



Effectiveness of Aloe-vera in Mandibular Third Molar Extraction Socket.

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ABSTRACT

Aim:- Purpose of this study was to evaluate the benefits of Aloe-vera (*Aloe barbadensis* Miller) in healing of extraction socket of surgically removed mandibular 3rd molar.

Material and Methods:- The study consisted of total 10 patients (7 male and 3 female) who underwent bilateralsurgical removal of impacted mandibular 3rd molar. In all patients, randomly selected one side extraction socket was allowed to heal by conventional manner (Control group) and other side placement of Aloe-vera gel soaked sponge was carried out (Experimental group). Post-operative evaluation included assessment of pain, swelling, mouth opening, soft tissue healing, wound dehiscence, and paraesthesia on 1st, 3rd and 7th post-operative day. Post-operative radiological density was evaluated on 6th months follow-up.

Results:- Pain, swelling, and soft tissue healing was better in experimental group compared with the control group. Bone healing was also better in the experimental group compared with the control group at the end of 6 months. Wound dehiscence and paraesthesia was not observed in any of the cases.

Conclusion:- Aloe-vera can be used as an adjunct to promote healing and osseous regeneration. The results of study demonstrated that Aloe-vera is a safe biomaterial for post-extraction soft tissue as well as bony healing.

KEYWORDS:- Extraction Socket, 3rd molar, Aloe vera, Bone Healing.

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I. INTRODUCTION

Surgical removal of impacted mandibular 3rd molar is most commonly performed procedure and often followed by varying degrees of pain, swelling, trismus, and delayed healing.¹ These problems are often accompanied by surgical site infection and alveolar osteitis (dry socket). Although the incidence of healing complications is relatively low, many patients report a negative impact on lifestyle and oral function after 3rd molar surgery.²

Socket healing is a highly coordinated sequence of biochemical, physiologic, cellular, and molecular responses involving numerous cell types, growth factors, hormones, cytokines, and other proteins, which is directed toward restoring tissue integrity and functional capacity after injury. It is a specialized example of healing by secondary intention.³

Several methods of controlling the immediate inflammatory response associated with the 3rd molar surgery are found in the literature. Different surgical closure techniques with or without incorporation of

drains, use of drugs such as analgesics, corticosteroids and antibiotics, physical therapeutic methods such as cryotherapy and laser application are some of the methods to control the inflammation.⁴

Aloe-vera (*Aloe barbadensis* Miller) is well-known herbal medicine for wound healing.⁵ Many biological effects, including wound healing, anti-viral, anti-bacterial, laxative, anti-tumor, anti-inflammation, and immunomodulating effects have been attributed to this plant, in particular, its polysaccharides.⁶ Aloe-vera with no reported side effects contains growth factors that bind to the fibroblast and insulin-like growth factor receptor in the wound area and subsequently produce collagen and proteoglycans which results in increased tensile strength of the wound.⁷

Acemannan acetylated polymannose is extracted from Aloe-vera parenchyma. It stimulates periodontal ligaments cells, dental pulp cells, bone marrow stromal cells proliferation, differentiation, and mineral depositions through activation of growth factors and extra-cellular matrix expression in vitro. It also induces reparative dentin formation, periodontium regeneration, and tooth socket healing in animal models. Clinically, acemannan has enhanced oral aphthous ulcer healing and prevented the incidence of alveolar osteitis in patients. However, the effect of acemannan on bone formation in human tooth socket healing is not known.⁵

Thus this study investigated efficacy of Aloe-vera on post extraction pain, swelling, trismus, soft tissue healing, wound dehiscence, and paraesthesia. The effects of Aloe-vera on accelerating bone healing in extraction sites after the surgical removal of mandibular impacted 3rd molars were also evaluated.

II. MATERIAL AND METHODS

The present study involved 10 patients, including 7 male and 3 female, referred to the Department of oral and maxillofacial surgery of College of Dental Sciences and Research Centre, Ahmedabad.

Inclusion criteria:-

- 1) Patients between 18-35 years of age.
- 2) Bilateral impacted mandibular 3rd molar with similar position and angulation.
- 3) Surgical removal of 3rd molar due to caries, periodontal reasons or prophylactic removal of bilateral impacted mandibular 3rd molar.
- 4) Patients with no general medical contra-indication for oral surgical procedures. (American Society of Anesthesiologists ASA-I or ASA-2).
- 5) Patients who were willing to come for regular follow-up.

