

Clinical and Microbiological Assessment of the Results of Combined Treatment of Patients with Alveolar Osteitis

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Received: August 27, 2020; **Published:** December 29, 2020

Abstract

Objective: To study the effectiveness of combined treatment in patients with alveolar osteitis after tooth extraction.

Materials and Methods: The 87 patients with alveolar osteitis were selected for the study (from 2017 to 2020). Clinical and radiological methods were used to evaluate socket. To conduct a comparative analysis of the treatment results, two groups were formed: Group I is represented by 44 patients with alveolar osteitis received complex treatment with the inclusion of hyaluronic acid (HA) and magnetic-laser therapy. The II group is represented by 43 patients, with alveolar osteitis received treatment without the inclusion of hyaluronic acid (HA) and magnetic-laser therapy. To assess the pain syndrome in dynamics, we used visual analogue scale. Group 1 patients, the VAS score indicator shows that by the 5th procedure in 93% of cases the pain is completely absent, and only 1 patient has mild pain. Patients of the 2 group, we observed a similar picture only on the 7 - 8th day of treatment. When comparing 2 groups the best pain relief was patients first group. Hyperemia of the mucous membrane of the socket of the extracted tooth on the 5th day of treatment is completely absent in the 2nd group only in 32% of patients of the 1st group, this indicator reaches 98%.

Conclusion: The results of the treatment showed that, complex treatment using Hyaluronic acid (HA) and magnetic-laser therapy reduced the time pain, recovery time, increase the effectiveness of treatment. Thus, on the basis of clinical data, it can be concluded that the anti-inflammatory effect of hyaluronic acid (HA) and magneto-laser therapy is more pronounced than standard treatment methods.

Keywords: *Hyaluronic Acid (HA); Magnetic-Laser Therapy; Alveolar Osteitis*

Introduction

From the probable complications post extraction tooth, we can mention alveolar osteitis, bleeding, pain, swelling, trismus, damage to the inferior alveolar nerve, oroantral communication, periodontal problems in surrounding teeth and teeth displacement to noble anatomic spaces. Among the complications associated with the operation of tooth extraction, alveolar osteitis also called dry socket or alveolitis continues to occupy a leading place. Most authors describe following clinical manifestations: spontaneous, constant radiating pain, worse by night. Signs of inflammation around the socket of a previously extracted tooth - such as hyperemia, swelling gums, while the alveolus is empty, or filled with food debris, or necrotic clot [1,2].

Alveolar osteitis is a nest after extraction that shows an open bone that is not covered by a blood clot or healing epithelium and exists within or around the perimeter of the nest or alveoli for several days after the removal procedure [3].

Alveolar osteitis lesions occur in approximately 1% to 5% of all extractions and in up to 38% of mandibular third molar extraction [4].

Food particles and bacterial biofilm may hinder contact of the healing epithelium with the exposed bone, which may prolong the healing time of the alveolar osteitis. This fermentation may result in the formation of toxins or antigens that may irritate the exposed bone, produce an unpleasant taste or halitosis, and cause pain throughout the jaw.

When analyzing the composition of the isolated microorganisms were revealed the following *Streptococcus* spp isolated in 35.7%, *Staphylococcus aureus* golden - 12.5%, *Actinomyces* spp - 10.7%, *Candida* spp - 8.9%, *Enterococcus* spp - 8.92, *Corynebacterium* spp - 7.14%, *Escherichia coli* - 7.14%, *Staphylococcus pneumoniae* - 5.35%, *Clostridium* spp - 3.6% [5].

Microorganisms can enter the post-extraction wound from odontogenic and non-odontogenic foci of chronic infection. However, evidence suggests that bacteria is not the main cause of alveolar osteitis dry socket lesions [6].

During surgical interventions in the oral cavity, the prevention and development of postoperative edema, hematomas, and local inflammatory reactions are of particular importance. This is due to the anatomical and physiological features of the maxillofacial region: a developed circulatory network, contamination of the oral cavity with microorganisms, the proximity of foci of chronic infection (odontogenic, tonsillogenic, etc.) One of the main reasons for the development of inflammatory complications that occur after tooth extraction is an increase in the virulence of pathogenic microflora with a decrease in the resistance of oral tissues.

