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From Tradition to Innovation: A Narrative Review of Evolving Therapeutic Strategies in Dry Socket Management

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Abstract

Dry socket (aka, "alveolar osteitis") (AO) is a self-limiting and most common complication of dental extraction, especially extraction of third molars.

Dry socket happens when a blood clot at the tooth's removal site does not form, comes out or dissolve before the wound has healed. Usually, clot forms at the site of extraction contain cells that are needed for proper healing of the site.

Dry socket is a condition occurring after extraction that shows exposed bone not covered by blood clot or healing epithelium and exists inside or around the perimeter of the socket or alveolus a few days after tooth extraction.

The most common risk factors of dry sockets are smoking, surgical trauma, single extractions, age, sex, amount of anaesthesia, previous surgical site infection, medical history, and systemic disorders such as diabetes.

Different materials and methods of dry socket management mentioned in this review have the aim of relieving patient's pain and promote healing at the site of extraction. Treatment of dry sockets with intra-alveolar zinc oxide eugenol dressings did reduce the pain; however, the healing time was invariably prolonged.

The aim and objective of this narrative review is to approach the most advanced and developed treatment of dry socket management. Knowing the most common and frequent risk factors of dry sockets helps to determine high risk patients and treatment planning.

Keywords: Dry socket, Surgical trauma, Anaesthesia, Post-operative pain

Introduction

One of the most common practices carried out in dental clinics in a daily basis is dental extraction especially the removal of wisdom teeth which may be fully erupted or partially impacted by surrounding bone. Such surgeries

of removal of the wisdom tooth may cause complications in patients such as nerve damage which may lead to the loss of taste sensation, facial paralysis; bone fracture; inflammatory conditions such as swelling, dry socket, delayed healing, post-operative pain, hematoma etc. The overall complication rate in patients is usually low but we cannot ignore it.

The definition of dry socket may differ by different authors but the main concept of dry socket is defined as an area of exposed bone, characterised by the absence of a fibrin clot in an extraction socket, either due to the failure in clot formation or loss of clot post-formation, with the patient usually presenting in moderate to severe pain. Also, improper maintenance of wound sockets can lead to dry sockets. The patient may not be able to prevent food particles or the tongue from the exposed bone. Food particles collected inside the socket may dislodge a blood clot by obstructing contact of a reforming blood clot with the exposed bone. Which may lead to the delayed healing of dry socket lesions.

Sometimes halitosis may occur due to dry socket lesions. The main reason behind it is the production of acid by fermented process occurring through bacteria present on food particles which is collected inside the socket. [1] A dry socket also may lead to intense pain, fever and an unpleasant taste. Dry sockets have become stressful and a burden on patients because they can result in repeated return visits to the dentist for significant pain relief as well as prolonged discomfort for the patient. This prolonged discomfort may also serve to negative perceptions and fears surrounding access to dental care. To treat dry sockets there is no specific cleared treatment is available but, in this review, we trying to investigate the aetiology, prevention and management of it by reviewing the current literature. [2]

To review the literature, studies were selected from PubMed, Scopus, Web of science and Google scholar without restrictions on publication year, to provide a comprehensive overview of dry socket management. The review focused on pathogenesis, causes and tradition to latest methods of dry socket management. The search term included “alveolar osteitis” ,”fibrinolysis” , ”zinc oxide eugenol dressing”. The research encompassed, case report and systemic review.

Pathogenesis of dry socket

Dry socket refers to the inflammation of the alveolar bone which commonly occurs as a complication of tooth extraction.

Dry socket lesion pathogenesis can explain various facts about dry sockets including the findings that smoking and the use of oral contraceptives [3] increase the incidence of dry sockets.

Traumatic extractions, where heavy luxation or forceps forces are required to extract teeth particles, increase the incidence of dry socket lesions [4]; that plasmin-induced fibrinolysis activity seems higher in dry socket lesions compared to non-dry-socket post-extraction sockets[5,6]; and that bacteria do not seem to initiate dry socket lesions.

