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REVIEW ARTICLE

TRUE PAIN OF FALSE HEALING -VARIOUS TREATMENT MODALITIES (A RESEARCH PERSPECTIVE)

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ABSTRACT

In routine extraction procedures dry socket remains the most common complication with diverse etiology. This research article addresses various treatment options from preclinical and clinical point of view for dry socket (Alveolar Osteitis or AO) management with an aim to guide the dental health care professional for patient preparation and management of this painful condition. It is a common condition arising after an extraction of mandibular molars along with postoperative pain in and around the extraction site, accompanied by a partially or complete loss of blood clot leaving the exposed alveolar socket with or without halitosis. The treatment modes include conventional methods like use of medicated gauze, herbs, antibiotics, gel, irrigation. In other words it can be treated by copious use of irrigation, eugenol dressings, analgesics, antibiotics and maintenance of oral hygiene. One of the most important factor to consider is whether the patient have followed post extraction instructions or not?

Keywords: Extraction, Dry socket, Pain, Treatment, Wound healing, Preclinical research.

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INTRODUCTION

In oral surgery and dentistry most common routine procedure is exodontia. Dry socket also known as 'Alveolar osteitis' most commonly occurs after extraction of a tooth. Dry means "as the tooth socket appears dry". In other words it is a post-operative complication that interferes with the normal healing process of the extraction wound. Pain of dry socket becomes severe at any time between the 24 and 78 hours post extraction, accompanied by a partial or entire loss of blood clot exposing the alveolar socket to food and saliva with or without halitosis [1,2]. Patient may not experience such pain due to any other reasons before extraction as he/she has to suffer after extraction.

Normally after a tooth is extracted, a blood clot covers and protects the underlying jawbone forming the first step in healing. If the blood clot is lost or in other words it does not form, then bone is exposed and healing is delayed. This exposed bone of a dry socket is very sensitive and the patient may complain of moderate-to severe pain radiating in the region of affected side of jaw which could last for a longer duration of ten to forty days along with bad taste or bad odour from mouth [3]. Figure.1 depicts the etio-pathogenesis of dry socket.

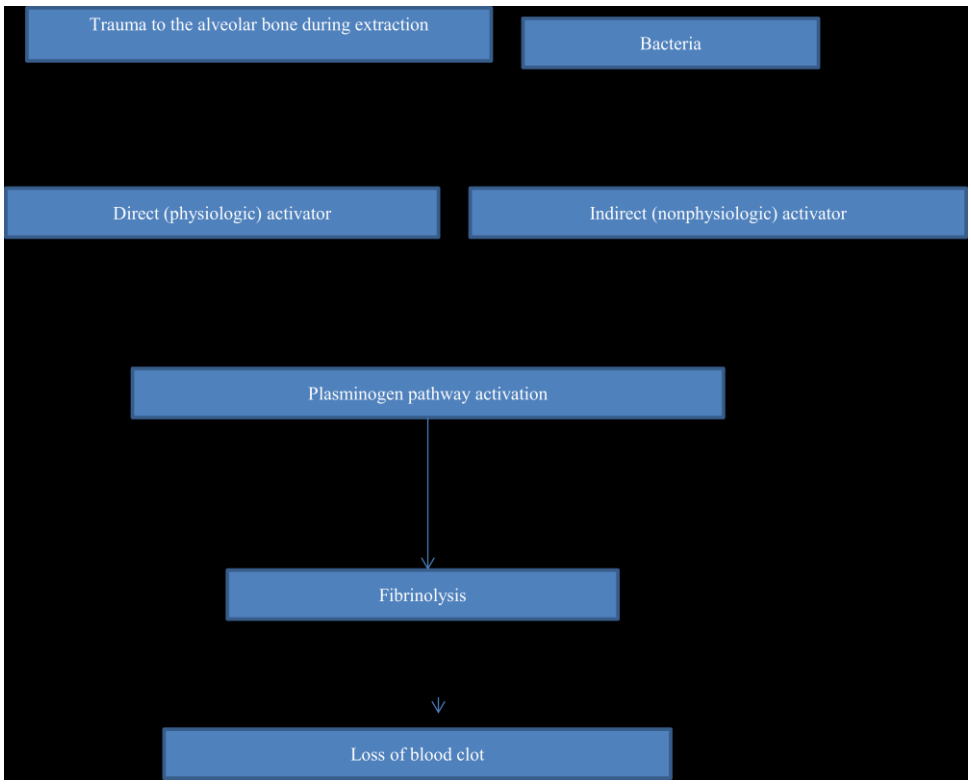

Fig .1 Etio-pathogenesis of dry socket

The aim of this paper is to evaluate the different treatment methods used in the management of dry socket. What new research in animals and humans has been