Among the causes of alveolar osteitis, the leading role belongs to a pathogenic infection that develops in the absence of a blood clot or its premature destruction in the hole of an extracted tooth. In the literature, there are indications of the existence of factors that can impede the formation or contribute to the destruction of an already formed blood clot [7]. Most authors agree that surgical trauma and the complexity of the operation play a significant role in the development of alveolar osteitis. This may be due to a more active release of direct tissue activators, secondary to bone marrow inflammation, after more complex and, therefore, more traumatic extractions [8].

Some authors believe that the use of vasoconstrictor drugs, administered in conjunction with local anesthetics, leads to prolonged vasospasm and prevents the formation of a blood clot in the tooth socket [9].

There are authors who did not find a significant difference in the distribution of alveolar osteitis of the well after extraction of teeth under infiltration anesthesia compared with conduction [10].

At present, it is accepted that local ischemia due to a vasoconstrictor during local anesthesia does not play a role in the development of alveolar osteitis. They found a significant difference in the distribution of dry socket of the well after extraction of teeth under infiltration anesthesia compared to conduction [11,12].

It is believed that infection of the hole plays a significant role in the development of dry socket, which is facilitated by an unsatisfactory level of oral hygiene. It has been proven that the frequency of dry socket increases in patients with poor oral hygiene.

Risk factors include smoking, surgical trauma, age, gender, medical history, systemic disorder, extraction site, anesthesia experience, operator experience, use of antibiotics before surgery, difficulty of the operation and infection at the previous surgical site, as well as oral contraceptives, menstrual cycle and immediate post-extraction irrigation with saline [13].

Since alveolar osteitis is the most common postoperative complication after removal, many researchers have tried to find a successful method of prevention.

Numerous methods and techniques are offered throughout the existing literature to help prevent alveolar osteitis. However, this area remains a controversial topic, as no method has been universally recognized. A sufficient number of methods have been proposed for the complex treatment of alveolar osteitis, however, none of them is universal, treatment of alveolar osteitis.

Despite the large number of proposed drugs and treatment methods, the problem of prevention of alveolar osteitis remains relevant.

The regular prophylactic use of systemic pre-and/or postoperative antibiotics is challenged due to the development of resistant bacterial strains, possible hypersensitivity and unnecessary destruction of the host commensals.

One of the pharmacological methods used in the prevention of dryness includes the use of antibiotic drugs after extraction and antiseptic rinses. To combat purulent-inflammatory diseases and complications, new types and classes of antibiotics are being developed [14,15].

However, resistance to them is rapidly developing. In this regard, many researchers speak of a serious “crisis of antibacterial therapy”. Pathogenic and conditionally pathogenic microflora is in most cases polychemoresistant due to the irrational use of antibiotics.

Several studies have reported that prior to and perioperative use of 0.12% chlorhexidine reduces the incidence of alveolar osteitis after removal of the third molar of the lower jaw [16]. In addition, various combinations of antibacterial agents in the form of pastes, emulsions, solutions are proposed for the treatment of alveolar osteitis.

Alvogyl (Septodont, Inc., Wilmington, DE) is widely used in dry socket management and is often referred to in the literature. Alvogyl contains butamben (anesthetic), eugenol (analgesic) and iodoform (antimicrobial). Some authors noted a slowdown in healing and inflammation when the nests were filled with alvogyl. They did not recommend using it in outlets [17].

When treating alveolar osteitis, the objective is to optimize the lesion such that the socket is optimally capable of forming an enduring layer of epithelium that covers the exposed bone inside the socket. To do this, under anesthesia, can try to cause bleeding into the socket.

Such circumcision can cause the bone to become immediately covered by a blood clot, which will reduce the total number of days that this hypersensitive bone is exposed and helps ensure that the epithelium grows systematically over the remaining exposed bone of the dry socket.

The alveolar osteitis medicament should cover the exposed bone for several days with a resorbable, but durable cover, which will protect the bone from painful mechanical stimulation, food impaction, and bacterial infiltration [18,19].

At the same time, antiseptic medications often cause allergic reactions, and therefore one of the alternatives to medications can be a physical treatment method such as physiotherapy methods.

Physiotherapy methods occupy an important place in rehabilitation complexes in various fields of medicine, being a powerful reserve for increasing the effectiveness of preventive, curative and rehabilitation measures [20].

