

Non Anesthetic Second Stage Implant Surgery by 970 nm Diode Laser

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Abstract: The second-stage surgery of submerged implants can be performed with soft tissue lasers with minimal bleeding, trauma, and pain. This study was designed to assess dental implant uncovering with a 970 nm diode laser without anesthesia, and to compare its performance with traditional cold scalpel surgery. Fifty patients with a completely osseointegrated implants participated in this study. Patients were divided into two groups. For the study group, second-stage implant surgery was done with a 970 nm diode laser in a 3W power. For the control group, the implants were exposed with a surgical blade. Certain parameters were used for evaluation of the two techniques. The use of the diode laser obviated the need for injected local anesthesia; there was a significant difference between the two groups regarding the need for anesthesia, duration of surgery, postoperative pain, time for healing and taking the impression ($P < 0.0001$). The 970 nm with 3W diode laser cuts tissue precisely without infiltrative anesthesia and with excellent homeostasis. Because of lower amount of tissue destruction with the laser surgery the gingival contours seem to be stable after laser implant recovery procedure. Thus laser technique provides an efficient, safe, and patient-friendly method for the performance of second-stage implant surgery, allowing a faster rehabilitation phase.

Keywords: Diode Laser, Implant uncovering.

I. Introduction

One of the most interesting uses of lasers in implant dentistry is When lasers are used for uncovering in second stage implant surgery providing less postoperative pain, less bleeding, and faster healing[1] There was a concern in the past about using lasers around dental implant as it may damage the topography of the implant surface Kreisler et al compared the effects of various laser wavelengths on titanium implants he concluded that NdYAG and HoYAG lasers are contraindicated on osseointegrated implant surface irrespective of power output, the Er:YAG and Co2 output powers must be limited to avoid implant damaging while (Gallium-Aluminum-Arsenide (GaAlAs)) are safely used as no structural damage to the implant surface was occurred after laser irradiation[2]. The diode wavelength is poorly absorbed by titanium and the implant body temperature did not elevate significantly during laser exposure[3] The ability of the diode laser not to effect neither polished titanium or SLA disks was confirmed by Stubinger et al[4]. Stubinger also showed that the, diode lasers seem to be the only laser systems offering surface preservation and safely used with Zirconia implants[5]. Diodes come in different wavelength, the energy from these lasers targets pigments such as hemoglobin and melanin in the soft tissue. This energy is delivered by a fiber in contact mode. By conditioning, or carbonizing, the fiber, the tip heats up this heat is transferred to the tissue and effectively cuts by vaporizing the tissue. The tissue is vaporized because of the physical contact of the heated tip of the laser with the tissue, rather than from the optical properties of the laser light itself[6] except for the 980-nm (970 nm \pm 15 nm) diode laser has significantly higher absorption in water, which makes it cuts more optically than thermally, with an optical penetration of less than 300 microns (μ m) this makes a 980-nm diode laser potentially safer and therefore more useful around implants[7]. it has excellent properties of incision, excision and coagulation of the soft tissues. The clinical findings were excellent Intra and postoperatively, due to its sufficient cutting abilities, precise incision margin, excellent coagulation effect, and extremely small zone of thermal necrosis in surrounding tissues[8].

The tissue ablation of diode laser, at times without the need for anesthetic, while controlling bleeding, provide the surgeon a great view of the surgical site. Finally we try to study the effect of 970nm diode laser on the oral soft tissue covering the dental implant during the exposure phase of second stage surgery and select the appropriate parameter which giving the excellent performance of that wavelength and comparing it with conventional cold scalpel surgery.

II. Patients And Methods

Before starting with this study a pilot study was done to evaluate (clinically) the effects of 970 nm diode laser on oral soft tissue, defining the most appropriate applied laser power to achieve tissue cutting in effective and safe way. The Clinical in vitro preliminary study had shown that soft tissue surgery done by 3W laser power was more reasonable as doing the same procedure by a power of 2W, 2.5W and 3.5W.