Birn hypothesized that trauma during extraction or the presence of a bacterial infection somehow facilitates the release of plasminogen tissue activators in the post-extraction socket, resulting in the plasmin induction of fibrinolysis that dislodges the blood clot that formed after the extraction and causing a dry socket lesion [7,8]. Dry socket lesions routinely exhibit an eventual stoppage of blood flow to the socket. This idiopathic ischemia counteracts the effect of fibrinolysis and is presumably a cause of dry socket lesion initiation and pathogenesis.

During a traumatic extraction, heavy luxation or forceps forces transfer to the jawbone surrounding the roots and may crush bone on the intaglio surface of the extraction socket [9-11] This can induce necrosis or apoptosis of osteoblasts within the extraction socket Studies have shown that mechanical stress (excess tensile or compression forces) on osteoblasts can activate cellular signaling pathways that lead to osteoblast apoptosis. [12-15]

The necrosis of bone cells, occurring over a >24-hour delay period after an extraction, may result in the bone cells releasing urokinase plasminogen tissue activator, which is the main plasminogen activator released in dry socket lesions [16] The urokinase plasminogen tissue activator then converts plasminogen to plasmin. The plasmin may directly result in the lysis of a blood clot that initially formed in the socket. However, a major function of plasmin is to initiate blood vessel perfusion to bring blood, immune system cells, and complements to the intaglio surface of the socket to begin resorbing the necrotic osteoblasts. In dry socket lesions, however, an idiopathic blood vessel ischemia event is eventually observed that prematurely blocks this capillary perfusion-mediated immune system activation process. [17,18]

Due to the lack of blood flow to the intaglio surface of the socket, the immune system cells and their complement factors cannot be brought to the intaglio surface of the socket to resorb the necrotic bone cells lining the socket. Instead, clinical observation seems to show that the socket heals by a mechanism where vital epithelium, initially present at the outer perimeter of the socket, grows gradually from the outer perimeter of the socket inferiorly into the socket down to the apex of the socket. [19] As the vital epithelium gradually covers the surface area of the socket intaglio surface, the epithelium brings blood vessels, immune system cells, and their complements in direct contact with the necrotic bone cells of the socket to begin resorbing the necrotic bone cells. [20] This process of epithelium growth may take several days; during this time, the uncovered bone is painful to the touch and is vulnerable to painful contact with bacterial biofilm or food impaction.

Management of dry socket

Different materials used in the treatment of dry sockets:

Vitamin C

Vitamin C(4000mg\day) is necessary for the secretion, synthesis and maturation of collagen. Vitamin C supplements help to regulate wound healing. The dry socket showed faster healing following treatment with vitamin c. [21] The anaesthetic gel contained prilocaine and lidocaine with anaesthetic effects on nerve endings. The thermosetting gel showed significant pain relief compared to eugenol. [22] SaliCept has acemannan, which acts as anti-inflammatory, anti-bacterial and immune-modulating, whereas Alvogyl has eugenol, iodoform and butamen which acts as sedative, anti-microbial and anesthetic. Low-level laser therapy works at the molecular level to enhance proliferation and promote wound healing and pain relief. Low-level laser therapy showed superior results among 4 groups. A salicept patch is an acceptable alternative to alvogyl in the treatment of dry sockets. [23]

GECB: (Eugenol, Guaiacol, Chlorobutanol)

The effective ingredients of GECB are 3% eugenol (Merck), 3% Guaiacol (Merck), and 1.6% Chlorobutanol in the pastille. Guaiacol enhances cellular proliferation. GECB and ZOE both have eugenol but GECB is better in pain-relieving properties and is superior to ZOE which showed a significant reduction in pain symptoms while zinc oxide eugenol showed acceptable results.[24]

Neocone contains polymyxine B sulfate which has anti-microbial properties against gram-negative bacteria, tyrothricin which has effects on gram-positive bacteria and spirochetes, neomycin sulfate which has a broad-spectrum impact and tetracaine hydrochloride works as a local anesthetic. Alvogyl was quicker in initial pain relief but neocone showed complete pain relief and faster healing. [25] Hydrogen peroxide is an oxidizing agent which releases oxygen and creates a foaming action which removes the food debris and kills the anaerobic bacteria such as actinomyces viscosus, strep. mutans and treponema denticola which play a role in the etiology of dry sockets. The duration of treatment was less in the experiment group compared to the traditional group. Hydrogen peroxide is effective and safe for use in the treatment of dry sockets. [26]