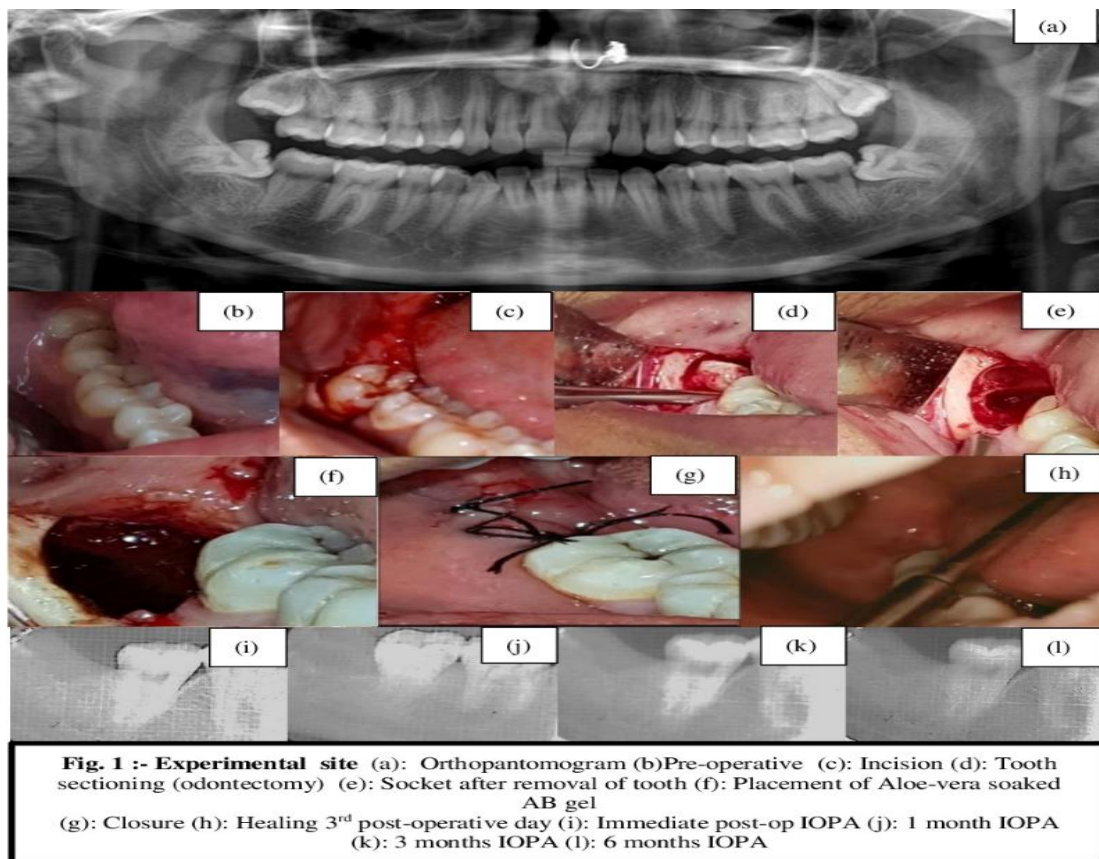
Exclusion criteria :-

- 1) Any acute or chronic infection related to mandibular 3rd molar.
- 2) Any pathology related to mandibular 3rd molar.
- 3) Any uncontrolled systemic condition.

All the patients were selected according to selection criteria. After obtaining complete history, patients were examined clinically and radiographically and were explained about the procedure, complications, and the follow-up period involved in the study. Written informed consent was taken.

