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Effect of 810nm Diode Laser on Post-operative Pain Adjunct to Periodontal Flap Surgery

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Abstract

Introduction: Surgical lasers have been used in periodontal therapy. The anti-pain mechanism of low-level laser is not yet clear however, numerous studies have pointed out the physiological changes from light interference with various cells as the cause. Low-level laser can also modify the inflammatory process in a dose-related mechanism; and thus, it can reduce the inflammatory pain.[2]

Methodology: A sample of 10 systemically healthy subjects aged 30-60 years diagnosed with chronic periodontitis having a probing pocket depth ≥5mm and clinical attachment loss ≥4mm bilaterally in the region of the maxillary first premolar, second premolar and first molar were recruited from the out-patient, Department of Periodontics, A.B.Shetty Memorial Institute of Dental Sciences. The subjects were blinded as to which surgical site received the laser therapy following conventional periodontal flap surgery (Test Group). The subjects were recalled one week after scaling and root planing for the periodontal flap surgery. At the baseline visit, the contralateral surgical sites were randomly assigned to the control group or the test groups using a coin-flip.

In the test group, following the removal of soft deposits through scaling and root planing, the laser probe of 0.8W CW diode was used in a light contact, sweeping mode to cover the entire inner surface of the flap. Ablation was carried out from base of the flap to its coronal portion. **Results**-Median pain score did not differ significantly between the test and the control at 0 day, 1day , 2day and 5 day ($P>0.05$) ,day7 ($P=0.087$). Friedman test showed overall there was significant difference in pain score from o day to day7test. Pain score differs significantly from day 0 to day7 ($P<0.05$), day1 to day7 ($P<0.05$), day2 to day7 ($P<0.05$) except day5 to day7 ($P>0.05$) within test group.

Conclusion-Lasers currently have a variety of uses in dentistry, although low-level lasers have been found beneficial in reducing the pain response after periodontal surgery in present study, but studies with larger sample are required to see significant association.

Key words- *Diode laser, periodontal flap , pain response*

Introduction

Periodontal surgery is a plastic surgical procedure designed to restore and regenerate normal form and function to lost and damaged periodontal structures.

Generally, surgery is indicated when the periodontal pocket persists even after the non-surgical procedures of Phase I treatment. The purpose of surgical pocket therapy is to eliminate the pathological changes in the pocket walls in order to create a stable, easily maintainable state and if possible, to promote periodontal regeneration.

Surgical lasers have been used in periodontal therapy. Based on the type of the laser, power setting and wavelength, it can be used to excise the epithelium of the periodontal pocket during scaling and root planing and periodontal surgery, to eliminate calculus, granulation tissue and bone during resective and regenerative surgery, in the management of post-operative pain, enhanced coagulation and as a bactericidal agent.[1]

Pain control following any surgical procedure is an essential part of periodontal treatment. This pain could be due to tissue trauma and the release of inflammatory mediators, which reaches its highest following the cessation of local anesthesia. Low-level Laser Therapy has been suggested as a pain-control protocol. The anti-pain mechanism of low-level laser is not yet clear, however, numerous studies have pointed out the physiological changes from light interference with various cells as the cause. The offered mechanisms include: stability of the lipid double membrane and its proteins, the enhancement of revival system and the increase in ATP production. Low-level laser can also modify the inflammatory process in a dose-related mechanism; and thus it can reduce the inflammatory pain.[2]

Hence, a study was planned to assess the postoperative pain and healing following conventional periodontal surgery without the use of a diode laser and comparing it with the use of an 810nm diode laser adjunct to periodontal flap surgery for the treatment of chronic periodontitis.

Material and Method

The study was a randomized, single masked split-mouth study. Ethical clearance was obtained from the institution ethics committee. A sample of 10 systemically healthy subjects aged 30-60 years diagnosed with chronic periodontitis having a probing pocket depth ≥5mm and clinical attachment loss ≥4mm bilaterally in the region of the maxillary first premolar, second premolar and first molar were recruited from the out-patient, Department of Periodontics, A.B.Shetty Memorial Institute of Dental Sciences. Subjects were excluded if they were smokers, were pregnant or gave history of long term steroidal and/or antimicrobial therapy.