Low-level laser therapy

LLLT (low-level laser therapy) promote fibroblasts, epithelialization, collagen maturation, and angiogenesis and reduces pain. It also has anti-inflammatory effects. In this study, LLLT showed superior results for the treatment of dry sockets [27]. Ozone has strong anti-microbial properties with the ability to penetrate both hard and soft tissue; and promote epithelization. Ozone gel enhanced healing and relieved the severe dry socket pain faster as compared to alvogyl. [28] LIPUS affects the gingival cells and increases m-RNA of proliferative cells along with connective tissue growth factors which promote soft tissue healing. LIPUS showed significantly superior results when compared to LLLT, placebo LLLT and placebo LIPUS for socket pain control. [29]

Platelet rich fibrin

PRF (platelet-rich fibrin) works at the molecular level. It enhances angiogenesis, cellular migration, epithelialization and bone regeneration. PRF showed earlier pain relief and good wound healing within 24 hours and with minimal analgesic intake. [30] Turmeric contains curcuminoids which are prostaglandin inhibitors, stabilizers of the liposomal membrane and inhibitors of the activity of leukotrienes as well as thromboxaneB4. It is anti-inflammatory, antioxidant and anti-microbial, and enhances regeneration. Turmeric-treated Group A showed faster pain relief and faster wound healing. [31]

Alvogyl

Alvogyl has sedating, antimicrobial and anaesthetic effects. ZOE has sedating effects. The study claims that alvogyl provides faster pain elimination of dry sockets and better results. [32] Colloidal silver protects against Streptococcus mutans, Streptococcus sanguis, and Streptococcus salivarius and the biofilm created by these bacteria. It is biocompatible. Antihomotoxic drugs have anti-inflammatory properties. Combined use of colloidal silver, Traumeel S which has anti-inflammatory action and Polymic showed faster results to eliminate socket symptoms up to 2-3 days. [33]

Clindamycin

Clindamycin has antibacterial action. It works by inhibiting ribosomal translocation or protein synthesis. Rifampicin carries anti-bacterial action and works by inhibiting bacterial DNA-dependent RNA synthesis. Clindamycin showed significant results in pain relief when compared with rifampicin and sterile saline. [34] CGF is a cocktail of growth factors which enhances, angiogenesis, epithelialization, collagen, and cellular proliferation and works at the molecular level to expedite the healing process and the granulation tissue formation. It also has anti-inflammatory effects and modulates healing and pain control. Patients in CGF-treated Group II showed earlier granulation tissue formation and pain relief by day 4, while Control Group

sockets showed delayed granulation tissue formation and prolonged pain. [35]

LLLT induced biostimulation

LLLT-induced biostimulation. It directly acts on mitochondria and increases the amount of ATP, which results in intracellular metabolic changes promoting proliferation, migration, and epithelialization and it also stimulates platelet-derived growth factor. LLLT irradiation is superior to the conventional treatment approach in terms of pain relief and formation of granulation tissue within 7 days. Promotes faster healing of dry socket. [36] Both CGF (concentrated growth factor) and LLLT promote angiogenesis and granulation tissue formation in dry socket through biostimulation and immunomodulation effects. It facilitates the resolution of inflammation and increases the wound resistance to infection. The CGF-treated socket was superior to LLLT in its ability to generate 75% granulation tissue and eliminate pain symptoms by day 7 post-treatment.

