



A NOVEL TREATMENT AID TO ORTHODONTIC GINGIVAL ENLARGEMENT WITH PHOTODYNAMIC THERAPY COMPARED TO CHLORHEXIDINE AND DIODE LASER AS ADJUNCT TO SCALING AND ROOT PLANING - A SPLIT MOUTH STUDY

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ABSTRACT

Background And Objectives: Inflammation or enlargement of gingival tissue is one of the most common problems associated with fixed orthodontic mechanotherapy. It increases bacterial retention and alters the equilibrium of oral microflora. There are various treatment modalities for orthodontically induced gingival inflammation/enlargement. Scaling and Root planing (SRP), antiseptic agents such as Chlorhexidine (CHX), LASER therapy and Photodynamic therapy (PDT) may help to reduce this. The objective of this study was to assess and compare the outcome of all the four treatment modalities. **Methods:** Twenty patients undergoing orthodontic treatment with gingival inflammation/enlargement were selected and the quadrants were divided randomly into four groups; SRP alone, SRP + 0.2% Chlorhexidine, SRP + DIODE LASER and SRP + PDT. Treatment was done once every month for 6 months. Periodontal parameters were assessed at baseline, third and six months. Plaque-index, Gingival-index, Bleeding-on-probing, Probing-pocket-depth and Gingival-overgrowth-index were assessed at every monthly visit. **Results:** Statistically significant improvements were found in six months follow-up period for all the variables compared with baseline. The improvement in clinical parameters were significantly greater in Group 4 compared to Groups 1, 2 and 3. **Conclusion:** Within the limits of study, it can be concluded that combination of multiple applications of 0.2% Chlorhexidine subgingival irrigation, LASER Therapy and PDT provide additional benefit to SRP in terms of clinical parameters. Even though all treatment modalities showed good results, Photodynamic Therapy showed better improvement in all the clinical parameters followed by low-level laser therapy and 0.2% Chlorhexidine subgingival irrigation.

KEYWORDS : Ortho-Perio inter relation; Gingival overgrowth; Scaling and root planing; Chlorhexidine gluconate irrigation; LASER; Photodynamic therapy

INTRODUCTION

Orthodontia and Periodontia possesses a symbiotic interrelationship. Orthodontic mechano-therapeutic procedures induce gingival tissue reactions like gingival enlargement.^{1,2,3} This is modified by localized or generalized inflammatory tissue growth.^{4,5} Orthodontic treatment increases bacterial retention and alters the oral microflora.⁶ Plaque is the main factor in development of gingivitis leading to initiation, progression and recurrence of periodontal diseases.^{7,8,9} Scaling and root planing (SRP) is considered the "gold standard therapy" for treatment of periodontal diseases.¹⁰ Clinically SRP decreases probing pocket depth and enables attachment gain.¹¹ However unsatisfactory outcomes arise due to poor access to base of deep periodontal pockets in patients with fixed orthodontic appliances. Adjunctive treatment strategies using antimicrobial irrigation in conjunction with SRP have been evolved based on the assumption that bacteria left behind during mechanical debridement could be eliminated by application of an antimicrobial solution deep into the pocket.¹²

Low-level laser therapy (LLLT) has both localised and generalised anti-inflammatory effects.¹³ LLLT modulates the chain of inflammatory processes triggered during orthodontic treatment thereby maintaining periodontal health.¹⁴

Photodynamic therapy (PDT) is based on use of photosensitizing chemicals with light of an appropriate wavelength. PDT has cytotoxic effects on microorganisms through the liberation of free radicals and singlet oxygen species thereby reducing the inflammation.¹⁵

Although there are various modalities for the treatment of gingival inflammation and enlargement associated with orthodontic therapy, literature provides limited evidence of comparing the efficacy of 0.2% Chlorhexidine subgingival

irrigation, Low-level laser therapy (LLLT) and Photodynamic therapy (PDT) for the treatment of gingival inflammation or enlargement due to orthodontic treatment. This study was an attempt to assess the outcome of all the four treatment modalities and compare their efficacy.

Objectives

To evaluate the clinical efficacy of SRP alone in the management of gingival inflammation/enlargement in patients undergoing orthodontic treatment.

To evaluate the clinical efficacy of SRP + 0.2% Chlorhexidine in the management of gingival inflammation/enlargement in patients undergoing orthodontic treatment.

To evaluate the clinical efficacy of SRP + Diode Laser in the management of gingival inflammation/enlargement in patients undergoing orthodontic treatment.

