THE ROLE OF OZONATED WATER IN THE SUCCESS OF THERAPY OF CHRONIC APICAL PERIODONTITIS. CASE REPORT
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ABSTRACT
This case report describes the achievement of endodontic space decontamination with ozonated water (conc. 20 mg mL\(^{-1}\), 1 min) used as canal irrigant to a central incisor from the maxilary, second quadrant, diagnosed with progressive diffuse chronic apical periodontitis. Conservative treatment of the root canal was performed in a single session. Postoperative clinical and radiological examination after 3 months revealed complete healing of periapical lesions of endodontic origin. Proper diagnosis of periapical lesions and unconventional treatment of the complex system of infected root canal allowed complete healing of the lesion without interfering through surgical endodontic therapy. This case report demonstrates the successful healing of persistent periapical lesions using an alternative (non-conventional) method with ozonated water.

Keywords: apical periodontitis, mechanical and chemical debridement, ozonated water.

INTRODUCTION
Antiseptic properties of ozone have been analyzed and discussed extensively in the literature (Lezcano et al., 2001, Shin et al., 2003), the bactericidal, fungicidal and virucidal effects being highlighted since the early twentieth century (Guerra, 1997). From then until now ozone had a wide application in many medical fields, including in the field of dentistry. Successful decontamination of infected root canals, in particular those with persistent apical periodontitis, remains a clinical challenge. Successful decontamination of infected root canals, in particular those with persistent apical periodontitis, remains a clinical challenge. The main objective of endodontic therapy is to substantially reduce or even eradicate microbial load from the root canal system through mechanical and chemical debridement followed by root canal in order to prevent bacterial recolonisation (Nair, 2006).

Ozone is a chemical compound composed of three atoms of oxygen (O\(_3\) - triatomic oxygen). It is a form of energy higher than that of atmospheric oxygen (O\(_2\)). It has a remarkable antimicrobial capacity and is different from antibiotics, as microbes are not resistant to the chemical - O\(_3\) (Restaino et al., 1995). Ozonated water with a concentration of 20 mg mL\(^{-1}\) applied for one minute, proved to be nontoxic to oral cells in in vitro studies (Estrela et al., 2007, Noguchi et al., 2009). It has been scientifically proven that ozone has a good biocompatibility with human oral epithelial cells (BHY), gingival fibroblasts (HGF-1) and periodontal cells.
(Huth et al. 2006, Filippi et al. 2001). Now it is more often discussed about the features of ozone as a possible alternative antiseptic agent in dentistry due to its antimicrobial capabilities (Paraskeva and Graham 2002). Ozone is a powerful oxidizing agent, showing obvious bactericidal properties and much lower toxicity compared with sodium hypochlorite (Nagayoshi et al., 2004).

CASE REPORT
A patient (P.C.), aged 39, architect, came to Medical Center of Dental Faculty „M. Kogalniceanu” U.M.F. “Gr. T. Popa” Iasi accusing moderate pain to 2.1. associated with a sinus tract in the maxillary vestibule beside the apex. The patient did not present significant overall medical history. Also, the patient told us that this condition began insidiously, evolving slowly after about two years from the former intervention on the tooth. Extraoral examination did not reveal any signs or symptoms. The patient had pain at biting pressure. On inspection there was a final coronal filling made with physiognomic material (composite). During the palpation a percolation area was observed in the final coronal filling. Palpation and percussion of the tooth in question was painful. Periodontal probing at 2.1. and 2.2. revealed no presence of periodontal pockets. Vitality tests were negative, both cold with tetrafluoroethane (Pharmaethyl Spray, Septodont®), and hot with heated gutta-percha (gutta-percha sticks h01061, Colten®). The results of the sensitivity pulp test on 2.2 was normal. Radiological examination revealed a definitive root filling performed by cementing a single cone calibrated to the apical constriction. The advantages of this technique, as one knows, are simplicity and rapidity of execution. Instead the disadvantages are more numerous: the overall effectiveness in preventing microleakage is much weaker compared to other filling techniques, sealant solubility and the extent of the cement filling, the single cone does not provide a 3D sealing of the root canal.

