The Effect Of Low Level Laser Therapy On Osseointegration Of Immediate Implants In Maxillary Central Incisors

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ABSTRACT: Marked qualitative and quantitative alterations occur in the alveolar ridge following the loss of teeth. Many tails for ridge preservation have been introduced to allow proper positioning of dental implants; one of which is immediate implantation. This study **aimed** to evaluate the effect of the low level laser therapy on bone healing around immediate dental implantation of maxillary central incisors. **Methods:** Eleven patients were included in this study seeking replacement of their non-restorable maxillary central incisor tooth, and were randomly divided into two groups. Group A: laser group (six patients) and group B: control group (five patients). Each patient of both groups received immediate implant at the fresh extraction socket and covered with collagen membrane. Laser group subjected to a total of eight sessions of diode laser of wave length 980 nm and average power 500 mw scheduled in two sessions weekly started immediate postoperatively for five minutes per session. All patients were evaluated by periapical digital radiograph immediately, two weeks, one, three and six months postoperatively. Digora software was used to monitor the changes within bone density through those periods in both groups. **Results**: However, the results revealed that laser group showed increase in means of bone density compared to control group through all follow up intervals, it was statistically significant at 6 months. **Conclusion:** Low level laser has a positive effect on stimulation of bone healing around immediately inserted dental implants.
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KEYWORDS: Immediate implant, Low level laser.

1.INTRODUCTION:

The progressive loss of the alveolar bone begins following tooth extraction, and it is usually accompanied by reductions in both the quality and quantity of hard tissue. It was shown that major changes in the extraction site occur in the first 3−12 months after tooth extraction, and an estimated 50% decrease in buccolingual width was demonstrated in the same period, *Schropp et al.,(2003).* Placing implants immediately after tooth extraction can eliminate the waiting period for socket healing and reduce the bone resorption that normally occurs following the loss of teeth, *Werbitt and Goldberg (1992).*

Immediate implantation is defined as the insertion of an implant into an empty alveolus when the mucosa is already open, immediately or only a few days after extraction. Placement of an implant will inhibit post extraction alveolar bone resorption. The time during which the patient is edentulous is short ended, because healing of the alveolus and implant occurs simultaneously, *Barzilay* et al.,(1991); *Artzi and Nemcovesky (1997);Araujo,et al.,(2003).*

A traumatic extraction technique is very important

for the success of immediate implants and facilities maintenance of the maximum amount of bone, *Wagenberg and Ginsburg(2001); Douglass and Merin(2002).* It also allows for the preservation of buccal plate of bone; preventing perforations or fracture of the alveolar bone, without which an immediate implant might be contraindicated, *Schulte(1982).*

Primary stability of immediate implant is essential and achieved when the micro-movement of the implant-bone interface is below the threshold at which fibrous encapsulation occurs, and eventual implant failure, *Beckeret al.,(2005).* Bone quality, quantity, geometry of the implant, residual extraction site morphology, and surgical technique are important clinical determinants that affect primary stability. Which is essentially the most important osseointegration pre-requisite because it allows for vital bone maintenance, clot stabilization, prevention of soft tissue collapse and epithelial down-growth, *Cavicchia and Bravi(1999); Hahn(2000); Wagenberg and Ginsburg(2001);. Fugazzotto* (2002). The important aspects of residual extraction site morphology are axial inclinations, root curvature, dilacerations, and location of the socket apex, *Hahn(2000). Cavicchia F, Bravi* (1999);*Dougles and Cavcchia(2002)* reported that 3-5 mm of sound bone beyond the apex is desirable in order to better facilitate osseointegration.

However, immediate implantation has provided implant dentistry the opportunity to achieve better functional and esthetic results. The incongruity between the shape of the implant body and that of the socket walls may leads to a gap between the walls of the extraction socket and the implant, *Hahn(2000).* This gap is usually widest at the coronal part of the socket. This leads to ingrowth of the non-osteogenic connective tissue into the space around the implant and thus prevents new bone formation, *Lazzara(1989.)* These challenges can be counteracted by the use of barrier membranes and different graft materials, *Postlewaite et al.,(1978).* Collagen membrane; seemed to be an ideal due to its intrinsic hemostatic properties; stabilizes blood clot, compatibility with host tissues and resorbability. Also collagen membranes have the following criteria that make it attractive for use in guided bone regeneration (GBR) procedures; it is easily manipulated and adapted, has no adverse tissue reaction, infection or delayed healing, *Postle waite et al.,(1978*);*Quteish et al.,(1991).*

