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Ra'ed Mohammed Ayoub Al-Delayme[1-3]* and Lutfi Ghulam Awazli[4]

[1]Eastman Institute for Oral Health, University of Rochester, School of Medicine and Dentistry, New York, USA
[2]Faculty of Dentistry, Dijlah University College, Baghdad, Iraq
[3]Oral and Maxillofacial Dept., Alyarmouk Teaching Hospital
[4]The Institute of Laser for Postgraduate Studies, University of Baghdad, Iraq

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***Corresponding author:** Ra'ed-Mohammed Ayoub Al-Delayme, Eastman Institute for Oral Health, University of Rochester, New York, USA, Faculty of Dentistry, Dijlah University College, Baghdad, Iraq, Oral and Maxillofacial Dept, Alyarmouk Teaching Hospital, Tel: 314-5701653;
Email: Read_Ayoub@urmc.rochester.edu

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Research Article

Evaluation of the effectiveness of 940nm Diode Laser in second-stage Dental Implant Surgery compared with the Conventional Scalpel Procedure: An *in vivo* Study

Abstract

Background: Modification of the surgical laser technique could make it useful in dental implantology. The incisional mode of the diode laser can be used safely to uncover implants as long as care is taken to prevent heat conduction from surrounding tissues back into the implant.

Purpose: To evaluate the effectiveness of using a 940 nm diode laser in second stage implant surgery compared to a conventional scalpel approach.

Material & Methods: This prospective, intra-individual, double-blind, randomized controlled trial was carried out in the Iraqi specialized dental implant and cosmetics center. Twenty-one patients, with a total of 112 endossous dental implants, were identified as having Osseo integrated dental implants and who were ready for second stage dental implant surgery were divided into two groups: 1) scalpel exposure and 2) laser exposure using a 940-nm diode laser.

Results: The 940 nm diode laser resulted in minimal postoperative pain, decreased edema with less inflammatory response, enhanced homeostasis, and regular wound healing. The laser treatment also decreased the time required for final impression and improved patient health quality life.

Conclusion: The use of a 940 nm diode laser to perform second stage dental implant surgery is effective and can yield better clinical and subjective results compared to the conventional scalpel surgical exposure.

Introduction

A dental implant is a perimucosal device which is biocompatible and bio functional. An implant is placed within the mucosa or on bone associated with the oral cavity to provide support for fixed or removable prosthetics [1]. In both cases, natural teeth or implants support the attached gingiva around the restoration providing long-term, aesthetic and functional prosthetic restorations [2].

The biological width is comprised of sulcus depth, junction epithelium and connective tissue attachment up to the alveolar bone crest. Normal, healthy subjects demonstrate an adequate biologic width when a 2 mm to 2.5 mm distance is present from the base of the gingival sulcus to the height of the crestal bone. In the absence of any periodontal disease there is a normal variation in biologic width around a tooth [3].

There are a variety of commercially available dental implant systems. Each dental implant system varies with branding, patented technology and materials, historical case success rates, and implant system establishment [4].

Sufficient attached gingiva (AG) around the teeth and fixed restorations indicates an absence of local traumatic factors from dental or soft-tissue origin [5].

Different techniques can be used for the second stage of surgical implants, including uncovering the area with a scalpel or puncher, ceramic bur, electrosurgery, partial thickness flap, partial thickness flap and inserted connective tissue graft, and partial thickness flap and free epithelial-connective tissue graft [6-11].

Modification of the surgical laser technique could make it

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useful in dental implantology. The incisional mode of the diode laser can be used safely to uncover implants as long as care is taken to prevent heat conduction from surrounding tissues back into the implant. This is done simply by limiting prolonged exposure [12]. When using the proper wavelength, titanium does not absorb, but rather reflects, the laser energy. Another excellent use of the laser is for removal of any hyperplastic peri-implant tissue [13].