Physiotherapy methods effectively used as a complement to traditional therapy in dentistry [21]. A known technique for the treatment of alveolar osteitis using ozone therapy [22].

In the last decades, the use of low-level laser therapy has increased as a non-pharmacological adjunct to the treatment with low collateral index in periodontology, implantology, it was pointed that the therapy is known for its efficiency with pain reduction, wound healing and inflammation.

Diode lasers have been shown to have potent bactericidal effects based on this diode laser, carbon dioxide (CO₂) and Erbium Yttrium, Aluminum, Garnet (Er:YAG) lasers are suitable for irradiating [23,24].

Besides the well-established conventional therapies, the low-level laser therapy comes as a support, with the goal to help in the reestablishment and faster cure.

In their studies, Kaya G., *et al.* found that treatment of alveolar osteitis was significantly better in patients who were treated with curettage and irrigation, followed by continuous diode laser irradiation, than in patients who were treated with curettage and irrigation, and then applied directly to the socket with Alvogyl [25].

The low-level laser therapy is internationally accepted as cell bio-modulator, used to reach ideal therapeutic effects, acting in the reduction of the pain response, with anti-inflammatory effects, stimulating local microcirculation and wounds repair, promoting a rapid recovery, which brings better quality of life to the patient [26].

In a cell level, studies evidence that the laser beam penetrates in the interior of the tissue where it is absorbed by chromophore molecules (light absorbers) that generate the increase adenosine triphosphate quantities (ATP), accelerating the metabolism and producing a physiological response.

The wavelength or laser type ought to be specific for each treatment, although there is not a range of studies with representativeness to define the best type for each dysfunction.

Literature presents the different active means: the red emission laser ($\lambda = 630$ to 690 nm) indicated for ulcers, herpes and open wounds healing; the near infrared types (over 700 nm), like the gallium arsenide and aluminum diode laser (GaAlAs, $\lambda = 790$ to 830 nm) which is used for analgesia, swelling, tendinitis, nerve regeneration and chronic ulcers and the gallium arsenide laser (GaAs, $\lambda = 904$ nm) indicated for the treatment of sports morbidity, postoperative pain and swelling/edema. Moreover, helium neon gas (HeNe, $\lambda = 632,8$ nm) and indium gallium arsenic phosphate (InGaAlP, $\lambda = 633$ nm) are mentioned, both indicated for wounds repair [26]. Known studies on the use of low-intensity laser radiation with a wavelength of $0.63 - 0.65$ microns and $0.85 - 0.89$ microns accordingly, in the treatment of alveolitis.

The same way that the nonsteroidal anti-inflammatory drugs (NSAIDs), with common use in surgical practice, the low-level laser therapy promotes the same results, however without the side effects. It is worth mentioning that, for immuno-impaired individuals, such as people with diabetes, the benefits described by this therapy are more significant, for they present the same tissue response, also in adverse conditions [27,28].

Magnetic-laser therapy is one of the methods of physiotherapy and accelerates the healing and regeneration of tissues after damage, eliminates pain and swelling. Magnetic-laser field act on the molecules of cell structures, to activate the processes of metabolism of cells and the activity of enzymatic systems, stimulation of nerve cell and lymphocyte respiration. At the tissue level, there is observed: improved microcirculation, accelerated revascularization and reinnervation, decreased intracellular and intercellular edema, increased blood oxygen saturation at the microcirculatory level. The effect of a magnetic field on the surgical field also has an anti-inflammatory, analgesic, regenerating and accelerating tissue healing effect [29,30].

Such a similar therapeutic effect of laser radiation and magnetic field implies an increase in efficiency when used together.

Therefore, the effectiveness of magnetic-laser therapy in the treatment of alveolar osteitis needs to be studied.

Hyaluronic acid (HA) is a glycosaminoglycan is one of the main linear extracellular matrix polysaccharides that can be found in various tissues of the body, especially in connective tissue and synovial fluid. It has many functions, such as the elastic viscosity of synovial fluid in the joints, control of tissue hydration and the mechanism of cell detachment with anti-inflammatory & anti edematous properties. With the advances in understanding of inflammatory mechanisms and wound healing process associated with tooth socket, numerous extracellular matrix components like hyaluronic acid, chondroitin sulphate and fibronectin are identified as promoters of periodontal healing and regeneration.