Low Level laser Therapy (LLLT) is used to promote healing of tissues rather than incising them. Several claims have been made about the effectiveness of low level laser therapy, including stimulated cell growth, cell regeneration, increased cellular activity, reduced pain and edema, increased re-vascularization, reduced fibrous tissue formation, and accelerated wound healing and bone repair, *Kert J; Rose(1989); Nemeth(1993); Goldmanet al.,(1995).*

LLLT has the potential of beneficial effects on peri-implant hard and soft tissues regeneration. Under stable and no hurtful surgical conditions, irradiation with low-power laser could reduce healing time and accelerates implant osseo-integrations, *Colls (1986).* Some authors suggests that laser irradiation modify cell metabolism and play two principal roles in stimulating bone formation, one is stimulation of cellular proliferation, and the other is stimulation of cellular differentiation, resulting in an increase in the number of more differentiated osteoblastic cells and an increase in bone formation, *Barazily(1993).* The aim of this study was to evaluate the effect of Low Level Laser on the bone healing around immediate dental implant.

2.PATIENTS AND METHODS:

2.1.Patients:

Eleven patients seeking replacement of their badly decayed or broken maxillary central incisor tooth were selected for the current study from those attending Oral & Maxillofacial department, Faculty of Oral and Dental Medicine, Cairo University.

The age ranged from 22 to 40 years and two out of ten patients were females.

The patients included in this study were evaluated through a case history, clinical (Fig 1) and radiographic examination using digital panoramic radiographs (Fig 2). The selected patients were free from any systemic diseases, have no history of jaw irradiation, local infection, non-smokers, and non-alcoholic or drug abusers and have good oral hygiene.

All patients received collagen membrane to cover the defect around the implant and were randomly divided into two groups(according to laser application) into:

Group A: (study group 6 patients) subjected to laser bio-stimulation starting immediately after implantation.

Group B: (control group 5 patients) left without laser application

Fig. (1): A photograph showing badly decayed maxillary right central incisor.

Fig. (2): Preoperative panoramic radiograph for one of the cases.

2.2. Methods:

2.2.1. Scheme of the work

- All patients were informed about immediate implant placement procedures and laser application sessions and they gave their approval to participate in this study with written consent.

- Dental implants were placed in the sockets immediately after extraction of non-restorable maxillary central incisors. Cases of traumatic extraction were excluded from this study.

2.2.2.Operative procedures:

The treatment protocol was essentially the same for all patients and included:

A sulcular marginal incision was performed around the tooth to be extracted. A mucoperiosteal elevator was applied buccally and palatally till reached the crestal alveolar bone, creating a gingival pouch on both sides, permitting inspection of the integrity and thickness of the buccal alveolar wall, then one releasing vertical incision made labially on the distal side of the extraction socket only (Fig 3). Atraumatic extraction of remaining root of maxillary central incisors was performed. Then, the socket was derided by careful curettage using small curette and proper irrigation with saline solution to remove any connective tissue tags or any remnants of periodontal ligaments (Fig4).

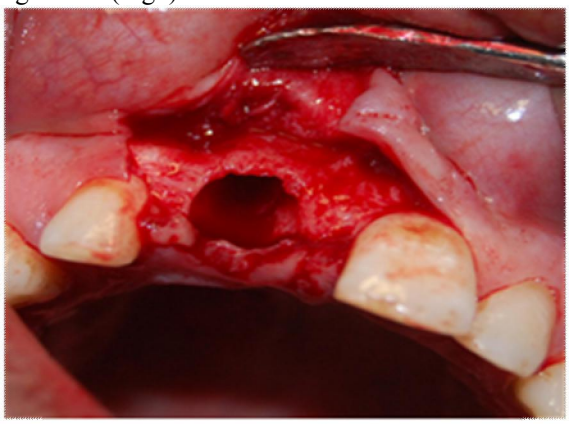

Fig 3 A photograph showing flap design

Fig 4 photoradiograph showing socket curritage of remaining peridotium

included:

Implant was extended 3 to 5 mm beyond the apex of the extracted root to achieve primary stability of the fixture. The sequential drills were used to complete drilling of the implant site (Fig.5).

The implant (Spectra system – USA) (Fig 6) was seated manually about 2/3 of the implant length (Fig 7) and then fully seated using ratchet and stopped at the alveolar crest of the buccal surface (Fig. 8, 9).