For implant exposure in 2-stage implants, exposure of the osseointegrated dental implant in the second surgical phase can be done using Laser HF (Implant exposure mode, 975 nm, 4W, CW) and healing abutment may be placed [14]. Re-exposure of the Osseo integrated dental implants may be performed using the Laser HF following peri-implant mucositis and a healing abutment can be placed again. A PDT using Laser HF (PDT mode, 660 nm, 50 mW, 30 s interval), in combination with antibiotic therapy for 5 postoperative days can be prescribed [15,16].

The aim of the study is to evaluate the effectiveness of using a 940-nm diode laser in the second stage of implant surgery and compare the results with traditional scalpel approach.

Material and Methods

This prospective study included 21 patients with a total of 112 end osseous dental implant who were identified as having Osseo integrated dental implants and were ready for second stage dental implant surgery. The study was carried out in the Iraqi specialized dental implant and cosmetics center, Baghdad, Iraq, from April 2014 to November 2014. The study protocol was approved by the Laser Institute Committee for Research Ethics Concerning Human Subjects according to Helsinki guidelines

The patients included 12 (57.14%) males and 9 (42.85%) females with a total of 112 implants. Their ages ranged from 18 to 61 years. All patients had more than one dental implant, and 15 (71,14%) patients had a history of partial edentulous, 4 (19.04%) had complete edentulous in both the upper or lower jaws, and 2 (9.52%) had full upper and lower jaws.

The details of the surgery were verbally explained to the patients. Patients were examined and evaluated clinically and by radio graphically. All patients had Osseo integrated dental implants.

In this prospective, intra-individual, double-blind, randomized controlled trial, patients underwent at least two previous dental implants. They were not given any preoperative medications. They were divided into two groups: 1) scalpel exposure and 2) laser exposure.

The scalpel exposure group consisted of 10 patients who had 56 dental implants and their ages was from 20-59 with the mean age 35.37 ± 15.89 years at the time of operation. The Laser exposure group consisted of 11 patients who have 56 dental implant with age range was 18-61 with the mean 41.28 ±19.52 years at the time of operation.

All patients were routinely examined using conventional panoramic radiographs. Demographic and clinical data, including information concerning patient age, sex, clinical presentation, past surgical history, and medical history were recorded. The report includes the following parameters:1) gingival status, 2) soft tissue thickness (STT) was determined using a dental probe with a rubber stop, 3) oral hygiene, 4) bone quality, and 5) the duration of surgical operation of each group. With regards to number (4), all implant sites were classified as bone type II (implant bone site with a thick layer of compact bone surrounding a core of dense trabecular bone) or bone type III (implant bone site with a thin layer of compact bone surrounding a core of dense trabecular bone) according to Lekholm and Zarb [17].

Patient inclusion criteria were: delayed loading dental implant, delayed insertion dental implant, two stage protocol of dental implant, and healthy keratinized gingival tissues.

The exclusion criteria were: any systemic diseases affecting bone metabolism or wound healing, smokers, failed dental implant, any signs of inflammation or signs of peri-implant inflammation, patients who missed examination appointments, radiolucent line around the dental implant, exposed dental implant and parafunctional habits which could influence osseointegration.

Implant procedure protocols

Patients received at least two dental implants with a minimum length of 12 mm (taper, external hexagon connection; BioHorizons, Laser-Lok, USA.)

Implant placement was performed by the same surgeon and according to the manufacturer's recommended protocol using labially or buccaly based flap. All surgical procedures were performed without intercurrences, and post-operative follow up was favorable for all patients. Each of the 21 patients was radiographed immediately after surgery and at 3 month and 6 months flow up.

After completion of the osteointegration period, the second stage was performed for each patient and the environment preparations in both groups was the same.

In the scalpel group the exposure was made in an ordinary manner using the scalpel to create a circular incision smaller than the size of the dental implant and using infiltration local anesthesia.

