

REVIEW ON CONVENTIONAL AND NOVEL TECHNIQUES FOR TREATMENT OF ALVEOLAR OSTEITIS

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ABSTRACT

The incidence of oral infections is increased to a large extent in recent years. Alveolar osteitis (AO) commonly known as Dry Socket is one such commonly occurring complication on mandibular tooth extraction. Alveolar osteitis is mainly associated with postoperative pain inside and around the extraction site and accompanied by a partial or total disintegrated blood clot within the alveolar socket. Various conventional methods are used for management of Alveolar osteitis like gels, rinse, and medicated gauze. Use of novel methods can prove to be more effective in treatment of Alveolar osteitis since it provides local delivery of drug with sustained and controlled release, low dose thus leading to reduced side effects with a better patient compliance compared to conventional methods. This review describes the aetiology, treatment of Alveolar osteitis and the need and future scope of novel methods for treatment of Alveolar osteitis.

Keywords: Alveolar osteitis, Dry socket, mandibular tooth, medicated gauze, sustained and controlled release.

INTRODUCTION

As per the World statistics conducted by World Health Organization (WHO), 2012 the burden of oral diseases is very high in India. They can affect the peridontium, cheeks, palate, floor of the mouth, tongue. The prevalence of various oral diseases in India is Dental caries (40-45%), periodontal diseases (40%), Malocclusion (30% of children). Oral diseases can be severe if not treated properly and hence maintaining oral hygiene is important to reduce the risk of infections. There are various oral infections like Periodontitis, characterized by destruction of the periodontal ligament, resorption of the alveolar bone, and the migration of the junctional epithelium along with the tooth surface [1], Oral Candidiasis, a common oral and per oral opportunistic infection that usually results from overgrowth of endogenous *Candida* fungal microorganisms [2], Aphthous Ulcer, Dental caries, Xerostomia, Alveolar Osteitis.

Alveolar osteitis (AO) is a well known complication which occurs on tooth extraction. It is commonly known as Dry Socket. The treatment of AO includes conventional methods like use of antibiotics, medicated gauze, gel, rinse. It is a very common condition arising on extraction of mandibular molars it is associated with postoperative pain in and around the extraction site, accompanied by a partially or totally disintegrated blood clot within the alveolar socket, with or without halitosis. The incidence of dry socket ranges from 0.5-5% for all routine extractions, can reach up to 38% on extraction of impacted mandibular third molars[3]. Alveolar osteitis generally arises between one and three days post extraction and the duration usually ranges from 5 to 10 days. The incidence of dry socket is higher in the mandible, occurring up to 10 times more often for mandibular molars compared with maxillary molars[4]. The term "dry socket" or alveolar osteitis was originally coined in 1896[5]. It has also been referred to as alveolar osteitis, localized osteitis, alveolalgia, alveolitis sicca dolorosa, septic socket, necrotic socket, localized osteomyelitis, fibrinolytic alveolitis[6].

Etiology

One of the main conditions for dry socket is that there is an increased local fibrinolysis which leads to disintegration of the clot i.e. conversion of Plasminogen to Plasmin. The fibrinolysis is the result of plasminogen pathway activation, which can be accomplished via direct (physiologic) or indirect (nonphysiologic) activator substances. Direct activators are released after trauma to the alveolar bone cells. Indirect activators are released by bacteria.

The fibrinolytic activity is local because initial absorption of plasminogen into the clot limits the activity of plasmin [7, 8]



Fig. 1: Shows Alveolar socket after extraction of mandibular molar [6]

There are several other contributing factors which precipitate dry socket.

Gender

It was observed that occurrence of dry socket in female patients is up to 4.1% versus 0.5% of men, a 5-fold increase in the incidence compared to males. Due to changes in endogenous estrogens during the menstrual cycle the chances of dry socket in females is increased since Estrogens activate the fibrinolytic system in an indirect way. Hence menstrual cycle should be taken into consideration before scheduling extraction. Dry socket may affect women in ratio of 5:1 with respect to males [8,9]. It is also found that there is a two to three fold increase in incidence of Alveolar osteitis in females compared to males [10].

Lack of operator experience

A surgeon's inexperience could be related to a bigger trauma during the extraction, especially surgical extraction of mandibular third molars. Incidence of dry socket increases if the extraction is performed by a less experienced operator. Therefore the skill and experience of the operator should be taken into consideration [8].

