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How to manage a dry socket?- review of the latest treatment methods

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Abstract:

Introduction

Alveolar osteitis is the most common postoperative complication of tooth extraction. This medical condition has been recognized for decades, however its treatment approach is diverse with varying outcome.

Aim of the study

The purpose of this review is to examine and discuss contemporary methods of treating dry socket. Through a synthesis of available studies, the paper aims to identify the most beneficial methods to deal with this post-extraction complication.

Materials and methods

An analysis of scientific articles available in Pubmed and Google Scholar databases was conducted. The study used publications from 2017 to 2024. The search process included the use of the following keywords: “dry socket”, “alveolar osteitis”, “alveolitis sicca dolorosa”, “socket pain treatment”.

Results

Thirty-five articles were selected and reviewed carefully and independently by all authors. The agents used in the treatment of dry socket were classified as: remedies, drugs and medications, blood products, and technologies. Each group of agents is described with a discussion of their therapeutic efficacy.

Summary

Dry socket is a common dental problem. Currently, non-invasive methods of treating this complication are preferred. Modern solutions can provide quick and effective therapy. The treatment should relieve discomfort and promote tissue regeneration. Despite various methods, there is still no clear opinion on the best way to treat dry socket.

Key words: dry socket; alveolar osteitis; alveolitis sicca dolorosa; socket pain treatment

Introduction

Alveolar osteitis (AO) also known as dry socket or alveolitis sicca dolorosa (ASD) is the most common postoperative complication of tooth extraction. The incidence of dry socket varies between 3-4% after conventional extractions. This condition is diagnosed up to 10 times more frequently after the surgical removal of impacted third molars, accounting for 25-35% of all surgical extractions.[1] Dry socket has been recognized for decades; however, the approach to its treatment varies and yields different results.

This condition was first described by Crawford in 1896.[2] Clinically, it manifests as acute pain at the extraction site and surrounding area, which appears 1-3 days after the procedure.[5] This is accompanied by increased fibrinolytic activity, triggered by direct (plasma-derived) and indirect (tissue) plasminogen activators, resulting in partial or complete breakdown of blood clots in the alveolus. The duration of AO is estimated to be 7-10 days.[2]

Dry socket has a multifactorial etiology. General factors affecting its occurrence include i.a. age, female gender, systemic immunity, nutritional deficiencies. Local factors we can mention include anatomical location, poor oral hygiene, smoking, local circulation, local anesthesia and vasoconstrictors, and estrogen-containing contraceptives, among others.[1,3] It has also been suggested that it is excessive trauma during surgery that leads to osteoblast necrosis, which disrupts the metabolic integration of the blood clot. Specific bacteria that promote fibrinolytic activity may also be involved in the pathogenesis of dry socket. These include Bacteroides oralis, Treponema denticola and species of Fusobacterium, Peptococcus and Streptococcus.[4,5]

A review and analysis of scientific studies published between 2017 and 2024 presents a variety of methods for dealing with dry socket symptoms. There are no standard recommendations for the treatment of alveolar osteitis, which makes it difficult to take effective measures in clinical practice.

Materials and methods

An analysis of scientific articles available in Pubmed and Google Scholar databases was conducted. The study used publications from 2017 to 2024, which were most relevant to the topic under discussion. We selected 35 publications based on which we considered the problem of dealing with the complication of dry socket. Inclusion criteria were clinical studies in English Language pertaining to local treatment of alveolar osteitis. The focus was on what material or technology was used to treat the dry socket and the outcome of the treatment. The search process included use of the following keywords: “dry socket”, “alveolar osteitis”, “alveolitis sicca dolorosa”, “socket pain treatment”.

Results

Out of all search results, 57 articles were extracted and evaluated for their content on alveolar osteitis. Further qualification included analysis by reading the full texts to determine whether the articles included the dry socket treatment method and the results of a particular procedure. A total of 35 articles were considered eligible and were selected and reviewed thoroughly and independently by all authors. The means used in the treatment of dry alveolus were classified as: remedies, drugs and medications, blood-based products and technologies.