In the laser group the soft tissue was excised using the 940-nm laser diode excision preprogrammed system with minimum time between two sides is one wee

Application of a topical anesthesia or local infiltration technique was used if needed. A small opening was made using the 940 nm laser diode and the opening was widened until the cover was fully exposed. We used a diode laser (commercial trade mark epic biolase), which emits a wavelength of 940 +/- 10 nm, and a power output of 0.4-10 W in a pulse duration of 100 microseconds, and a pulse interval of 200 microseconds, with a duty cycle 33%. The optic fiber used was 300 µm with a length of 9 mm. The power used was 0.9 W, and the mode was

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continuous emission CP1 (Comfort Pulse). The aiming beam was a visible laser diode, max 1 mW, 625– 670 nm, continuous or intermittent.

The excision program was selected for uncovering the dental implant using the laser device. The power used was 0.9 W, the mode was pulsed emission CP1 (Comfort Pulse), pulse duration was 100 microseconds and pulse interval 200 microseconds, duty cycle (33%) and the optic fiber used was 300μm with a length of 9 mm. The laser was used to create a small opening, which was increased until any part of the cover screw appeared. Next, ablation of the tissue over the implant was performed until the surgical opening became just large enough to allow removal of the screw. In both groups the healing screw was opened and the gingival healing abutment was inserted inside the dental implant according to the size and shape of the implant used .

Patient assessment

Operative assessment : For comparison of the two techniques, the following parameters were assessed by a well-trained qualified person who was blind to the study group:

Soft tissue thicknesses

The need for local anesthesia

The duration of surgery (in min)

Intraoperative bleeding, rated by the surgeon on a three-point category rating scale (1 = minimal bleeding; 2 = normal bleeding; 3 = excessive bleeding)

Pain, which was evaluated with the aid of a 100-mm visual analogue scale (VAS)

Postoperative assessment : All the patients in both groups were assessed at the 1st, 2nd and 3rd week postoperatively by a well-trained qualified person who was blind to the study group. Assessment criteria included the following:

Gingival bleeding evaluated by

Naked eye seen by opening of the gingival former

Bleeding in probing (using periodontal probe), according to the following modified criteria:

0 No bleeding

1 Only one bleeding point

2 Several isolated bleeding points or a small blood area

3 Cavity filled with blood soon after probing.

4 Profuse bleeding when probing, blood spread outside the cavity

Gingival color using following modified gingival index

Normal gingiva color.

Slight change in color, slight edema.

Moderate redness and glazing.

Marked redness.

The absence or presence of soft tissue edema.

Need for second correction.

Time for impression taking.

Statistical analysis

Statistical analysis was performed using SPSS13.0 (Statistical Package for Social Sciences, Chicago, Ill). The paired *t* test was used for analyzing the parameters predicting the changes of the scalpel and laser group.

Results

All the patients returned for follow up, no patient was excluded in the post-operative period. Our results depend mainly on clinical observations, patient complaints, postoperative clinical index, and follow-up appointments at different postoperative times.

Operative assessment results

Prior to second stage the soft tissue thickness (STT) was determined using a dental probe with a rubber stop in both groups. STT was nearly equal in both group with no significant differences.

We used infiltration local anesthesia for all surgical scalpel implants but we only needed to provide infiltration local anesthesia to 4 patients in the laser group. The mean operation time was significantly longer in the laser group. The statistic result of bleeding index showed that the laser group had significantly less bleeding. The VAS result also showed a significant difference with a lower VAS mean in the laser group as shown in table 1.

Postoperative assessment results

The site was evaluated at the 1st, 2nd and 3rd post-operative week in both groups. The bleeding was evaluated by two approaches: 1) immediately after opining of the abutment healing and 2) by the bleeding index using periodontal probe. Examination of the laser exposure confirmed significant less bleeding compared to the scalpel procedure.

Table 1: Operative assessment in both groups.

	Scalpel group	Laser group	P value
Soft tissue thicknesses at the time of second stage (mm)	0.83	1.54±.63	1.68±0.49
Cases Need for infiltration local anesthesia	0.001†	4(7.14 %)	56(100%)
Mean of surgical duration procedure in (min)	0.018*	2.18±.75	1.25±.30
Intraoperative bleeding	0.003†	1.02±.47	2.16±.22
Pain (VAS)	0.011*	16.54±1.82	32.84±2.56

Abbreviation: *P <.05.;†P <.01.