To evaluate the clinical efficacy of SRP+ Photodynamic Therapy using Indocyanine green as a photo sensitizer in the management of gingival inflammation/enlargement in patients undergoing orthodontic treatment.

To compare the results of the above four groups.

MATERIALS & METHOD

Source And Method Of Collection Of Data -

Among the 70 patients referred to Department of Periodontics, Coorg Institute of Dental Sciences, 20 patients between age group of 14-27 years were selected by flip of a coin (11 males and 9 females). The patients were undergoing orthodontic treatments with fixed appliances and had gingival inflammation and enlargement. Patients were selected and quadrants were divided randomly into four groups. The study was explained and written consent was obtained prior to

commencement of study. Each quadrant of selected patients was subjected to: - Scaling and Root planing (SRP) alone, SRP + 0.2% chlorhexidine subgingival irrigation, SRP + LASER therapy with Diode Laser of 810nm wavelength and SRP+ Photodynamic Therapy (PDT) using indocyanine green photosensitizer once every month for six months. For all patients, clinical periodontal parameters were assessed at baseline, third and six months. The parameters considered were; Gingival index (GI), Bleeding on probing (BOP), Plaque Index (PI), Sulcus Bleeding Index (SBI), Probing pocket depth (PPD) and Gingival Overgrowth Index (GOI)

Criteria For Subject Grouping

This was a split mouth study design wherein four quadrants from each patient were randomly allotted to either of four groups.

Group 1 - SRP alone

Group 2 - SRP + 0.2% Chlorhexidine Mouthwash (HEXODENT®, 0.2% Chlorhexidine Mouthwash B.P)

Group 3 - SRP + LASER (Diode Laser, 810nm, AMD Picasso®)

Group 4 - SRP + PDT (Indocyanine green-Aurogreen®, Aurolab, Madurai, India) The patients was recalled for follow-up, up to six months at one-month intervals.

Inclusion Criteria:

1. Patients aged between 14-27 yrs.
2. Patient undergoing orthodontic treatment and referred to Department of Periodontics for gingival inflammation and enlargement in all four quadrants.
3. Patients without any systemic illness.
4. Patients without any history of known drug allergy especially to indocyanine green.
5. Non-smokers.
6. Patient who has gingival overgrowth index ≥ 1 in each quadrant.

Exclusion Criteria:

1. Patients on drugs which induces gingival enlargement, e.g. calcium channel blockers, anticonvulsants or immunosuppressants.
2. Patients with lingual orthodontic appliance.
3. Pregnant or lactating women.
4. Female patients on hormonal therapy.
5. Patients who are not competent of giving consents.
6. Relapsed periodontal surgery patients who do not follow proper oral hygiene practices.

Treatment Method

1. Scaling And Root Planing –

After thorough clinical examination all participants received detailed instructions about oral hygiene and underwent the following conventional therapy:

- Dental plaque and supragingival calculus removal – Scaling
- Subgingival Calculus removal – Root planing

2. Subgingival Irrigation With 0.2% Chlorhexidine –

The treatment procedure consisted of isolating one quadrant with cotton rolls, air drying the teeth and irrigating subgingivally the mesiobuccal, distobuccal, mesiolingual and distolingual areas of the teeth with solution of 0.2% chlorhexidine digluconate (HEXODENT®, 0.2% Chlorhexidine Mouthwash BP). The subgingival irrigation was done at each of the four sites for 5 seconds with a flow rate of 20 ml/min with 5ml sterile syringe with blunt tip.

3. Laser Therapy –

After conventional therapy, one of the quadrants received low-level laser treatment. Laser irradiation therapy was conducted once in every month. The soft tissue wall of the periodontal pocket was irradiated with an 810 nm AMD Picasso

diode LASER operating at 0.1W output power, continuous wave with a 300 μ m optical fiber tip. Irradiation was performed in contact mode to remove the pocket epithelium all around the teeth. To minimize collateral damage the tip was moved at a constant speed of 1mm/s in an apico-coronal direction with a sweeping zigzag motion. Fiber end was checked at every irradiation for a carbonized tip (hot tip).

4. Photodynamic Therapy –

The photodynamic therapy was applied using 810 nm diode lasers at a power of 0.1W in continuous mode with 1mg/ml solution of Indocyanine green (ICG) as a photosensitizer. [Aurogreen®, Aurolab, Madurai, India]. Freshly prepared photosensitizer was prepared by adding 25 mg sterile lyophilized powder with 5 ml sterile water provided by manufacturer resulting in 0.5% solution. The solution was filtered using 0.2-micron syringe filter and drawn in a sterile syringe. Periodontal pockets were filled with the dye for 3 minutes from the bottom using a blunt cannula. Areas were isolated with cotton rolls and high vacuum suction and excess photosensitizer was removed by distilled water irrigation prior to the therapy.