Description of the state of knowledge

Remedies

These measures include: Snakehead fish extract (Channa striata), Miswak paste, black seed oil, honey, boric acid, and organic olive oil.

Based on studies conducted on a rat model, it has been demonstrated that snakehead fish extract (Channa striata) positively influences the treatment of dry socket by increasing the expression of TGF-β1. TGF-β1 is a key growth factor that stimulates the proliferation of keratinocytes and fibroblasts, which leads to wound contraction and angiogenesis, resulting in faster wound healing. Additionally, this substance includes a variety of nutrients, such as albumin, amino acids, zinc, copper, and iron, which have properties that support fibroblast proliferation. The study results indicate a statistically significant difference in TGF-β1 expression between the control group and the groups treated with snakehead fish extract, including the existence of a dose-response relationship.[6]

Miswak paste, containing extract from the arak tree (Salvadora persica), exhibits astringent, antibacterial, antifungal, analgesic, and anti-inflammatory properties, which help in quickly alleviating discomfort. Similarly, black seed oil, containing thymoquinone, has strong analgesic, anti-inflammatory, and antioxidant properties. This oil promotes soft tissue regeneration and aids in the formation of new granulation tissue.[7,9] The mixture of Salvadora persica and black seed oil has a major impact on the treatment of dry socket. A study of 52 patients, where the efficacy of the mixture and Alveogyl was compared, showed a significant reduction in pain within three days of treatment in both study groups. However, there were no significant differences in the degree of pain reduction between the groups.[7] In studies by Khan et al., patients using nigella experienced complete pain relief by the second day after the procedure, while those using Alveogyl continued to feel pain for several more days. In addition, the nigella mixture required fewer applications, indicating its higher effectiveness.[8] The effect

of black seed oil was also studied in comparison with eugenol, which is widely used in dentistry for its analgesic and antiseptic properties. Considering 36 patients, the group treated with black seed oil achieved better results in terms of both tissue healing and reduction of inflammation. Statistically significant differences were observed on the seventh day of the study. In the black seed oil group, faster coverage of exposed bone walls with healthy granulation tissue was demonstrated.[9]

Natural substances used in the treatment of dry socket also include honey. Honey significantly reduces inflammation, hyperemia (excessive congestion), and pain, bringing relief to patients. Additionally, it exhibits antibacterial and anti-inflammatory properties, which help keep the wound clean and prevent further infections. These properties are due to its high osmolality, acidity and the presence of enzymes such as glucose oxidase. Honey helps maintain the moisture of the wound, which is beneficial for the healing process, while having no side effects. In a study by Ansari et al., significant improvement in the formation of granulation tissue within the socket was observed from the fifth day of treatment using honey.[10]

Boric acid is a substance commonly used in superficial bacterial skin infections. Its application is also effective in decreasing the number of aerobic and facultatively anaerobic bacteria in tooth sockets. However, this substance does not bring the expected results in the context of bone regeneration during the healing process of alveolar osteitis.[11]

Studies have also been conducted on the use of olive oil in reducing the symptoms of dry socket. It has been shown that olive oil reduces the amount of dental plaque and minimizes the bacteria Streptococcus mutans and Lactobacillus, thus improving gingival health. In addition, its topical application has reduced drug-induced xerostomia in patients and significantly improved pain and burning sensations in patients with burning mouth syndrome (BMS).[12] According to Khan et al., we can conclude that olive oil, although it alleviates the clinical symptoms that occur while struggling with dry socket, does not directly affect the healing process. Compared to NBF (Nano-Bio Fusion Gel), it gives worse results in reducing the pain experienced by patients.[13]

Drugs and medications

The drugs and medications discussed in the article include: Alveogyl, Neocone, zinc oxide with eugenol, chlorhexidine, gel containing 0.2% chlorhexidine, 0.5% chitosan, 0.15% allantoin and 5% dexpanthenol, hyaluronic acid with octenidine dihydrochloride, lidocaine hydrochloride-loaded chitosan-pectinhyaluronic polyelectrolyte complex, tranexamic acid, oxytetracycline-hydrocortisone ointment, rifampicin-containing antibiotic agent, clindamycin-containing antibiotic agent, and complex of guaiacol and β-cyclodextrin.