One operator was enrolled to treat all subjects. The subjects were blinded as to which surgical site received the laser therapy following conventional periodontal flap surgery (Test Group). Clinical parameters such as clinical attachment loss, pocket depth, bleeding on probing, plaque index and gingival index were recorded at baseline followed by oral prophylaxis.

The subjects were recalled after one week to undergo subgingival scaling and root planing. Oral hygiene instructions were reinforced after each appointment.

The subjects were recalled one week after scaling and root planing for the periodontal flap surgery. At the baseline visit, the contralateral surgical sites were randomly assigned to the control group or the test groups using a coin-flip.

In the test group, following the removal of soft deposits through scaling and root planing, the laser probe of 0.8W CW diode was used in a light contact, sweeping mode to cover the entire inner surface of the flap. Ablation was carried out from base of the flap to its coronal portion. Care was taken to avoid any laser contact to the root surface or the alveolar bone by placing a periosteal retractor between the hard and soft tissue. Ablation debris on the fiber was cleaned using damp, sterile gauze. Each flap was treated for 30 seconds amounting to possibly 1 minute per tooth. The control group received only the conventional periodontal surgery and a sham application of the diode. The surgical procedures were carried out one week apart. The periodontal flap was sutured with an interrupted suture using 3- 0 black silk suture in all patients. Surgeries performed on all patients were virtually identical. All procedures were completed within a 1-hour time frame.[1,3,4]

Oral hygiene instructions were reinforced and each subject was prescribed the use of a 0.2% Chlorhexidine mouthwash twice daily and Dolo 650 (650mg Paracetamol) as required (8 hourly and not more than 3 times/day) for the management of pain following each surgical procedure.

The post-operative tissue oedema seen in both the groups was assessed clinically after one week. Post-operative pain and discomfort was assessed using both, the visual analog case on Day 0, Day 3, Day 5 and Day 7, and, the number and frequency of painkillers taken post-operatively.[1]

Results

The 10 subjects sample comprised of 5 females and 5 males in the age range of 42-57 years. Descriptive statistics such as median, interquartile range were calculated. Mann Whitney test was used to compare the scores between the groups. Friedman and Wilcoxon

Sign Rank Test was used to compare the scores within the groups. P<0.05 is considered to be statistically significant. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp was used for statistical analysis.

Table 1: Pain score between test and control- Mann Whitney test

		Median	Interquartile Range [Q1, Q3]	P
Day0 Pain Score	pain response test	4.00	2.75,5.25	0.669
	pain response control	4.00	3.00,5.50	
Day1 Pain Score	pain response test	2.00	1.75,3.50	0.312
	pain response control	3.00	2.00,4.50	
Day2 Pain Score	pain response test	1.50	1.00,2.00	0.266
	pain response control	2.50	1.00,3.00	
Day5 Pain Score	pain response test	0.00	0.00,1.00	0.259
	pain response control	1.00	0.00,1.00	
Day7 Pain Score	pain response test	0.00	0.00,0.00	0.087
	pain response control	0.00	0.00,1.00	

Median pain score did not differ significantly between the test and the control at 0 day, 1day , 2day and 5 day (P>0.05) ,day7 (P=0.087)

Table 2 Median pain scores (Interquartile range) within the test group

	N	Median	Interquartile Range [Q1, Q3]
Day0 Pain Score	10	4.00	2.75,5.25
Day1 Pain Score	10	2.00	1.75,3.50
Day2 Pain Score	10	1.50	1.00,2.00
Day5 Pain Score	10	.00	0.00,1.00
Day7 Pain Score	10	.00	0.00,0.00

Friedman test- chi square=37.665 , P <0.001 sig

Friedman test showed overall there was significant difference in pain score from o day to day7, but to find which

group differs significantly we use wilcoxon sign rank test

Table 3 Median pain scores (Interquartile range) within the control group

	N	Median	Interquartile Range [Q1, Q3]
Day0 Pain Score	10	4.00	3,5.50
Day1 Pain Score	10	3.00	2,4.50
Day2 Pain Score	10	2.50	1,3.00
Day5 Pain Score	10	1.00	0,1.00
Day7 Pain Score	10	0.00	0,1.00