In addition, Hyaluronic acid can be used safely in medicine as it is non-immunogenic and non-toxic [31,33]. Hyaluronic acid plays a multifunctional role in the wound healing process. In dentistry, it was first used in the treatment of periodontal diseases such as gingivitis. Wondering to see if there is any there is any beneficial value of local administration of 0.8% Hyaluronic acid gel formulation in the treatment of dry socket.

Objective of the Study

To study the effectiveness of combined treatment in patients with alveolar osteitis after tooth extraction.

Materials and Methods

The 87 patients with alveolar osteitis were selected for the study (from 2016 to 2020). The ages of the patients ranged between 24 and 53 years (46 males and 41 females). All patients presented alveolar osteitis complications associated with the operation of tooth extraction. Clinical and radiological methods were used to evaluation socket.

The clinical study took into account: the localization of the defect, the presence of an inflammatory process, the volume of the bone and soft tissues of the jaw in the surgical area extracted tooth.

Among patients, most often developed in areas of premolars and molars of the lower jaw (54.9%), premolars and molars of the upper jaw (19.3%), front teeth of the upper jaw (16.6% about). Least of all, this process developed in patients after the removal of the front teeth of the lower jaw (9.2%). Clinically, alveolar osteitis outlet is revealed in patients after extraction, which shows an open bone not covered by a blood clot.

All patients underwent local and general treatment, including antiseptic treatment, the appointment of anti-inflammatory and anti-microbial agents.

Curettage of dry socket was performed after anesthesia and socket well was washed with a chlorhexidine solution and after that they achieved that the socket was filled with blood and a blood clot formed.

To conduct a comparative analysis of the treatments results, two groups were formed:

- Group I is represented by 43 patients with dry socket received complex treatment with the inclusion of magnetic-laser therapy, hyaluronic acid (Gengigel®) was applied to the socket. Patients received magnetic- laser irradiation 7 days with a wavelength of 810 nm and a density of 100 mW during 5 min. The exposure was carried out using the apparatus "Milta" (RF, Moscow).
- The II group is represented by 45 patients, with dry socket was observed, received treatment without the inclusion of hyaluronic acid (Gengigel®) and magnetic-laser therapy, nothing was applied to the socket.

Sample for microbiological examination was taken before starting therapy. Sterile curette was moved to the bottom of respective socket and put into a vial containing anaerobic culture media. Bacteria were identified based on their morphotype i.e. shape, size and motility and were divided into three groups: Gram positive cocci, Gram negative bacilli (straight rods, curved rods, motile rods) and filamentous bacteria. From 100-150 bacteria examined, data was recorded as relative percentage of each of these bacteria. Microbiological sampling at the reexamination was before clinical examination at 1 weeks.

To assess the pain syndrome in dynamics, we used Visual Analogue Scale (VAS) [34]. Visual analogue scale (VAS) is a straight line, the starting point of which corresponds to the absence of pain, and final - intolerable pain. At equal intervals under the line are numbers from 1 to 10, indicating the intensity pain and characterized by supporting words: absent, weak, moderate, strong, unbearable.

Patients noted pain intensity in the first visit, as well as in dynamics on the 3rd, 5th, 7th day, respectively. Patients were instructed that a score of 1 to 3 was indicative of mild pain, 4 to 6 was indicative of moderate pain and 7 to 10 was indicative of severe. Patients were instructed to note the intensity of pain at the first visit, as well as in dynamics on the 3rd, 5th, 7th day, respectively.

The study was reviewed and approved by the Ethics Committee of the of the Yerevan State Medical University after M. Heratsi (protocol N12, 05.9.17) and in accordance with those of the World Medical Association and the Helsinki Declaration.

Results

It was found that in patients undergoing of hyaluronic acid (Gengigel®) and magnetic-laser therapy, complete replacement of blood clot with granulation tissue and the process of marginal epithelization was noted by the 7th procedure.

Group 1 patients, the VAS score indicator shows that by the 5th procedure in 93% of cases the pain is completely absent, and only 1 patient has mild pain.

Patients of the 2 group, we observed a similar picture only on the 7 - 8th day of treatment. When comparing 2 group the best pain relief was patients first group.