Alveogyl is one of the most popular medical products used in the treatment of dry socket. It contains iodoform, butylparaminobenzoate, eugenol and Penghawar fibers, among others. The formulation exhibits antiseptic, anti-inflammatory and local anesthetic effects, and additionally has an analgesic effect by inhibiting prostaglandins. Compared to zinc oxide with eugenol (ZOE), the preparation significantly reduces pain and leads to earlier relief of symptoms. Alveogyl also has a stronger anti-inflammatory effect than ZOE.[14] In studies comparing the average time needed to achieve pain relief after applying Alveogyl, ZOE, and Neocone, it was shown that the Alveogyl dressing works approximately 3.5 times faster than ZOE and more than 2 times faster than Neocone.[15]

Neocone is an antibiotic formulation that contains polymyxin B, tyrothricin, and neomycin sulfate, in addition to tetracaine hydrochloride, which enhances the product with a local anesthetic effect.[15] Although this preparation is slower acting than Alveogyl, it yields significantly better results than ZOE. Tewari et al. observed clear signs

of healing in the group treated with Neocone on the 7th day of dry socket treatment, while over 20% of patients treated with ZOE were still struggling with an empty socket, redness, or exposed bone.[16] ZOE is used in the treatment of dry socket due to the specific properties of eugenol, which denatures proteins in the lipoprotein layer of the nerve membrane, preventing the initiation and propagation of action potentials, leading to pain control. Zinc oxide has certain properties that support healing, such as angiogenesis and reepithelialization. Treatment with ZOE has a distinct analgesic effect, but the healing process after its application is slower compared to traditional curettage.[17]

A popular antiseptic agent that effectively combats bacteria and reduces the number of postoperative complications is chlorhexidine (CHX). According to the research, the use of rinses with CHX significantly reduces pain, swelling and the incidence of dry socket seven days after third molar removal surgery.[18,19] An experimental gel containing 0.2% chlorhexidine, 0.5% chitosan, 0.15% allantoin and 5% dexpanthenol has also proven effective in managing postoperative discomfort. Chitosan is a natural polymer with antibacterial, hemostatic and anti-inflammatory properties. It also forms a protective layer that supports tissue regeneration and reduces the risk of infection. Allantoin accelerates the wound healing process by stimulating cell regeneration and helps maintain a moist environment inside the alveolus. Dexpanthenol is a precursor of vitamin B5 (pantothenic acid), which plays a key role in the regeneration of skin and mucous membranes. The aforementioned substances act synergistically to decrease pain, trismus and inflammation, while promoting the healing process. In the studies by Sáez-Alcaide et al., dry socket did not develop in any of the patients in the group using this experimental gel, whereas it occurred in 13.9% of sockets in the control group. On this basis, the gel containing chlorhexidine, chitosan, allantoin and dexpanthenol was found to minimize the risk of developing alveolar osteitis after tooth extraction.[19]

Hyaluronic acid also plays an important role in the treatment of dry socket. Hyaluronic acid (HA) is a non-sulfated polymer of glycosaminoglycan, whose long chains are major components of synovial fluid, skin, mucosa, cartilage and extracellular matrix. In damaged tissue, the long chains of HA are degraded, and the resulting low molecular weight chains trigger an inflammatory response, cell migration, and angiogenesis. Once granulation tissue is formed, HA begins to absorb free radicals, thereby reducing oxidative stress in the newly formed tissue.[20,21] Suchánek et al. first described a special pharmacological device composed of 2.5% HA, octenidine dihydrochloride (OCT- a disinfectant with a broad spectrum of action), and calcium chloride in the form of a dissolvable sponge, which acts antiseptically and coats the wound. The treatment protocol involved irrigating the extraction wound with 2 ml of 3% hydrogen peroxide and 2 ml of water for injection, followed by placing the described device in the wound. This procedure was repeated daily until the pain subsided or for a maximum of 7 days. The study showed that the device was effective in 96% of cases, with no side effects.[20] The treatment method described above was used in the studies by Kapitán et al. The authors demonstrated that smoking and previous treatment with Alveogyl might prolong the treatment time using HA + OCT. In three patients without these risk factors, treatment lasted 2-3 days. A patient previously treated with Alveogyl and a smoker required six and seven intra-socket applications of the device, respectively.[21] Hyaluronic acid can also be part of a chitosan-pectin-polyelectrolyte complex loaded with lidocaine hydrochloride, which can be used to treat dry socket. According to Supachawaroj et al, complexes containing 1.5% hyaluronic acid showed the best stability and efficiency in controlled lidocaine release. Lidocaine release was rapid in the first 5 minutes, then maintained at a constant level for 24 hours, allowing for pain and inflammation relief throughout the day.