Carbonization and thermal damage of the adjacent tissue can be reduced to a minimum, the soft tissue cut can be done faster, the cut is more precise and the healing is faster ,thus the impression could be taken after a week.

This clinical study included fifty patients requiring surgical uncover of previously placed dental implant;28 were women and 22 were men, and they ranged in age from 20 to 60years.Details of the treatment were discussed with the patients, and all signed an informed consent agreement .The patients were then divided into two groups using a simple randomization procedure:

A-The control group comprised 24 patients. For these patients, the implants were exposed through incision using a No. 15 surgical blade with infiltrated anesthesia. Small circular incision was made to expose the dental implant in most cases ,some cases treated through raising a partial thickness flap .

B-The study group comprised 26 patients. For these patients, the second-stage surgery was done using a 970 nm diode laser system (SIROLaserAdvance; Sirona Dental Systems GmbH, Germany) The programme for implant uncovering was selected by moving between the integrated programmes in the device. The power used was 3 W, the mode was continuous emission, and the optic fiber used was 320µm in diameter. In most of the patients, no injectable anesthesia was used, only topical anesthesia; however, 2patients felt some pain, so local anesthetic was infiltrated.

The implant sites were assessed with the help of the dental probe, then the laser was used to create a small opening, which was increased until any part of the cover screw appeared. Next, removal of the tissue over the implant was performed until the surgical opening became just large enough to allow removal of the screw. After this step, the cover screw of the implant was removed and a suitable healing abutment was attached.

While the laser was in use, an assistant was asked to hold the suction tip near the area of surgery, and a saline drip was applied to the surgical site.

Application of the laser was intermittently stopped every 15–20 seconds to examine the tissues for any burning effects to the gingiva and to avoid any increase in soft tissue or bone temperature.

Postoperatively, no patients were prescribed antibiotics. For analgesia, paracetamol 500 mg four times daily was prescribed only when necessary.

The patients were asked to return after 1 week. A clinical assessment of the peri-implant tissues was made at the end of surgery and again 7 days after the operation, to evaluate the healing status and the possibility of taking an impression. The absence or presence of soft tissue inflammation, edema, gingival bleeding, and pain was assessed.

The evaluation of tissue healing was done by discussion with the prosthodontic staff who were blinded to the technique used for implant uncovering.

For comparison of the two techniques, the following parameters were assessed:(1)the need for local anesthesia and the amount used during surgery (in ml). (2)The duration of surgery (in second).(3) Intra operative bleeding, rated by the surgeon on a four-point category rating scale (0=no bleeding ,1 = minimal bleeding; 2 = normal bleeding; 3 = excessive bleeding).(4) Subjective pain, which was evaluated with the aid of a visual analogue scale (VAS), with 0 anchored by ‘no pain’ and 5 anchored by ‘worst pain imaginable’. The patients were instructed on how to use the VAS and recorded the intensity of postoperative pain daily for the first 7 days. The patients were also asked to record their use of analgesic medication during the postoperative period.(5)The possibility of taking an impression seven days after surgery.

III. Statistical Analyses

Statistical analyses were undertaken using SPSS version 15 for Windows soft-ware (SPSS Inc., Chicago, IL, USA); Significance of difference was assessed using Student-t test for two independent means. The significance level was set as $p < 0.0001$.

IV. Results

On comparing the laser-treated patients to the patients managed with a blade there was a significant difference between the two groups regarding the need for anesthesia ($P < 0.0001$).Only two of the twenty six patients in the study group needed infiltration of a small amount of local anesthetic (0.55ml) and the rest of the patients tolerated the procedure with only topical anesthesia. In contrast, all the control patients required infiltration of anesthesia in the buccal and lingual or palatal side (the mean volume of local anesthetic used was 1.37ml) see Table(1)

Table (1) The mean and the standard deviation of the amount of injected anesthesia in the laser and scalpel wound groups.

