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CASE REPORT

Laser Biostimulation of Free Gingival Grafts Around Dental Implants

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ABSTRACT

Objective: Long-term edentulousness causes big alterations in mandible such as keratinized tissue is reduced or lost and vestibular sulcus becomes too shallow. As a consequence, free gingival autograft is usually mandatory. The aim of this case report was to evaluate the effect of diode laser bio-stimulation on FGG procedure around dental implants in edentulous patients.

Material and Methods: Three edentulous female patients (59 and 64 and 79 years old) were referred to our department in different time periods. All patients had serious alveolar bone loss because of prolonged edentulism. In clinical and radiographical examinations, it is observed that patients had lack of keratinized tissue around 6 dental implants placed in mandibular canine positions. The healing caps had been placed and there were severe soft tissue problems and disorientations and also ulcerations around healing caps. Patients were really uncomfortable and in pain because of ulcerated mucosa. Conventional vestibuloplasty and gingivectomy procedures were performed in one patient. The problem continued, lips covered healing caps again and patient was suffering from the pain again. After then in order to reduce the pain and stimulate soft tissue healing, diode laser bio-stimulation were performed in all three patients along with the FGG procedure. Totally six FGG procedures were performed in three patients.

Results: Mild pain was observed in donor site and other than that there was no pain or discomfort in all patients. After 30 days, the keratinized tissues around dental implants were increased and the discomfort and pain were gone. Healing caps were placed again and the patients were treated successfully.

Conclusion: Diode laser bio-stimulation reduced the post-surgical pain and discomfort caused by FGG procedure around dental implants in elderly patients.

Key Words: Diode laser, Bio-stimulation, FGG, Dental implants

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INTRODUCTION

Periodontal plastic surgery is the definition adopted by the American Academy of Periodontology (AAP) proposed by Miller in 1988[1] to substitute mucogingival surgery; these surgical procedures are performed to correct or eliminate anatomic, developmental or traumatic deformities in morphology, position and/or amount of gingiva.[2] These procedures aim to correct the esthetic problems and increase thickness of the soft tissues around the relevant teeth or implants.[3, 4] Handling periimplant soft tissues might be more troublesome and challenging.

Since FGG was described by Björn[5] in 1963, it was widely utilized for increasing the width of keratinized tissue and root coverage in periodontal surgery. Its predictability was marked in several clinical studies, which demonstrated newly created keratinized tissue stability of up to 4 years.[6-9] Mandibular anterior sextant is the most affected region and the major causes of the recession are lack of keratinized tissue, high frena attachments and shallow vestibular depth. Because of the cortical bone structure, this situation is more obvious in mandibular anterior region of edentulous patients.

Due to the further bone loss, along with the bone crest keratinized tissue also crashes in edentulous area. Lack of keratinized tissue is especially a major problem in implants placed to edentulous patients. Apical positioned flap surgery, vestibuloplasty, free gingival autografts, subepithelial connective tissue grafts or pedicle flaps may be used to prevent recession and/or increase keratinized tissue width.[10, 11] These procedures might be used before, during or after implant surgery. In addition, mild soft tissue problems might get worse after implant replacements. As a consequence of keratinized tissue loss, lip covers the healing cap of the implants.

In these cases, peri-implant plastic surgery is often required in order to maintain peri-implant tissue health. As an additional problem in the elderly patients, soft tissue healing might be altered and the most important issues are graft viability and the blood circulation in the tissue adjacent to the graft bed. In order to stimulate healing, certain agents or procedures such as diode-laser bio-stimulation of the soft tissues could improve healing and success rate of the FGG procedure and reduce post-surgical pain and discomfort.

Low level laser therapy (LLLT) may be used to increase vascular supply and stimulate biological response in FGG procedure. For the first time, LLLT was used as a treatment tool by Mester et al. to improve wound healing in rats.12 They suggested that LLLT accelerates wound healing facilitating collagen synthesis, increasing the secretion of growth factors and angiogenesis and thus accelerate wound healing.13 LLLT uses low-powered laser light at wavelengths from 632-1064 nm in the range of 1-1000 mW.

The main purposes of using these lasers are biostimulation or photobiomodulation.[14] Biostimulation effect is thought to be caused by inducing the intracellular metabolic changes, resulting in faster cell division, proliferation rate, migration of fibroblasts, rapid matrix production, promote fibroblast maturation and proliferation, macrophage phagocytosis and lymphocyte activation.[15]

It has also been reported that LLLT reduces the pain and discomfort after surgery.[16] It inhibits nociceptive signals and controls pain mediators by stimulating

the release of endogenous endorphins (β-endorphin), decreasing the activity of bradykinin and C fibers.[17, 18] LLLT decreases the firing frequency of nociceptors, with a threshold effect seen in terms of the irradiance required to exert maximal suppression thereby it has analgesic effect on nerves.[19]

Despite many benefits and widespread use, LLLT has not been accepted by the medical and dental community because of the lack of adequate controlled clinical studies. The aim of this case report was to evaluate the effect of diode laser bio-stimulation on healing of FGG procedure around dental implants and decreasing pain in donor site in edentulous elderly patients.