Lidocaine combined with PEC showed no cytotoxicity and could additionally support cell proliferation, which is beneficial for the healing process of the socket.[22]

Tranexamic acid (TXA) is an antifibrinolytic agent that inhibits the proteolytic degradation of fibrin by preventing the attachment of plasminogen and plasmin. It has been shown that the application of a gelatin sponge soaked in a 5% TXA solution into the tooth socket reduces postoperative pain and decreases the risk of alveolar osteitis in patients after the extraction of third molars. There was no significant impact of TXA on the incidence of swelling or limitation of mouth opening.[23]

Oxytetracycline-hydrocortisone ointment has also proven effective in reducing the risk of AO. Oxytetracycline provides the formulation with an antibacterial effect, while hydrocortisone is an anti-inflammatory drug. Patients who were treated with the ointment gauze after extraction experienced less pain compared to the control group. This was measured using the Visual Analogue Scale (VAS) and the number of painkillers taken. In the study by Otake et al., the occurrence of dry sockets was notably lower in the group using gauze soaked with oxyteracycline-hydrocortisone ointment (0.9%) compared to the control group (19.6%).[24]

In order to improve the comfort of patients suffering from alveolar osteitis, the effectiveness of rinsing the socket with antibiotic solutions was also studied. Rinsing with a solution of clindamycin (600 mg I.M/I.V vial) and rifampicin (125 mg I.M vial) was used every two days for 10 days, following prior curettage of the alveolus and the application of local analgesics. Both antibiotics appeared to be more efficient in healing the alveolar mucosa than saline (control trial). Clindamycin was observed to be more effective in reducing pain and accelerating healing compared to rifampicin.[25]

A future alternative in the treatment of dry socket may be the complex of guaiacol and β-cyclodextrin. This complex exhibits potent antimicrobial activity against six oral bacteria with low cytotoxicity. Histological studies of the alveolar healing process in rats showed that after 7 days of treatment with the Gu/βcd complex, bone trabeculae formation was observed in the apical parts of the sockets. After 14 days, bone tissue occupied the apical and middle parts of the alveolus, and after 21 days, the entire socket was filled with newly formed bone. The healing process was more advanced than with the use of Alveogyl.[26]

Blood-based products

Among the blood products used to treat dry socket, we can mention concentrated growth factor and platelet-rich fibrin.

Concentrated growth factor (CGF) is the third generation of autologous plasma extract, prepared using a special centrifugation program. In clinical studies, CGF has been shown to accelerate the healing process and decrease pain and swelling. In patients where CGF was applied to dry socket in gel form, the formation of granulation tissue inside the socket was observed as early as the 4th day after application, whereas after curettage and saline irrigation this did not occur until day 7.[27] CGF also proved more successful in both alleviating pain and promoting tissue regeneration compared to low-level laser therapy.[28]

Platelet-rich fibrin (PRF) is a second-generation platelet concentrate used in a wide range of clinical applications, such as extractions, gingival recessions, regeneration of intrabony defects, and sinus lift procedures. Similar to CGF, it is obtained through the centrifugation of the patient's blood, after which it is separated from other blood components. In dry socket therapy, PRF in the form of a three-dimensional gel is placed in the alveolus and stabilized with sutures. It has been shown that PRF significantly reduces pain and accelerates the healing of both

soft and hard tissues within the socket.[29] In a study by Keshini et al., it was demonstrated that both PRF and Alveogyl reduce pain as early as the third day after application. However, PRF also supports cell migration and proliferation, which accelerates the tissue regeneration process and makes it a beneficial alternative in the treatment of alveolar osteitis.[30]

Technologies

The technologies included photobiomodulation, ozone therapy and low-level laser therapy.