Oral micro-organisms

Micro-organisms like *Enterococcus*, *Streptococcus viridians*, *Streptococcus*, *Bacillus coryneform*, *Proteus vulgaris*, *Pseudomonas*

aeruginosa, *Citrobacter freundii*, and *Escherichia coli* were found to be present in the alveolus. It was observed that there is a possible association of *Actinomyces viscosus* and *Streptococcus mutans* at the extraction site which further leads to delayed healing of the

extraction socket. It is also observed that anaerobic micro-organisms like *Treponema denticola* have Plasmin like fibrinolytic activity which can be one of the risk factors to increase incidence of dry socket [6].

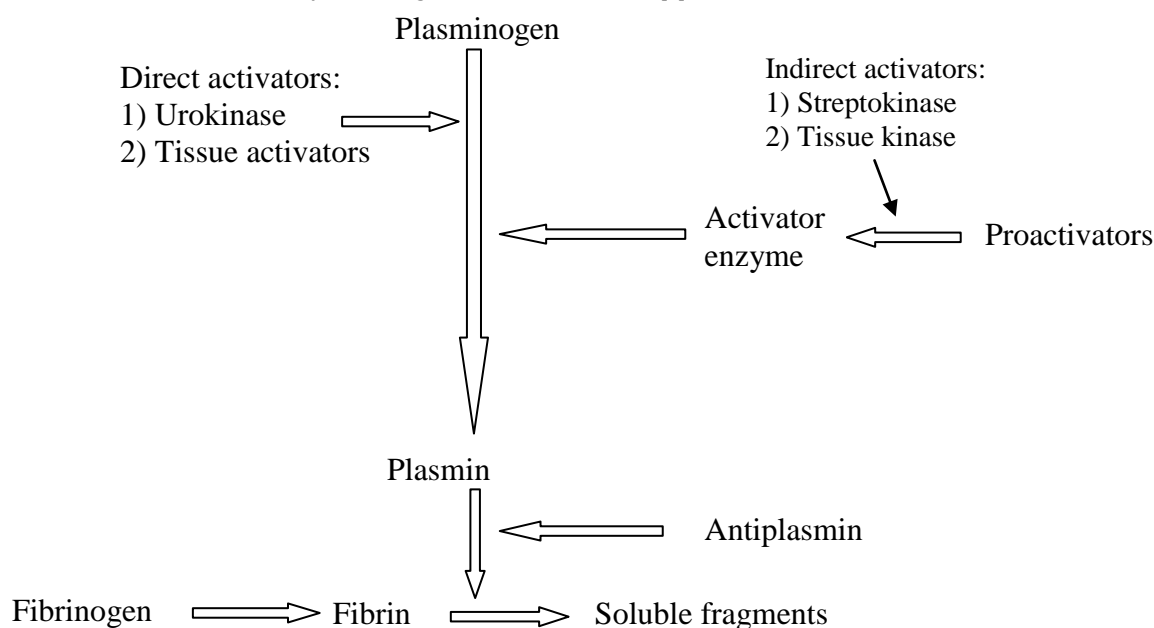


Fig. 2: Shows etiology of Alveolar osteitis [9]

Smoking

Smoking has been shown to reduce neutrophil chemotaxis and phagocytosis, and impede production of immunoglobulin. Nicotine is absorbed through oral mucosa and hence acts as a vasoconstrictor. In a study of 400 mandibular extractions it was observed that, the incidence of dry socket was substantially greater in smokers than in non-smokers (6.4% vs. 1.4%, respectively), with patients who smoked 10 cigarettes/day had a 12% chance of developing the condition and those who smoked 1 pack/day had a 20% chance. Incidence of dry socket also increases to 40% if the patient smokes either on the day of the surgery or within the first 24 h after surgery. Also there are chances of removal of the clot through suction and negative pressure during smoke inhalation leading to dry socket [4, 11]. Smoking water pipes or cigarettes may increase the risk for dry socket following extraction of mandibular molars [12].

Oral contraceptives

Increase in the use of oral contraceptives can increase the incidence of AO. Estrogen plays a significant role in the fibrinolytic process. It is believed that they indirectly activate the fibrinolytic system (increasing factors II, VII, VIII, X, and plasminogen) and therefore increase lysis of the blood clot [8]. The risk of post extraction complications for mandibular third molars increased with females who are on oral contraceptives [11].

Trauma

Incidence of alveolar osteitis increases with excessive trauma during extraction, especially in procedures that involve reflection of flap and excessive removal of bone. Mandibular third molar surgery is a relatively difficult and long procedure involving flap reflection, grinding into dense bone and tooth splitting. Hence, the third molar area is the most common site of dry socket occurrence. Excessive trauma causes compression of the bone lining the socket impairing vascular penetration. Subsequently excessive trauma can lead to the thrombosis of the underlying vessel [13].

