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The use of physiotherapy in the regeneration of periapical bone structures of the teeth, prepared to load the prosthetic

Zastosowanie fizjoterapii w procesie regeneracji struktur kostnych okołowierzchołkowych zębów przygotowywanych do obciążenia protetycznego

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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Summary

The aim of this work was to investigate whether the use of magnetoledotherapy will accelerate the elimination of osteolytic lesions of the dental periapical area, and provide for prosthetic treatment. What impact on time of healing does the inflammatory change location, type of treatment or patient's age have? 69 patients underwent the examination. The problem of osteolytic lesions in the course of protracted or protracted acute dental periapical tissue inflammation was determined. Patients were divided into two research groups: group L – treated with magnetoledotherapy and group K – treated without the support of magnetoledotherapy. In the first group we applied the electromagnetic field, generated using the Viofor JPS Clinic apparatus.

Our studies have confirmed the effectiveness of magnetoledotherapy in the accelerated decommissioning of the osteolytic lesion. This provides evidence of the appropriateness of this method in the treatment of protracted dental periapical tissue inflammation, in teeth qualified for prosthetic load. Magnetostimulation combined with LED energy is an adjunctive procedure, adopted in order to eliminate osteolytic inflammatory changes of dental periapical tissues. It can be used in all age groups with the same good result. After applying magnetoledotherapy, in the course of the dental periapical tissue repair process of tooth treated endodontically for the first time as well as reendodontically, no differences were found. This shows the opportunity of using magnetoledotherapy in all cases of protracted periapical tissue inflammation.

Keywords: magnetoledotherapy • reconditioning of bone structures

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Introduction

Chronic inflammation of the dental periapical tissues is a slow, long-term disease process that may last from months to years. In most cases it proceeds asymptomatically and is diagnosed by chance on the x-ray picture, while we are planning prosthetic treatment. Despite the significant development in endodontics and great clinical experience of dentists, choosing the way of treatment, especially extensive inflammation, is still problematic [7,9,10]. None of the previous endodontic methods contributed to the acceleration of bone structure disappearance, which usually lasts from 6 to 24 months.

If proper endodontic treatment does not bring the expected results, because of the extent of periapical inflammation (more than 1 centimeter), it is advisable to use conservative-surgical procedures. It consists in implementation of appropriate root canal treatment and surgical apicotomy, hemisection or radiculectomy with retropreparation and reverse root duct filling. After the resection surgery, the tooth has got approximately 30% less root vertical dimension, which makes it a deficient resistance pillar for eventual prosthetic treatment. Furthermore, there is a great danger that the damage of vascular-nerve fasciculi of adjacent teeth will occur. Another problem may be the presence of an additional root canal, which causes a serious complication – resumption of periapical tissue inflammation.

When the patient chooses prosthetic treatment, he expects a rapid aesthetic and functional effect. However, no tooth with noticeable chronic periapical tissue inflammation can be used in prosthetic restoration. Fast and efficient elimination of the infection gives the opportunity for immediate prosthetic load and implementation of cosmetic dental filling. The last decade of research shows that magnetostimulation and magnetoledotherapy treatment creates such a chance [1,4,12].

Magnetoledotherapy is a method based on joint use of light energy, obtained from a high-powered LED (light emitting diode) and electromagnetic field with low frequency and magnetic induction. Optical radiance in a range of visible radiation (RED) and infrared (INFRARED) is emitted at a constant frequency 181.8 Hz and is one of the fundamental components of the JPS system. The use of "panel" type magnetic-luminous applicators, but also smaller applicators with a diameter of 19.6 centimeters, allows individual application of light radiation – ledotherapy or joint use of light and electromagnetic field – magnetoledotherapy. Figure 1 shows magnetic-luminous applicators that produce heterogeneous, alternating electromagnetic field and use LED (light emitting diode) energy. They emit radiation in the range:

- Visible light, red – with R applicator (wavelength about 630 nm).
- Invisible infrared – with IR applicator (wavelength about 860 nm).
- Mixed light - with RIR applicator.

