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Effect Of Diode Laser As An Adjunct To Modified Widman Flap Surgery In The Treatment Of Chronic Periodontitis: A Split Mouth Randomized Controlled Clinical Study

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Abstract

Background and objectives – Surgical procedures for periodontal pocket therapy like modified Widman flap (MWF) therapy can be used either alone or with adjunctive antimicrobial therapy like lasers. Laser therapy is regarded as an effective modality for optimum repair of tissues and pain control. This study was done to evaluate the effectiveness of diode laser as an adjunct to MWF surgery in patients with chronic periodontitis.

Methodology - A split mouth study was conducted on 15 patients with chronic periodontitis, who were treated with MWF surgery in the control sites and MWF surgery along with adjunctive use of 810nm diode laser in the test sites. Gingival Index (GI), Pocket Depth (PD), Relative Attachment Level (RAL) and Gingival Recession (GR) at baseline and 6 months after surgical intervention were assessed. Tissue colour (TC) and tissue edema (TE) were measured after 7 days and compared. Similarly, Visual Analog Scale (VAS) scores for each day until day 7 were obtained from the patient and mean values for the same were derived and compared.

Results - All clinical parameters significantly improved after therapy in both groups. Percentage reduction of pockets in control and test groups were 52.4% and 52.9% respectively. A significantly greater reduction in TE and higher VAS scores were observed in the laser treated group.

Conclusion – The use of diode laser did not provide any significant benefit to the treatment outcome. Nevertheless, the use of diode laser did not lead to any postoperative complications or impede tissue repair.

Keywords: Chronic periodontitis, Modified Widman flap surgery, Diode laser, Split mouth study, Periodontal pocket

Introduction

Periodontitis is an inflammatory disease of the periodontium, mainly initiated by plaque bacteria which causes destruction of alveolar bone and periodontal ligament, apical migration of the epithelial attachment resulting in the formation of periodontal pocket. These pockets favour further plaque accumulation resulting in progression of periodontal disease and ultimately tooth loss.[1,2] Other signs and symptoms of periodontal disease include bleeding gums, gingival recession, tooth mobility and pain. [3]

Periodontal therapy is aimed at disease prevention, slowing or arresting disease progression, regeneration of lost periodontal tissues, and maintaining the achieved therapeutic endpoints.[4] A variety of techniques have been proposed for the elimination of periodontal pockets and Modified Widman Flap (MWF) surgery is one of the surgical procedures which has been used with great success.[5,6,7]

Over the last decade, the invention of LASERS has been a major breakthrough in the field of dentistry due to several proposed advantages. Lasers as an

adjunct to periodontal therapy have been demonstrated to enhance periodontal wound healing, have an antimicrobial effect, reduce gingival inflammation, allow complete removal of pocket epithelium and expedite new attachment.[8,9,10]

However, there is a need for more data on the effect of lasers in procedures such as flap debridement surgeries. Also, contradictory data regarding wound healing and postoperative pain in patients treated with adjunctive lasers, makes additional studies essential.

Hence, this study envisages to evaluate the use of diode laser as an adjunct to MWF surgery for the treatment of periodontal disease and to compare it with MWF surgery alone.

Materials And Methods

This was a split mouth, comparative study conducted on patients who reported to the Department of Periodontics, V.S. Dental College and Hospital, Bengaluru, Karnataka, India during the period from September 2019 to December 2020. The patients who fulfilled the inclusion criteria were selected for the study after ethical clearance was obtained from the institution. Participation of the subjects was voluntary and a written informed consent was obtained before treatment.

Inclusion criteria: Patients who are in the age range of 18 - 60 years, probing pocket depth ≥5mm in at least 3 teeth after phase I therapy in two quadrants, presence of at least ≥ 20 teeth, plaque index ≤ 1 after phase I therapy, radiographic evidence of alveolar bone loss.

Exclusion criteria: Patients presenting with confirmed diagnosis of any systemic disease or on medication, pregnant and lactating mothers, heavy smokers (>10 cigarettes/day), alcoholic patients, patients who have undergone periodontal treatment within a period of 6 months.

A total of 15 patients, with probing pocket depth ≥5mm in at least 3 teeth in two quadrants were selected and divided into control and test sites. Control sites were treated with MWF surgery alone while the test sites were treated with MWF surgery along with adjunctive use of diode laser.

