Alveolar Osteitis
A General Dentist's Overview

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Introduction

"I'd rather go through labour pains again than experience the pain and anguish I'm having from this 'dry socket'.

This quote is from a female patient that I recently treated for a 'dry socket' at my dental practice.

The most common complication in the healing of human extraction wounds is that condition known as a 'dry socket', alveolar osteitis, alveolitis sicca dolorosa or fibrinolytic alveolus. The dry socket is basically a focal osteomyelitis in which the blood clot has disintegrated or been lost, with the production of a foul odour and mild to severe pain, but no suppuration. The condition derives its name from the fact that after the clot is lost, the socket has a dry appearance because of the exposed bone.

The average incidence appears to be 3% of all extractions and may be as high as 22% of third molar extractions under local analgesia, but these figures may vary with the skill of the surgeon/dentist and prophylactic measures used. There may be a slightly greater incidence in females than males and the peak age range is 20-40 years. Few cases are seen in children and the elderly. Mandibular teeth appear to be three times more prone than maxillary teeth.

The aetiological and predisposing factors for alveolar osteitis are obscure. Numerous articles published over several decades support an interdependent combination of factors that contribute to the prevalence of alveolar osteitis. However, the evidence, although compelling, is far from complete. These aetiological and predisposing factors will be discussed later.

One must bear in mind that the treatment and management of a 'dry socket' can never be taught or learnt by means of fixed rules, recipes or patterns. There are simply too many varying treatment modalities presented by very well respected authors. All signs,

symptoms and special test information must be considered in the light of basic science knowledge and then analysed logically at the level where the disease is located.

Aetiology and Predisposing Causes

Many studies have been documented on the alleged contributing factors of alveolar osteitis. Its is impossible to review all of the available literature, but it is essential for the clinician to have a familiarity with which factors appear to play the most dominant role in the cause of alveolar osteitis.

It seems to be not so well understood whether the cause of the alveolar osteitis is local, systemic and whether it is vascular or infective.

Several possible reasons for the loss of the clot from the socket are advanced. A popular concept is that the clot is washed out of the socket by the patient. This idea is not tenable since within a short time of the extraction, the clot adheres quite firmly to the socket wall. Patients are usually advised not to rinse out the mouth during the first 24 hours after the extraction, not because of the risk of dislodging the entire clot from the socket, but because they might start the socket bleeding again. If the clot were to be forcibly removed from the socket at this time, the result would be further haemorrhage, not an empty socket.

Infection and fibrinolysis of the clot is another common suggestion. A variety of organisms can be cultured from dry sockets including fusiform bacilli, spirochetes, diplococci and streptococci. Support for the infective cause of the clot destruction comes from the degree to which antibiotic prophylaxis and careful pre-operative toilet of the tooth and oral cavity can reduce its incidence. For instance 200mg metronidazole, 8 hourly for 3 days can produce a significant protection against a dry socket, suggesting that anaerobes may play an important role.

However, infection may not be the only cause of clot lysis because alveolar osteitis may occur irrespective of the care and skill of the operator or of the trouble taken to prevent infection of the extraction wound.

Jensen[1], in his research labelled the role of the bacteria as the cause of alveolar osteitis as unclear. Treiger and Schlagel[2] expressed the belief that anaerobic bacteria are involved, but offered only indirect evidence. Regarding pre-existing infections such as pericoronitis, there seems to be a recurrent theme of confusion in the literature. Several authors have proposed a positive relationship between pre-existing infections and an increased risk for alveolar osteitis, whereas other authors believe infection is only a minor factor that interacts with other factors.

It has been suggested that extraction trauma as well as subsequent infection of the socket activates plasminogen to plasmin, which causes lysis of the fibrin clot. Investigations have demonstrated the presence of both tissue activation and plasmin in the alveolar bone adjacent to the affective connective tissue type of marrow characteristic of the jaws in the age group 20-40. However, an inhibitor of fibrinolysis, tranexamic acid, failed to prevent the occurrence of alveolar osteitis. This was considered to be due to inadequate local concentration of the drug in the alveolar bone. Many authors believe surgical difficulty and surgeon experience are at least contributing factors or play varying roles in the incidence of alveolar osteitis.

