive preparations. Each activation cycle of the heat-carrier lasts 10 s with an interval 10 s. During activation, the heat carrier makes short excursions of 2 mm up and down in order to shake the irrigant. After each cycle, the irrigant is replaced with fresh solution in order to have hypochlorite with greater amounts of active chlorine. By heating, however, the same solution until complete evaporation after a couple of cycles, the title of chlorine will drastically reduce. The activation cycle is repeated 5 times. During each activation of the irrigant, the vapors are sucked by a pipe. There were carried out tests on extracted teeth for periodontal reasons to assess during the irrigant heating if there were leaks of irrigant or vapors beyond the apex. The root canals were prepared up to a measure of 30/06. The irrigant was brought to working length with an endodontic needle with lateral exit. Then the heat carrier was passively inserted to 3 mm from the working length and has been activated. During activation, the apical foramen was observed at 10× (stereo microscope) to assess the leak of irrigants or vapors. No leakage was highlighted. Another parameter considered was the heating of the outer surface of the root, at the third coronal level, middle, apical and at the foramen level. During activation of the irrigant with an infrared thermometer (resolution: 0.1 °C) the temperatures on the outer surface of the root were evaluated. Using the values exposed in the operating protocol external temperature higher than 42.5 °C were not detected, which is below the levels of heat (47 °C) dangerous for the cells of the periodontal ligament (Fig. 4).[19,20]

Conclusions

The awareness of the difficulty of access mechanically to tissues and to pathogens present in the endodontic space and in the dentinal tubules, led us to develop operating methods that use chemicals agents that can reach deeper endodontic spaces, optimizing the apical flow (Endovac) or decreasing the surface tension by the addition of surfactants. The described technique is able to enhance simply and considerably the use of sodium hypochlorite, making it easily accessible even to generic operators. Of course, to confirm what we have described, further research and scientific studies are needed, although at the clinical level, the results by using it are very satisfactory (Figs. 5—7).

Conflict of interest

The authors have no conflict of interest.

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