After selection, all patients were subjected to Phase I therapy, which included full-mouth scaling and root planing and oral hygiene instructions. The patients were monitored, and, after achieving a satisfactory level of plaque control, baseline data were collected. The parameters evaluated at baseline were PlI, GI, PD, RAL and GR. OPG and IOPA radiographs were taken pre operatively for radiographic evidence of periodontal disease. All clinical measurements were made with a UNC-15 probe and a custom-made acrylic stent to ensure reproducibility of all measurements at baseline and 6 months postoperatively.

After administration of local anesthesia, MWF surgery was performed for the control sites. (Images 1-5)

In the test group, additional use of diode laser (PICASSO model; Ga-Al-As diode laser with wavelength 810nm) was done with a power of 1W, using a 400 µm tip, in continuous mode to de-epithelialize the inner side of the flap from the free gingival margin to the bottom of the flap. The diode laser was also used to photo-biostimulate the site with a power of 0.1W. Care was taken to avoid any laser contact to the root surface or the alveolar bone aiming the laser (810 nm) beam at a 45° angle to the soft-tissue flap. The resultant char layer was totally removed with moist gauze before replacing the flaps. The flaps were sutured with interrupted sutures using 4-0 black silk suture in all patients. (Images 7-12)

After the procedure, the patients were given postoperative instructions and medications (Amoxicillin 500mg tid as an antibiotic and Ibuprofen 200mg bid for 5 days as an anti-inflammatory agent) and were instructed to rinse with CHX mouthrinse (0.2%) twice daily for 1 minute. The time interval between the surgeries in control site and test site was 2 weeks.

Patients were recalled after 7 days for suture removal and then at 6 months post operatively. TE, TC were recorded at the 7th day and VAS score for each day till the 7th day was collected from the patients. PlI, GI, PPD, RAL, GR were assessed at the 6 month visit. Custom made acrylic stents and a UNC-15 probe were used for standardization of all measurements. Clinical photographs and IOPA radiographs were taken for record purposes at various surgical steps and during follow up visit at 6 months.

Statistical Analysis

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Data was analyzed using the statistical package SPSS 22.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p<0.05$. Descriptive statistics was performed to assess the mean and standard deviation of the respective groups. Normality of the data was assessed using Shapiro Wilkinson test. Inferential statistics to find out the difference within and between the groups was done using paired t test and independent test respectively, to measure the association between categories.

Results

On Intragroup comparison, the test group showed statistically significant decrease in the GI, PD, RAL, 6 months after surgical intervention when compared to baseline (Table 1, Chart I, Image 6) Similarly, comparison of GI, PD, RAL and GR between pre and post treatment period was done in the control group. The result showed statistically significant decrease in these parameters 6 months after surgical intervention when compared to baseline (Table 2, Chart II, Image 13)

Intergroup comparison showed that there was no statistically significant difference in GI, PD, RAL and GR between the test and control groups when the parameters were recorded at baseline and 6 months postoperatively. (Table 3, Chart III)

TC and TE at surgical sites were evaluated 1 week after surgery. The color of the tissue was not significantly different between the test and control study sites. With respect to TE, significantly less edema was seen at the test sites. (Table 4, Chart IV)

The VAS mean values for test group was 1.39±0.26 and for control group was 0.97±0.26. Statistically significant differences between study groups were seen, favoring the control group. (Table 4, Chart IV)

Discussion

In recent years, the use of laser therapy has been evaluated as an adjunctive tool to conventional/mechanical procedures commonly practiced in the treatment of periodontal and peri-implant diseases. LLLT has shown to facilitate collagen synthesis, angiogenesis, stimulate the release of growth factors and increase the proliferation of human fibroblasts[11], retard epithelial downgrowth, help in the formation of new connective tissue attachment[12] and also reduce production of inflammatory mediators.[13,14] Lasers exhibit photothermal and photodisruptive effects, which ensures complete removal of pathogens within the periodontal pocket, thus helping in optimal healing of periodontal tissues and formation of new attachment.[15]

In this present split mouth study, a total of 15 patients were treated with MWF surgery in the control sites, while the test sites were treated with MWF surgery along with adjunctive use of 810nm diode laser.