The incidence of alveolar osteitis after extractions for which a local anaesthetic with a vasoconstrictor has been used appears to be greater than after a general anaesthetic, although not all investigators have found this to be so. In theory, vasoconstrictors may temporarily inhibit the vascular component of the inflammatory reaction and tend to favour the establishment of a local infection. Similarly, when excessive vasoconstriction is used, the socket may open to contamination by saliva for some time before bleeding occurs. However, the article by Fridrich and Olson[3] is unanimous in that vasoconstriction plays no role in the development of alveolar osteitis, but in the case of saliva there are varying opinions whether saliva plays a role.

Excess trauma during a forceps extraction is associated with an increased tendency to 'dry socket'. This may result from the crushing and devitalisation of the socket wall and thrombosis of the underlying vascular plexus. Such trauma would also increase the release locally of plasminogen activators.

Similarly, conditions with sclerotic and relatively avascular bone are also prone to socket infection. In some, otherwise normal jaws, a socket may be related to a localised mass of sclerosed bone. Sclerotic masses may involve much of the alveolar process in Paget's Disease and the entire jaw may exhibit increased density in osteoporosis and some other rare skeletal disease. In Paget's Disease hypercementosis of the teeth further increases the difficulty of extractions and the resultant crushing of the adjacent bone. Incidentally, it is only the sclerotic masses in Paget's Disease, which are less vascular than normal. The rest of the abnormal bone is markedly more vascular.

In jaws, which have received a therapeutic dose of irradiation, the blood supply is reduced to obliterative endarteritis. Furthermore, where there are additional local or systemic factors the possibility of extension to an osteomyelitis is a possible complication. Pre-existing infection in the form of acute or chronic periapical and periodontal disease seems to be of little importance, but the extraction of teeth during an acute ulcerative gingivitis is an invitation to trouble.

Other factors that might predispose to a 'dry socket' are those that influence vascular function, such as the oral contraceptive pill and smoking. Most authors have indicated that patients who smoke have 2-5 times the risk of non-smoking patients for developing alveolar osteitis. The combination of cigarette smoking and oral contraceptive use could theoretically result in up to a 10-fold increase in the risk of developing alveolar osteitis, and susceptible patients should be pre-surgically cancelled accordingly.

A study recently published in General Dentistry, The Clinical Journal of the Academy of General Dentistry, reports that women who take oral contraceptives experienced a 31

percent incidence of 'dry sockets' after molar extractions performed in the first 22 days of their menstrual cycle. Within two or three days after oestrogen use was discontinued, the extraction site tissue began the healing process. For women whose molar extractions were performed on days 23 through 28 of their cycle, no incidence of 'dry socket' occurred.

"Unless there is an emergency, women using birth control should try to schedule their extractions during the last week of their cycle, when oestrogen levels are inactive", recommends Dr Rich, DDS, FAGD, a spokesperson for the Academy of General Dentistry, "The healing process can then begin immediately."

Patho-physiology

The efficient delivery of care in the dento-alveolar area not only involves accurate diagnosis, effective anaesthesia and skilful surgical technique, but also the sequence of normal biologic events that result in a healed extraction site without untoward sequalae.

After tooth extraction, an orderly sequence of events causes normal tissue healing. The alveolar socket fills with blood that undergoes coagulation and contraction. Angioblastic growth into the clot occurs, while epithelium covers the clot. Fibroplasia into the clot then ensues, with cellular elimination of fibrin and blood debris. A various amount of osteoid is then produced by induced mesenchymal cells. Woven bone is formed, followed by osteoblastic and osteoclastic activity that ends in mature bone, often with some loss of total bone volume.