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With regards to gingival color, both groups were similar in the 1st post-operative week, while at the 2nd and 3rd post-operative weeks the gingival tissue was significantly closer to the normal healthy gingiva in the laser group. The same result was obtained regarding peri-implant soft tissue edema with no edema in any patient by the end of the 3rd post-operative week. By the 2nd and 3rd weeks, we were unable to confirm that any case required secondary corrections, but by the 3rd week 7 cases in the scalpel group required secondary correction, while no case in the laser group needed secondary correction as shown in table 2.

All of these previous factors indicate that impressions can occur in the 1st post-operative week. We took split impression for cases in the laser group which did not interfere with the final prosthetic design. In the scalpel group, we were unable to take any impression in the 1st week, and instead needed to wait until the rest of cases in the laser group finished in the end of second post-operative week, in scalpel group, three of cases still need additional time.

Discussion

The goal of second stage surgery is to create keratinized gingiva that is free from the attached gingiva and extends from the gingival margin to the mucogingival junction [18]. This can be produced by different methods. The aim of this prospective, intra-individual, double-blind, randomized controlled trial was to create a combination of keratinized and non-keratinized peri-implant mucosa with less tissue destruction compared to standard surgical methods.

Lang and Loe [19], published the first controlled clinical study that examined the relationship between the width of keratinized gingiva and gingival health. They reported that over 80% of tooth sites with at least 2 mm of keratinized gingiva (with at least 1 mm being attached) showed gingival health, whereas the sites with less than these parameters had varying amounts of gingival inflammation.

A combination of keratinized and nonkeratinized peri-implant mucosa gives the prosthetic restoration a more natural look [20]. Cochran *et al.* (21), proposed that a minimum of 3 mm of peri-implant mucosa, referred to as the biologic width, is required for a stable epithelial connective tissue attachment to form and serves as a protective mechanism for the underlying bone [22]. The establishment of the biologic width around teeth also involves crestal bone loss as was observed in a surgical tooth lengthening study by Oakley and coworkers [23].

Three methods for cutting oral soft tissues are used commonly in dentistry, namely blade, electro surgery and laser, and each of these methods works well [24].

Diode laser provides great benefit over many other lasers because of its small size. The diode laser also provides a wide spectrum of utility in many medical fields ranging from physiotherapy, photodynamic therapy and surgical excision. Another important advantage of the diode laser is that it transmits through an optic fiber that can be easily used in different regions [25].

The wavelength of the diode laser is considerably more absorbed due to its hemoglobin choromophore [26]. This initial test of the effectiveness of laser vaporization method showed that the precise cutting tool minimally changed the adjacent tissue, coagulation and sealing of small vessels is excellent and this lead to less post-operative bleeding [27].

Soft tissue management around dental implants can be difficult to solve with traditional means such as electrosurgery or surgical blades. Many monopolar electrosurgery units can reverse osseointegration with inadvertent contact with the implants after a matter of seconds [28,29].

In a two stage technique where an implant is placed surgically and covered with soft tissue in the initial stage, the implant must be uncovered at the second stage. If the implant is crestal or slightly supra crestal, and there is adequate soft tissue existing, the diode laser can be used to safely remove overlying soft tissue [30,31].

In our study, the time to perform laser exposure was prolonged compared to the time required with scalpel

Table 2: Postoperative assessment in different times in both groups.

		1st P.O. week			2nd P.O. week			3rd P.O. week		
Criteria	Index	Scalpel group	Laser group	P	Scalpel group	Laser group	p	Scalpel group	Laser Group	p
Bleeding	Seen by opening	54(96.4)	16(28.5)	0.000‡	23(41)	2(3.5)	0.000‡	3(5.3)	0	0.000‡
	Bleeding on probing	3.9±.56	2.1±.34	0.007†	2.8±.69	0.45±.65	0.007†	1.7±.5	0	0.000‡
Gingival color	Gingival index	3.7±.22	2.7±.43	0.053	3.56±2.77	2.1±1.44	0.007†	2.5±.95	1.33±.62	0.000‡
Preimplant soft tissue edema,	Present	41(73.2)	11(19.6)	0.149	19(33.9)	0	0.008†	0	0	
	Absence	15(26.7)	45(80.3)		37(66)	0		0	0	
Secondary correction	Need	N/P	N/P		N/P	N/P		7	0	0.000‡
	No need	N/P	N/P		N/P	N/P		49	0	
impression taking		0	37(66)	0.000‡	18(32.1)	19(33.9)	0.49*	31(55.3)	0	0.000‡

Abbreviation: N/P. not applicable; *P <.05. †P <.01; ‡P<.001.