Systemic diseases

Systemic disease could be associated with alveolar osteitis. Diabetic patients can be more prone to development of alveolar osteitis due to altered healing. But no such scientific evidence exists to prove a relationship between systemic diseases and alveolar osteitis [8].

Age

Alveolar osteitis commonly occurs in age group of 20 – 40 years of age with a peak value in the age range 30 – 34 years and rarely after 50 years of age [14]. Adult patients with age group above 21 years of age requires more time for recovery after third molar surgery [15].

Excessive irrigation

Excessive irrigation can interfere with clot formation and delay the healing of sockets. It also leads to increase in bacterial infection. However there is lack of evidence to confirm this assertion [13].

Flap designs/Sutures

Previous literature study claims that design of flaps and sutures affect the development of Alveolar osteitis but it is also reported that use of flap designs has no significant effect on incidence of Alveolar osteitis and there is no reduction in postoperative complications [16].

PREVENTION

Oral infections can be treated locally or systemically. Local drug delivery can be advantageous over systemic route to treat oral infections since local drug delivery require low dose, side effects are less, site specific, reduced microbial resistance, reduce dose administration frequency, prolonged residence time and deliver drug in a controlled and sustained manner [17]. Use of novel drug delivery systems to treat oral infections can be an effective way to prevent, treat and reduce the incidence of oral infections compared to conventional methods. Conventional methods include gel, rinse, paste, paint, powder, mouth wash. Thus there is a need in designing novel dosage forms to treat oral infections by which the human

population is widely affected. Numerous conventional methods and techniques are available to assist with prevention of alveolar osteitis.

Antibiotics

Systemic antibiotics which are effective in prevention of alveolar osteitis are Penicillin's, Clindamycin, Erythromycin and Metronidazole. Development of resistant bacterial strains and hypersensitivity is possible on routine use of systemic antibiotics pre and/ or postoperative [9].

Local application of Tetracycline compared to other antibiotics show promising results in reducing incidence of Alveolar osteitis [18]. Use of Tetracycline has showed side effects along with foreign body reactions. The reported method of delivery included powder, aqueous suspension, gauze drain and Gel foam sponges [8].

Chlorhexidine

Chlorhexidine (CHX) is a bisdiguamide antiseptic with antimicrobial properties. The use of CHX as a mouthrinse and as a preoperative irrigant of the gingival crevice has been shown to significantly reduce the quantity of oral microbial populations. Several studies have reported that the pre or postoperative use of CHX mouthrinse significantly reduces the incidence of AO after the surgical removal of mandibular third molars. A 50% reduction in the incidence of AO was observed in patients who prerinsed for 30 seconds with a 0.12% CHX solution [13]. Use of 0.2% bioadhesive CHX gel reduced incidence of AO in percent similar to use of 0.2% CHX mouthwash. No adverse effects are observed [19]. CHX in rinse or gel form at doses of 0.12% or 0.2% with different administration regimens can be used for the prevention of AO. Using 0.12% of CHX rinse is also effective in prevention of Alveolar osteitis and which is a more economic [20]. Use of 0.12% Chlorhexidine rinse for two weeks post operatively reduced the incidence of Alveolar osteitis. Incidence of Alveolar osteitis in smokers is reduced who rinsed with Chlorhexidine [21]. Preoperative use of Chlorhexidine can reduce the incidence of Alveolar osteitis by approximately 40% [22].

Eugenol containing dressing

Eugenol acts as an obtundent. It was found that eugenol causes local irritation and delayed wound healing. Commercial dressing Alvogyl® is available which contains eugenol, which is to be replaced probably every two days [3]. Immediate use of medicated packing reduced the incidence of Alveolar osteitis in patients with impacted third molars. The medicated packing consists of Petroleum jelly, Balsam of Peru and Eugenol. The incidence of Alveolar osteitis was 8% in sockets which were immediately packed with medicated dressing and 26% in sockets which were not immediately packed [23].

Steroids

Topical corticosteroids have been reported in the prevention of Alveolar osteitis. Even though the corticosteroid has been reported

to decrease immediate post-operative complications, it failed to reduce the occurrence of Alveolar osteitis after extraction. The topical application of a Hydrocortisone and Oxytetracycline mixture however, has been shown to significantly decrease the incidence of AO after the removal of impacted mandibular third molars [13].

Antifibrinolytics

Tranexamic acids have been reported to be used to prevent incidence of Alveolar osteitis [8]. It is also observed that use of Tranexamic acid on mandibular third molar extractions did not show any significant reduction in incidence of Alveolar osteitis [24].