This sequence of normal healing does not always occur. For instance, in alveolar osteitis one must be careful to distinguish true alveolar osteitis, in which premature loss of a formed extraction socket blood clot occurs, from conditions in which pre-existing alveolar bone hypovascularity prevents initial formation of a blood clot, such as osteoprosis, dysplasia and radiation-induced osseous hypovascularity.

Many researchers have examined the process by which alveolar osteitis develops and have tried to identify the precise mechanism, but it was Birn's[4-6] classic series of articles between 1963-1977 that provided a better understanding of the patho-physiology. According to Birn[4-6], the trauma of surgery or existing inflammation causes the alveolar bone or adjacent tissues to release stable tissue activators, which convert plasminogen in the blood clot to plasmin, a fibrinolytic agent. This dissolves the blood clot, releasing kinins from kininogens, which cause pain. According to Birn, this generally occurs as early as the second day after surgery, and rarely before, because a blood clot contains anti-plasmin, which must be consumed before clot dissolution can take place. Within the framework of the fibrinolytic theory of alveolar osteitis, clot lysis and loss may be viewed as multifactorial in origin. According to Patrick J. Vezeau[16], probable contributing mechanisms may include:

1. Plasminogen-mediated fibrinolysis caused by physiologic tissue-type plasminogen activators liberated locally by surgical trauma to local tissues.
2. Plasminogen-mediated fibrinolysis by nonphysiologic activators elaborated by oral bacteria present in or introduced into the extraction wound.
3. Nonplasminogen-mediated fibrinolysis mediated by other mechanisms, such as bacterial-liberated substances.
4. Leukocyte-mediated fibronlysis (plasminogen-mediated and plasminogen-independent) occurring as a result of the acute local inflammatory response to surgical trauma or local bacterial challenge.

As previously noted when one reviews the literature, one can see that within the conflicting 'world' of the cause of alveolar osteitis, there is just no simplistic answer. The initiation of the fibrinolytic process appears to be related to an interfacing of multiple, interdependent factors. Therefore as we will see later on, controlling any single factor attacks only part of the problem.

Let us look at a case study:

A healthy 26 year-old female patient presents at your surgery with a clinical diagnosis of a 'dry socket'. Let us discuss the treatment and management of such a case.

Patient History and Clinical Examination

Before any treatment has been done or any treatment and management options have been discussed, taking a history is imperative.

In my practice, before a patient is seen, the patient is required to complete a form that covers any relevant medical history and previous dental history.

When consulting with the patient, listen to what the patient tells you about the problem. When did the pain start? The pain[20] of a 'dry socket' characteristically occurs 2-4 days after a tooth has been extracted since this is the time required for the blood clot to break down. The patient reports some time after this, so pain is described as lasting for hours or days. It is usually moderate to severe, constant, diffuse pain, occurring of its own accord, without the application of external stimuli. The pain is normally well localised to the socket, but may radiate to the ear, or other parts of the face. In some cases the pain is exceptionally severe. This is attributed to the release of kinins as a result of the action of plasmin activators on kininogen present in the alveolar process.

Steven Morrow, DDS, Oakland, California, reminds us to maintain complete records. In a court of law, there is no substitute for accurate records.

After listening to the patient and having recorded down all relevant information, I then proceed to an extra-oral and intra-oral examination, keeping in mind that there is a patient behind the 'dry socket'.

Patients are very sensitive to oral stimulation, so one should use a gentle touch. Placing a hand on their shoulder for example, works wonders. A gentle touch says, "I have to do this to help you, but I care about you"

After one has donned his gloves, he can no longer place a kind hand on the patient's non-sterile shoulder. Face masks, eye protection, gowns and gloves tend to depersonalise the dentist/patient relationship, so one should take a moment to establish the "I care" feeling before donning ones infection barriers.