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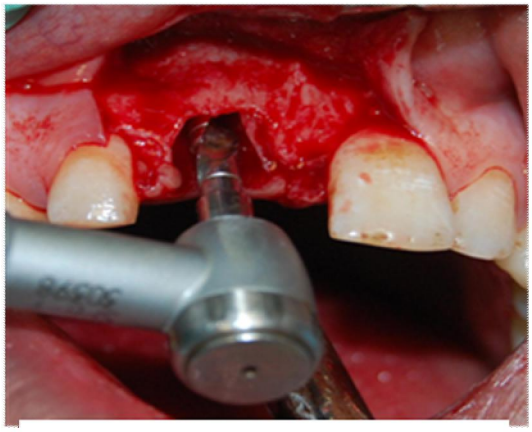

Fig. (5): A photograph showing preparation of the implant site

Fig 6: A photograph shing the spectra system implant

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between the flap and the alveolar bone (Fig. 11). The periosteum of reflected flap was horizontally dissected to lengthen the flap to permit covering the collagen membrane, and then the flap was repositioned and sutured

2.2.3.Laser application

In study group (group A) patients, laser bio-stimulation (Sirolaser-USA) was applied in a total of eight sessions using diode laser 980 nm and average power 500 m watt with two sessions weekly starting immediate post operatively. Along the pre-adjusted time (5 minutes) the buccal, palatal and the crestal aspects of the implants were subjected to the laser beam, the applicator tip was moving in a continuous slow circular motion just not touching the tissues; directed to implant site to insure full exposure of implant site by laser beam (Fig. 12).

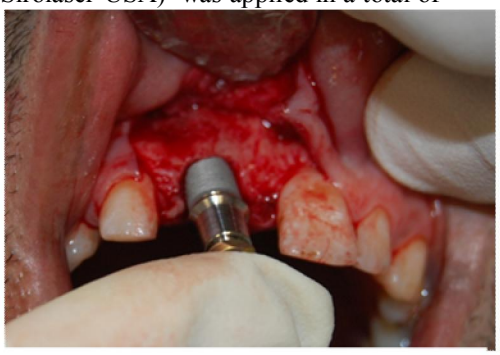

Fig. (7): A photograph showing manual seating of the implant

Fig. 8: A photograph showing seating of the implant using ratchet

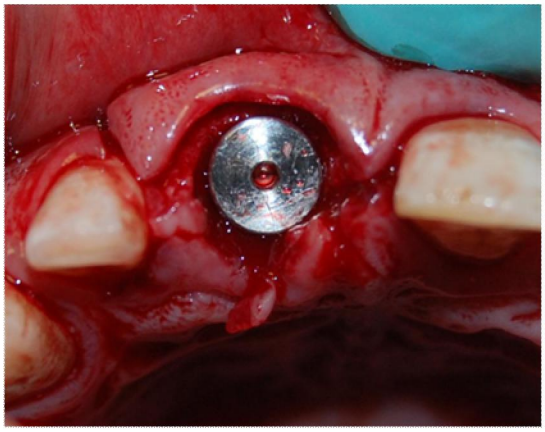

Fig.9: A photograph showing complete seating of the implant at the alveolar crest

Fig 10: Collagen membrane used (Biotieck Italy)

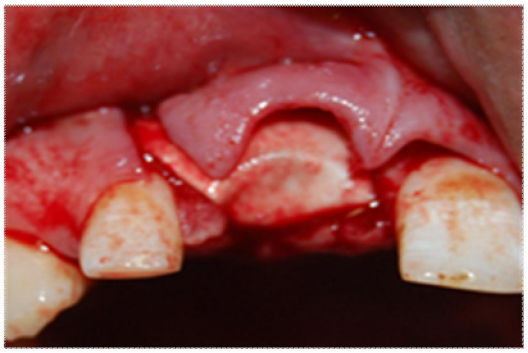

Fig. (11): A photograph showing collagen membrane over the implant site.

2.2.4.Radiographic assessment:

Bone healing was evaluated radiographically through direct digital periapical radiographs for both groups. The Rinn XCP instrument (Rinn corporation, XCP instrument for extension cone paralleling technique, IL., USA), the digital x-ray system and software (Digora, Sorredex-Finland) and a reusable imaging plate were used for this procedure (Fig 13).

Fig. (12): A photograph showing laser application at the implant site in a case of the study group.

2.2.4.Radiographic assessment:

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Fig 13: A photograph showing Rinn XCP with film holder and radiographic template

2.2.5.Measurement of bone density:

The soft-ware of the Digora system was used for evaluating the changes in bone density mesial and distal to the implant in all patients. The peri-implant densitometric measurements by Digora were performed as follows:

Two lines were drawn mesial and distal to the implant one on each side. The first line extended from the first flute of the implant to the apex of the implant passing just tangential to the flutes (Fig.14). Bone density along each of the two lines was recorded and then the mean value of the readings was calculated for further evaluation.

