Comparative Evaluation of Er:Cr:YSGG, Diode Laser and Alvogyl in the Management of Alveolar Osteitis: A Prospective Randomized Clinical Study

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Abstract

Introduction Alveolar osteitis (AO) is a well-known complication following tooth extraction. Plethora of literature is available regarding its treatment modalities signifying that none of the treatment is as effective as any another treatment. LASER on the other hand, has been used to promote soft tissue healing.

Material and method In order to evaluate the effects of laser on healing of AO we undertook a randomized clinical trial. In the trial, sixty patients diagnosed with AO were randomly divided into three groups viz: alvogyl, diode laser and Er:Cr:YSGG laser (erbium chromium yttrium scandium gallium garnet).

Results On analyzing the results, diode laser at 1.0 W power settings (energy: 20–25 J/cm²) in non-contact, continuous mode was found to be the most effective for both pain relief and healing improvement.

Conclusion The diode laser is an acceptable and effective non-dressing treatment modality for alveolar osteitis, which is the most common painful complication following extraction.

Keywords Alveolar osteitis · Low level laser therapy · Erbium chromium yttrium scandium gallium garnet laser · Alvogyl

Introduction

Alveolar osteitis (AO)/dry socket is the most common and most studied complication of exodontia. The term “dry socket” was first coined by Crawford in 1896 [1]. The

reported incidence of AO is 3–4 % following routine dental extractions and 25–30 % after the surgical removal of impacted third molars [2]. Patient usually presents with persistent, radiating postoperative pain in and around the extraction site within 2–4 days after extraction. Pain is not easily relieved by analgesics and is often accompanied by halitosis [2]. The primary aim of management is to relieve pain and promote healing of exposed bone primarily by palliative means. Traditionally this is achieved with the help of intra-alveolar medicated dressings consisting of antibacterial, topical anesthetic and obtundant agent or combination of all these agents [2]. Zinc oxide eugenol, alvogyl and salicet patch have been used with different reported success rates [3]. Recently laser has gained popularity for various medical ailments in terms of better pain relief and faster healing. Diode laser has been used in AO for pain management and has been found to be effective at low energy level [3]. Er:Cr:YSGG laser is a surgical laser, but at a low power setting (soft tissue mode) it is found to be very effective for soft tissue procedures owing to its high bactericidal potential and healing enhancement properties [4]. So keeping in mind the traditional but controversial palliative treatment modalities for this painful condition (AO), we endeavoured to explore the effectiveness of both type of lasers in AO management.

Methodology

The present prospective randomized clinical study was conducted to compare the clinical outcome of alvogyl, diode laser and Er:Cr:YSGG Laser (in soft tissue mode) in the management of AO. Sixty systemically healthy patients who reported with post-extraction pain (non-surgical extraction including third molar) and subsequently

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diagnosed with AO in the department of oral and maxillofacial surgery during October 2011 to April 2013, were randomly divided into three groups (twenty each) using systematic random sampling method. Diagnosis of AO was made on the basis of characteristics as per Blum (2002) [2]. Patients who were on radiotherapy, bisphosphonate therapy, anticoagulant therapy and those with known generalized vascular or metabolic disorders were excluded from the study. Once diagnosed, pain score was recorded on patient's evaluation form. Under local anesthesia infiltration socket was irrigated with 25 ml normal saline.

Treatment Groups

Group I

A loose dressing of alvogyl (Septodont, Cambridge, Canada) was gently placed in socket (Fig. 1).

Group II

Decontamination of socket was done with diode laser (Picasso Dental Diode Laser, company-AMD lasers, Class 4 laser with 810 nm wavelength) at 1.0 W (watt) power (energy output 20–25 J/cm²), using fiber-optic disposable filament in non-contact and continuous mode (Fig. 2).

Group III

Decontamination of socket was done using an Er:Cr:YSGG laser (Waterlase, 2780 nm wavelength, class IV Laser with a fiber optic delivery system in non-contact mode, G9 with diameter of 600 micrometer and 9 mm length) with laser settings of 1.0 W (watt) and air/water spray (13 and 11 %) (Figs. 3, 4).