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exposure, but this is not always true as the laser may in some cases shorten the operation time. The duration of time may be affected by the skill of the operator, the equipment available and the clinical entity of the gingival tissue [32].

The use of high power, short pulse durations and high frequencies offers a high cutting speed and a deeper cut similar to the cw-mode, but using the super pulsed mode will make the margins of the cut more defined and straighter [33,34].

Our statistical analysis of immediate post-operative pain sensation revealed that the same patient experienced significantly less pain during the laser procedures compared to the conventional scalpel procedure because the thermal necrosis created by the tissue vaporization sealed the ends of sensory nerves, decreasing their ability to transmit stimuli [35], in addition to the fact that protein denaturation decreased the pain [36].

Reports of pain relief mechanisms appear to originate in stimulating oxidative phosphorylation in mitochondria and through modulating inflammatory responses [37]. In addition, the extraordinary rapid cell vaporization with loss of intracellular fluid, chemical mediators (cytokines) and denaturation of intracellular substance and protein is posited to result in a markedly less intense local inflammatory response and consequently less local pain, edema and cicatrix formation [38,39]. This may explain the need for less local anesthesia during laser surgery compared to the scalpel incision in our study and in the previous study [40].

In addition, the immune reaction component presents a range of diode laser treatments antigen, antibodies, cytotoxic protein and sub-epithelial lymphocyte are all denaturated due to deeper penetration of the laser. This means that destruction of the diseased epithelium with its surface anti-gene, decreases the risk of edema, and the dressing layer of denaturated protein enhances healing with less risk of secondary infection [41]. The bactericidal effect may reduce inflammation in oral and dental treatment which decreases the incidences of infection [42]. This observation confirmed in this study in all postoperative period.

During treatment coagulation was very good during operative laser procedure which is in agreement with a related article [43-45], which stated that improved hemostasis through enhanced coagulation can occur with laser use. This mechanism occurs when at least two scenarios are observed: tissue absorption and a controlled heat build-up, resulting in coagulation of blood proteins and sealing of small diameter vessels [46,47], The warming of tissue to more than 60°C will result in protein denaturation and coagulation [48], which are useful properties to control bleeding.

A second stage surgical procedure for dental implant was attempted using the 940 nm diode laser, which confirmed that laser exposure decreases discomfort and improves operative and post-operative results. Unfortunately, there are similar studies has been conducted except the studies of El-Kholey [49], but the study was between the different groups without intra-individual observations, and the diode 940 nm width varied.

The advantages of using lasers in implant dentistry are the same as for any other soft tissue dental procedure. These advantages include increased hemostasis, minimal damage to the surrounding tissue, reduced swelling, reduced infection, and reduced pain postoperatively. Due to the hemostasis provided by lasers, there is a significant advantage of improved visibility during surgery [45]. One advantage of the use of lasers in implantology is that impressions can be taken immediately after the second stage of surgery because there is little blood contamination in the field due to the hemostatic effect of the lasers. There also is minimal tissue shrinkage after laser surgery, which assures that the tissue margins will remain at the same level after surgery. In addition, the use of the laser can eliminate trauma to the tissue flap reflection and suture placement [50].

Conclusion

The use of a 940nm diode laser to perform second stage dental implant surgery is effective and improves clinical and qualitative results compared to the traditional scalpel surgical exposure, including minimal postoperative pain, edema with less inflammatory response with enhance homeostasis and regular wound healing, all of which decrease the time required for taking the final impression and improving patient health quality life.