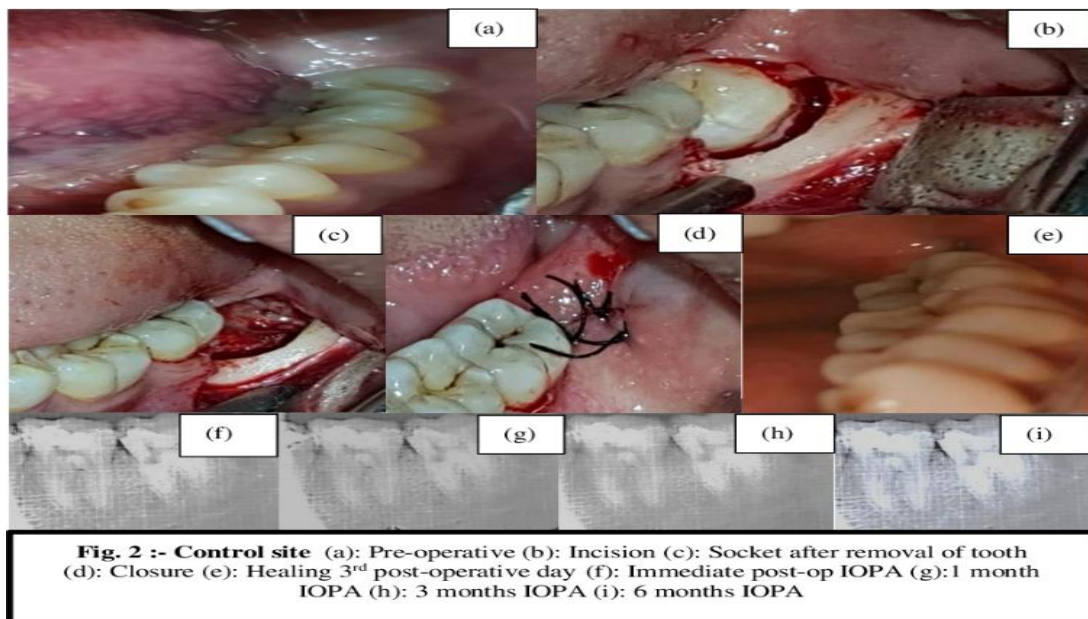
Procedure :-

Following routine surgical protocols, both sides of impacted mandibular 3rd molars were removed on same appointment. On both sides after giving local anesthesia, classical Ward's incision was given (Fig.1 :-b and Fig.2 :-b). After delivering the tooth on control side, wound was closed with 3.0 black silk sutures. While on experimental side, before closing the wound Aloe-vera soaked AB gel was placed (Fig.1 :- a-g). Extraction socket was measured in all three dimensions. Total of the socket dimensions was divided by 3. Obtained value was considered as size of AB gel. AB gel was soaked in 500 mg of Aloe-vera retrieved from capsule and 2 ml of normal saline. Aloe-vera paste soaked AB gel was placed in socket and wound was closed in similar manner as in control group.



Clinical evaluation included assessment of pain (by VAS score), soft tissue healing (by Laundry, Trunbul, and Howley Index), facial swelling, inter-incisal distance, wound dehiscence and paraesthesia on 1st, 3rd and 7th post-operative day. Post-operatively IOPA with lead mesh grid was recorded immediately and after 1 month, 3 months, and 6 months (Fig.1 :- i-l and Fig.2 :- f-i) for both side in all patients. IOPA was then converted to digital format and assessed for radiographic density using MATLAB process by histogram comparison.

All data was tabulated in excel sheet for statistical evaluation. Pearson's correlation and paired t-test were used to assess the correlation between the experimental and control groups.



III. RESULTS

The study included 10 patients with age ranging from 18 to 35 years with the mean age of 26.1 years. Male to female ratio was 2.3:1.

1) **Pain :-** Post-operative pain was noted subjectively on 1st day, 3rd day and on 7th day using VAS (Visual Analogue Scale). The mean post-operative score was 6.5, 3.5 and 1.2 on 1st, 3rd, and 7th post-operative day respectively in control group. Whereas, in experimental group same was 4.7, 2.6, and 1 respectively. So, post-operative pain was higher in control group than experimental group.

2) **Soft tissue healing :-**

Soft tissue healing was assessed using Index by Landry, Turnbull, and Howley. The mean score was 2.9, 3.8 and 4.8 on 1st, 3rd, and 7th post-operative day respectively in control group. Whereas, in experimental group same was 3.3, 4.6, and 6 respectively. So, there was significant difference between the experimental and control group.

3) **Facial swelling:-**

Facial measurements were made based on the method described by Gabka and Matsumara. The facial swelling for the control group was 11.64cm, 11.57cm, and 11.29cm on post-operative days 1st, 3rd, and 7th respectively, whereas it was 11.56cm, 11.39cm, and 11.11cm, respectively, in the experimental group for the same period.

The facial swelling was highest on 1st post-operative day and gradually reduced over the following days for both groups. The swelling was lower for the experimental group at all time points when compared with the control group.