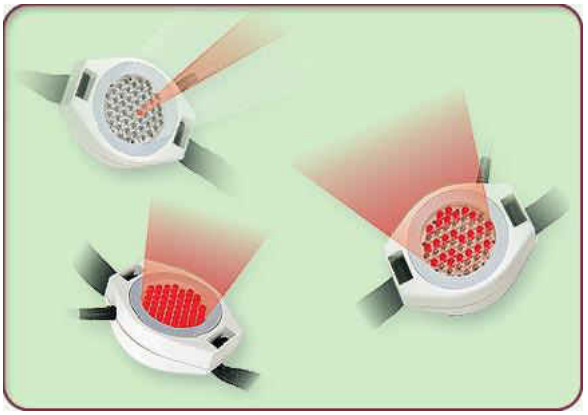

Fig. 1. Magnetic-luminous IR applicator used in the studies (indicated by an arrow)

The measurable effect of quickly implemented, comprehensive therapy, using the basic and supporting methods, is saving the patient's teeth or their roots, as the most suitable, biocompatible and the cheapest "implants".

Aim of Work

The aim of this work was to investigate whether the use of magnetoledotherapy will accelerate the elimination of osteolytic lesions of the dental periapical area, and provide for prosthetic treatment. What impact on time of healing does the inflammatory change location, type of treatment or patient's age have?

Material and Methody

69 patients underwent the examination. The problem of osteolytic lesions, in the course of protracted or protracted acute dental periapical tissue inflammation, was recognized in their x-ray pictures. All patients of both sexes, aged 16-82, gave their permission for endodontic or reendodontic treatment combined with magnetoledotherapy. Patients were divided into two research groups:

L – test group treated with magnetoledotherapy and

K – control group treated without the support of magnetoledotherapy.

Test group L consisted of 38 patients; they had altogether 45 teeth requiring root canal treatment. In 21 cases the clinical condition of their teeth crown indicated the need for reconstruction, by using prosthetic methods – crown-root refill and prosthetic crown. Each time, conservative endodontic procedure or revision of last treatment was employed.

To support the implementation of therapy in group L, we applied the electromagnetic field, generated using the Viofor JPS Clinic apparatus (Figure 2). Physical treatment was executed every day, except Sundays. We used parameters M1 P3, which presume constant application of desired density.

Fig. 2. VIOFOR JPS CLINIC apparatus with magnetic-luminous applicator, while performing the surgery

Control group K consisted of 31 patients (38 teeth). In this group, we reported 19 teeth requiring prosthetic treatment. In these patients we did not apply any supportive procedure, except endodontic proceedings.

Objectification of rating x-ray pictures was achieved by using a personal computer and some computer programs. All radiological images, in both groups, were carried out in one x-ray laboratory, using the same apparatus, adopting identical parameters. They were also regularly scanned and stored in the computer. In order to minimize possible errors and distortions during image processing, we used the same high-resolution scan device (Mustek brand), with exactly the same parameters. Digital images of conventional photos, saved in the computer, were not exposed to any further action such as improving the sharpness, the contrast etc. Thus, as in the case of digital radiovisiography, 8-bit maps of traditional radiograms were created to set up an objective evaluation of the images in grayscale. Assuming that we can illustrate the difference between output image and control snapshots, which is considered by a doctor as an improvement, we reduced the measurement range. Afterwards, we managed to estimate the results with the aid of Corel Draw. It means that we developed graphic charts of distribution of shades of gray – histograms in comparable samples – areas of measurement frames. In the Results Statistical Processing Program another analysis has been made, by designating concrete numerical values derived from analyzed samples: centroid of histograms, cumulative distribution, probability function density and the displacement degree of the gray spectrum around the horizontal axis (x).

Results

After analyzing the results, we noted that to obtain a satisfactory therapeutic effect, it is necessary to conduct about 36 magnetoledotherapy procedures. The smallest number of supportive interventions was required by lesions located in the lateral part of the jaw bone: only 29. For complete reconditioning of disease alteration, located in the lateral areas of the mandible, 31 magnetoledotherapy procedures were needed. The Kruskal-Wallis test was performed ($p>0.05$). It showed that location of lesion does not have an important impact on final results of magnetoledotherapy.

Among patients who never underwent the endodontic treatment, the average number of supportive procedures which improved the regeneration is 36.1. In the group of patients who underwent the reendodontic treatment, to achieve a satisfactory effect, about 37.9 applications were essential. Kolmogorov-Smirnov λ compliance test ($p>0.05$) results revealed that neither the type of performed endodontic treatment nor revision of earlier treatment had a crucial influence on therapy final outcome.

Taking into account the age of patients, the rehabilitation bone structure processes were completed at the earliest in 18 cases of patients under 35 years of age. The average number of magnetoledotherapy applications that give a satisfactory effect in this group is 33.

Statistical analyses showed that treatment using supportive procedures of magnetoledotherapy is more effective than endodontic treatment without any physical support (Figure 3).