References

1. Gahlert M, R.Ohling S, Wieland M, Sprecher CM, Kniha H, et al. (2009) Osseointegration of zirconia and titanium dental implants: a histological and histomorphometrical study in the maxilla of pigs. Clinical Oral Implants Research 20: 1247-1253. Link: https://goo.gl/UGtdJq

2. Jarmar T, Palmquist A, Brånemark R, Hermansson L, Engqvist H, et al. (2008) Characterization of the surface properties of commercially available dental implants using scanning electron microscopy, focused ion beam, and high-resolution transmission electron microscopy. Clin Implant Dent Relat Res 10: 11-22. Link: https://goo.gl/XmHzLF

3. Quirvnen M, Van Assche N, Botticelli D, Berglundh T, (2007) how does the tuning of implant placement to extraction affect outcome? Int J Oral Maxillofac Implants 22: 203-223. Link: https://goo.gl/6CqJVW

4. Palma-Carrió C, Maestre-Ferrín L, Peñarrocha-Oltra D, Peñarrocha-Diago MA, Peñarrocha-Diago M (2011) Risk factors associated with early failure of dental implants. A literature review. Med Oral Patol Oral Cir Bucal 16: e514-e517. Link: https://goo.gl/5MWccs

5. Brisman DL (1996) the effect of speed, pressure and time on bone temperature during the drilling of implant sites. Int J Oral and Maxillo fac Implants 11: 35-37. Link: https://goo.gl/SGrq5H

6. Beagle JR (1992) Surgical reconstruction of the interdental papilla: case report. Int J Periodontics Restorative Dent 12: 145-151. Link: https://goo.gl/DVMyVc

7. Matthews DP (2008) the pediculated connective tissue graft: a novel approach for the "blown-out"' site in the esthetic zone. Compend Contin Educ Dent 29: 350-357. Link: https://goo.gl/t6EBo8

8. Misch CE, Al-Shammari KF, Wang HL (2004) Creation of interimplant papillae through a split-finger technique. Implant Dent 13: 20-27. Link: https://goo.gl/uPdXYZ

Citation: Al-Delayme RMA, Awazli LG (2017) Evaluation of the effectiveness of 940nm Diode Laser in second-stage Dental Implant Surgery compared with the Conventional Scalpel Procedure: An *in vivo* Study. Int J Oral Craniofac Sci 3(2): 039-045. DOI: http://doi.org/10.17352/2455-4634.000030

9. Nemcovsky CE, Moses O, Artzi Z (2000) interproximal papillae reconstruction in maxillary implants. J Periodontol 71: 308-314. Link: https://goo.gl/UwGG9q

10. Salama H, Salama M, Garber D, Adar P (1995) Developing optimal peri-implant papillae within the esthetic zone: guided soft tissue augmentation. J Esthet Dent 7: 125-129. Link: https://goo.gl/5qmWQe

11. Scharf DR, Tarnow DP (1993) the effect of crestal versus mucobuccal incisions on the success rate of implant osseointegration. Int J Oral Maxillofac Implants 8: 187-190. Link: https://goo.gl/wdDVL9

12. Deppe, H, Horch HH (2007) Current Status of Laser Application in Oral and Cranio-Maxillofacial Surgery. Medical Laser Application 22: 39-42. Link: https://goo.gl/MtCH46

13. Romanos GE (2003) Laser Surgical Tools in Implant Dentistry for the Long-Term Prognosis of Oral Implants. International Congress Series 1248-109-114. Link: https://goo.gl/x8aL7V

14. Giannini, R, Vassalli M, Chellini F, Polidori L, Dei R, et al. (2006) Neodymium: yttrium Aluminium Garnet Laser Irradiation With Low Pulse Energy: a Potentional Tool for the Treatment of Periimplant Disease. Clinical Oral Implants Research 17: 638-643. Link: https://goo.gl/pLnb9y

15. Pjetursson BE, Tan K, Lang NP, Brägger U, Egger M, et al. (2004) A systematic review of the survival and complication rates of fi xed partial dentures (FDPs) after an observation period of at least 5 years-I: Implant supported FDPs. Clin Oral Implants Res 15: 643-653. Link: https://goo.gl/L3dsbN