4) **Inter-incisal distance:-**

The mean maximum inter-incisal distance (MID) was 31.5 mm, 35 mm and 40.4 mm respectively in control group. Whereas, in experimental group same was 34.1 mm, 37.2 mm, and 40.8 mm respectively. Thus, MID values were better among patients in the experimental group as compared to the control group.

5) **Bone healing :-** Higher grey scale values were found in experimental group control group during follow-up periods.

Follow-up	Control group (Mean)	Experimental group (Mean)	p value
Immediate post-operative	66.80	68.60	0.65
1 month post-operative	75.10	77.40	0.61
3 months post-operative	78.00	85.50	0.03
6 months post-operative	84.90	93.80	0.01

Table 1 :- Comparison of grey scale values.

IV. DISCUSSION

The surgical removal of 3rd molar teeth may result in a number of complications including pain, swelling, trismus, bleeding, alveolar osteitis (dry socket), wound dehiscence, or nerve dysfunction. 3rd molar extraction presents a challenge to surgeons and so to solve or reduce these problems, many drugs, bio-factors, and methods have been studied.¹¹ In the literature, many applications have been investigated to reduce postoperative complications of impacted mandibular 3rd molar surgery such as different surgical approaches, wound closure techniques, low-laser therapy, ozone therapy, and usage of medical drugs. Indeed, some of these applications can reduce the postoperative pain, swelling, trismus etc.¹²

Aloe-vera is an herbal plant used in a variety of medical conditions for wounds healing and to decrease tissue damages. Aloe-vera has a potential role in defence mechanisms, and it has a variety of components to help combat oral conditions and periodontal disease.⁷ Research has revealed that growth factors are significant for wound healing. Aloe-vera contains growth factors that bind to the fibroblast IGF receptor in the wound area and subsequently produce collagen and proteoglycans which results in increased tensile strength of the wound. Aloe-vera is also used to hinder acute inflammation however, contrasting to steroids, it stimulates fibroblasts to enhance wound healing and prevent the spread of infection.⁷

Yagi et al. reported that Aloe-vera gel contains a glycoprotein with cell proliferating-promoting activity, while Davis et al. noted that Aloe-vera gel improved wound healing by increasing blood supply (angiogenesis), which increased oxygenation as a result. Angiogenesis is the growth of new blood capillaries and is a part of tissue regeneration.¹⁰

In this study of evaluating healing potential of Aloe-vera on 3rd molar socket included 10 patients. The mean age of the sample population was 26.1 years (18-35 years) which included 7 males and 3 females. In each patient one side of the mandibular 3rd molar socket was treated as conventional manner (Control group) and in the other Aloe-vera soaked AB-gel (Experimental group) was placed.

A study by Vijaya Lakshmi Nimma et al. concluded that Aloe-vera group showed a significant decrease in pain after two hours on the day of extraction followed by 2nd, 3rd, and 7th post-operative day which was statistically significant and better than the control group.⁷ Our results were similar to their results.

Soft tissue healing index by Landry, Turnbull, and Howley showed better soft tissue healing for experimental group compared to control group. This healing potential in the Aloe-vera group can be attributed by three main factors: (a) Reduced pain and inflammation; (b) Stimulation of fibroblasts to functionally produce collagen and proteoglycans; (c) Increased wound tensile strength. It is thus evident that Aloe has its role in pain and inflammation, where common oral disease like periodontal diseases, a known reason for tooth extraction is also treated effectively with this miracle medication.⁷ Our results of effects of Aloe-vera on healing were similar to the results of Vijaya Lakshmi Nimma et al.⁷

During the process of healing, Aloe-vera stimulates fibroblasts and fibroblasts produce new collagen. However, we should note that macrophages can also stimulate fibroblasts. The effect from macrophages was indirect and the effect is direct from Aloe-vera, thus between the margins of wound new collagen forms. These collagen bonds are responsible for tensile strength.⁷

In this study wound dehiscence was noted in one patient on experimental site after placement of Aloe-vera and closure with three interrupted sutures. Following which the suturing techniques used for closure of wound was horizontal mattress suture. Though the simple interrupted suturing technique is most commonly used after impacted mandibular 3rd molar surgery. In some patients wound eversion can not be achieved with the same. Ahmet Hu'seyin Acar et al. compared simple interrupted sutures versus horizontal mattress suture following removal of impacted 3rd molar. They concluded that horizontal mattress suturing has no negative impact on postoperative trismus, pain, and swelling, and is superior to simple interrupted suturing in terms of primary wound healing.¹²