Patients	Patients who had infiltration anesthesia, n (%)	Mean of the amount of anesthesia in ml	Std. Deviation
Study group	7.69%	0.0423***	0.14946
Control group	100%	1.371	0.479

t=13.001 which reveals high significant difference for $P < 0.0001$

The post-operative experience of pain is a complex phenomenon, influenced by psychological, environmental and physical factors. VAS(visual analog scale) is a reliable method to assess pain in clinical settings. In the study group 21 of 26 patients felt 0 no pain and only five patients felt slight annoying pain where no patients feels neither little ,lots of nor very strong pain. While in control group only 4 of 24 patients felt 0 no pain ,14 patients felt slight annoying pain ,4 patients felt little pain and 2 patients felt more than little pain see Fig. (1) showing that the laser surgery more comfortable than scalpel surgery.

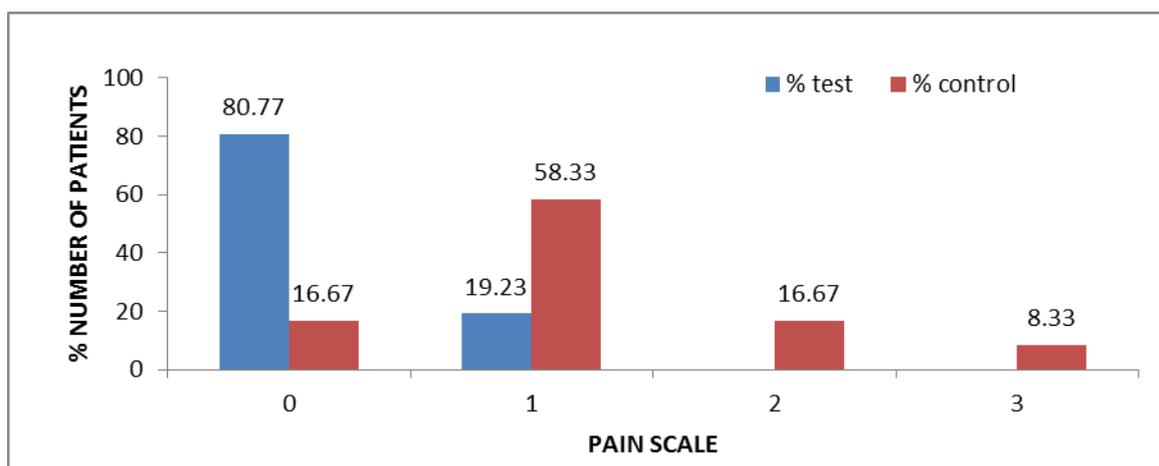


Fig. (1): Difference in pain scale between the two groups.

A peri-implant soft tissue evaluation was performed 7 days after surgery. In the laser-treated group, the surgical sites of 23 of 26 patients had healed completely at the 7-day appointment and there were no signs of inflammation, redness, burning, or oedema. The patients needed no post-operative analgesics. The impressions could be taken at 1 week after the laser surgery .only in three patients healing was satisfactory at 7 days after surgery, but there was some oedema at the gingival margins; therefore the impressions were taken after an additional 3 days.

In control group healing took longer time and the mean of time of taking the impressions for the scalpel-treated patients was 11.96 days, while it was 7.35 days for the study group. The difference between the two groups regarding this variable was highly significant ($t = 14.973$ for $P < 0.0001$) Fig. (2) shows the results in some of the cases.