Firstly a thorough extra-oral examination should take place. One should look at the symmetry of the face and the ability to open and close the mouth. Feel for swollen glands and lymph nodes. The regional lymph nodes may be tender and can be enlarged. There is rarely a pyrexia associated with a 'dry socket'. The intra-oral examination then follows. In the mouth, examine the soft tissue, the palate and the teeth, even if they are not a source of complaint.

Clinically[18], the gingival margin of the socket is usually swollen and dusky red. The socket is either devoid of clot, or contains a brown, friable, sometimes-foamy clot, which is easily washed out. Food debris may have accumulated in the socket, which, with the disintegrating clot, produces a foul taste and smell. If this material is washed away, the bone of the socket wall is seen to be bare and it may be extremely sensitive if touched. If the gingival margin about the socket has already contracted, it can be difficult to examine the socket and appreciate that it does not contain a normal clot.

Radiographs will show the outlines of the socket and should be taken to confirm the absence of a retained root, foreign body or a loose fractured fragment of the septal or alveolar bone. Usually, radiographically there is no abnormality. The appearance and time since extraction make the diagnosis easy in most cases. However, sometimes the condition is less acute and the socket is partly healed. A partly healed, partly covered dry socket can continue untreated for months causing pain occasionally which lasts for

several hours as a dull ache. Sometimes no socket is obvious but a closed 'dry socket' may be postulated and after the area is surgically opened the pain ceases.

Treatment and Management of a 'Dry Socket'

Because the patient may be suffering with severe pain, sympathetic and prompt treatment is required. All disintegrating clot and food debris should be irrigated away with warm saline and a suitable dressing should be inserted into the socket.

Usually the area of the 'dry socket' is very sensitive to touch. Before one cleans and packs the socket, one can administer a local anaesthetic, infiltrating buccally and palatally or lingually. One should always be gentle and administer the anaesthetic solution very slowly after having applied a topical anaesthetic. One should avoid giving local anaesthesia with a vasoconstrictor or one can consider a nerve block prior to treatment.

The big question in the treatment of a 'dry socket' is what medicaments does one place in the extraction site and what type of dressing is used to obtain fast, optimal healing that is pain free.

Every clinician has his or her favourite treatment, despite the lack of any credible evidence that any one of them has a therapeutic advantage over another.

Topical application of medicaments applied to a 'dry socket' achieve a greater local concentration than can normally be expected from systemic administration and help to minimize possible side effects and sensitisation than may accompany systemic administration.

Various literature has been reviewed regarding the efficacy of intra-alveolar antibiotic and antifibrinolytic therapy as a post-extraction step to prevention.

Antimicrobials applied both systemically and topically generally have been shown to decrease incidence of alveolar osteitis. Every imaginable antibiotic, individually or in a combination, in a varying formulation and dosages and applied via numerous carriers, has been used through the years in an attempt to prevent alveolar osteitis. Generally, the drug of first choice[7] has been penicillin G and V, which act against streptococci, treponemes, most oral bacteriodes, neisseria and most gonococci. Systemically administered penicillin V has been shown to statistically reduce alveolar osteitis after third molar removal. The topical use of penicillin in extraction sites, initially reported, has not been a subject in the literature for several decades.

In the 1970's and early 1980's, sulphur cones were in vogue, but were eventually removed from the market because of concerns over allergenicity and questionable efficacy. They were also found to retard healing[8].

Although antibiotics appear to decrease the incidence of alveolar osteitis, a review of the efficacy of the intra-alveolar antibiotics derived from numerous published studies from 1955-1999, suggest the benefits are insufficient to warrant the risks of antibiotic use.

Antifibrinolytic agents have changed the treatment of mild to moderate bleeding diatheses in oral surgery patients.[9,10] Investigations into the fibrinolytic nature of alveolar osteitis indicated that the topical use of para-hydrobenzoic acid (PHBA) in extraction wounds significantly decreased the incidence of mandibular third molar alveolar osteitis in a dose dependant fashion.[11-13] However, the antibacterial nature of PHBA may have contributed to these findings.