Anesthetics

It was found that Bupivacaine Hydrochloride reduced post-operative pain after extraction of mandibular third molars by irrigating the socket with Bupivacaine Hydrochloride, a local anesthetic [25]. Also, Articaine, a local anesthetic provides better post-operative anesthetic effect compared to Mepivacaine on removal of lower third molars [26].

Low Level Laser Therapy (LLLT)

On comparing the efficacy of Low Level Laser Therapy, SaliCept and Alvogyl in management of Alveolar osteitis it was found that Low Level Laser Therapy (LLLT) increases speed of wound healing and reduces inflammation compared to Alvogyl and SaliCept. LLLT is applied after irrigation of socket with continuous-mode diode laser irradiation (808 nm, 100 mW, 60 seconds, 7.64 J/cm²) [27].

Biodegradable polymers

Poly lactic acid, a biodegradable ester acts as a clot supporting agent by providing a stable support for blood clot [8]. Use of Poly lactic acid granules increased the incidence of Alveolar osteitis [28].

Topical haemostatics

Used to control hemorrhage and for wound protection. ActCel® is a topical hemostatic made from treated and sterilized cellulose. ActCel® enhances coagulation process and also acts as bacteriostatic [29].

Gloves

Use of clean gloves instead of sterile gloves by surgeons had no significant effect on post operative complications during wisdom tooth surgery and even there is no marked bacterial contamination in the operated sockets [30].

Oxidized Cellulose Foam (OCF)

A potent Haemostatic reduces the incidence of AO. The incidence of Alveolar osteitis in patients treated with Oxidized Cellulose Foam was found to be 5% which was found to be significantly lower than in patients who were not treated with OCF [31].

PATENTS AVAILABLE

Table 1: Shows list of patents available on novel techniques for treatment of AO

| No | Title | USPTO ID | Filing date | Abstract |
|----|--|--------------------|-------------|--|
| 1 | Techniques for prevention of AO [32]. | 5006071 | May 9,1988 | A moldable, absorbable dressing made of Plaster of Paris is placed into the socket. The dressing contains 5% of Tetracycline and 0.001% of Hydrocortisone absorbable Gelatin sponge is immersed in semi-liquid paste of Plaster of Paris and then compressed slightly and placed in cavity |
| 2 | Bioresorbable tooth extraction socket dressing [33]. | US 2005/0036955 A1 | Aug 13,2003 | A flowable, moldable, bioresorbable, non allergenic, biocompatible, crosslinked collagen derivative dressing is used for prevention of post extraction Alveolar osteitis in form of gel which gels at body temperature. Dressing is prepared by reacting collagen and a non-cytotoxic crosslinking agent and administered using a medical syringe. |
| 3 | Prevention and treatment of Alveolar osteitis [34]. | US 2008/0241795 A1 | Mar 26,2007 | Silver as an antimicrobial agent in form of nanoparticle, microparticle or biodegradable, bioadhesive polymeric carrier in a is released in a controlled and sustained manner in to the cavity to prevent AO. |
| 4 | Compositions and methods to prevent and treat dry | US 2011/0129801 | Nov 27,2009 | A medicated dressing of 1-3 Beta D-Glucan is designed to absorb the wound fluid and retain blood clot at the site, to encourage tissue regeneration and |

socket post operatively A1
after tooth extraction
surgery [35].

enhance wound healing along with a anesthetic to manage the pain associated with AO.

Future scope

From literature survey it is observed that there is no proper dosage form for treatment and prevention of AO. Thus developing dosage forms which would provide a sustained drug release, reduce bacterial infection, help in wound healing, act as haemostatic and provide a better patient compliance with an analgesic effect is required to treat AO. Current marketed formulations for treating AO are SaliCept® patch containing Acemannan hydrogel, Alvogyl® containing Eugenol, ActCel® a haemostatic, Chlorhexidine gel and rinse. Novel dosage forms can be developed for this commonly occurring oral condition since they will increase residence time combined with controlled drug release, local action, reduced dose and dosing frequency and patient compliance.

Conclusion

Dry socket is a commonly encountered postoperative condition in patients undergoing mandibular third molar surgery. The management of which mainly includes reduction of pain until socket is healed, prevent bacterial growth and control bleeding. Treatment options for dry socket are limited but use of antibiotics, Eugenol dressings, analgesics, irrigation of socket are few of the methods to reduce the incidence of dry socket. Despite of several years of research and extensive literature there is no significant progress to address this condition, the etiology of Alveolar osteitis is not fully known. Further research and investigations are required to be carried out to draw firm conclusions and provide a better way in management of this condition by using novel dosage forms.

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