

Impact of ozone on healing after alveolectomy of impacted lower third molars

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Due to its proven therapeutic effect, ozone has been used in many fields of dentistry. Historical facts showed that Edward Fisch was the first dentist who used ozone in 1950.¹ Ozone used in medicine is a mixture of gases consisting of 95-99.95% oxygen, and 0.05-5% pure ozone. It is the strongest oxidant known, and it is also considered as the best antibacterial, anti-parasitic, and antiviral agent. In addition, ozone in human body enhances metabolism of oxygen, induces specific enzyme processes, and activates immunological response.¹

Surgical removal of the third molars in the lower jaw is one of the most common dento-alveolar procedures, when an impacted third molar cannot erupt into its normal functional position.^{2,3} The most common reason for an impact is a mechanical obstruction during eruption.^{2,3} The impacted third molars can be the cause of many symptoms, such as, local or general head neuralgias, acute inflammation of surrounding soft tissue (pericoronitis), resorption of the root of the neighbor tooth, and apical pulp infection, and so forth.^{2,3} Moreover, impacted third molar can also be destroyed by caries. Postoperative period of a wound is often accompanied with discomfort, pain, ankylostoma, and swelling.^{2,3} Factors that increase the risk of developing difficulties after tooth extraction are: traumatic extraction; pre-surgical infection; smoking; gender; the site of extraction; usage of oral contraceptives; usage of local anesthetics with vasoconstrictors; non-adequate postoperative hygiene; and inexperience of the surgeon.^{2,3} Postoperative difficulties are mainly related in the healing of the surgical wound.^{2,3} Owing to the ability to eliminate 98% of the bacteria, viruses, and fungi at the place of usage, ozone therapy lowers the possibility of the emergence of postoperative infections and pain, and oxygenation of the tissues helps the regeneration, and speeds up wound healing.¹ The objective of this research was to evaluate the effect of ozone in wound healing, pain, and other side effects, which may occur after the

alveolectomy of the impacted third lower molar. We also aim to compare whether there are differences between patients who were subjected to ozone therapy, or not.

A total of 60 patients who needed extraction of the impacted third lower molar were included in this study. Twenty-two of them (36.7%) were males, and 38 (63.3%) were females. The average age was 27 years. Seventeen subjects (28.3%) were smokers. All patients signed an informed consent. The subjects were divided into 2 groups (30 patients each), depending whether they received (study group), or not (control group) the ozone therapy after tooth extraction. Patients with any history of systemic or psychiatric disease, heart stimulators, asthma, pregnancy, psychological and neurological disorders, and who preoperatively took antibiotics or analgesics were excluded. One experienced dental doctor graded the patients' oral hygiene after the tooth extraction using grades from 0 (excellent hygiene) to 4 (worst hygiene). It was found that: 25% of the patients had grade 0; 28.3% had grade 1; 36.7% had grade 2; 8.3% had grade 3; and 1.7% had grade 4. All surgical procedures were carried out under local anesthesia using 4% articaine hydrochloride with a vasoconstrictor (Ultracaine DS Forte [Hoechst Canada Inc., Montreal, Quebec, Canada]). After applying the anesthesia, the future surgical area received the ozone therapy by gingival probe (GI) for 40 seconds, set at intensity 4 (only in the study group). After the tooth extraction, the area again received the ozone therapy with the alveolar (AL) probe (study group only), and the capillary probe (KP) was also set for 40 seconds at intensity 4. Eventually, the last ozone therapy after tooth extraction was performed with the GI probe (intensity 4, duration - 40 seconds). Ozone therapy was applied using the device ElektroMagneTron (Mymed-Mylius medizinische GmbH, Töging am Inn, Germany). It is a medical device designed according to the security rules valid in the European Union (IEC 601, DIN EN 60601, IEC 127). The device functions at the average pulse frequency of 1200 Hz, the pulse span 7 μ s, and a voltage of 3000-30,000 V with the adapter for electrical power supply (input 230 V/output 24 V). All patients were provided with postoperative written instructions on how to eat, and maintain oral hygiene after the tooth extraction. Postoperative control recalls were made after one, and again after 7 days, when the evaluation of the wound healing was carried out, and the area in the study group was treated by GI (40 seconds, intensity 3), and the stitches were removed on the seventh postoperative day. All patients graded the degree of pain caused by the extraction of the lower third molar (0 - no pain, 1 - low pain, 2 - moderate pain, and 3 - high pain) at recall examination. They also assessed presence of odor (0 -

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no, 1 - yes), and a need for pain relief medication intake (pain killers). A telephone interview was also obtained on the fourteenth day after the tooth extraction, when patients were asked only to assess the degree of pain. None of the patients took antibiotics after the surgery. One experienced specialist of oral surgery graded the degree of wound inflammation and swelling at the recalls (inflammation: 0 - no symptoms, 1 - symptoms present [swelling: 0 - not present, 1 - hardly visible, 2 - moderate, 3 - high]).

Statistical analysis was performed using the PASW Statistics version 18 (IBM, Chicago, IL, USA). Descriptive statistics was carried out, and the hypotheses were tested using the χ^2 test, and Fisher exact test. The significance was set at $\alpha=0.05$.