In contrast to the previously mentioned hydrocarbon compound, aprotinin is a bovine-derived polypeptide that is an inhibitor of the plasminogen activator plasmin and of killikrein, thus potentially decreasing fibrinloysis and bradykinin formation.[14,15]

The mixed results[16] with antifibrinolytic topical medicaments in preventing extraction site healing delay is surprising, considering that fibrinolysis is the most accepted cause of alveolar osteitis. These results may be attributed to the fact that either,

1. Local factors such as tissue activators or bacterial activators causing plasminogen activation may be overwhelming, even in the presence of topical antifibrinolytics, or
2. Nonplasminogen fibrinolysis such as leukocyte mediated or direct bacterial fibrinolysis, may be the predominant factor in alveolar osteitis.

The topical use of aspirin in the extraction socket is highly questionable[17] because it is known to cause chemical burns to tissues, induce allergic reactions and increase the inflammatory reaction during healing.

There are many dressing formulations marketed for the treatment of alveolar osteitis.

The purpose of a dressing is[18]:

1. To protect the bone from irritation by food debris accumulating in the socket.
2. It should provide pain relief so that the use of narcotic medication is not necessary.
3. Inhibit the growth of bacteria and fungi.
4. Suppress the bad odour often emanating from the empty alveolus.
5. Finally, the dressing should dissolve slowly or extrude as healing progresses, so that is neither incorporated in the granulation tissue nor prevent it filling the socket.

Probably, the oldest and most widely used method of treatment for a 'dry socket' is simply palliative medication and permitting nature to heal the wound.

Many European and Scandinavian authors have promoted the use of zinc oxide and eugenol paste to treat and prevent alveolar osteitis.

The use of zinc oxide and eugenol dates back to the 1960's, when Mainous[19] reported a foreign body reaction 8 weeks after the intra-alveolar packing of an extraction site with zinc oxide and eugenol paste. He cautioned against assuming that this paste is a completely innocuous material and advised that it should not be left in surgical sites for lengthy periods.

Eugenol is a phenolic compound that denatures cellular proteins, fixes the cytoplasm of surface epithelium, induces a significant inflammatory response, is neurotoxic and is able to cause interruption of neural transmission.[21-23] 'Dry sockets' which have persisted for weeks, lined with yellow-brown bone and which show no signs of healing have usually been dressed with a eugenol containing dressing. Several authors have examined the role of intra-oral bandages placed in over the socket as a means of protecting the site and reducing the incidence of alveolar osteitis. Unfortunately there is no substantial evidence of benefit.

Hellem and Nordenram[24] studied the use of a gauze sponge saturated with Whiteheads varnish (a combination of iodoform, balsam tolutan and slyrax liquid in a base liquid), which was sutured over the site. Although the authors believed the dressing reduced the pain, swelling and trismus, the incidence of diagnosed alveolar osteitis was not addressed and they clouded the results by using antibiotics systemically.

The use of inert hydrophilic dextrin polymer beads, Dextranomer (Pharmicia (GB) Ltd.), appears both to relieve pain and encourage rapid healing, but the socket has to be dressed daily with the fine beads alone or in glycerine and then sealed with orabase gel. The preparation probably absorbs exudates and toxins, relieving pain and inflammation and does not interfere with healing.

Gelfoam has been used in many protocols, as a preferred medium for carrying the various solutions into the socket. Gelfoam is a resorbable gelatin sponge. The structure of gelfoam is such that it cannot be placed into the socket passively. It must be compressed and then it expands, absorbing fluids and putting pressure on the alveolar walls. Peterson

et al[25], noted some mild delay in epithelial healing when gelfoam was used. Rossman and Rees[26] did not observe any delay in wound healing from the use in gelfoam and it appears to be resorbed with little reactivity, but they noted that it does not have bacteriostatic properties. The manufacturer does not recommend the use of gelfoam in the presence of infection or abscess formation.