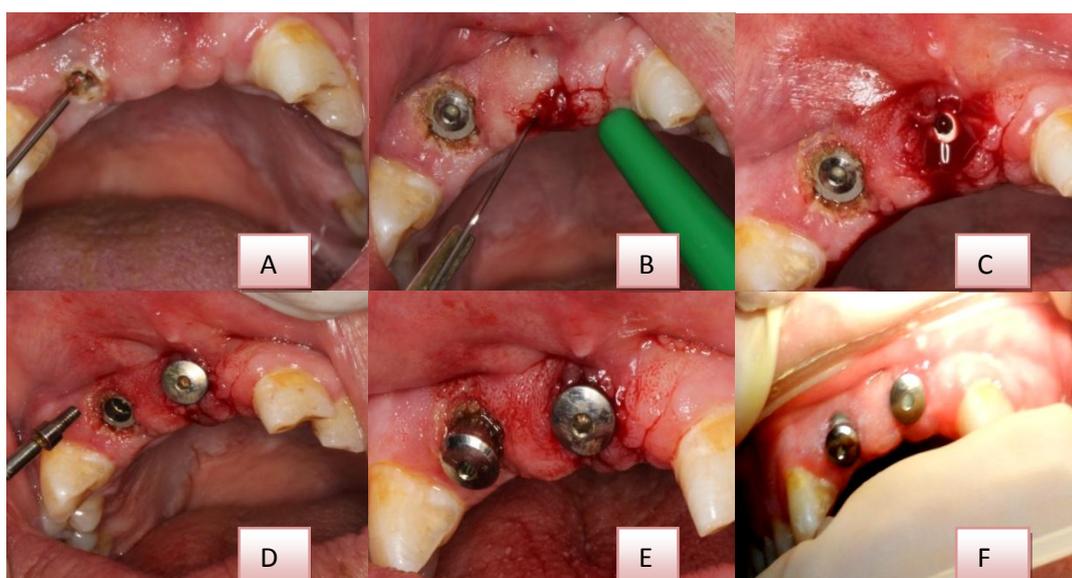


Fig.(2):The exposure of two implants replacing the central incisors the right dental implant by using the laser and the left one by using scalpel and the difference of the two technique in regarding to bleeding. A- During laser surgery B-After laser treatment &during conventional technique C-After exposure of the

two implant and the difference in bleeding D-Removing the cover screw the laser treated one with no bleeding E-the gingival formers of the two implants were in place F- After ten days shows complete healing of the laser treated one while slight oedema and redness of gingiva in the scalpel treated one.

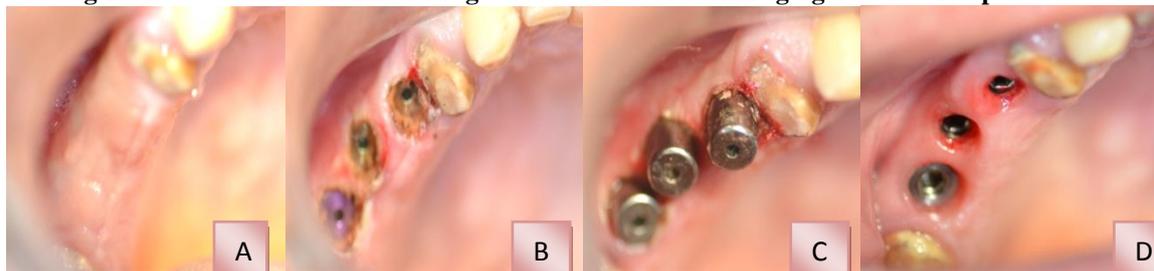
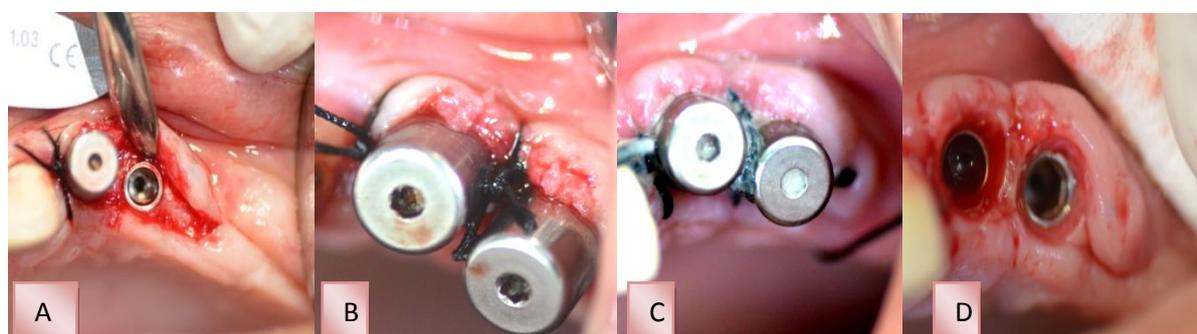