Clinical Parameters Used:

1. **Plaque index (PI)** - Sillness and Loe in (1964)
2. **Gingival index (GI)** - Loe and Sillnes J (1963)
3. **Sulcus Bleeding Index (SBI)** - Muhlemann and Sons (1971)
4. **Probing Pocket depth (PPD)** - measured by using a UNC - 15 probe taken from gingival margin to base of the pocket.
5. **Gingival overgrowth index (GOI)** - Angelopoulos & Goaz (1972)

RESULTS

Statistical Analysis

The data was coded and fed in SPSS software (Version no - 23) for statistical analysis. Descriptive statistics included mean and standard deviation. Inferential statistics included one-way ANOVA followed by Post hoc Tukey's test. The level of significance was set at 0.05 at 95% confidence interval.

Inter Group Comparison

Plaque Index – Inter group comparison shows reduction in PI values in all the groups as compared to baseline, yet the values are not statistically significant.

Gingival Index - Inter group comparison shows significant changes from baseline to 3rd month and to 6th month.

Probing Pocket Depth – Inter group comparison shows non-significant statistical changes in the baseline between the treatment groups. Moreover, in 3rd month group-4 showed statistically significant changes with a mean value of 0.36500 ± 0.11298 and in 6th month, group-3 and group-4 showed high significance with a mean difference of 0.37500 ± 0.10523 , 0.59000 ± 0.10523 respectively.

Sulcus Bleeding Index – Inter group comparison shows non-significant statistical changes in the baseline between the treatment groups. In 3rd month and 6th month group-3 & group-4 showed a statistically significant changes with a mean value of 0.33000 ± 0.28754 , 0.62000 ± 0.28754 & 0.29000 ± 0.27708 , 0.73000 ± 0.27708 respectively.

Gingival Overgrowth Index - Inter group comparison shows statistically non-significant changes in the baseline and 3rd month between the treatment groups. In 6th month, group-4 showed a statistically significant changes with a mean value of 0.42000 ± 0.14622 .

Intra Group Comparison

Plaque Index – Intra Group Comparison for group I shows

statistically significant reduction between baseline to third month and sixth month of 0.43500 ± 0.16238 and 0.74000 ± 0.16238 respectively. Group II results show statistically significant reduction in all comparative periods i.e. from baseline to third month, sixth month and from baseline to sixth month. Group III results show statistically significant reduction between baseline to third month and sixth month. Group IV results show statistically significant reduction in all comparative periods i.e. from baseline to third month, sixth month and from baseline to sixth month.

Gingival Index – Intra Group Comparison of group I from baseline to sixth month shows statistically significant reduction. Group II results show statistically significant difference between baseline to third month and sixth month. Group III & Group IV results shows statistically significant reduction in all comparative periods i.e. from baseline to third month, sixth month and from baseline to sixth month.

Probing Depth – Intra Group Comparison of Group I & Group II values show similar statistically significant reduction from baseline to third month and sixth month. Group III & Group IV results shows statistically significant reduction in all comparative periods i.e. from baseline to third month, sixth month and from baseline to sixth month.

Sulcus Bleeding Index- Intra Group Comparison of Group I & Group II values shows statistically significant reduction from baseline to sixth month. Group III values show statistically significant reduction from baseline to third month and sixth month. Group IV results show statistically significant reduction in all comparative periods i.e. from baseline to third month, sixth month and from baseline to sixth month.

Gingival Overgrowth Index- Intra Group Comparison of Group I results shows statistically significant reduction in all comparative periods i.e. from baseline to third month, sixth month and from baseline to sixth month. Group II values show statistically significant reduction from baseline to sixth month. Group III values show statistically significant reduction from third month to sixth month and from baseline to sixth month. Group IV results show statistically significant reduction in all comparative periods i.e. from baseline to third month, sixth month and from baseline to sixth month.