Hyperemia of the mucous membrane of the hole of the extracted tooth on the 5th day of treatment is completely absent in the 2nd group only in 32% of patients of the 1st group, this indicator reaches 98%.

In present study, microbiological examinations bacteria were identified based on their morphotype i.e. shape, size and motility and were divided into three groups: Gram positive cocci, Gram negative bacilli (straight rods, curved rods, motile rods) and filamentous bacteria.

From 100 - 150 bacteria examined, data was recorded as relative percentage of each of these bacteria.

There was reduction in the number of gram negative bacilli and relative increase in the number of positive coccoid cells, in all 2 treatment modalities compared to baseline. 1 group presented decrease in gram negative bacilli (45.2% at baseline to 27.4% at 1 weeks) and relative increase in gram positive coccoid cells (54.80% at baseline to 72% at 1 weeks). In group comparison there was no statistically significant difference found in microbiological parameters ($p > 0.05$). 2 group showed decrease in gram negative bacilli (45.2% at baseline to 30% at 1 week) and relative increase in gram positive coccoid cells (54.80% at baseline to 70% at 1 weeks).

Thus, on the basis of clinical data, it can be concluded that the anti-inflammatory effect of magneto-laser therapy is more pronounced than standard treatment methods.

Statistical analyses

Statistical analyses were performed using SPSS software ver. 22.0 (IBM, Armonk, NY, USA), and MedCalc program for Windows. To test the significance of variations in the BOP, PPD, MBL, the t-test was used. The minimum level of statistical significance was set at a value of less than 0.05.

Discussion

Alveolar osteitis is a widespread disease, which, according to various authors, accounts for 24 - 35% of all cases of complications encountered in patients after tooth extraction [35,36].

One of the main reasons for the development of inflammatory complications that occur after tooth extraction is an increase in the virulence of pathogenic microflora against the background of a decrease in the resistance of tissues of the oral cavity. Therefore, one of the most important issues of modern dentistry is the treatment of the wound surface after surgery.

Among the causes of alveolar osteitis, the leading role belongs to a pathogenic infection, which develops in the absence of a blood clot or its premature destruction in the hole of the extracted tooth. Most often, the cause of the development of alveolar osteitis is *Staphylococcus aureus* and epidermal, diplococcus, *Streptococcus* [37-39].

It is well known that postoperative inflammatory reactions reach a maximum level 2 days after surgery and usually resolve within 1 week. Thus, the first week after surgery has a strong impact on the quality of life of patients, and it is extremely important to eliminate the associated factors that affect the initial phases of wound healing. Therefore, one of the most important issues in modern dentistry is the issue of treatment of alveolar osteitis. Despite years of research, little progress has been made in treating this common and unpleasant postoperative condition in patients.

All this makes us look for new approaches to the prevention and treatment of purulent-inflammatory complications. It should be noted that the search for new methods for preventing the development of complications after tooth extraction surgery and their treatment continues to this day. Of great importance in solving this problem is local treatment, which is carried out using various wound dressings. Modern coatings should prevent the development of infection and its penetration into the wound, protect the wound from injury, absorb the resulting exudate and prevent its accumulation under the dressing.

At the same time, there are sufficient grounds for the development and inclusion in the program of combating postoperative complications of physical factors. Possessing anti-inflammatory, antibacterial, analgesic, stress-limiting, immunomodulatory and regenerative action.

This diversity reflects the relevance of the problem itself and requires further study.

One of these physiotherapeutic factors is the low-intensity lasers and electromagnetic field, the use of which using modern electronic technologies, make it possible to choose the necessary optimal frequency for a particular patient, due to which all physiological effects are significantly enhanced and the effectiveness of this unique physiotherapeutic factor is [40,41].

Diode lasers have been shown to photobiomodulatory effects promoting wound healing and tissue regeneration. Diode lasers stimulate fibroblasts and osteoblasts, cause increased production of RNA messengers, which leads to significant collagen production during tissue healing [42-45].

Magnetic-laser supportive therapy may be considered an adjunct to the conventional surgical treatments of alveolar osteitis [46,47].

It is advisable to include a course of magnetic-laser therapy in the complex of therapeutic measures for dry sockets that occurs after removal.

