ORIGINAL ARTICLE

The Effects of Low Level Laser Therapy on Osseointegration of Dental Implants

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Purpose: The aim of this study is to asses the clinical effectiveness of a low level laser therapy with respect to the acceleration of the bone regeneration and osseointegration of dental implants.

Material and method: In this clinical study a total number of 50 implants were placed in 37 patients. 20 patients had an OsseoPulse Model AR 300 Bone regeneration System (Citagenix, Canada) positioned over the surgical site, by the patient, on a daily basis for 21 days post implant placement. The used model generated the energy of 20mW/cm2 for 20 minutes at wavelengths of 618nm. Implant stability was measured with an Osstell Mentor device (Osstel, AB, Sweden) using the resonance frequency analysis at the time of implant placement 15, 30, 60 and 90 days post insertion. Implant stability was measured in ISQ values - implant stability quotient.

Results: The implants treated with the low level laser therapy demonstrated higher ISQ values at 15, 30 and 60 days compared to the control group.

Conclusion: These results suggest that low level laser therapy has a favourable effect on the healing and osseointegration of the dental implants.

Keywords: dental implants, low level laser therapy, bone regeneration

Introduction

Low level laser therapy (LLLT) was pioneered by Mester in 1960 who demonstrated an increase in the collagen synthesis in skin wounds [1]. In implant dentistry the most recent research has focused on the effect of LLLT in the reduction of the healing time following the implant placement and to improve the bone regeneration. The successful outcome of the implant treatment depends on the osteogenic cells to induce bone formation around dental implants. Bone formation at the bone interface is a very complex physiological process and is influenced by a series of biomechanical, biochemical, hormonal, pathologic reactions and by skeletal cells [2]. It has been suggested that LLLT may influence the healing process by affecting various tissue responses such as blood flow, lymphatic flow, inflammation, cellular proliferation and differentiation [3]. A few studies on the use of the LLLT relevant to implant treatment have been published in the last years. Most of the studies done were animal studies [3, 4, 5, 6, 7, 8, 9, 10, 11]. In the recent years the studies performed by Kandra et al [12, 13] demonstrated that the low level laser therapy stimulates the bone implant interaction. The histomorphomeric analysis of the treated groups demonstrated a higher bone to implant contact than the control groups. These findings suggest that the LLLT might have a favourable effect on the healing and attachment of the titanium implants. Khandra et all 2008 [14] demonstrated that LLLT has the ability to stimulate the attachment and proliferation of the human osteoblasts like cells cultured on titanium implant material indicating that LLLT can modulate the activity of cells surrounding implant material.

The main objective of this study is to evaluate the clinical effectiveness of low level laser therapy on dental implant stability with respect to the stimulation and acceleration of the bone-implant interface healing.

Material and method

The investigation will compare two separate groups of patients (27 patients and a total number of 50 implants). In each group a total number of 25 implants were considered. The implants -Internal Hex (Biohorizons, Canada) - were placed according to the manufacturer instruction at a controlled torque of 35N/cm2 to ensure a standardized placement. A healing abutment was placed in a single stage surgical approach in order to facilitate the reading of the stability during healing.

Control – untreated group – (15 patients received 25 dental implants either in the maxillary or on the mandibular arch) in this group the patients with dental implants received no post-operative treatment with the OsseoPulse phototherapy device.

Treated group – in this group patients (12 patients received 25 dental implants) received postoperative treatment with the OsseoPulse phototherapy 20 minutes per day for 21 consecutive days.

In both groups, the implant stability was measured using the Osstell Mentor device. Measurements were taken at 0, 15, 30, 60, 90 post operative. The device produced an electromagnetic pulse and measured the resonance frequency of the vibration of the dental implants known as the implant stability quotient (ISQ). Implant stability was measured by using an Osstell mentor device using the resonance frequency analysis (RFA). The smart peg is attached to the implant by the means of a screw connection and is excited by a magnetic pulse from a hand held computer. The vibrations of the smart peg are measured and an im-

Table I. Data table for the control group – no LLL treatment. ISQ values measured at day 0, 15, 30, 60, and 90 days post surgical.

	DAY 0	DAY 15	DAY 30	DAY 60	DAY 90
1	80	61	62	64	67
2	78	76	75	70	74
3	76	74	66	68	72
4	65	65	62	64	64
5	80	75	70	72	77
6	62	60	62	70	78
7	85	81	57	58	64
8	76	65	77	84	
9	60	54	42	70	75
10	56	53	48	67	74
11	79	77	71	75	76
12	76	67	71	76	76
13	62	57	51	60	72
14	76	65	59	62	77
15	60	60	42	70	73
16	62	58	48	67	74
17	79	77	72	75	
18	76	76	71	76	
19	70	68	62	68	
20	74	71	64	75	75
21	67	62	64	70	72
22	65	63	62	69	72
23	70	62	67	65	68
24	76	59	65	62	77
25	82	48	60	73	75
Mean	71.68	65.36	62.00	69.20	72.95
Standard Deviation	8.17	8.67	9.60	5.90	4.08