In the test group, additional use of diode laser was done to de-epithelialize the inner side of the flap from the free gingival margin to the bottom of the flap. The laser was used with a power of 1W, using a 400 µm tip, in continuous mode, a setting that has the least side effects on periodontal tissues but positive effects on removal of pocket epithelium and subgingival flora.[16] *Kreisler* et al showed that 1W power has no or little effects on root surface and attachment level of periodontal tissue, while 1.5W and higher power cause thermal damage and attachment loss.[17] In the present study, the use of diode laser did not lead to any postoperative complications, thus indicating that 810nm diode laser with the specified settings can be used safely as an adjunct to conventional therapy. This is in accordance with several studies that provided outstanding results without complications and high patient as well as clinician satisfaction.[18,19,20]

Plaque index was recorded in order to evaluate and monitor the oral hygiene status of all patients, which showed no statistically significant difference from baseline to 6 months. However, a slight increasing trend with time implied the need to re-motivate the patient at recall interval, which was done.

Reduction of gingival inflammation makes the gingiva fibrous and firmer, which inturn makes flap management easier. The tendency for bleeding is also reduced, facilitating proper surgical field inspection. Gingival index was recorded for every patient, which showed significant reduction in both control and the test groups when intragroup comparisons were done from baseline to 6 months. Reduction of gingival index was an expected outcome because of removal of local stimulating factors followed by reduction in clinical signs of inflammation including edema, erythema and bleeding on probing. However, on intergroup comparison, there was no statistically

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significant difference found between the groups. This is in accordance with previous studies by *Zare* et al and *Lobo* et al, where diode laser was used as an adjunct to nonsurgical periodontal therapy in which no difference was observed between the case and the control groups with respect to gingival index scores.[16,17]

Periodontal surgery contributes to the long-term preservation of the periodontal tissues by facilitating plaque removal and infection control through reduction of the deepened pockets. In the present study, the mean reduction in PD and RAL in the test group was found to be 3.27 and 4.57 mm respectively, and that in the control group was 3.24 mm and 4.2mm. These reductions showed statistical significance within the groups but insignificant when intergroup comparison was done. Both treatment outcomes thus seemed to be equally beneficial. These results were in accordance with the results obtained in a study by *Aena* et al, which was conducted to compare the tissue response and postoperative pain after the use of a diode laser (810 nm) as an adjunct to MWF surgery.[18] Similar results were obtained in another study by *Gokhale* et al, done to evaluate the efficacy of diode laser as an adjunct to mechanical debridement versus conventional mechanical debridement in periodontal flap surgery.[19]

Intragroup comparison of GR values showed significant increase from baseline to 6 months in both control and test groups. Several explanations have been suggested for the postoperative increase in gingival recession including lack of bone support for the flap, thin gingival tissue with limited blood supply and postoperative shrinkage of the flap.[20,21] Several studies reported that periodontal surgical procedures resulted in postoperative recession. *Isidor* et al compared the clinical results of root planing to modified Widman flap and reverse beveled flap without osseous surgery. All the surgical procedures resulted in a significant recession compared to baseline.[22] *Kaldahl* et al reported that statistically significant recession occurs for several surgical modalities, such as flap debridement, osseous surgery, and root planing.[23] In the present study, postsurgical recession was lesser when compared to the other studies as the operator decided to advance the flap coronally during the final suturing phase to compensate for the lost tissues. Another reason could be the short follow up period of 6 months postoperatively. A longer follow up period for the same patients may have brought in varied results with respect to GR post-surgery.

In this study, tissue response to the two treatment procedures was examined using TC and TE scores, 7 days after surgery. Intergroup comparison of TC revealed no statistically significant difference, but the finding of a statistically significant reduction in tissue edema scores in the laser treated sites may indicate a role of the laser in promotion of healing. Tissue damage is decreased during laser use as there is minimal collateral damage. Laser therapy thus results in wound healing comparable to or better than that observed with conventional surgery that generally shows an initial lag in soft tissue wound healing.[24] The finding from this study is substantiated by randomized control studies by *Amorim* et al and *Ozcelik* et al who reported that LLLT significantly promoted healing of tissues after various periodontal surgical procedures.[25,26] The difference in edema reduction in the test sites compared to control sites is statistically significant, but because the variation was minimal, it may not be of much clinical significance.