Fig. 1 Alvogyl placed in AO socket

Fig. 2 Diode laser irradiation of AO socket

Fig. 3 Er:Cr:YSGG laser irradiation of AO socket

Fig. 4 Photograph showing the non-contact mode of LASER probe

Follow Up

During postoperative period tablet Paracetamol 500 mg (Acetaminophen) was prescribed for pain relief as required, but no antibiotics were advised. Every patient was reviewed on 4th, 7th, 10th and 14th post treatment day. If the patient complained of intolerable pain or no relief in symptoms on follow up, the respective procedure was repeated.

Outcome Assessment

Healing Assessment

Healing assessment was done on 4th, 7th, 10th and 14th post treatment day using a modified healing score. The parameters were adapted from the studies using different signs to evaluate healing [3]. The sum total of these signs was used for describing the healing as minimal/moderate/best healing (Table 1).

Pain Assessment

Pain intensity level was recorded for every patient at diagnosis and daily for next 14 days using Visual Analogue Scale (VAS) [5] from 0 (no pain) to 100 (severe intolerable pain) and Verbal Rating Scale (VRS) [6] from 0 (no pain) to 4 (severe intolerable pain) in patient's Evaluation Form.

Table 1 Modified healing scores

Parameters	Scores	
	Present	Absent
1. Denuded bone	0	1
2. Absence of healthy granulation tissue (presence of Whitish slough)	0	1
3. Tenderness	0	1
Total	0	3

Score 0 indicates minimal healing and score 3 represents best healing

Table 2 Inter-group comparison for confounding variables

Variables	Group I No. of patients	Group II No. of patients	Group III No. of patients	<i>p</i> value*
Female	14 (70 %)	14 (70 %)	13 (65 %)	NS
Antibiotic taken (amoxicillin + metronidazole)	20 (100 %)	20 (100 %)	18 (90 %)	NS
Non-smoker	19 (95 %)	18 (90 %)	18 (90 %)	NS
Routine extraction	20 (100 %)	20 (100 %)	19 (95 %)	NS
Non-traumatic extraction	10 (50 %)	12 (60 %)	9 (45 %)	NS
Age in years (mean $\pm$ SD) ^{\$}	39.2 $\pm$ 11.0	34.4 $\pm$ 12.7	33.7 $\pm$ 9.5	NS (>0.05)
Time interval for AO after extraction (in days) (mean $\pm$ SD) ^{\$}	1.2 $\pm$.5	1.1 $\pm$.3	1.1 $\pm$.3	NS

Statistical Analysis

Statistical analysis was performed using the Statistical Package for Social Sciences, version 19.0, for Windows (SPSS, Chicago, IL, USA). The Kruskal–Wallis, Mann–Whitney and Chi Square tests were used to assess the differences within and among groups and for repeated measurement Friedman test was used with *p* value <0.05 considered statistically significant.

Results

All three groups were similar in terms of age, sex, cause and type of extraction, smoking, antibiotics (Amoxicillin + Metronidazole) intake after extraction and the time interval between extraction and AO development as shown in Table 2.

Fifty-eight patients (96.7 %) who subsequently developed AO had completed the post extraction antibiotic (Amoxicillin + Metronidazole) course. Fifty-five patients (91.7 %) were nonsmokers who developed AO after extraction. The extraction was traumatic in twenty-nine patients (48.3 %). The main cause of extraction was caries in fifty-five patients (91.7 %) and in rest five patients it was trauma and peri-coronal infection. The majority of cases were reported in mandibular teeth with predominant involvement of molars.

Pain Comparison

Intergroup and Intragroup Pain Correlation

VAS and VRS score showed statistically significant decrease in pain within all three groups from pre-treatment to fourth post treatment day.