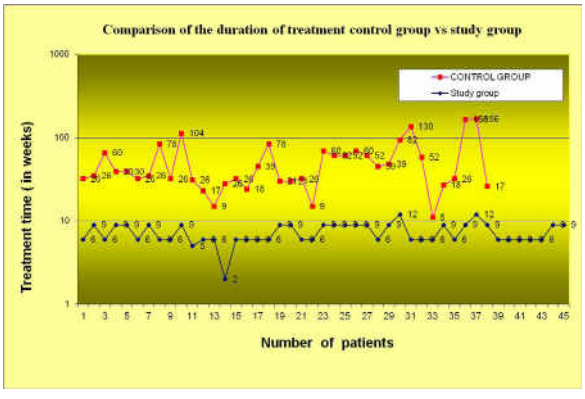

Fig. 3. The treatment time of the periapical inflammatory changes (expressed in weeks) carried out in: test group L and control group K

According to the graphs, the time of periapical inflammatory changes treatment in the test group (L) (blue color) lasted from 2 (minimum) to 12 weeks (maximum). In half of the cases (23 patients) of the test group (L), the time needed to obtain successful reconditioning of periapical

inflammatory change, after using magnetoledotherapy, was 6 weeks, in 18 cases 9 weeks, and in only 2 cases 12 weeks. In this group the mean time necessary for complete recovery, confirmed on the x-ray pictures, is 8.5 weeks, about 2 months (Figure 4).

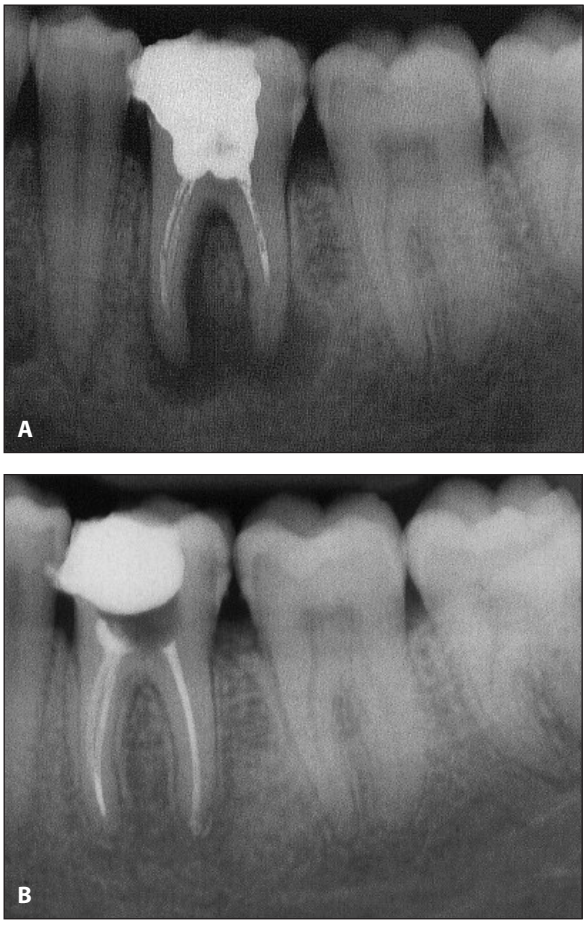

Fig. 4. The x-ray images of 21-year-old patient J.Sz. from test group (L) – tooth 46: A – before the magnetoledotherapy; B – after 30 procedures of magnetoledotherapy

In the control group (K) the range of time needed for regeneration was from 5 weeks (1 case) to 156 weeks (2 cases). In 10 cases, time needed for periapical inflammatory change total recovery lasted 26 weeks (6.5 months). The average time of the treatment of chronic periapical tissue inflammation in the control group (K) was 44 weeks (about 11 months). The efficiency of physiotherapy cure was defined by differentiation of the approximation equations towards time. The equations symbolize the changes on the gray scale before and after treatment. After accepting the most favorable conditions for control group rehabilitation (K) the duration of cure is reduced by 73%.

Discussion

Magnetotherapeutic applications used in medicine developed significantly in the 1950s and '60s. Introduced in the last decade of the twentieth century, JPS VIOFOR System received a lot of interest among medical investigators, who constantly examine its effectiveness in selected diseases. The device generates an electromagnetic field in sawtooth form impulses with multiple apex frequency spectrum. Properly chosen parameters of the electromagnetic field intensify processes of tissue respiration, activate or inhibit the enzymatic reaction, and influence acid-base as well as water and electrolyte management [2,11,13]. Studies about the effect of electromagnetic fields on bone tissue were conducted by Tobon et al. [15]. The authors found accelerated bone remodeling, from coarse to lamellar, in the group of dogs undergoing long bones' osteotomy. They also found rapid physical rehabilitation and return to full efficiency.