Photobiomodulation therapy (PBM) is a treatment method that uses light to stimulate biological processes in tissues. The mechanism of action of PBM involves improving the quality and speed of tissue repair, which may include stimulation of collagen fiber maturation and organization, fibroblast proliferation, epithelialization, and angiogenesis. To assess the effectiveness of this therapy in reducing the risk of dry socket, studies were conducted on patients with bilaterally impacted lower third molars. Each patient underwent two surgeries, with one side of the oral cavity receiving PBM therapy and the other side receiving a placebo treatment. The therapy significantly reduced the incidence of AO compared to the control group. Photobiomodulation was shown to reduce the risk of dry socket by half. In addition, patients undergoing treatment reported lower pain levels during the first five days after surgery, which resulted in a fewer need for pain medication.[31] The role of photobiomodulation in the treatment of alveolar osteitis was also evaluated. PBM therapy was more effective in long-term pain reduction compared to Alveogyl alone. However, the most successful therapy was found to be Alveogyl combined with photobiomodulation using a 660 nm diode laser, following prior curettage of the socket.[32]

Ozone is a naturally occurring substance consisting of three oxygen atoms. Ozone promotes hemostasis, prevents microbial growth and has a beneficial effect on the metabolism of various biological components in tissues. In dentistry, it is valued for its antibacterial properties and for accelerating wound healing. A study by Torul et al. reported differences between the use of Alveogyl, ozone and ozone combined with concentrated growth factor (CGF) in the treatment of dry socket. The most effective method turned out to be the combination of ozone with CGF. All patients treated with this method had healthy granulation tissue within the alveolus by the 7th day of therapy. Additionally, this group exhibited the lowest consumption of pain medications. The pain experienced by patients treated with ozone alone was less than in the control group (Alveogyl), but greater than in the CGF + ozone group.[33] Ozone also has a role in reducing the risk of dry socket after surgical extraction of third molars. A study that compared the effectiveness of ozone and chlorhexidine gel (CHX) in decreasing pain intensity and the incidence of dry socket showed that both ozone and CHX were effective in reducing pain and preventing this complication, with ozone demonstrating slightly better preventive ability.[34]

Another technology used is low-level laser therapy (LLLT), which promotes biostimulation of cells through the application of light of a specific wavelength. This therapy has a significant impact on the treatment of alveolar osteitis by reducing inflammation, stimulating blood circulation and supporting the formation of granulation tissue. In addition, the laser stimulates fibroblasts, responsible for the production of collagen and other structural elements, which accelerates the process of repair and regeneration of damaged tissue. Kamal and colleagues compared the effectiveness of low-level laser therapy with traditional treatment using alveolar curettage and saline rinse (control group). Patients undergoing laser therapy experienced a substantial reduction in pain as early as day 4 of therapy. Pain measured on the Visual Analog Scale (VAS) on the 7th day decreased to levels of

0-1, while it remained at 2-4 in the group subjected to traditional methods. They also observed a greater amount of granulation tissue within the alveolus compared to the control group, confirming the higher efficacy of low-level laser therapy.[35]