There was better pain control in groups II and III than in group I. The difference was statistically significant between group II, group I and group III (*p* < 0.05). The pain control in group III was better than group I although difference was

Table 3 Inter-group pain correlation (VAS)

VAS scores	Group I (Mean $\pm$ SD) (n = 20)	Group II (Mean $\pm$ SD) (n = 20)	Group III (Mean $\pm$ SD) (n = 20)	p value [§] p < 0.05
VAS-0	73 $\pm$ 12.2	70.3 $\pm$ 10.3	70.4 $\pm$ 13.7	NS
VAS-1	55.1 $\pm$ 15.4	52.4 $\pm$ 17.2	47.3 $\pm$ 20.7	NS
VAS-2	46.1 $\pm$ 16.8	32.5 $\pm$ 18.4	37.0 $\pm$ 18.8	NS
VAS-3	33.4 $\pm$ 16.3	15.1 $\pm$ 16.4	26.5 $\pm$ 18.1	<0.05
VAS-4	20.4 $\pm$ 17.9	6.7 $\pm$ 8.8	15.2 $\pm$ 14.5	<0.05
VAS-5	15.6 $\pm$ 18.2	3.3 $\pm$ 6.6	6.7 $\pm$ 11.1	<0.05
VAS-6	19.2 $\pm$ 21.6 (n = 8)	5.3 $\pm$ 5.0 (n = 3)	9.7 $\pm$ 14 (n = 7)	*

n no. of observations

[§] Kruskal–Wallis test and Mann–Whitney test

* Statistical analysis was not done due to missing values (i.e. no symptoms)

Table 4 Inter-group pain correlation (VAS) (3rd, 4th and 5th day)

Groups	I versus II (p value)	II versus III (p value)	I versus III (p value)
VAS-3	0.002 (<0.05)	0.056 (<0.05)	0.26 (>0.05)
VAS-4	0.007 (<0.05)	0.043 (<0.05)	0.38 (>0.05)
VAS-5	0.018 (<0.05)	0.414 (>0.05)	0.10 (>0.05)

Kruskal–Wallis test and Mann–Whitney test for VAS score comparison between three groups on third, fourth and fifth post treatment day

Table 5 Inter-group healing correlation

Modified healing scores	Group I (Mean $\pm$ SD)	Group II (Mean $\pm$ SD)	Group III (Mean $\pm$ SD)	p value p < 0.05
Heal-4 (n = 20)	1.6 $\pm$ 0.6	2.3 $\pm$ 0.7	1.9 $\pm$ 0.5	0.006 (<0.05)*
Heal-7 (n = 20)	2.5 $\pm$ 0.5	2.8 $\pm$ 0.4	2.7 $\pm$ 0.4	NS
Heal-10 (n = 20)	2.9 $\pm$ 0.2	3.0 $\pm$ 0.0	3.0 $\pm$ 0.0	NS
Heal-14 (n = 20)	3.0 $\pm$ 0.0	3.0 $\pm$ 0.0	3.0 $\pm$ 0.0	NS

NS non significant

* Kruskal–Wallis test and Mann–Whitney test, heals 4, 7, 10, 14 are modified healing score on 4th, 7th, 10th, 14th day

not statistically significant (Tables 3, 4). Eight patients in group I, seven patients in group III and only five patients in group II took rescue medication on first day of treatment. On subsequent days only group I patients required medications for pain control.

Intergroup and Intragroup Healing Correlation

Healing improvement was significantly better in group II on fourth post treatment day as compared to group I ($p < 0.05$). Statistically significant improvement in healing was reported with in all three groups from first to second follow up (Tables 5, 6).

Nine patients in group I, four in group III and three patients in group II required second application of respective treatment.

Table 6 Correlation of healing between three groups (fourth day)

Groups	Heal-4 (p value)	p value
I versus II	0.006	<0.05*
II versus III	0.081	>0.05
I versus III	0.157	>0.05

* Kruskal–Wallis test and Mann–Whitney test

Discussion

Dry socket is a complication that occurs frequently after tooth extraction, causing discomfort, pain and fetid odor. As the exact etiology of condition is not known and pain is usually the chief complaint, it is managed by palliative means with the primary aim being to relieve pain and to

promote healing. As the pain is subjective and can vary from person to person so in addition to determining pain relief, other objective criteria are also needed to assess the efficacy of any method of treatment. So along with VAS and VRS scores for pain assessment, in the present study we also assessed the healing by using modified healing score for comparison of three different treatment modalities for AO.

Regardless of the management modality, irrigation and gentle debridement plays an important role as it removes food debris and foreign body, which in turn can slow down the healing process and increase pain by promoting infection. Thus irrigation and debridement is an integral part of any method of treatment of AO, but as a sole modality it is found to be insufficient to provide adequate control over pain and healing associated with AO [3].