Table II. Data table for patients treated with LLL. ISQ values measured at day 0, 15, 30, 60, 90 post surgery

	DAY 0	DAY 15	DAY 30	DAY 60	DAY 90
1	72	75	82	87	87
2	53	66	70	75	82
3	57	62	75	78	78
4	57	75	76	78	83
5	71	75	75	76	79
6	62	63	65	65	71
7	62	62	68	69	73
8	62	73	80	81	85
9	48	49	72	75	78
10	49	52	76	80	82
11	53	59	75	75	75
12	42	53	70	75	75
13	51	60	61	69	72
14	71	80	80	82	84
15	73	75	75	75	75
16	67	71	76	76	78
17	66	67	68	68	73
18	71	74	75	75	77
19	63	65	73	78	
20	71	77	77	79	
21	62	80	81	85	85
22	65	78	79	84	
23	53	66	70	75	78
24	62	80	81	85	85
25	53	66	70	79	79
Mean	60.64	68.12	74.00	76.96	78.82
Standard Deviation	8.68	9.09	5.31	5.48	4.74

plant stability quotient is recorded by the computer. ISQ values are scaled from 1 to 100, the higher the ISQ value the more stable the implant.

Results

The implants in the control group (no LLLT treatment) demonstrated a mean ISQ value at Day 0 = 71.68, Day 15 = 65.36, Day 30 = 62, Day 60 = 69.20 Day 90 = 72.9 (Table I). For the implants in the study group – treated with the LLLT for 21 consecutive days – the implants demonstrated a mean ISQ at Day 0 = 60.64, Day 15 = 68.12, Day 30 = 74, Day 60 = 76.96 Day 90 = 78.82 (Table II, Figure 1).

Discussions

The data collected revealed that during the healing phase of the implants in the control group with no LLLT treatment, the ISQ values varied from the time of surgery to the loading time, from a lowest of 48 to a highest of 82. The decrease in the ISQ values was the lowest between 15 and 30 days after the surgery. After that, the values of the ISQ increased again during the late healing time (2-4 months) until the loading time. For the implants treated with the LLLT, there is no decrease in the values of the ISQ at 30 days post-surgically. Furthermore the ISQ values were higher on the same periods of time as the numbers of the control groups. At 90 days however, there was no difference in the ISQ values between the two groups.

A number of different studies indicate that the implants with an ISQ value of 65-69 correspond to stability sufficient for the loading of the dental implants with the final restoration. For the control group this value was achieved about 70 days after the insertion of the dental implant. The implants treated with LLLT achieved the same level of stability in less than a month (28 days), 42 days earlier than the non-treated group, which represents a 60 % decrease in the total healing time. A faster healing time means a faster integration and restoration of the dental implants.

The major difference between the two groups of implants was noted between 15 and 30 days after the surgery. The implants in the control group had a significant decrease in the stability, their ISQ values dropping to an average below 63 and coincides with the initial resorptive phase of the bone implant healing phases (during this phase the implant stability has the lowest value). For the implants

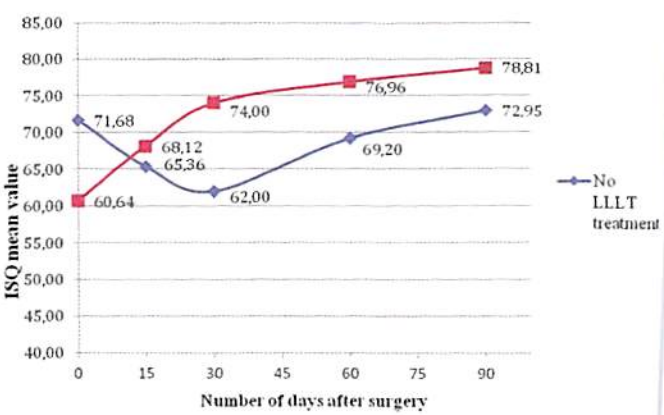

Fig. 1. Implant stability graph

treated with the LLLT this decrease in the ISQ value and therefore the decrease in implant stability was not observed. This result suggests that the resorptive phase of the dental implant healing might be eliminated.

Conclusions

The data obtained from this study demonstrate that the treatment of the dental implants with a low level laser at the red to near infrared spectrum (680nm) has the ability to speed up the healing process allowing the implants a faster osseointegration compared to the untreated dental implants. By treating implants with the LLLT there is a decrease in the time required for the healing by about 60% of the total healing time. The implants treated reached the highest level of stability required for loading on an average of 28 days compared with the non treated implants, 42 days earlier than the non treated group. The low level laser therapy for implant treatment seems feasible and may be therapeutic benefit in accelerating implant healing.

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