done for dry socket treatment? Which medical treatment over conventional one of irrigation with saline and dressing provides a faster remission of the intensity and duration of pain? and secondarily, which treatment promotes alveolar mucosa healing more effectively?

Preventive measures for dry socket

A dry socket may be prevented by providing an aseptic environment, atraumatic instrumentation, adequate irrigation during the use of rotary instruments, scheduling extractions in females when estrogen levels are low or inactive i.e. during the last week of menstrual cycle (days 23 through 28). Patient's pain should be relieved and quality of life should be improved thus minimizing the cost of treatment [5]. Keeping in mind of the risk factors can help in prevention. Table 1 presents risk factors associated with condition

. **Table1. Risk factors associated with dry socket**

S no.	Risk factor	Statement	Etiology	R
1.	Site of Extraction	Alveolar ostetis more commonly occur in the mandible than in the maxilla, lower wisdom teeth, where the incidence may be significantly more than 3%.	This is due to the relatively poor circulation of the mandible and higher tendency of food debris to accumulate in lower jaw sockets	3
2.	Location of sockets	Posterior socket (molars) than anterior sockets (incisors and premolars)	As the size of the produced surgical cavity is relatively larger.	3
3.	Infection	Alveolar osteitis is more likely to occur where there is a pre-existing infection in the oral cavity like acute necrotizing ulcerative gingivitis or chronic periodontitis	The oral flora in such persons illustrate haemolytic conditions which may predispose to dry sockets development.	3
4.	Smoking	There is greater risk of dry socket associated with the smoking and	This is due to the vasoconstrictive action of nicotine on tiny blood	3

		use of tobacco.	vessels	
5.	Surgical trauma	Traumatic tooth extraction	Excessive extraction force burnishes the socket bony walls and crushes blood vessels thus resulting in release of direct tissue activators which interfere with healing.	3
6.	Use of oral contraceptive	The elevated levels of progesterone and estrogens present in oral contraceptives	Oral contraceptives can cause dilation of the blood vessels, inflammation and delay healing of the gums and lower a woman's pain tolerance level, making more vulnerable to pain in this condition	3
7	Radiotherapy	exposed bones of the jaws present with several changes to the tissue	This is due to the decreases blood supply	3
8	Insufficient experience	during surgical extraction of mandibular third molars.	bigger trauma could be related to lack of skills and surgeon's inexperience.	4
9	Surgical trauma and difficult extraction	Surgical extractions, in comparison to nonsurgical extractions	due to more liberation of direct tissue activators secondary to bone marrow inflammation	4
10	Systemic disease	diabetic or immunocompromised patients	due to distorted healing pattern	4

Various treatment modalities for dry socket

Aloe vera- Aloe vera was found to be very effective as a traditional wound healing medicine. When it was applied on extraction site it cured wound properly thus preventing dry socket formation due to its powerful healing properties. Various components such as Polysaccharides found in the gel of the

leaves promote healing of the wound [6,7,8] ,glucomannnan and giberrelins accelerate wound healing along with prevention of infection [6]. Mechanism of action of Aloe vera pertains to presence of growth factors responsible for binding to the fibroblast IGF receptor in the wound site producing proteoglycans and collagen resulting in increased tensile strength of the wound [9]. SaliCept Patch (The SaliCept Patch is a freeze-dried pledget which contains acemannan hydrogel obtained from the clear inner gel of Aloe vera leaf results in bone regeneration, it acts by stimulation of Bone Marrow Stromal Cells (BMSCs) proliferation followed by differentiation into osteoblasts and finally bone regeneration [9].

Cloves (Syzygium Aromaticum) - Essential oil extracted from cloves contain eugenol which is used as dry socket dressing due to its versatile properties such as antiseptic, antimicrobial, antiviral and antifungal [10].