The use of lasers has become synonymous with patient comfort and painless procedures. Decreased pain and swelling is achieved due to laser sealing of the lymphatics and nerve endings. Biostimulation of the wound area and enhanced wound healing may also take place.[27] In this study, patients' discomfort/ pain perception was recorded using a VAS for each day till the 7th day after surgery. VAS is highly subjective and dependent on individual experience, but the split mouth study design of the trial overcomes this drawback, as the patient serves as both test and control. Most patients complained of slight pain on the first day after surgery, and negligible pain thereafter. Interestingly, it was found that more patients experienced higher pain on the test sites compared to the control sites. Similar results were reported in another study wherein diode lasers were used as an adjunct to open flap debridement.[28] However, the pain assessment result obtained in the current study contradicts those from various other studies which reported that diode lasers were beneficial in terms of pain management.[29,30] In disagreement with these results, *Masse* et al and *Ambrossini* et al found no statistically significant

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differences in pain scale values in control sites compared to the laser sites.[31,32] The higher pain in the test sites, in this study, could be attributed to high psychologic expectations or an exaggerated response to the additional armamentarium and precocious procedures that were followed. Although statistically significant, the VAS scores in the two groups were not extremely divergent.

Limitations of the present study include a short follow up period, lack of microbiological assessment and inadequate blinding during treatment procedure.

Conclusion

Within the limitations of the study, it can be concluded that the use of diode laser did not provide any significant benefit to the treatment outcome on the whole. Nevertheless, the use of diode laser did not lead to any postoperative complications or impede tissue repair.

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IMAGES

Image 1: Preoperative recording of clinical parameters in the control group using a customized occlusal stent at baseline

Image 2: Incisions given for modified Widman flap

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Image 3: Reflection and debridement

Image 4: Interrupted sutures with 4-0 silk sutures

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Image 5: Placement of periodontal pack

Image 6: Postoperative recording of clinical parameters after 6 months

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Image 7: Preoperative recording of clinical parameters in the test group at baseline

Image 8: Incisions given for modified Widman flap

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Image 9: After final debridement

Image 10: Use of diode laser to de-epithelialize the inner side of the flap

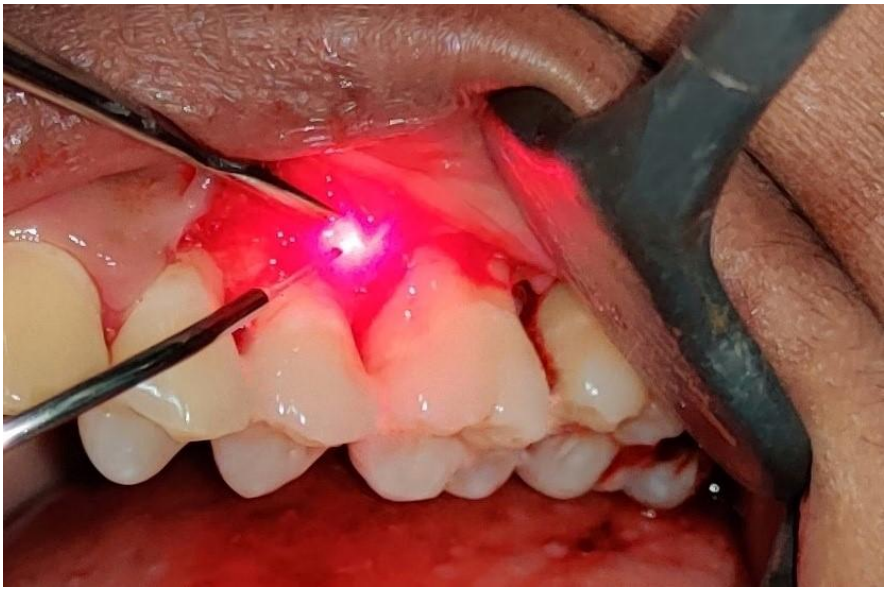

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Image 11: Interrupted sutures with 4-0 silk sutures

Image 12: Placement of periodontal pack

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Image 13: Postoperative measurement of clinical parameters after 6 months

Table 1 –Intragroup comparison of mean values of GI, PD, RAL and GR at baseline and 6 months post operatively in Test Group using paired t test

Variables	Time	Mean±SD	Mean difference	T	P value
GI	Baseline	1.3±0.39	0.55	2.98	**0.008***
	6 month	0.75±0.44			
PPD	Baseline	6.95±0.81	3.27	10.8	**0.0001***
	6 month	3.68±0.51			
RAL	Baseline	11.74±1.03	4.57	8.71	**0.0001***
	6 month	7.17±1.38			
GR	Baseline	0.18±0.08	-0.62	3.79	**0.001***
	6 month	0.80±0.51			