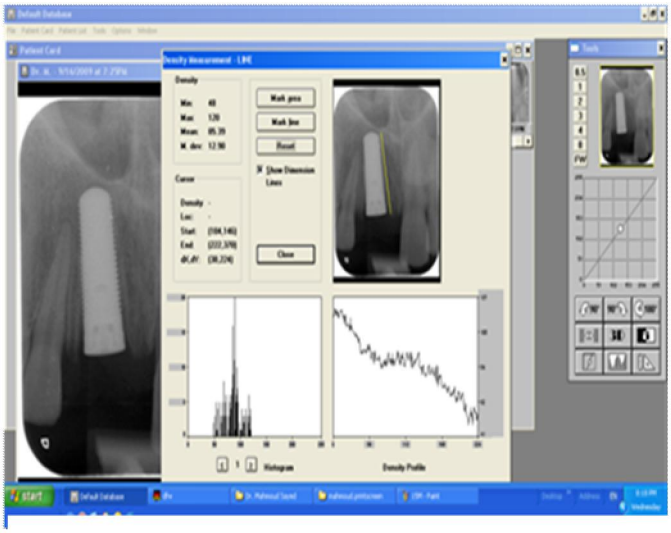

Fig. (14): Measurement of bone density using Digora soft ware

Fig.(15): A photograph showing connected abutment

Fig. 16. photograph showing cemented crown.

At six months after surgery, Completion of the final prosthetic crowns were performed (Fig. 15) and prepared for final prosthesis. (Fig. 16)

2.2.6. Statistical analysis

Data were presented as mean and standard deviation (SD) values. Student's t-test was used to compare between the two groups. Paired t-test was used to study the changes by time within each group.

Percent change data showed non-normal (non-parametric) distribution, so Mann-Whitney U test was used to compare between the two groups. This test is the non-parametric alternative to Student's t-test.

3.RESULTS:

3.1.Clinical results:

All patients reported post-operative modrate pain in the first day and decreased gradually and subsided completely two to three days in laser group and continued for more two days in the control group. All patients reported little to moderate swelling in the second and third day after implant placement in both groups, however it decreased gradually but faster in group A till disappeared completely after 5 days for all cases, group B swelling disappeared only at 7 days expect one case which reported a large size swelling and continued up to 10 days.

Post-operative healing was uneventful in all surgical sites with no signs of infection, at the time of suture removal, the gingivae showed normal color and complete healing was noticed at two weeks without exposure of the membrane, moreover after three months one case of laser group showed minimal exposure of the covering screw.

Table (1): The mean, standard deviation (SD) values and results of Student's t-test for comparison between bone densities in the two groups

Group / Period	Control		Laser		*P*-value
	Mean	SD	Mean	SD	
Immediate post-operative	97.7	4.7	96.7	7.1	0.849
2 weeks	103	6.1	107	3.6	0.383
1 month	125	10	130.3	12.7	0.598
3 months	129	14.1	144.7	18.2	0.304
6 months	136.3	15.2	173	14.1	0.037*

**: Significant at P ≤ 0.05*

3.2.Densitometric analysis

The mean and standard deviation values of bone density in Laser group (group A) immediate post-operatively were 96.7 ± 7.1 and in control group (group B) were 97.7 ± 4.7. Student's t-test showed that there was no statistically significant difference between the two groups (*P*-value = 0.849).

After 2 weeks, the mean and standard deviation values of bone density in laser group were 107 ± 3.6 and in control group were 103 ± 6.1. Student's t-test showed that there was no statistically significant difference between the two groups (*P*-value = 0.383).

After 1 month the mean and standard deviation values of bone density in Laser group were130.3 ± 12.7 and 125 ± 10 in control group. Student's t-test showed that there was no statistically significant difference between the two groups (*P*-value = 0.598).

After 3 months, the mean and standard deviation values of bone density in Laser group were144.7 ± 18.2 and 129 ± 14.1 in control group. Student's t-test showed that there was no statistically significant difference between the two groups (*P*-value = 0.304).

Moreover the mean and standard deviation values of bone density in Laser group at 6 months were 173 ± 14.1and 136.3 ± 15.2 in control group. Student's t-test showed that there was a statistically significant difference between the two groups (*P*-value = 0.037). Laser group showed statistically significantly higher mean bone density than control group.