'Conventional treatment'

For dry socket advocate medicaments and drugs for local treatment. The procedure begins with gentle curettage to debride the slough in the socket, followed by irrigation and the creation of a new blood clot. The irrigation solution use may comprise of only physiological saline solution or other irrigant solution such as chlorhexidine and hydrogen peroxide. This is then followed by insertion of a dressing into the socket that comprise of medicaments such as alvogyl, zinc oxide eugenol, oil of clove/eugenol, antihomotoxic, colloidal silver, SaliCept or antibiotic dressing such as chlortetracycline, rifampicin, clindamycin and metron idazole gel. This treatment strategy is considered 'conventional' because curettage and wound debridement is the basic principle of management in poor wound healing and creation of a new clot revive the wound healing mechanism by repeating the clotting, inflammatory and proliferative phases. Insertion of other therapeutic dressings into the socket following 're-freshening' of the wound healing cascades is controversial with some benefits and drawbacks.

This review shows alvogyl, zinc oxide eugenol, eugenol and Neocone have stood the test of time as the most popular dry socket dressing. Alvogyl is an alveolar hemostatic-analgesic paste with a fibrous consistency and good adhesion from the Penghawar fibers. It is a one-step, self-eliminating treatment that requires no suture and no special care. Other studies have observed damage to granulation tissue within the healing dry socket when intra-socket dressings are plugged in tightly and the possible cytotoxicity effects of these materials on stem cells when introduced in high doses, preventing active angiogenesis during the proliferative phase.

Antibiotic Irrigant solutions

Antibiotic irrigant solutions such as clindamycin, Rifampicin and Chlortetracycline is clinically effective but controversial due to such practices of low dose topical antibiotics currently raises the current global issue of emerging antibiotic resistance in the community, and the dental practitioner needs to be aware of these implications. This treatment caused significant change in the microbiota of the extraction socket by decreasing the number of anaerobes while increasing the amount of multi-resistant microorganisms.

Ozone

Represented as O_3, is a naturally occurring gaseous molecule of triatomic allotrope of oxygen. In dental surgery, ozonated water was used to promote homeostasis, enhance local oxygen supply and inhibit bacterial proliferation. Study found Ozone to be

superior to alvogyl based on the assessment of pain symptoms. The regenerative capacity of Ozone therapy is reflected in its ability to stimulate the expression of vascular endothelial growth factor (VEGF), transforming growth factor-β (TGF-β), and platelet-derived growth factor (PDGF) proteins in wound healing. Ozone therapy is safe and non-toxic and the technology is environmentally friendly.

Conclusion

The occurrence of dry sockets in everyday oral surgery or dental practice is unavoidable. The risk factors for this temporary and debilitating condition are identified. Surgeons must recognize these risk factors in patients with particular medical conditions and include this information as a part of the informed consent, some of these factors could be Smoking, surgical trauma, single extractions, age, sex, medical history, systemic disorder, extraction site, amount of anaesthesia, operator experience, antibiotics use before surgery, difficulty of the surgery and the previous surgical site infection in addition to oral contraceptive use and menstrual cycle.

A dry socket is a self-limiting condition, the cause of which remains elusive. Healing of dry socket is facilitated and accelerated through reducing the insult to the wound by food debris and microorganisms, by irrigation of the socket with chlorhexidine, followed by placement of alvogyl dressing or, if unavailable, instructing the patient in-home use of a syringe for irrigation of the socket until the socket no longer collected by debris, and the prescription of potent oral analgesics.

All treatments included in the review aimed to decrease the incidence of dry sockets and relieve the patient's pain to promote alveolar mucosa healing in dry sockets. Given the heterogeneity of interventions and the type of measurement scale, the results are difficult to compare. Curettage and irrigation should be carried out in a dry socket, as well as another therapy such as LLLT, zinc oxide eugenol or plasma rich in growth factors, which are the ones that show better results in pain remission and alveolar mucosa healing. Assessment of alveolar bone exposure must be a factor to consider in future research. Taking into account the scientific quality of the articles evaluated, a level B recommendation is given for therapeutic interventions proposed for the treatment of dry sockets. Treatment options for this condition are generally limited and directed toward palliative care. Prevention methods include avoiding smoking before and after surgery and traumatic surgery, the use of antibiotics, such as azithromycin, can be considered, and chlorohexidine rinse or gel can be effective in the reduction of dry socket incidence. While evidence supports a regenerative approach for dry socket healing, the old treatment modality controlling infection, inflammation and pain prevails.

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