Propolis - Propolis is another compound mixture which is prepared from combination of bee released and plant-derived compounds. It possess a large variety of activities such as antifungal, antibacterial, anesthetic etc. It has been used in dentistry for dry socket along with several other uses mentioned here [11].

Zinc oxide-based dressings - These dressings serve to provide a physical barrier against the entry of food or other materials in extraction socket. Zinc oxide can be used either in the form of a paste or cement to cover the extraction sockets or gingival tissues. These dressings may be divided into eugenol based and non-eugenol based materials. Eugenol has anaesthetic properties and its use is indicated in the presence of inflammation to diminish postoperative pain.

Alvogyl – Alvogyl is a proprietary material with its active ingredients such as eugenol (essential oil derived from numerous plants, including cloves), iodoform (an iodine-based antimicrobial agent) and butamben (an ester local anaesthetic) used for the treatment of alveolar osteitis primarily. Several other materials are mixed with these active ingredients to form a paste-like consistency. Alvogyl is placed into a painful extraction socket to eliminate the pain and infection.

Bismuth iodoform paraffin paste (BIPP) – It is a combination of bismuth and iodoform mixed with paraffin, which when applied to open wounds allows outstanding healing with reduced incidence of infection. At present, BIPP is used as a wound packing and dressing material in case of risk of dry socket [12] (Table 2).

Table 2-Various treatment modalities along active ingredients beneficial in dry socket

Substance	Active ingredients	Mode of action

Aloe vera	Polysaccharides, glucomannnan and giberrelins	binding to the fibroblast IGF receptor in the wound site producing proteoglycans and collagen resulting in increased tensile strength of the wound
SaliCept Patch	Acemannan hydrogel	stimulation of Bone Marrow Stromal Cells (BMSCs) proliferation followed by differentiation into osteoblasts and finally bone regeneration
Cloves	Eugenol	antiseptic, antimicrobial, antiviral and antifungal properties
Propolis	combination of bee released and plant-derived compounds	antifungal, antibacterial, anesthetic properties
Zinc oxide-based dressings	Zinc oxide, Eugenol	anaesthetic properties
Alvogyl	Eugenol, Butamben, Iodoform	antimicrobial agent, local anaesthetic
Bismuth Iodoform paraffin paste	Bismuth and iodoform paraffin	wound healing

Other topical modes of treatment include placement of lidocaine gel, irrigation of extraction socket with physiologic saline, irrigation of the socket by 0.12-0.2% chlorhexidine rinse and instructing in home irrigation with syringe. The use of both antibiotics such as topical tetracycline powder and systemically penicillins, clindamycin and metronidazole has been found to reduce the incidence of dry socket. Incidence of AO after impacted mandibular third molar removal has been significantly decreased after topical application of a Hydrocortisone and Oxytetracycline mixture.

Low Level Laser Therapy (LLLT) increases speed of wound healing as compared to alvogyl. LLLT is applied after irrigation of socket with continuous-mode diode laser irradiation (808 nm, 100 mW, 60 seconds, 7.64 J/cm2) [13]. Post-operative pain after extraction of mandibular third molars was found to be reduced by irrigating the socket with Bupivacaine Hydrochloride (a local anesthetic). ActCel® is a topical hemostatic made from cellulose which is first treated and then sterilized it acts as bacteriostatic agent enhancing coagulation process [13]. Polyactic acid- a biodegradable ester provides a firm hold for blood clot thus acting as a clot supporting agent [14].

Various herbs used in dry socket remedy are-

Turmeric –This herb soothes the dry socket by its anti-inflammatory properties. Turmeric helps in reducing the severe pain of dry socket when applied along with salt. It reduces discomfort, kills contaminating bacteria and cures the dry socket. For speedy recovery 400 to 600 mg of the extracts or powder out of Turmeric can be used in combination with clove oil.

Witch Hazel - A herb also known as witch hazel indicated in inflammatory conditions is used on the skin directly to reduce pain of any kind. The leaves of the herb are said to be very effective for reducing pain, swelling and contamination resulting from the dry socket. The oil of the plant is utilized for the treatment of dry socket by application on the affected area gently for three days until the inflammation resolves.