Fig.(3): The second stage uncovering of three maxillary implants with the tissue friendly diode laser scalpel 970nm in a very short time which was taken 45 seconds for each one. A-Before treatment B-Atraumatic implant exposure with precise cutting edge C-Bloodless surgical site no need for suturing with gingival former in situ for tissue conditioning D-After1 week good gingival contour and excellent healing.



Fig(4): Rising flap for implant exposure in the maxillary premolar region which appears to be invasive technique ,taking longer time as compared to laser treatment and requires suturing for tissue closure , it consume 900 seconds(15 minutes). A -Exposure of the implant by rising a flap with surgical blade No .15 B-While suturing the flap with gingival forma in site C-7days later incomplete healing of gingiva D- After removal of the gingival former swelling and bleeding of gingiva which are signs of inflammation.

V. Discussion

The Photothermal interaction is the basic mechanism of the surgical lasers , in this process the laser energy transformed to heat energy as it was absorbed inside the tissue resulting in structural changes of that tissue subsequent to a rise in tissue temperature ,the increase in the local tissue temperature is the governing significant parameter of all thermal laser tissue interaction ,that when laser appropriately applied, it can produce reactions ranging from incision, vaporization, to coagulation depending on the type of the tissue and laser parameter[9,10,11]. When the tissue is heated by laser beam to temperatures over 60C, it under-goes coagulation and as a result of photo-coagulation, protein, enzymes, cytokines and other bioactive molecules will undergo instant denaturation, the molecular structures of tissue collagen altered from trihelical to randomly disturbed helical polymers and coils which will lead to shrinkage of the collagen fibers, the lased tissue constricts against the proximal vasculature and the vessels shrink as a result of the collagen in their walls which result in enhanced hemostasis. Laser damage to erythrocytes attracts a population of platelets which encourage intraluminal thrombosis, further decrease in the blood loss and this explains why the laser wound group had minimal blood loss in comparison to the scalpel wound group[12] 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 and this may explain the need for small amount of local anesthesia required to perform laser surgery in comparison to the scalpel incision[13].

The time to perform laser incision is less than the time required to perform scalpel incision but this not always as it may be affected by the skill of the operator [13]. The high affinity of diode laser for hemoglobin and melanin giving it high cutting efficiency on gingival tissues therefore the laser procedure seems to be more comfortable for the patients, more manageable for the operators ,and faster than the scalpel procedure[14].

Decreased postoperative pain is another positive effect attained with surgical laser application. The physiology of this effect remains unknown. According to one theory, pain reduction is attributed to the protein coagulum formed on the wound surface after laser irradiation, thus acting as a biological dressing and sealing

sensory nerve fibers. Moreover, the decreased tissue trauma is considered to contribute to the reduction of postoperative pain[15].

When there is no harm for the soft tissue, there is no retraction of the tissue, so the impressions can be taken as soon as possible without delay[16]. The great decontamination capability of diode laser permits to work in an almost sterile operative field (a 98% reduction of pathogenic bacteria), with clear advantages for rapid wound healing and decreasing possibilities for post-operative infections[17]. This explains the difference between the two groups on the time of taking the impression.

VI. Conclusion

Diode laser of 970 nm wavelength in a power of 3 W can be used effectively at second stage surgery instead of scalpel, the laser cuts precisely without infiltrative anesthesia and excellent homeostasis will be resulted and seems to minimize during and post operative pain. The gingival contours remain stable after laser implant recovery procedure. The time needed for tissue healing is short, which results in a shorter time to rehabilitation of the patient.

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