The use of magnetic-laser therapy reduces the inflammatory manifestations of dry sockets, which developed after tooth extraction, and accelerates the reparative processes in the mucous membrane of the hole of the extracted tooth. One of the reasons for such rapid changes should be the normalization of microcirculation in the area of inflammation due to the reduction of thrombosis in microvessels and the activation of anti-inflammatory systems under the influence of oxygen ions. Effectiveness of magnetic-laser therapy on pain reduction can be explained by the fact laser light absorbed by nociceptors, exert an inhibitory effect on A and C pain fibers, which slows conduction velocity, and suppresses neurogenic inflammation [48].

Based on this, research is needed to illustrate the clinical benefits of treatment alveolar osteitis using magnetic-laser therapy.

The developed optimal parameters of magnetic-laser therapy (exposure time of 5 minutes in intensive mode for 5 - 7 days after tooth extraction helps to normalize the course of the wound process of the socket of a extracted tooth. To achieve an optimal clinical result, at least 7 sessions of magnetic-laser therapy are necessary.

The results of our research have shown that Magnetic-laser therapy have shown promising therapeutic effect in treatment of alveolar osteitis. Magnetic-laser therapy (exposure time of 5 minutes in intensive mode for 5 - 7 days after tooth extraction helps to normalize the course of the wound process of the socket of an extracted tooth. To achieve an optimal clinical result, at least 7 sessions of magnetic-laser therapy are necessary.

The Visual Analogue Scale (VAS) pain scores for each group patients with alveolar osteitis at each time were analyzed. A reduction in the duration of pain in patients of the first group compared to patients second group shows the effectiveness of magnetic-laser therapy. Magnetic-laser irradiation will significantly decrease pain, swelling, inflammation and stimulate the covering of the exposed bone through the stimulation of fibroblasts. Magnetic-laser therapy promote to increase blood flow by vasodilation and also reduces edema.

Hyaluronic acid (HA) plays a multifaceted role in regulating various biological processes and maintaining homeostasis in the body. HA is an essential component of connective tissue and plays an important role in maintaining the elasticity and viscosity of the extracellular matrix [49-51].

Several studies in the literature report that HA reduces symptoms, especially pain in patients with osteoarthritis. Gotoh., *et al.* reported that HA has an analgesic effect by covering the bradykinin receptors in synovial tissues and supporting an analgesic role [52]. In addition, they suggested a correlation between the molecular weight of hyaluronic acid (HA) and its analgesic effect. Nelson., *et al.* investigated the efficacy of oral administration of hyaluronic acid (HA) using spectral analysis of serum and joint fluid in patients with osteoarthritis of the knee joint [53].

Gokmen., *et al.* stated that the hyaluronic acid (HA) applied after the third removal of the molars showed less leukocyte infiltration and greater angiogenesis [54]. Coray., *et al.* evaluated the efficacy of hyaluronic acid (HA) spray after the third molar removal and indicated that post-hyaluronic acid (HA) surgery reduces swelling and may lead to a decrease in alveolar osteitis [55]. Juhas., *et al.* reported a decrease in the size of the wound, although there was a decrease in pain [56]. Similarly, Onisti., *et al.* in addition to reducing the size of the wound, they also reported a decrease in pain in half of the patients and without pain in most others [57]. Ballini., *et al.* studied the effect of esterified hyaluronic acid in the treatment of infrabony periodontal defects [58].

Based on above concept a treatment modalities, hyaluronic acid (HA) gel was used for the adjunctive in present study. In our study, a decrease in pain in the hyaluronic acid (HA) group may be due to the anti-inflammatory contribution of hyaluronic acid (HA).

Thus, it was concluded that hyaluronic acid (HA) reduces not only pain, but also local and systemic inflammation. In our research the use of combined exposure of a constant magnetic field and laser radiation was found to promote treatments effectiveness alveolar osteitis.

Conclusion

The results of the treatment showed that, complex treatment using hyaluronic acid (HA) and magnetic-laser therapy reduced the time pain, recovery time, increase the effectiveness of treatment. Thus, on the basis of clinical data, it can be concluded that the anti-inflammatory effect of hyaluronic acid (HA) and magneto-laser therapy is more pronounced than standard treatment methods.

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Volume 20 Issue 1 January 2021

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