Patients' assessment of the degree of pain experienced after extraction of the third lower molar is shown in Figure 1. Considering a degree of pain experienced by the patients after tooth extraction, 23% in the study group, and only 10% in the control group had no pain at all on the first day. There was a statistically significant difference between groups also on the seventh postoperative day ($\chi^2=7.778$; degrees of freedom (df)=2; $p=0.02$). Fifty percent in the study group, and only 16.7% in the control group had no pain at all. The disappearance of pain and lowering of pain intensity in both groups is clearly visible (Figure 1). The study group reported significantly lower percentage of odor (13.3%) on the first day in comparison to the control group (46.7%), as well as on the seventh postoperative day (study group - 3.3%, control group - 43.3%) ($\chi^2=6.405$; df=1; $p=0.026$ using Fisher exact test). The need of medication

intake lowered significantly from day one to day 7 after the surgical procedure in both groups. There was a significant difference considering the need for pain relief intake between the study group (75.9%) and the control group (100%) on the first day after the surgery, as well as on the seventh day (study group - 13.3%; control group - 33.3%) ($\chi^2=8.216$; df=1; $p=0.005$ using Fisher exact test). On the fourteenth day nobody needed pain relief. Considering the symptoms of inflammation, there was no significant difference between the groups on the first day ($p>0.05$), while on the seventh day, 70% in the study group had no inflammation in comparison to the control group (40%) ($\chi^2=5.455$; df=1; $p=0.037$). The highest observed degree of swelling was moderate. On the first postoperative day, the swelling was absent in 36.7% and low in 56.7% in the study group, in comparison to the control group (absent in 13.3% and low in 86.7%) ($\chi^2=7.150$; df=2; $p=0.028$ using Fisher exact test). On the seventh postoperative day, no swelling was observed in 73.3% of patients in the study group, and in 50% of patients in the control group.

Contemporary literature suggests that subjective discomfort has been found to be significantly higher after the surgical removal of the impacted mandibular third molars, than after the routine extractions of other teeth.^{2,3} The size of the wound swelling depends on the degree of tissue trauma and the patients' variability considering microbial flora in the oral cavity, and individual response differences.^{2,3} The degree of pain also depends on tissue trauma and/or infection. Usually, it is necessary to routinely treat the pain after extraction with pain relief medications in a period of 2-3 days.²⁻⁵ No significant

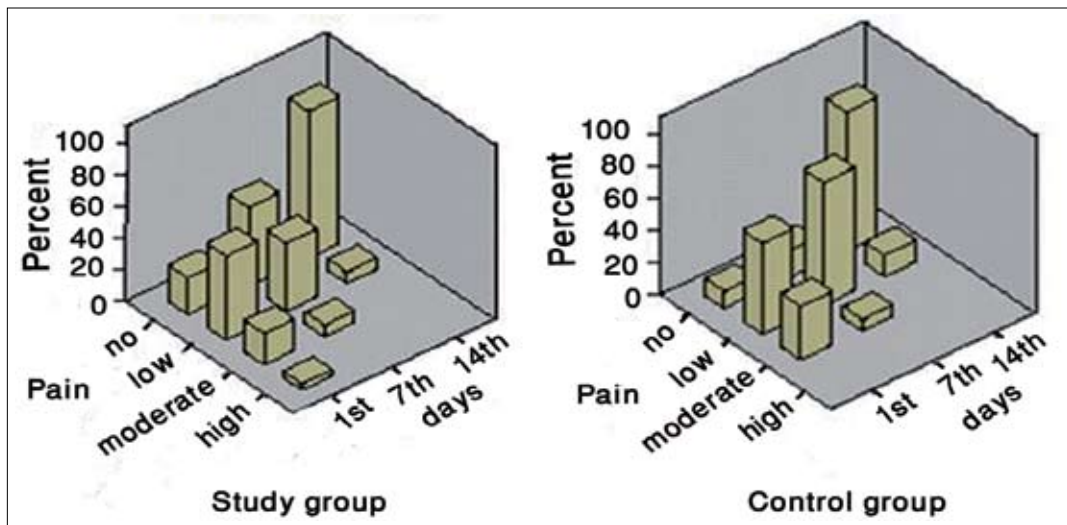


Figure 1 - The degree of pain assessed by patients after the extraction of the third lower impacted molars on the first, seventh, and fourteenth day after the surgical procedure in the study group who received the ozone therapy, and in the control group that did not receive the ozone therapy.

difference in postoperative complications with regard to gender has been reported.⁴ Recent literature suggests a significant recovery of patients within 5 days after a surgical procedure. Pain, which is of highest degree on the first day, reduces towards painlessness afterwards.⁵ This is in agreement with the results of the present study. Moreover, this study revealed significantly lower degree of pain in patients in the study group than in the control group (Figure 1). A total of 36.7% of the subjects who received ozone therapy did not develop any swelling during the first postoperative day. In the “ozone group” a higher intensity of ozone was applied immediately after the extraction of the impacted third lower molar due to its anti-microbial effect, and later a lower intensity was applied in order to induce better wound healing and avoid potential harmful influence of high ozone concentrations.¹ The advantage of the ozone generating instrument used in this study is in its possibility to control the output power, and in the fact that the ozone was generating in the very tip of the probe in the close system. The ozone was formed at the area of application and by regulating the output power, the ozone quantity was adjusted according to clinical needs.

An interest in applying ozone in dentistry is increasing recently, due to its potential ability to reduce inflammation by destroying microorganisms and speeding up wound healing. The advantage of ozone is that, its use appears to be completely safe and with almost no side-effects or negative influences on human health. None of our patients received antibiotic therapy during the study in order to follow up only possible effects of ozone, and to compare it to the control group.

In this study, the intensity of pain and other discomforts after surgical extraction of the impacted

third lower molar were significantly more reduced in patients who received the “ozone” therapy in comparison to the control group. However, these are preliminary clinical results in a small group of patients, and more research on a larger sample will be necessary in the future. Therefore, within the limitation of the present study, we conclude that introducing ozone in the standard surgical protocol would contribute to a better postoperative quality of life.

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