***P<0.05 is statistically significant**

GI Gingival Index
PPD – Probing Pocket Depth
RAL – Relative Attachment Level
GR – Gingival Recession
SD – Standard Deviation

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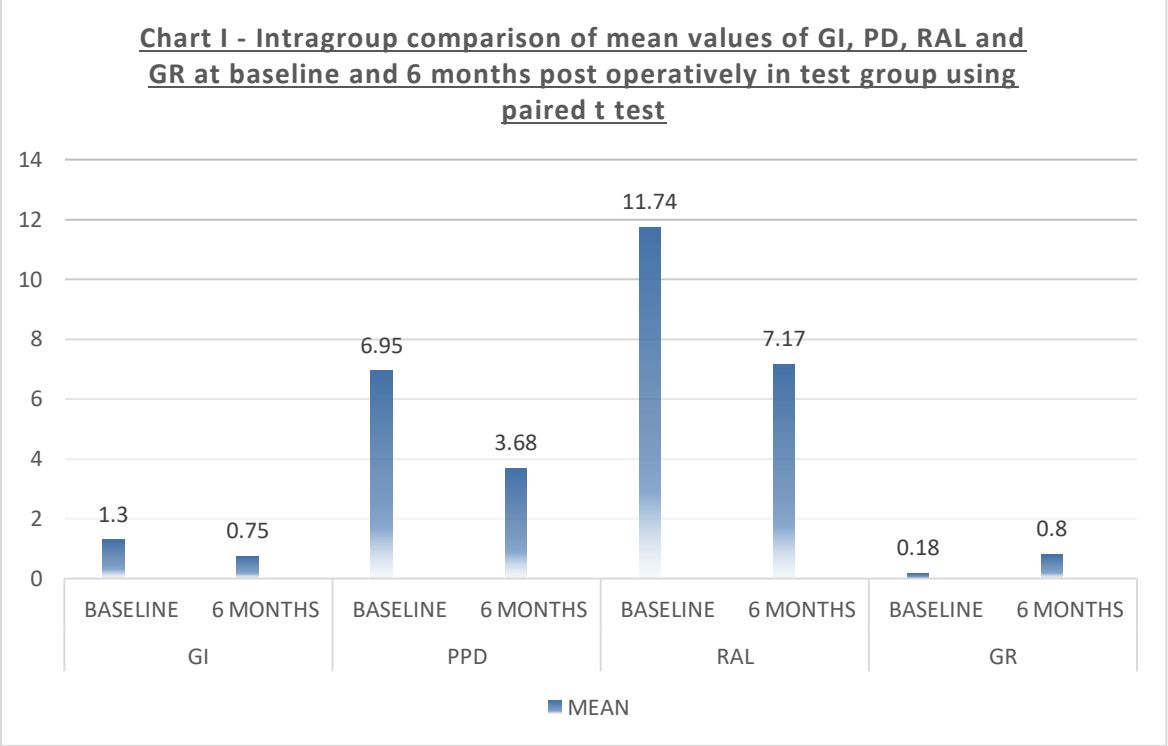

Table 2 – Intragroup comparison of mean values of GI, PD, RAL and GR at baseline and 6 months post operatively in Control Group using paired t test

Variables	Time	Mean±SD	Mean difference	T	P value
GI	Baseline	1.32±0.40	0.62	4.58	**0.0002***
	6 month	0.7±0.15			
PPD	Baseline	6.81±0.64	3.24	12.9	**0.0001***
	6 month	3.57±0.46			
RAL	Baseline	11.15±0.76	4.2	12.85	**0.0001***
	6 month	6.95±0.70			
GR	Baseline	0.10±0.09	-0.43	5.30	**0.001***
	6 month	0.53±0.24			