MATERIAL METHODS

Material-Methods: Case 1: A 59-year old female patient was referred to our clinic with a lack of keratinized tissue around 2 dental implants placed in mandibular canine positions. Patient was really uncomfortable and in pain because of ulcerated mucosa. Healing caps were removed and conventional vestibuloplasty and gingivectomy procedures were performed. 15 days later, the ulcerated areas were healed and healing caps were replaced again. The problem continued, lips covered healing caps again and patient was suffering from the pain again. In order to reduce the pain and stimulate soft tissue healing, diode laser biostimulation were performed along with the FGG procedure around both canine implants. Diode laser biostimulation was also performed in palatal donor site. .

Case 2: A 64-year old female patient with a lack of keratinized tissue around mandibulary canine implants was treated with FGG procedure to avoid unnecessary scar formation around implants. FGG around mandibular canine implants were performed and laser biostimulations were performed in both donor and recipient sites.

Case 3: A 79-year old female patient who had three dental implants at mandibulary right and left canine and right central incisor positions with same problems was admitted to our clinic. FGG procedure with laser biostimulation was performed.

Surgical procedure

The direct technique of free gingival graft proposed by Miller[20] was performed. After administration of local anesthesia, the recipient bed was prepared. In order not to expose the bone around dental implants, a split thickness flap was elevated and dissected.

In order to obtain a uniform palatal wound and a standard graft size, a standardized tinfoil template (7-10 mm) was used to mark the donor area. Subsequently, a standardized graft with a 1.5 mm thickness and 7x10 mm size was harvested from premolar-molar region of the hard palate. Finally, the harvested graft underwent a routine free gingival graft procedure to cover the denuded split thickness flap surface. The graft was secured at the recipient site with 6-0 polypropylene interrupted sutures and LLLT was performed at both donor and recipient sites. Then the FGG was covered with a periodontal dressing. After the surgical procedure, routine postoperative instructions were given to the each patient. Patients were prescribed parasetamol analgesic (Minoset, Bayer, Germany) and mouthwash (Kloroben, Drogsan, Turkey) for chemical plaque control. Patients were recalled at 15th for suture removal and first control, and at day 30 and day 60 for consequtive control sessions (Figure 1).

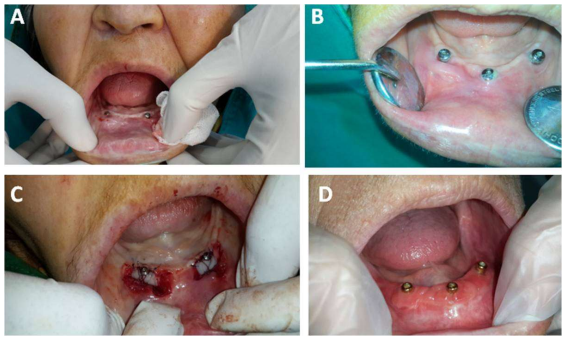

Figure 1. FGG procedure photographs.

A-B; Lack of keratinized tissue around dental implants in patient A and B
C; Operational view of FGG procedure of patient A
D; 2 months after FGG procedure of patient B

Low level laser therapy

Low level laser therapy was performed following surgery in each case. Laser application was performed for 60 seconds and five repeats, totally five minutes. The laser was fired in the non-contact mode, at a distance of 1 cm. The laser treatment was carried out with adequate eye protection for the patient, operator and the assistant. No additional laser treatment was performed at other visits of the patients.

A Ga-Al-As diode laser (continuous wave, Doris, CTL- 1106MX, Warsaw, Poland), with a wavelength of 820 nm and a fiber applicator 2 mm in diameter (Doris, CTL-2241), were used for the therapy. The irradiations were performed using the following parameters:

Output power (mW): 50 mW,

Energy dose (J): 0.15 J

Irradiance (W/cm2) : 1.6 W/cm2 ,

Energy density (J/cm2): 5 J/cm2

Subjective pain assessment

All the patients were asked to assess the pain on first, third, seventh and tenth day using a Visual Analog Scale (VAS) (Figure 2). The VAS for pain ranged from 0 (no pain) to 10 (severe pain).

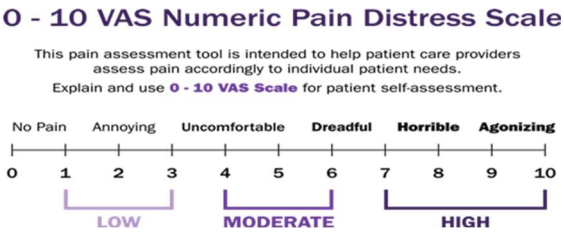

Figure 2. VAS Scale.

RESULTS

The results were satisfactory and none of the patients reported a VAS score higher than 6. The first patients reported a mild pain at first day, decreasing day by day (Table 1).