16. Gallucci G, Benic G, Eckert,S, Papaspyridakos P, Schimme M, et al. (2014) Consensus Statements and Clinical Recommendations for Implant Loading Protocols. Int J Oral Maxillofac Implants 29: 287-289. Link: https://goo.gl/7VCCae

17. Brånemark, Per-Ingvar, Zarb, George A, Albrektsson T (1985) Tissue-integrated prostheses; osseointegration in clinical dentistry. Quintessence Link: https://goo.gl/1TUcqZ

18. Ainamo J, Loe H (1966) Anatomical characteristics of gingiva. A clinical and microscopic study of the free and attached gingiva. J Periodontol 37: 5-13. Link: https://goo.gl/iDDhns

19. Lang NP, Loe H (1972) the relationship between the width of keratinized ginigiva and gingival health. J Periodontol 43: 623-627. Link: https://goo.gl/tqzV7Y

20. Hurzeler MB, Weng D (1996) a new technique to combine barrier removal at dehisced implant sites with a plastic periodontal procedure. Int J Periodontics Restorative Dent 16: 149-163. Link: https://goo.gl/wfVTwu

21. Cochran DL, Hermann JS, Schenk RK, Higginbottom FL, Buser D (1997) Biologic width around titanium implants. A histometric analysis of the implanto-gingival junction around unloaded and loaded nonsubmerged implants in the canine mandible. J Periodontol 68: 186-198. Link: https://goo.gl/vHtfy8

22. Lindhe J, Berglundh T, Ericcson I, Liljenberg B, Marinello CP (1992) Experimental breakdown of periimplant and periodontal tissues. A study in the beagle dog. Clin Oral Implants Res 3: 9-16. Link: https://goo.gl/ZgQi7o

23. Oakley E, Rhyu IC, Karatzas S, Gandini-Santiago L, Nevins M, et al. (1999) Formation of the biologic width following crown lengthening in nonhuman primates. Int J Periodontics Restorative Dent 19: 529-541. Link: https://goo.gl/xGckNe

24. Ramirez AM, Silvestre FJ, Simo JM (2007) Oral biopsy in dental practice. Med Oral Patol Oral Cir Bucal 12: 504-510. Link: https://goo.gl/feKfie

25. Goharkhay K, Moritz A, Wilder-Smith P, Schoop U, Kluger W, et al. (1999) Effects on oral soft tissue produced by a Diode laser in vitro. Laser Surg Med 25: 401-406. Link: https://goo.gl/gs3aDS

26. Wilder-Smith P. Arrastia AM, Liaw LH, Berns M. incision properties and thermal effects of thoursee Co2 laser in soft tissue. Oral Surg Oral Med Oral Pathol Oral Radio Endod 1995; 79: 685-691.

27. Sauerio, C, Eugenio M, Francesco S, Gianfranco F (2008) Fibrolipoma of the lip treatedby diode laser Surgery: a case report. Journal of Medical case reports 2: 301. Link: https://goo.gl/gQnctA

28. Massei G, Szmukler-Moncler S (2004) Thermo-explantation. A novel approach to remove osseointegrated implants. European Cells and Materials 7: 48. Link: https://goo.gl/L2h4xp

29. Wilcox Cw, Wilwerding TM, Watson P, Morris JT (2001) Use of electro surgery and lasers in the presence of dental implants. Int J Oral Maxillofac Implants 16: 578-582. Link: https://goo.gl/LQij58

30. Catone GA. Lasers in periodontal surgery. In: Catone GA, Alling CC (eds) Laser applications in oral and maxillofacial surgery. Saunders, Philadelphia. 1997; 181- 196.

31. Romanos GE, Everts H, Nentwig GH (2000) Effects of diode and Nd:YAG laser irradiation on titanium discs: a scanning electron microscope examination. J Periodontol 71: 810-815. Link: https://goo.gl/438eGK

32. Guy A, Charles C: Laser applications in oral and maxillofacial surgery. Chap Ten. laser management of discrete le-sions.1997; 115-116.