Traditionally a number of intra-alveolar dressings are used for the treatment of AO. These dressings are made up of combination of antibiotics, analgesics and anesthetic agents in different proportion. Alvogyl is an antiseptic paste, which contains Butamben (anesthetic), Iodoform (antimicrobial) and Eugenol (analgesic) [3]. The advantage of applying a dressing topically is achieving a greater local concentration of the substances than can normally be expected from systemic administration and also minimizing the possible side effects and sensitization associated with systemic route. Different purpose and benefits of an intra-alveolar dressing such as prevention of food debris accumulation in the socket along with antibacterial properties of medicaments which help to keep the socket disinfected and do not allow excessive inflammation to slow down healing; that they themselves promote healing and provide local pain relief have also been suggested [7]. But these intra-alveolar dressings are also not free from adverse effects, in fact some serious complications are reported and potential adverse effects have also been suggested with the use of intra-alveolar dressings e.g.: retarded or delayed healing, allergic reactions, foreign body reaction, nerve dysesthesia, myospherulosis, development of resistant bacterial strains and substantial added costs [8]. Dressing left in socket itself can act as a nidus for infection. In the present study as well we reported slower healing and relief in pain with alvogyl as compared to other groups.

Recently the paradigm has shifted in favor of non-dressing management modality for this painful condition such as LASER. In dentistry, the non-surgical or soft tissue lasers have been predominately used as low level laser therapy (LLLT) or ‘bio-stimulation’ [9]. LLLT is shown to enhance the fibroblast proliferation, neovascularization, early epithelization, increased mobility of keratinocytes, increased matrix synthesis and also enhances the phagocytic activity during initial phases of the repair thus facilitating debridement of the wound, thereby helping in healing process [10]. The mechanism of pain relief by

Laser is not well understood, although it has been suggested that LLLT helps to reduce inflammation by inhibiting the production of cyclooxygenase-2 and prostaglandin-2, potent mediators of inflammation [10]. Kaya et al. [3] showed that LLLT is superior to both alvogyl and salicet patch for AO management. Present study also confirmed the positive effect of diode on healing and pain associated with AO.

In contrary to literature, when diode laser was used at low power and energy in the present study, adequate pain relief and healing improvement was not obtained in AO. So we used diode laser at one watt power setting and higher energy (20–25 J/cm²) and it was found to be effective both in terms of pain and healing improvement. Gerald Ross reported complete pain relief in AO socket with Diode laser at 48 J/cm² [11] that also supports the present study findings.

Among surgical lasers Er:Cr:YSGG is most commonly used for hard tissue (dental and bony) procedures. But when using in soft tissue mode at low power settings they are also effective for soft tissue procedures. The proposed beneficial effects of Erbium laser are due to their high bactericidal potential even at low power settings [4]. In addition, Erbium laser was also found to improve the healing process as there is very less collateral and residual thermal damage because of its low penetration depth. Erbium laser has been used for periodontal and gingival surgeries and also for palliative management of aphthous ulcer and faster healing has been reported. This suggests that Erbium laser irradiation may be of therapeutic value for better wound healing and for pain relief. Molla [12] showed less pain and faster bone fill in tooth socket which was Er:Cr:YSGG laser irradiated immediately after extraction. When we used Erbium laser in AO it showed beneficial effects on both pain and healing but the improvement was slower when compared to diode laser. The possible explanation for these findings could be that in AO the bacteria is not the single etiological factor, that is one of the major target for erbium laser.

Present study showed slower healing with alvogyl as compared to the other groups. This study confirmed the beneficial effects of diode laser for AO, as the results showed faster improvement in pain and healing with diode laser group than with Er:Cr:YSGG and alvogyl groups. Within the limitation of the present study, it can be concluded that the diode laser is an acceptable and effective non-dressing treatment modality for alveolar osteitis provided the socket has been cleared off the food debris and foreign body for better decontamination of socket and for better pain relief.

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Compliance with Ethical Standards

Conflict of interest None.

Ethical Approval Prior ethical approval was taken from Ethical Committee of Institute.

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