***P<0.05 is statistically significant**

GI – Gingival Index
PPD – Probing Pocket Depth
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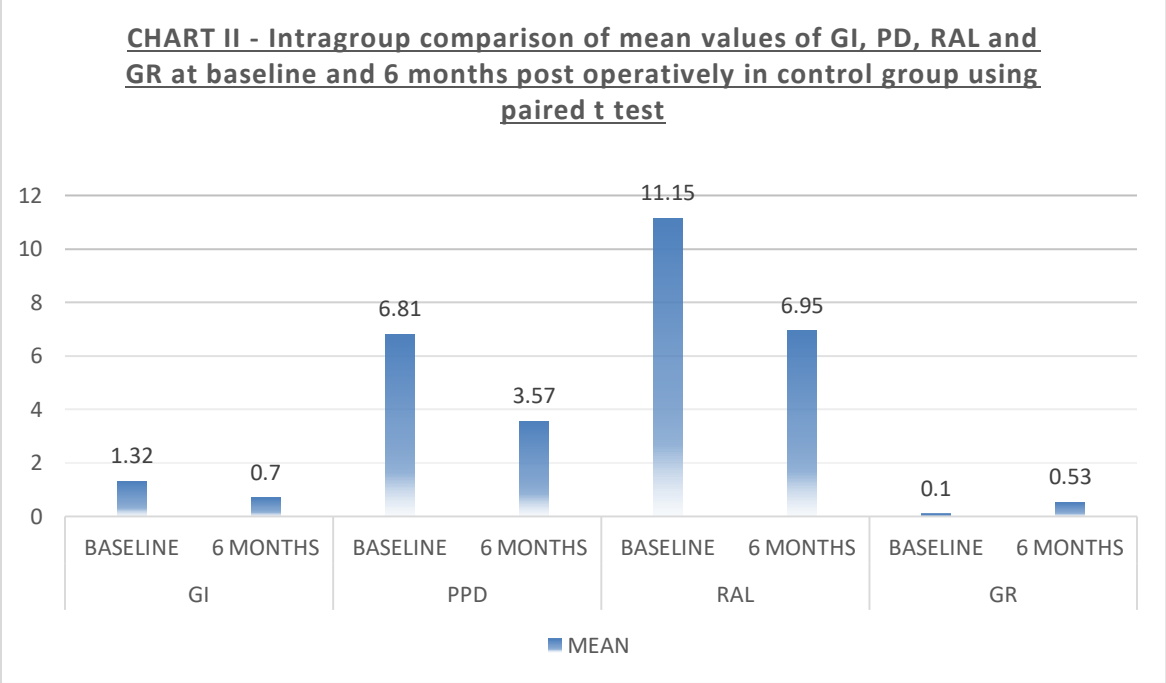

Table 3 –Intergroup comparison of mean values of GI, PD, RAL and GR at baseline and 6 months postoperatively between the Test and Control groups using independent t test

Variables	Time	Group	Mean±SD	T	P value
GI	Baseline	Test	1.3±0.39	0.11	0.91
		Control	1.32±0.40		
	6 months	Test	0.75±0.44	0.34	0.73
		Control	0.70±0.15		
PPD	Baseline	Test	6.95±0.81	0.67	0.42
		Control	6.81±0.64		
	6 months	Test	3.68±0.51	0.61	0.50
		Control	3.57±0.46		
RAL	Baseline	Test	11.74±1.03	1.45	0.16
		Control	11.15±0.76		
	6 months	Test	7.17±1.38	0.44	0.65
		Control	6.95±0.70		
GR	Baseline	Test	0.18±0.08	2.10	0.05
		Control	0.10±0.09		
	6 months	Test	0.80±0.51	1.51	0.14
		Control	0.53±0.24		

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***P<0.05 is statistically significant**