33. Stübinger S, Saldamli B, Jürgens P, Ghazal G, Zeilhofer HF (2006) Soft tissue surgery with the diode laser- theoretical and clinical aspects. Schweiz Monatsschr Zahnmed 116: 812-820. Link: https://goo.gl/gCzg7C

34. Black P (2007) Der Dentallaser in der oralen Chirurgie-Masterthese-Teil2 Laser Journal 16-21. Link: https://goo.gl/JMcsx8

35. Gold SI, Vilardi MA (1994) Pulsed laser beam effects on gingival. J Clin Periodontal 21: 391-396. Link: https://goo.gl/Y6FPJq

36. Muna S, Ahmed ELK, Ali S (2005) Egyptian Dermatology online J 1: 3. Link: https://goo.gl/8PrUPr

37. Walsh LJ, Goharkhay K, Verheyen P, Moritz A Low level laser therapy. Chapter 13 in: Moritz A, Beer F, Goharkhay K, Schoop U, Strassl M, Verheyen P, Walsh LJ, Wernisch J, Wintner E. Oral Laser Application. Berlin, Germany. Quintessenz Verlags-GmbH, 2006; 521-539:

38. Strong MS, Jako GJ, Polanyi T, Wallace RA (1973) Laser surgery in the aero digestive tract. Am J Surg 126: 529-533. Link: https://goo.gl/wc9Q39

39. Tuffin JR, Carruth JA (1980) The carbon dioxide laser. Br Dent J 149: 255-258. Link: https://goo.gl/yTPGiR

40. Shuller DE (1990) Use of the laser in the oral cavity. Otolaryngology Clin North Am 23: 31-42. Link: https://goo.gl/KkyYgh

41. Mortiz A, Schoop U, Gharkhay K, Wermisch J, Sperr W, et al. (1998) treatment of periodontal pockets with a diode lasers. Laser Surg Med 22: 302-311. Link: https://goo.gl/oMXnZ5

42. Wilder-Smith P, Dang J, Kuroseki T (1997) Investigating the range of surgical effects on soft tissue produced by carbon dioxide laser. JAM Dent Associ 128: 583-588. Link: https://goo.gl/Py2YBf

43. Pedron IG, Ramalho KM, Moreira LA, de Freitas PM (2009) Association of two lasers in the treatment of traumatic fibroma: Excision with Nd:YAP laser and photobiomodulation using InGaAlP. A case report. J Oral Laser Appl 9: 49-53. Link: https://goo.gl/oXyykr

44. Miyazaki H, Kato J, Watanabe H, Harada H, Kakizaki H, et al. (2009) Intralesional laser treatment of voluminous vascular lesions in the oral cavity. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 107: 164-172. Link: https://goo.gl/PwwnBG

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45. Genovese WJ, dos Santos MT, Faloppa F, de Souza Merli LA (2010) The use of surgical diode laser in oral hemangioma: A case report. Photomed Laser Surg 28:147-151. Link: https://goo.gl/TtFrk5

46. Black JF, Wade N, Barton JK (2005) Mechanistic comparison of blood undergoing laser photocoagulation at 532 and 1,064 nm. Lasers Surg Med 36: 155-165. Link: https://goo.gl/dShXZv

47. Black JF, Barton JK (2004) Chemical and structural changes in blood undergoing laser photocoagulation. Photochem Photobiol 80: 89-97. Link: https://goo.gl/PJioRM

48. Knappe V, Frank F, Rohde E (2004) Principles of lasers and biophotonic effects. Photomed Laser Surg 22: 411-417. Link: https://goo.gl/6jppyD

49. El-Kholey KE (2014) Efficacy and safety of a diode laser in second-stage implant surgery: a comparative study. Int. J. Oral Maxillofac. Surg 43: 633-638. Link: https://goo.gl/hM4j25

50. Martin E (2004) Lasers in dental implantology. Dent Clin N Am 48: 999-1015. Link: https://goo.gl/MBLBGs

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