Friedman test- chi square=37.871 P <0.001 sig

Table 4 Wilcoxon Signed Ranks Test within control group

	Day1 - Day0 Pain Score	Day2 - Day0 Pain Score	Day5 - Day0 Pain Score	Day7 - Day0 Pain Score	Day2 - Day1 Pain Score	Day5 - Day1 Pain Score	Day7 - Day1 Pain Score	Day5 - Day2 Pain Score	Day7 - Day2 Pain Score	Day7 - Day5 Pain Score
P	0.015	0.007	0.005	0.005	0.008	0.004	0.004	0.006	0.004	0.046

Pain score differs significantly from day 0 to day7 (P<0.05), day1 to day7 (P<0.05), day2 to day7 (P<0.05) and day5 to day7 (P>0.05) within control group

Table 5 Wilcoxon Signed Ranks Test- within test group

	Day1 - Day0 Painkillers	Day2 - Day0 Painkillers	Day5 - Day0 Painkillers	Day7 - Day0 Painkillers	Day2 - Day1 Painkillers	Day5 - Day1 Painkillers	Day7 - Day1 Painkillers	Day5 - Day2 Painkillers	Day7 - Day2 Painkillers	Day7 - Day5 Painkillers
P	.480	.059	.006	.004	.102	.017	.011	.023	.014	.317

Median pain killers used did not differ significantly between 0 day to day1, day0 to day2, day1 to day2 and day 5 to day7 (P>0.05). It differed significantly from day0 to day5, day 0 to day7, day1 to day5, day1 to day7, day2 to day5 and day2 to day7 (P<0.05) within the test group.

Discussion

This study found that diode laser use did not lead to postoperative complications or to impair tissue response, indicating that this type of laser has no detrimental effects when used in conjunction with periodontal flap surgery. Also, this study found that the postoperative pain and tissue oedema were reduced with the use of the diode laser. As the optimal dosage and treatment schedule has not been determined, it is difficult to evaluate the efficiency of LLLT. As a result, studies have encountered a wide range of clinical findings attributable to the differences in experimental and assessment methods and irradiation conditions.[5,6,7,8]

Despite the proposed benefit of LLLT, there are very few clinical studies using LLLT in gingival surgery, which makes comparing the results of the current study with previous reports difficult. Human randomized controlled clinical studies that analyzed periodontal healing response using LLLT are available.

The pain scales used in this study are subjective and highly dependent on individual experience. However, the patient served as both the control and the test. Patients were unaware of which site actually received laser treatment to reduce the 'placebo effect of laser treatment'. The subjective measure of the pain using the scale found differences between the control sites and the test sites. However the differences in pain and the number of painkillers taken did not show a statistically significant difference.

The mechanism of LLLT involves photoreceptors in the electron transport chain within the membrane of cell mitochondria. Absorption of light creates a short-term activation of respiratory chain components, promoting ATP production and activation of nucleic acid synthesis.[9]

LLLT has an additional effect on fibroblasts by promoting proliferation and increasing cell numbers, secretion of growth factors, and differentiation of fibroblasts into myofibroblasts. During wound healing the inflammatory response and synthesis of specific extracellular matrix molecules by fibroblasts; angiogenesis, reepithelialization and remodeling are regulated by growth factors including transforming growth factor-beta1 (TGF-β1) and basic fibroblast growth factor (bFGF). TGF-β1 plays an important role in wound healing by stimulating fibroblast proliferation, increasing the synthesis of extracellular matrix molecules and inhibitors of matrix metalloproteinases (MMPs), and inhibiting MMP synthesis. bFGF is a potent mitogen and chemo attractant for fibroblasts and endothelial cells and induces a predominantly angiogenic response in the wound and activates the neutral proteases in both epithelial cells and fibroblasts.[10,11]

Conclusion

Lasers currently have a variety of uses in dentistry, and some low-level lasers have been found beneficial in in vitro studies. However, clinical outcomes in vivo application of low-level lasers is still unclear, although this study found postoperative pain and tissue oedema were reduced with the use of the diode laser. To assess whether lasers provide additional benefits to periodontal treatment, studies with larger sample size are needed to be done.

Conflict of Interest -There are no conflicts of interest

Source of Funding-self

Ethical Approval --obtained

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