Boswellia – It is traditionally used for the treatment of various inflammatory conditions such as asthma, osteoarthritis, inflammation and arthritis. Boswellic acid along with resins present in the herb helps in reducing the pain and swelling and has an analgesic effect on the dry socket. Approximately 300 to 400 mg of the herb 3 times a day regularly for a few weeks is recommended for relief [15].

Honey- Honey (the common foodstuff) has several medicinal properties. In current ten years the medical community has begun to find its potential in the treatment of wounds again. A momentous reduction in inflammation, hyperemia, edema and exudation with creation of a soothing effect and a decline in the subject's pain and discomfort level has been observed with use of honey [16]. The dressing of sterile gauze soaked with honey, removed and replaced every day until the pain and discomfort is relieved has been observed to be effective. Honey has been found to discontinue bacterial growth due to its antibacterial potency especially if diluted because of its hygroscopic properties, its acidic pH and hydrogen peroxide generated enzymatically [17]. This hydrogen peroxide generated

enzymatically in the honey acts both as a preservative and antibacterial. Honey has also found to possess inhibitory action against bacteria including gram-positive and gram - negative microorganisms, anaerobes and aerobes [18].

Since far several preclinical and clinical studies has been conducted to rule out various treatment modalities for tooth extraction socket healing. A few of them are listed below-

Parathyroid hormone (PTH) therapy

In a preclinical research carried out to assess the effect of parathyroid hormone (PTH) therapy on tooth extraction socket it was found that intra-oral injection of PTH promotes healing in rats. In 1st study PTH was injected subcutaneously after mandibulat molar extraction intermittently for 7, 14 and 28 days and in 2nd study PTH was injected either intra-oraly or subcutaneously after maxillary second molar extraction. Healing was assessed by the method of micro-computed tomography and histomorphometric analyses. The findings suggest that PTH promoted tooth extraction healing by mechanism of suppressing ridge resorption, enhancing bone fill and promoting collagen apposition in soft tissue. Both approaches i.e. intra-oral PTH and subcutaneous injection were found promoting tooth extraction socket healing effectively [19].

Streptozotocin-induced diabetic irradiation

In streptozotocin-induced diabetic rats the histologic pattern of healing in molar tooth extraction sockets was observed following irradiation. Early healing process of the extraction socket among the diabetic and diabetic-irradiated groups was observed similar to the control group, but bone formation was delayed at 7 days after the treatment. Signs of necrosis were observed in alveolar bone surrounding the extraction socket after three days followed by hemorrhage in connective tissue within the socket at 14 days after treatment in the diabetic-irradiated group. This study indicated severe delay in the healing process of the extraction socket by irradiation in the diabetic state [20].

Spirulina and chitosan

Spirulina and chitosan are natural substances that can help tissue healing and possess the ability to help bone remodelling. To gain retention and stabilility for succesful prosthodontic treatment prominent residual ridge is essential which was found possible with combination of 12% gel of spirulina and 200 mg chitosan after tooth extraction in one study carried on Cavia cobaya. Findings showed faster wound healing evidenced by counting the amount of osteoclast, osteoblast

and colagen as an indicator since the combination was able to accumulate collagen fiber [21].

Xenograft

In this study the effect of xenograft placement on hard tissue modeling and remodeling of extraction sockets was studied in dogs. The presence of Bio-Oss Collagen allowed modeling and remodeling processes in the socket walls following tooth extraction. It was found to promote de novo hard tissue formation in the cortical region of the extraction site maintaining the hard tissue dimensions as well as preserving the ridge profile. Thus bone modeling may be endorsed by biomaterial placement in an extraction socket compensating at least for contraction of marginal ridge for the time being [22].

Freeze dried 90% Aloe vera

Density of collageneous fiber in extraction socket can be modulated by Freeze dried 90% Aloe vera as observed in incicivus tooth wound of Cavia cobaya. There was observed a significant difference in the number of collageneous fiber in control group and tested group due to aloe vera content. Aloe vera stimulates the growth of new fibroblast cell and accelerates wound healing due its components like glucomannan, gibberellins. Antimicrobial and anti septic properties of Aloe vera play a role in preventing infection helping locally in wound healing process. Aloe vera was peeled up and washed until it was free from yellow toxic resin and then freeze dried for use in study [23].