The image in Figure 1 shows a periapical osteolysis with diffuse outlines, bordering the neighboring tooth - 2.2. After a medical history was taken and clinical and radiological examination was made, a clinical diagnosis of diffuse progressive chronic apical periodontitis was given.

Endodontic retreatment on 2.1 was done in a single visit to the dentist. The desinfection of the tooth was performed with 2% sodium hypochlorite (2% Chloraxid, Cerkamed® - Poland). Isolation of the operative field was performed with cotton rolls and a saliva vacuum was applied after which the endodontic space was aproached. After entirely removing the root canal obturation, the Crown-Down root canal preparation technique was performed by using Kerr and Headstrom #40-15 needles (MailIfer Dentsply® - Elveția). Ozonated water was obtained by treatment of distilled water with ozone gas (75 μg mL⁻¹, for 15 minutes) using an ozone generator (Ozonytron, Biozonix – GmbH, Germany).
The measurement of the concentration of the ozonated water involves the oxidation of colorless indicators (diethyl-p-phenylene diamine) which are to turn to a pink color in the presence of ozone as compared to a reference sample (saturation point: 20 mg mL\(^{-1}\), Palintest Ozone Meter, Palintest Ltd, Gateshead, UK). Abundant irrigation with ozonated water with a concentration of 20 mg mL\(^{-1}\) for 1 minute was performed whenever a change in endodontic needle size was performed. Each irrigation with ozonated water was associated with ultrasonic waves. Working length was identified with apex locator (Root ZX II, J. Morita MFG. Corp. - Japan). Cold lateral condensation technique of the gutta-percha was used (gutta-percha cones # 15-40 - Meta Biomed Inc. USA; sealing cement - Endomethasone, Septodont Inc.) and a control radiography was performed. Two weeks after the endodontic treatment clinical signs and symptoms had dissappeared. Also on percutions and palpation of the inclined tooth no pain was registered. Both 2.1. and 2.2. were restored with a composite coronal filling (Special Competence Set, WP-DENTAL, Germany). The patient was clinically and radiologically reexamined after three months (Fig. 3).

**DISCUSSIONS**

For this tooth with chronic periapical lesion a presumptive diagnosis of diffuse progressive chronic apical periodontitis was made. Accurate diagnosis can be established, however, by histopathological examination. However, the clinical diagnosis was made on the basis of objective signs and symptoms such as diffuse radiolucent lesion with disappearance of lamina dura and periodontal ligament associated with negative results on pulp vitality tests on 2.1. For many years a controversy has been perpetuated on the number of treatment sessions (one visit versus two) for therapy of complicated pulp gangrene. A Cochrane systematic review conducted in 2008 showed no significant difference between the two situations (Figini et al., 2008). Studies conducted by several researchers (Cardoso et al., 2008) confirmed that ozonated water used as irrigation agent, significantly reduced the number of Candida albicans and Enterococcus faecalis in human root canals. After irrigation with ozonated water, E. faecalis and S. mutans suffered a significant decrease in their survival capabilities and ability to invade dentinal tubules. A higher metabolic activity was
discovered in fibroblasts that were treated with ozonated water while the fibroblasts treated with NaOCl (conc. 2.5%) showed a significantly lower rate. It is scientifically proven that the ozone has anti-inflammatory and immuno-modulating capabilities, due to the fact that it has an inhibitory effects on the NF-κB system which intervenes in inflammatory, immune and apoptosis processes (Huth et al., 2007). Ozone is more powerful than chlorine and works 3,000 times faster, without producing harmful decomposing agents (Bocci, 2002). Applications of ozone in dentistry are becoming more frequent, and endodontists should use to a maximum it’s antimicrobial capabilities and also it’s oxidizing properties for reducing the number of microorganisms of the root canal (Lynch, 2004).

CONCLUSIONS
In this clinical case periapical lesion healing was achieved in 3 months due to probable stimulation of the local immune response, following the beneficial action of ozone and an endodontic retreatment performed correctly. Healing through "restitutio ad integrum" of the periapical area, together with the absence of clinical signs and symptoms confirm the effectiveness of ozone therapy. Our results are consistent with the literature that the ozone can be successfully used in endodontics, constituting a helpful factor in the efficient, safe and successful treatment of chronic apical lesions.

REFERENCES
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