Dry socket was observed in 2 patients on the control site which were then managed by irrigation with betadine or saline and Alveogyl® dressing every alternate day. The reasons for this complication were failure on the part of patient to follow the post-operative instruction properly which was to avoid smoking for one patient. The other case of dry socket was observed in a female patient who was on oral contraceptives and was asked to discontinue but the patient didn't follow the instructions. The literature reports a frequency of dry socket ranging from 0.3–26% for all extractions and is known to occur more frequently following 3rd molar extraction. Several studies have suggested that increased age, being female, the use of oral contraceptives, smoking, surgical trauma, and pericoronitis are risk factors for dry socket.¹³ However complication of dry socket was not observed on the experimental site in both same patient. Aloe-vera application is proven to prevent the formation of dry socket when applied in extraction socket. Studies suggested that the SaliCept Patch (containing acemannan hydrogel) resulted in significant reduction in the incidence of alveolar osteitis as compared to clindamycin-soaked Gelfoam.¹⁶

Paraesthesia was observed in two patients of experimental group having a higher Pederson difficulty score. These patients were followed up and both showed completed recovery on the 7th post-operative day. Manson (1988) found no single factor to be causative but the most significant were the depth of impaction, removal of distal bone, elevation of lingual flap and length of operation time.¹⁴

In our study for assessment of radiographic density post-operatively we used IOPA with lead mesh grid. The lower molar area is the easiest location in the mouth in which to obtain clear and undistorted radiographs without the superimposition of confusing anatomic structures.¹⁵ Although cone-beam computed tomography (CBCT) provides a 3-dimensional image of bone volume and topography, and generates data of higher accuracy, sensitivity, reliability, and precision than periapical radiography. A drawback to CBCT analysis is that, due to ethical concerns, CBCT evaluation cannot be repeatedly used on human subjects, especially when dental implants will not be provided after the augmentation procedure.⁵ Also the cost effectiveness of the CBCT needs to be considered. So we used 2-dimensional imaging to observe changes in bone density using Adobe Photoshop software.

A study by Pornchai Jansisanont et al. and Cuong Le Van et al. demonstrated the Aloe-vera (acemannan) treated group had a significantly higher change in percentage radiographic density post-operatively compared with that of the control group.^{5,9} In our study also bone healing was more favourable in experimental group than control group 6 months post-operatively. These findings suggest that Aloe-vera accelerates early bone healing.

The underlying mechanism whereby Aloe-vera (acemannan) induces bone formation is still under investigation. The effectiveness of Aloe-vera (acemannan) could be mediated through the.⁵

- Up-regulation of cell proliferation,

- Expression of Runx2,
- Alkalinephosphatase,
- VEGF, GDF-5, BMP-2,
- TypeI collagen,
- Bone sialophosphoprotein,
- Osteopontin, or mineralization.

Another mechanism by which Aloe-vera stimulates osteogenesis may be the immunomodulatory function of it, which can shorten the inflammatory phase prior to the bone formation phase. Indeed, modulation of the inflammatory cell response can hasten bone tissue regeneration.⁵

V. CONCLUSION

Aloe-vera (*Aloe barbadensis* Miller) is known as an herbal medicine for wound healing. Aloe contains growth factors that bind to the fibroblast IGF receptor in the wound area and subsequently produce collagen and proteoglycans which result in increased tensile strength of the wound.

Aloe-vera is also used to hinder acute inflammation however, contrasting to steroids, it stimulates fibroblasts to enhance wound healing and prevent the spread of infection. In this study Aloe-vera was used as an adjunct to promote socket healing and osseous regeneration in mandibular 3rd molar extraction sites. Results obtained during the study clearly indicate a definite improvement in the soft tissue healing and faster regeneration of bone after 3rd molar surgery in cases treated with Aloe-vera.

This improvement in the wound healing, decrease in pain (VAS) scores, decreased post-operative swelling, and increase in the bone density in the socket treated with Aloe-vera signifies and highlights its use to induce and accelerate soft and hard tissue healing, thus being the safe biomaterial for post-extraction healing.

The present study was done with a smaller sample size hence further clinical trials with larger sample size is to be done to obtain more approving and conclusive results.

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