DISCUSSION

This study compared efficacy of 0.2% Chlorhexidine, Diode laser and Photodynamic therapy as an adjunct to SRP in treatment of gingival inflammation and enlargement in Orthodontic patients. Twenty subjects between 14 to 27 years were selected according to inclusion criteria. All treatment modalities were performed every month for 6 months. Clinical parameters were evaluated at baseline, 3rd month and 6th month. Clinical parameters recorded were PI, GI, SBI, PPD & GOI. The study showed statistically significant reduction of all clinical parameters for all groups. Scaling & root planing stabilizes most cases of gingival and periodontal diseases. This coincides with a study by Novokovic et al,¹⁶ where meticulous SRP have reduced inflammation through reduction of bacterial burden. The reduction of PPD might have resulted from complete re-epithelialization and healing by long junctional epithelium. Group-2 (SRP+CHX) showed significant changes from baseline to 6 months in all the clinical parameters. This is in accordance with a study by SoH et al.¹⁷ which showed significant reduction in PI, SBI, GI and PPD in CHX group (mean 1.2 mm). The greatest reductions in (supragingival) plaque and periodontal inflammation initiated within one week of commencement of irrigation and continued till the end of the treatment period. SRP+LASER group have shown significant reduction in all clinical parameters from baseline to 6th month, which was statistically significant. This is in accordance with the study by Märtu et al,

¹⁸ where LLLT slowed down periodontal inflammation by lowering BOP, PD scores and bacterial load. It has bactericidal effect on perio-pathogenic bacteria, modulates pain of orthodontic activation and causes faster recovery of initial periodontal status. LLLT was combined with PDT as a synergistic treatment modality, in a study by Lui et al¹⁹ as PDT generates toxic free radicals which destroys localized microbial entities. To our knowledge, no studies investigated all the four treatment modalities (SRP, CHX, PDT, and LLLT) clinically on a long-term basis and nonetheless their efficacy in the treatment of gingival inflammation of orthodontic patients. In this study, inter-group comparison in GI projected a statistically significant difference between Group-1 versus Group-3 and Group-4 without any significant change between Group-1 versus Group-2. This indicates that adjunctive use of PDT and LASER is better than SRP alone and SRP with CHX in the reduction of PI, GI, SBI, PPD and GOI scores. These results stand parallel to several studies; however with different methodologies, by Malgikar et al²⁰ and R. Attin et al²¹ whereby CHX, low-level lasers and PDT have reduced PI, PD, GI, SBI with resultant reduction of gingival inflammation. Qadri et al,²² found in their study that additional treatment with low-level lasers reduced inflammation of periodontium and probing pocket depth. The results are in accordance to our study. In our study from baseline to 6 months there is significant improvement in all the clinical parameters in all the groups but when comparing the differences between the groups results were significant only with PDT group. In case of gingival enlargement or overgrowth from baseline to 6th month, all the other three groups have shown significant reduction, except group-1. Whereas comparing between the groups, SRP + PDT group showed highly significant reduction in the gingival overgrowth. Irrespective of the results a few studies state that SRP + PDT does not have any added advantage over SRP.^{23,24} These variations in results are difficult to interpret due to heterogeneity in study designs with various types of photosensitizers and different wavelength of laser used. These results provide new data about repeated applications of PDT which are important in monitoring gingival health status in orthodontic population, in accordance with Gómez et al.²⁵ In the present study, the repeated treatment with SRP, CHX sub gingival irrigation, LASER therapy and PDT showed a remarkable positive effect over time.

CONCLUSION

The present short clinical trial suggests that all the four treatment strategies (SRP alone, SRP + 0.2% CHX, SRP + LASER & SRP + PDT) benefit patients under orthodontic treatment with gingival enlargement. Combination of multiple application of subgingival irrigation with 0.2% Chlorhexidine, LASER Therapy and PDT with 810 nm Diode laser and ICG dye are more beneficial than SRP. Even though all modalities showed good results, PDT showed better improvement in all clinical parameters followed by LASER therapy, 0.2% Chlorhexidine subgingival irrigation and SRP. Further long-term beneficial effects in comparison with conventional methods.

Tables

Intergroup Comparison

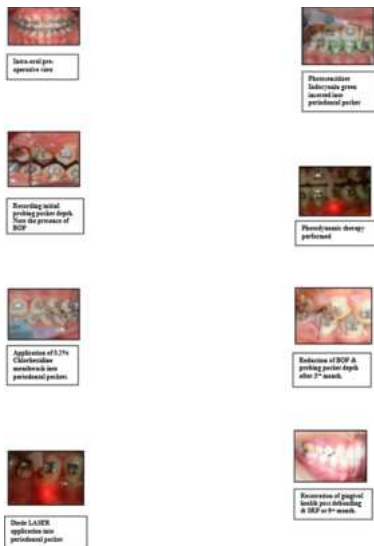
Parameters	Interv als	Sit e - 1	Sit e - 2	Sit e - 3	Sit e - 4	Dif f b /w 1 & 2	Dif f b/ w 2 & 3	Dif f b/ w 3 & 4	Dif f b /w 1 & 3	Dif f b /w 1 & 4	Dif f b /w 3 & 4
Plaqu e index (PI)	Baseli ne	1.9 800	1.9 600	1.8 300	1.8 900	0.0 20	0.13 60	0.0 60	0.1 50	0.0 90	0.0 60
	3 rd Month	1.5 450	1.5 400	1.3 950	1.3 650	0.0 05	0.14 5	0.0 30	0.1 50	0.1 8	0.0 30
	6 th Month	1.2 400	1.2 750	1.1 100	1.0 550	0.0 35	0.16 5	0.0 55	0.1 30	0.1 85	0.0 55