Time/Patient	Case 1	Case 2	Case 3
Day 0	6	6	5
Day 1	4	5	3
Day 3	1	2	0
Day 7	0	0	0
Day 10	0	0	0

Table 1. VAS scores of the patients after surgery.

Patients reported mild pain in palatal site for the first three days but none reported any other discomfort or complication and pain was gone three days after surgery. After 30 days, the keratinized tissues around dental implants were increased and the discomfort and pain were gone. Patients didn't suffer either from the FGG procedure or any swelling or bleeding of donor site in the palatal area. Healing caps were placed again and the patients were treated successfully.

The average keratinized gingiva gain in the first month for the case 1 is 2 mm, for the case 2 is 2.5 mm and for the case 3 is 3

mm. The 2-month results were the same in the first two cases but in case 3 after 2 month, the width of the keratinized tissue decreased from 3 mm to 1 mm but oral hygiene was not compromised and healthy texture of the peri-implant mucosa was maintained.

The effect of LLLT on pain reduction was observed after surgery. The patients were asymptomatic on seventh day.

DISCUSSION

Long-term edentulousness causes big alterations in mandible such as keratinized tissue is reduced or lost, lips and cheeks lose support and vestibular sulcus becomes too shallow. It has been reported that a wider zone of keratinized tissue around dental implants may provide better soft and hard tissue stability and maintenance of the implants.[21-23] Although there is no consensus on the minimally sufficient width and thickness of keratinized tissue, lack of keratinized tissue may cause poor oral hygiene and risk of soft tissue recession. In present cases we used FGG procedure to increase keratinized gingival width in elderly patients and LLLT to stimulate wound healing. Patients reported tolerable pain and discomfort related to FGG procedure and palatal wound.

Soft tissue augmentation is mainly indicated for both aesthetic reasons and good oral hygiene.[24] Besides the necessity of keratinized tissue presence, the best way for increasing keratinized tissue width is autogenous grafts such as FGG or SCTG procedures. The main disadvantage of autogenous tissue graft procedures are the morbidity associated with donor site and the subsequent healing process. And the most important factor for clinical success is graft survival depending on the blood vessels supplies of the neighboring tissues. The post-operative complications of soft tissue grafting procedures, including bleeding, swelling, pain and discomfort of both donor and recipient sites are also disadvantages of these procedures.[25,26] In order to minimize these problems, increase vascularization and promote wound healing, LLLT might be considered as an adjunct to the FGG procedure.

The most prominent feature of the LLLT during wound healing process is angiogenesis stimulating effect. LLLT causes an increase in local blood flow and vasodilation and smooth muscle relaxation.[15] Vasodilation brings the oxygen necessary for the healing and attracts immune cells to the wound. Increase in the microcirculation causes additional effects by removing intermediary accumulation metabolites. It has been shown that LLLT stimulates cell division especially in fibroblast and epithelial cells due to the intracellular metabolic changes.[27, 28] Rocha Jr. *et al*.[29] also concluded that LLLT accelerates the process of tissue repair by improving fibroblasts in irradiated cells, showing a significant increase in fibroblast proliferation and decrease in inflammatory infiltrate. In another study Saygun *et al*.[30] demonstrated that LLLT has biomodulation effect associated with an increased production of growth factors such as bFGF and IGF-1. It has also been shown that LLLT can be used to stimulate the growth of periodontal ligament fibroblasts[31]. Although only visual, we observed a beneficial effect of laser in our cases.

In addition to wound healing, clinical studies regarding the beneficial effects of LLLT on gingival inflammatory response and clinical parameters were also

reported.[32-34] LLLT activity depends on the dose, wavelength and the amount of applied energy. However, there is not a precise dose determined for each indication. Tough, it has been suggested that biostimulation dose should be range of 0.001 J / cm2 - 10 J / cm2.[35] Master et al. in 1997 suggested a dose of ≈1-2 J / cm2 for better wound healing.[12] In our study we used a total dosage of 5J/cm ^{2} energy density on each surface after treatment. This dose also has been shown in previous studies to increase the epithelialization and wound healing after gingivectomy and gingivoplasty procedures.[36,37]

In present cases, the recipient sites had scar tissues because of previous surgical procedures. In addition, patients were elderly and wound healing rate or capacity in these patients might be reduced. We used LLLT in order to eliminate negative effects of advanced age and previous implant surgeries. Although the results were entirely subjective, patients reported that they had comfortable recovery periods with minimal pain. However, some studies reported controversial results, and some researchers found no beneficial effect of LLLT on wound healing.[38,39] This diversity is probably caused by treatment factors and limitations in experimental design, including comparison of heterogenous clinical wounds, lack of control groups and limited or no blinding of investigators.

In conclusion, considering the limitations of this case report and based on patients' reports, these data suggest that oral application of LLLT reduced postoperative complications of oral surgeries and patients' discomfort. Further studies are needed, especially randomized controlled clinical trials, to help elucidate the impact of LLLT on periodontal surgical therapies and establish the ideal parameters for LLLT.

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