Leukocyte- and platelet-rich fibrin (L-PRF)

The effect of platelet-rich fibrin (L-PRF) and leukocyte on the pain and soft tissue healing following tooth extractions was studied. The use of L-PRF in post-extraction socket filling reduces the early adverse effects of the inflammation among human subjects. L-PRF could also help in preventing the surgical site infections such as post extraction alveolitis due to its immunological properties which are because of the presence of leukocytes with a consequent reduction of the inflammation symptoms [24].

β2-adrenergic receptor antagonists

As found in a study β2 adrenergic receptor antagonists could increase the count of osteoblast and decrease the count of osteoclast during extraction socket healing. The effect of β2-adrenergic receptor antagonists on count of osteoclasts and osteoblasts concerned with maxillary molar extraction socket healing was studied in rats. Propranolol was injected intraperitoneally in test animals. Maxillary bone was resected and the mean number of osteoclasts and osteoblasts in tooth socket was measured. After 7 days, the count of of osteoclasts in the controls was observed significantly higher than the test group. Osteoblasts were

increased equal to the controls but reached its highest at 21 day and proved a significant increase in comparison to the controls ($p< 0.05$).Results showed that β2 adrenergic receptor antagonists increase the count of osteoblasts and decrease the count of osteoclasts during healing of extraction socket [25].

Moringa oleifera

Role played by alveolar bone is very significant in providing support to dentures and teeth. Loss of this support due to alveolar resorption will cause aesthetic as well as functional problems. So preservation of extraction socket using bone graft is crucial for the maintainence of the alveolar bone dimension. Moringa oleifera leaf can augment the bone graft activity in new bone formation. In this experiment the effect of combined demineralized freeze-dried bovine bone xenograft (DFDBBX) and Moringa oleivera leaf extract was assessed. There was found decreased osteoclasts cocentration and increased count of osteoblasts in the tooth extraction socket sockets of cavia cobay [26].

Mangosteen peel extract

Mangosteen peel extract with demineralized freezed-dried bovine bone xenograft (DFDBBX) was used in socket preservation procedure to maintain alveolar bone. A combination of demineralized freezed-dried bovine bone xenograft (DFDBBX) with mangosteen peel extract in tooth extraction socket resulted in speeding up alveolar bone configuration with the formation of osteoblasts and osteoclasts in Cavia cobayas. Mangosteen peel extract was found to be most effective material combined with DFDBBX 2% can increase osteoblast and decrease osteoclast count in the socket of tooth extraction in Cavia cobaya [27].

Platelet-rich plasma

The quality of the residual bone after tooth extraction has a direct impact on treatment outcome of the implant. Bone repair progression was assessed in extraction socket area filled with platelet-rich plasma among male Cebus apella monkeys by histological and histometrical analysis done in 1, 3, 4 and 6 months intervals. After treatment with PRP it was found that treated socket was filled with large trabeculae of bone. Thus bone repair was observed to be enhanced by the use of platelet- rich plasma in alveolar sockets [28].

Soybean extract

Soybean extract was found to increase and promote bone healing processes after trauma and surgery. Phytoestrogen, a non-steroidal compound present in soybean extract which is also found in plants have estrogen-like activity and binds to estrogen receptors. Count of osteoblast cells in alveolar bone after tooth extraction was found increased

with soybean extract feeding. It was concluded that soybean extract feeding can increase the number of osteoblast cells when given for seven days before tooth extraction in comparison to when given after tooth extraction [29].

CONCLUSION

In spite of extensive research being carried, etiology of dry socket is not exactly known. The risk factors and preventive factors for this unbearable painful condition are clearly recognized i.e. age, sex, any systemic disorder, extraction site, amount of anesthesia, skills of operator as well as experience, prior use of antibiotics, history of smoking, surgical trauma. All this information should be documented in the informed consent. Proper medical and dental history of patient should be taken before extraction. Incidence of prior dental extraction associated with dry sockets should be reported. A large number of treatment modalities for dry socket are observed in preclinical and clinical studies as described in the present paper

Patient should be reassured about the problem and quality of life should be improved. Several intra-alveolar medicaments are suggested in the literature and are available in the market with some negative reactions reported so far. If such adverse reactions do occur, the literature is not able to provide enough support for the treating dental practitioner. The prescription for the management of this condition should begin with patient education material. Further investigations and well-designed studies are necessary to draw firm conclusions and to clarify this complication.

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