The results consisting of quickening the processes of bone texture regeneration in periapical inflammatory lesions correspond with results obtained by Dojs [5]. The author applied electromagnetic field without a light component and examined the effect of magnetic stimulation treatments on periapical osteodestructive change regeneration. 40% of patients did not receive any substantial bone regeneration sign, which she connects with the damaging effect of the material located in the root canal. Dojs achieved a faster therapeutic effect in the group of patients not yet treated endodontically. She observed a 90% level of increase in optical bone density after two months of electromagnetic field usage.

It is possible to find reports in the literature about the impact of lasers in acute and chronic dental periapical tissue inflammation treatment. In 1963 there appeared the first reports on attempts to apply a condensed light beam in clinical medicine. One year later Stern, Sognnaes and Goldman adopted a laser beam on the tooth's surface. The wavelength range extends from infrared to ultraviolet [3,8]. Its light is monochromatic, all photon particles having the same wavelength, and also collimating, which indicates the light beam's straight course, without scattering. Laser radiation is coherent, which means that all photons are emitted in the same phase. The light emitted from the LED diode used in this work has incoherent character, which is the only difference between the laser energy physical parameters. It can be observed that the biochemical laser effects are similar to the magnetoledotherapy effect on living tissues. However, it should be noted that the laser beam acts at the depth of 0.5-2 mm and the light emitted from the LEDs, consisting of the electromagnetic field, has the ability to penetrate several centimeters into the tissues. Worthy of attention is the comparison between LED applicator lighting field, close to 20 cm^2, and narrow laser emission 1-2 mm, which is not easy to accurately direct on periapical change in treated bone.

Pawińska and Stokowska applied laser biostimulation in the treatment of chronic and chronically acute periapical tissue inflammation. They used a CTL 1202 laser, emitting light waves with 904 nm length, using a dose value of 4J, once a week for about 2 months. Radiologi-

cal medical surveys were performed at 6 and 12 months after termination of endodontic treatment, using the Cieszyński isometric technique. This was followed by total apical periodontium reconstruction in 30% of cases [6]. Zakrzewska-Pysz et al., using the same type of semiconductor laser, applying energy output of 4J per cm² within 2 minutes twice a week, achieved better results. Entire or substantial bone regeneration was obtained in 82% of cases after 3 months of treatment. There were also positive analgesic results of laser therapy [16]. Sulka et al., using laser CTL 1202, applied a dose of 3-4J per cm² in chronic diseases and 2-2.5 J in severe cases. The researchers achieved 100% recovery among the examined patients after 12 months [14].

The effect of laser beam treatment cannot be considered as meaningful, because the disposal of an osteolytic lesion was always identified after several months following endodontic treatment closure. In our research we used supportive therapy of the electromagnetic field and light energy with wavelength 860 nm, emitted from LEDs. The overall regeneration of dental periapical tissues was gained much faster than with a laser beam. Therefore the treatment was considered as finite, in study group L, after 30-45 magnetoledotherapy treatments, which made a period of 6-9 weeks or 1.5-2 months. The osteolytic lesions' recovery within the tooth's root apical tissues, in the chronic

inflammation process, is still baffling. The vast majority of endodontists suggest the need for conservative treatment, even in cases with extensive and destructive bone changes.

The lengthy period of bone structure reproduction, described in the literature, indicates adopting additional methods and devices that would reduce the osteoregeneration term and eliminate the odontogenic infection area. The magnetostimulation adjunctive medication, combined with light energy emitted from high-energy LED diodes, used in this investigation, has never been used in oral cavity diseases.

Conclusion

1. Above-featured studies have confirmed the effectiveness of magnetoledotherapy in decommissioning of the osteolytic lesion. This is evidence for the appropriateness of this method in chronic dental periapical tissue inflammation treatment, in teeth qualified for prosthetic load.

2. Magnetostimulation combined with LED energy is an adjunctive procedure, adopted in order to eliminate osteolytic inflammation changes on dental periapical tissues. It can be used in all age groups with the same good result.

3. After applying magnetoledotherapy, in a dental periapical tissue repair process of teeth treated endodontically for the first time as well as reendodontically, no differences were found.

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