Changes by time within each group revealed a statistically significant increase in mean bone density through all follow-up periods in Laser group (group A).However, control group showed a non-statistically significant increase in mean bone density through all follow-up periods

Table (2): The mean differences, standard deviation (SD) values and results of paired t-test for the changes by time in mean bone densities in Laser group

Period	Mean difference	SD	*P*-value
Immediate – 2 weeks	10.3	4	0.047*
Immediate – 1 month	33.7	10.9	0.034*
Immediate – 3 months	48	16.6	0.038*
Immediate – 6 months	76.3	11.9	0.008*

**: Significant at P ≤ 0.05*

Table (3): The mean differences, standard deviation (SD) values and results of paired t-test for the changes by time in mean bone densities in control group

Period	Mean difference	SD	*P*-value
Immediate – 2 weeks	5.3	1.5	0.066
Immediate – 1 month	27.3	11.9	0.058
Immediate – 3 months	31.3	15.3	0.071
Immediate – 6 months	38.7	16.2	0.054

**: Significant at P ≤ 0.05*

4-DISSCUSION

In the present study we choose an immediate placement of implants into fresh extraction sockets as it offers many advantages over the classic protocol and have the potential to increase the patient's acceptance as agreed by *Barazily et al.,(1996)* and *Themar* (1998). It also eliminates the waiting period for socket consolidation, has fewer surgical sessions, a shorter total treatment time, reduced over-all costs, preservation of alveolar bone height and width for optimal functional and aesthetic results, *Ploizzi et al.,(2000).*

However it is reported that immediate implant placement may be adversely affected by the presence of some infection, lack of soft tissue closure and flap dehiscence over the extraction site, may contribute to implant failure, *Le Geros and Criag (1993);Ploizzi et al.,(2000).* Low level laser, as a bone attachment stimulating factors used in this study is recommended when negative factors predictive of poor osseointegration are identified which recommended by *Misska et al..*,(1997).

In the current study the essential primary stabilization of the immediate implant in its osseous location was successfully achieved by using implants of wider size and longer length of 3-5 mm than the extraction sockets, also a tapered implant design was used to compensate for the shape of the tooth root of the maxillary central incisor and to fill the space remaining at the cervical area. This was in agreement with *Missika et al.,(1996)* who recommended primary stability of the immediate implant depended on the implant width, length and design.

The collagen membranes used in our study enhances bone regeneration around immediately placed implants due to four mechanisms; the membrane prevents the mucosal tissue from collapsing into the socket, prevents the soft tissues from the oral cavity to grow into the socket, it stabilizes blood-clot within the socket and prevents growth factors induced by the surgical trauma in the socket to leave the socket, these concepts were accepted by *Werbitt(1992); Mellong and Triplett.*(1993)

In the present study, the used protocol of diode laser provide depth of tissue penetration of the laser energy used in LLLT is 5-10 mm, so both superficial and deeper structures can be affected and this agrees with *Gush and King*(1991).

Bone density were measured for both groups through periapical digital radiographs that were analyzed by Digora software using long cone paralleling technique and this choice in accordance with *Jeffcoat,(1992)* who recommend the same technique.

The use of long cone paralleling technique, to detect bone changes, together with Rinn XCP periapical film holders and individually constructed acrylic resin templates enabled obtaining a series of accurate and reproducible radiographs, as well as, fixing the target to film distance in each follow up period. This is in accordance with the technique used by *Ibrahim(1997)*; *Sakakura et al.,(2006)* reported that direct digital radiography enable the comparison between the sequential follow up images and detect minor changes in bone density, also *Asieh et al,(2011)*confirmed that the standardized densitometry using digital radiography is reliable for bone density measurement around implant in periapical radiography.

In the present study, patients of laser group expressed less pain and swelling compared to the control group in the first three days in the postsurgical period and this is in accordance with *Walsh(1997)* who reported that LLLT accelerate wound healing, reduce inflammatory processes and attenuate pain.

The exposure of the covering screw in one case of laser group may be due to local pressure from removable prosthesis that used for esthetic reason and maintaining the space until the final restoration.

The results of bone density by Digora was found that the mean bone density mesial and distal to the implants of laser group showed statistically significantly higher values than the control group especially at 6 months. These findings are in agreement with *Fulkhner(2001)* who also reported that bone density measurements are important when studying the healing response around dental implants.

While, bone density in control group increased insignificantly, laser group showed significant increase in percentage changes of bone density at all follow up periods and statistically significant higher than control group at six months. These results matched the findings reported by *Radwan,(2005) Harhash(2006); Amr(2008) and Nabila(2009)*

Conclusions

Low level laser therapy has significant effect on bone healing of immediate implants regarding bone density.

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