In a 1998 article, Eames[27] recommended that dentists fill extraction sites with benzocaine ointment, then cover it with gelfoam and suture the socket. In 4 days, the suture is removed and the benzocaine is reapplied. Although benzocaine is widely used as a topical anaesthetic and is relatively poorly absorbed, it does have a reputation of being able to cause contact sensitisation.

One must keep in mind that even though severe reactions from various intra-alveolar preparations are uncommon, all are accompanied by risks for reactions, complications and delayed healing. Should adverse reactions develop in a patient, the practitioner will find defence of the use of material difficult in a courtroom, based on the documented problems previously discussed, rare as they might be.

In my practice, once I have cleared out the socket with warm saline, I usually gently pack oil of cloves into the socket. Clove oil is derived from dried flowers of a plant and contains 15-18 eugenol, plus gum, resin and tannin. It acts as an analgesic and an anaesthetic germicide. Repeated application can damage musosa and other tissues. Toxicity has been reported from ingestion in large amounts. However, there is nearly universal agreement that the alleged reduction in symptoms is a trade-off for the significantly prolonged healing times and the laborious and repeated visits for replacement or removal of the packing.

Summers and Matz[28] noted retardation of healing and marked inflammation in dogs when sockets were packed with either zinc oxide, oil of cloves and cottonwool, or even a proprietary product, Alvogel. They did not recommend use of any of these formulations in wounds, but Alvogel is used despite the cautionary advisory.

Sometimes it is best just to provide support and understanding to the patient and treat the pain the patient is experiencing than to place a medicament into the socket after it has been washed and cleared with warm saline. Just let nature run its course. Laskin[29] once penned a provocative editorial entitled *"The Art of Doing Nothing"*. In that discussion, he noted how surgeons as a group always feel the need to do "something" when faced with a problem. He correctly observed that sometimes "knowing what not to do and when not to do it is an art we all have to learn."

Knowledgeable clinicians understand that prevention is better than cure and can adopt preventative measures to try and eliminate the incidence of a 'dry socket' after extraction such as:

1. Pre-operatively, scale and clean the teeth and improve oral hygiene as far as practical including the use of chlorhexidine gluconate mouthwash, if possible starting a few days before the extraction.
2. Execute the extraction carefully with minimal manipulation of the tooth.
3. Where a dry socket may be anticipated, give a 5-day course of metronidazole 400mg b.d. post-operatively. Tetracycline 250mg taken 6-hourly for a similar period is also effective.

One must never forget that one is dealing with a person that is experiencing pain. Always be sympathetic towards the patient. Irrigation and dressing the socket might have to be repeated as often as possible to control the pain. In severe cases, this may mean daily, for several days. In addition, for severe cases, an analgesic sufficient to control pain and night sedation are essential and metronidazole 400mg b.d should be prescribed for 5 days. On occasion, a long acting local anaesthetic such as marcaine could be administered, to allow the patient pain relief for a lengthy period of time.

Conclusion

The various studies dealing with the prevention of extraction wound healing complications indicate that the routine use of agents inserted into the socket is of only questionable value.

There may be some benefit derived in cases of difficult extractions, but since the actual incidence of complication in even these cases is low, chemotherapeutic adjuncts cannot be routinely recommended.

Probably, the most important single factor in the prevention of extraction complications is gentleness in handling living tissues. One should strive to produce as little trauma as possible, consistent with the successful completion of the operation.

As we grow in years and looking back at dental school days, one can see the rapid advancements in dentistry. It is imperative to keep up and maintain the knowledge that is being developed, as this is constantly changing and growing.

Seeing that there is no universal approach in the treatment and management of alveolar osteitis, our focus should be on educating our patients, with a view of reducing the incidence of alveolar osteitis by improving our knowledge and expertise in this area.

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