Conclusions

1. Extract from snakehead fish may be an effective agent in supporting wound healing after tooth extraction, reducing the risk of dry socket. However, its introduction into clinical practice requires further clinical studies with controlled and randomized trials to confirm the efficacy and mechanism of action of this extract in humans.
2. A mixture of Miswak paste and black seed oil can be an efficient substitute for Alveogyl in the treatment of dry socket.
3. Honey shows comparable efficacy to zinc oxide with eugenol in the management of alveolar osteitis.
4. Topical application of boric acid is effective in reducing bacteria in the socket, but it does not benefit the bone regeneration process.
5. Neocone appears to be a more potent dressing material for the treatment of dry socket compared to zinc oxide with eugenol, but there is a need for studies on a larger number of patients.
6. The use of chlorhexidine after extractions may be an efficacious prophylactic strategy.
7. It is advisable to conduct further studies on the role of a gel containing 0.2% chlorhexidine, chitosan, allantoin and dexpanthenol in the prevention of alveolar osteitis after the removal of the third molar.
8. The combination of hyaluronic acid and octenidine successfully treats dry socket, providing rapid pain relief, wound healing support and antiseptic effect, with no side effects, so it can be used widely.
9. Due to its biocompatibility plus anti-inflammatory and antibacterial properties, the PEC complex with lidocaine has great potential, but further studies are needed to fully confirm the therapeutic efficacy of the complex in the AO treatment.
10. The use of tranexamic acid and oxytetracycline-hydrocortisone ointment at the extraction site can effectively lower the incidence of dry socket and the intensity of postoperative pain in the first days after surgery.
11. Despite promising study results on the guaiacol complex with β-cyclodextrin, further clinical trials are necessary to better understand the mechanisms of action and to confirm the safety of the complex in humans.
12. Concentrated growth factor (CGF) and platelet-rich fibrin (PRF) can be successfully used in the treatment of alveolar osteitis in the dental office.
13. There is a need for further research on various photobiomodulation therapy protocols and their impact on the quality of life of patients after tooth extractions, as well as the potential use of PBM as a standard therapeutic method in dental surgery.
14. The combination of concentrated growth factor (CGF) and ozone has many advantages over traditional treatment methods and ozone alone, making it a method worth trying in the treatment of AO.
15. Patients suffering from dry socket undergoing low-level laser therapy (LLLT) experience rapid pain relief and an effective healing process.

Summary

Dry socket is one of the common dental complications, hence a variety of options for its treatment are being researched. The traditional invasive procedure is gentle curettage followed by irrigation of the alveolus. However, there are currently several non-invasive methods that demonstrate higher effectiveness in treating dry socket.

Noteworthy are natural substances such as a mixture of Salvadora persica and black seed oil, or honey. These agents promote the formation of healthy granulation tissue, aiding the healing of the socket. Additionally, they are free of side effects and may be better accepted by patients who avoid chemical substances.

In the early stages of intervention, fast-acting analgesics such as the commonly used Alveogyl are key. Also worth considering in clinical practice are new solutions, among others, a pharmacological device composed of 2.5% HA, octenidine dichydrochloride and calcium chloride, which has a very high efficacy and can cure a dry socket in as little as 2-3 days. In each case, the possible side effects of the substances used should be taken into account.

Products containing antimicrobial and antiseptic substances protect the alveolus from superinfection, helping the healing process, which occurs through the formation of healthy granulation tissue. Current therapeutic strategies modulate angiogenesis and tissue regeneration, rather than focusing solely on pain and inflammation control. Treatment modalities using blood-based products and low-level laser therapy, among others, are able to initiate fibrovascular tissue invasion into the alveolus, which is crucial in the initial phase of the healing process.

Scientific evidence indicates the need for a comprehensive approach that combines pain relief, anti-inflammatory and antioxidant actions, and strategies for granulation tissue regeneration. To achieve the best therapeutic outcome, it is advisable to use agents that complement each other's effects together. Unfortunately, there is still no consensus on the appropriate treatment for dry socket.

Author's contribution

Conceptualization, Laura Pacek, Aleksandra Wróbel and Aleksandra Dziewulska; methodology, Weronika Kiełt; software, Aleksandra Kudła; check, Weronika Kiełt, Klaudia Kowalska and Gabriela Broniec; formal analysis, Barbara Wajdowicz and Rozalia Czapiewska; investigation, Julia Kozłowska and Rozalia Czapiewska; resources, Barbara Wajdowicz; data curation, Aleksandra Wróbel; writing - rough preparation, Laura Pacek; writing - review and editing, Gabriela Broniec and Julia Kozłowska; visualization, Laura Pacek; supervision, Aleksandra Kudła; project administration, Weronika Kiełt; receiving funding, Aleksandra Dziewulska

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