Gingival index (GI)	Baseline	2.0	2.1	2.4	2.5	0.0	0.28	0.1	0.3	0.4	0.1
	3 rd month	1.8	1.7	1.7	1.5	0.1	0.20	0.2	0.0	0.3	0.2
	6 th Month	1.5	1.3	1.3	1.1	0.1	0.08	0.1	0.2	0.3	0.1
	Month	130	800	000	250	33	0	75	13	88	75
Sulcus Bleeding Index (SBI)	Baseline	2.8	2.8	3.0	3.0	0.0	0.23	0.0	0.2	0.2	0.0
	3 rd month	2.4	2.3	2.3	2.1	0.0	0.04	0.1	0.1	0.2	0.1
	6 th Month	1.9	1.8	1.7	1.4	0.0	0.16	0.3	0.2	0.5	0.3
	Month	800	850	250	200	95	0	05	55	6	05
Probing Pocket depth (PPD)	Baseline	4.5	4.3	4.4	4.4	0.2	0.12	0.0	0.1	0.0	0.0
	3 rd month	4.1	3.9	3.8	3.7	0.1	0.10	0.1	0.2	0.3	0.1
	6 th Month	3.8	3.7	3.5	3.3	0.1	0.26	0.2	0.3	0.5	0.2
	Month	900	800	600	500	10	5	15	75	90	15
Gingival overgrowth index (GOi)	Baseline	1.6	1.6	1.7	1.8	0.0	0.15	0.0	0.1	0.1	0.0
	3 rd month	1.5	1.5	1.4	1.3	0.0	0.06	0.1	0.0	0.2	0.1
	6 th Month	1.2	1.2	1.0	1.8	0.0	0.12	0.7	0.1	0.5	0.7
	Month	550	150	950	350	40	0	40	60	80	40

Intragroup Comparison

Parameters	Area	Baseline	Third Month	Sixth Month	F	Significance
Plaque index (PI)	Site 1	1.9800	1.5450	1.2400	10.491	0.000 (H.S)
	Site 2	1.9600	1.5400	1.2750	8.656	0.000 (H.S)
	Site 3	1.8350	1.3950	1.1100	13.962	0.000 (H.S)
	Site 4	1.8900	1.3650	1.3650	21.950	0.000 (H.S)
Gingival index (GI)	Site 1	2.0850	1.8750	1.5130	6.929	0.002 (H.S)
	Site 2	2.1350	1.7450	1.3800	14.272	0.000 (H.S)
	Site 3	2.4150	1.7800	1.3000	30.801	0.000 (H.S)
	Site 4	2.5250	1.5450	1.1250	45.952	0.000 (H.S)
Sulcus Bleeding Index (SBI)	Site 1	2.8430	2.4350	1.9800	3.836	0.027 (S)
	Site 2	2.8330	2.3500	1.8850	4.946	0.010 (S)
	Site 3	3.0650	2.3050	1.7250	10.474	0.000 (H.S)
	Site 4	3.0500	2.1450	1.4200	18.557	0.000 (H.S)
Probing Pocket depth (PPD)	Site 1	4.5850	4.1250	3.8900	16.042	0.000 (H.S)
	Site 2	4.3350	3.9600	3.7800	7.391	0.001 (H.S)
	Site 3	4.4550	3.8600	3.5150	41.689	0.000 (H.S)
	Site 4	4.4950	3.7600	3.3000	72.439	0.000 (H.S)
Gingival overgrowth index (GOi)	Site 1	1.6350	1.5600	1.2550	3.124	0.052 (N.S)
	Site 2	1.6400	1.5450	1.2150	4.176	0.020 (S)
	Site 3	1.7900	1.4800	1.0950	9.914	0.000 (H.S)
	Site 4	1.8150	1.3300	1.8350	19.618	0.000 (H.S)

Clinical Pictures



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