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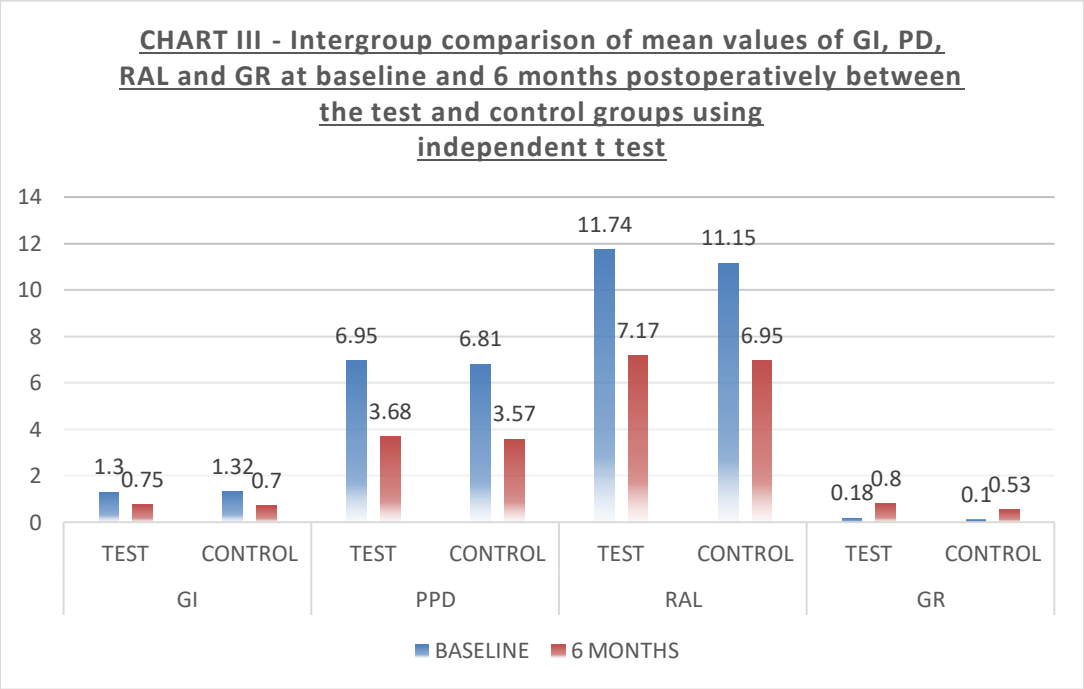

Table 4 - Comparison of mean tissue colour, tissue edema and VAS score 7 days postoperatively between test and control groups using independent t test

Variable	TEST	CONTROL	T	P value
Tissue colour	2.46±0.55	2.59±0.47	0.56	0.57
Tissue edema	3.03±0.22	3.32±0.62	2.83	**0.01***
VAS score	1.39±0.26	0.97±0.26	3.52	**0.002***

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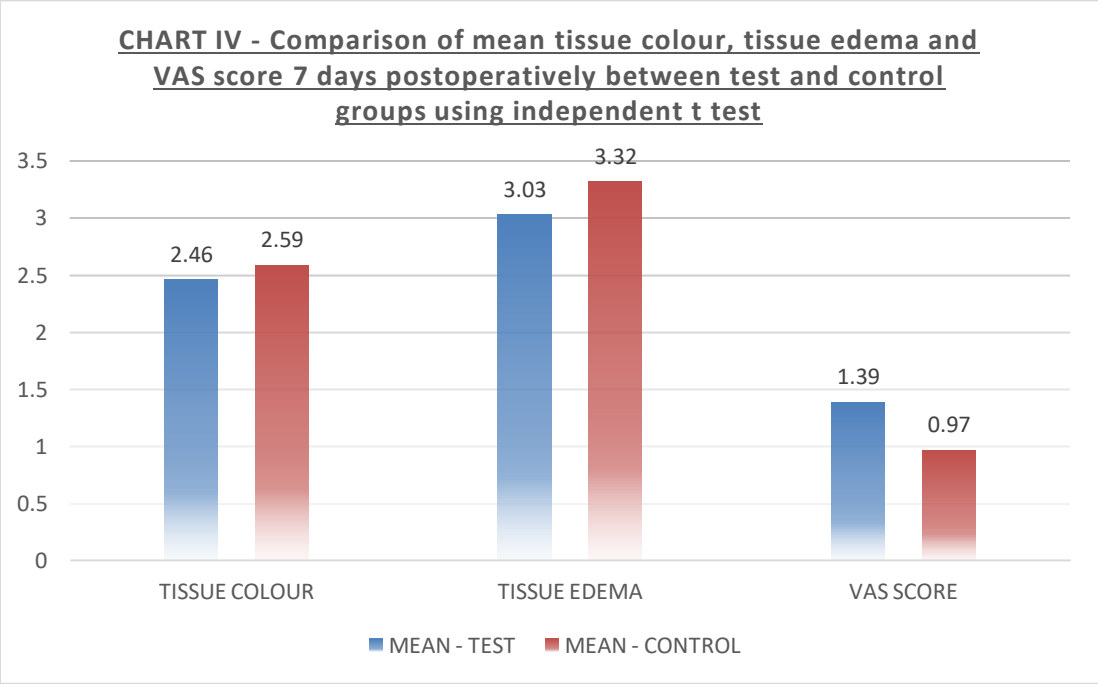
***P<0.05 is statistically significant**



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