Research Article
J Nepal Soc Perio Oral Implantol. 2022 Jul-Dec;6(12):67-73
https://doi.org/10.3126/jnspoi.v6i2.53007

Submitted: Nov 23, 2022
Accepted: Feb 19, 2023
Published: Feb 24, 2023

Locally Delivered Chlorhexidine Chip and Diode Laser in the Treatment of Periodontitis

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ABSTRACT

Introduction: Scaling and root planing (SRP) reduces periodontal inflammation but complete removal of bacterial deposits and toxins is not always feasible. Thus, adjunctive therapeutic strategies like use of local delivery of chlorhexidine (CHX) chip and laser therapy have evolved.

Objective: To compare effectiveness of locally delivered CHX chip with diode laser in treatment of periodontitis.

Methods: The non-randomised trial was done in Department of Periodontics at Peoples Dental College and Hospital (PDCH) from August 2019 to July 2020 after ethical clearance from Nepal Health Research Council. Study population was patients with chronic periodontitis with bilateral periodontal pockets in contralateral hemiarches exhibiting periodontal probing depth (PPD) of ≥5-7 mm attending PDCH. Written informed consent was obtained from all participants. Baseline parameters were recorded one week after full mouth SRP. In group A CHX chip was placed and in group B diode laser treatment was done. The parameters: Oral Hygiene Index-Simplified, Plaque Index, Gingival Index, PPD, and Clinical Attachment Level (CAL) were recorded at one month, three months, and six months.

Results: Fifteen patients were analysed. Comparison showed that PPD scores at one month and three months were significantly lower in Group A compared to Group B. Comparison of CAL scores at baseline of both the groups were same. At subsequent visits, CAL for Group A was lower than Group B, but mean difference was not statistically significant.

Conclusions: Both groups showed significant improvements compared with baseline. However, the difference in improvement of the PPD and CAL between groups was not significant.

Keywords: Chlorhexidine chip; clinical attachment level; diode laser; periodontal probing depth; scaling and root planing.

INTRODUCTION

Periodontitis is a chronic inflammatory response to the accumulation of microbial plaque and calculus on the root surface of the tooth that leads to breakdown of the surrounding periodontal tissues.[1] Complete removal of bacterial deposits and toxins from root surfaces and periodontal pocket is not always feasible with scaling and root planing (SRP).[2] Thus, numerous adjunctive therapeutic strategies have evolved.[3]

Chlorhexidine chip is a degradable local delivery system that delivers the antiseptic chlorhexidine and maintains effective levels of the drug in the periodontal pocket while simultaneously biodegrading.[4] The chip is indicated for use in periodontal pockets that are 5 mm or more.[5]

The diode laser exhibit bactericidal and detoxification effects without producing a smear layer[2] and allows the subgingival debridement and eradication of pathogenic microorganisms which provides new loci for attachment of connective tissue.[6]

A vast array of studies has been conducted revealing the efficacy of lasers and chlorhexidine chip separately but very few studies are conducted for comparing the effectiveness of chlorhexidine chip and diode laser as an adjunct to SRP. Therefore, the motive of this study is to comparatively measure the competence of diode laser and chlorhexidine chip as adjuncts to the scaling and root planing procedure.

METHODS

The non-randomised trial was done in Department of Periodontics at Peoples Dental College and Hospital, Kathmandu, Nepal. Study population was patients with chronic periodontitis who met the inclusion

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Citation
Bajracharya A, Shrestha SM, Pradhan A, Regmi S. Locally Delivered Chlorhexidine Chip and Diode Laser in the Treatment of Periodontitis. J Nepal Soc Perio Oral Implantol. 2022 Jul-Dec;6(12):67-73.

Figure 1: Placement of chlorhexidine chip in periodontal pocket.

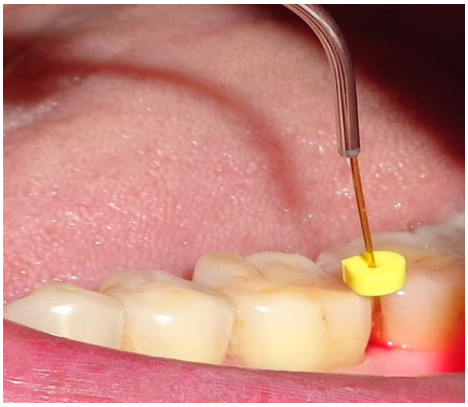

Figure 2: Diode laser therapy.

criteria attending People's dental college and Hospital, Sorhakhutte, Kathmandu, Nepal. The study period was from August 2019 to July 2020. Ethical clearance was obtained from the institutional review board of Nepal Health Research Council (Ref. 425). Written informed consent was obtained from all participants. Convenience sampling was done. The calculated sample size (n) was 17 in each group, according to the study reported by Bansal et al.,[7] where n was calculated using formula 2*(zα + zβ)^2 * s^2 divided by d^2. The value of z α was 1.96 at 95% confidence level, zβ was 0.84 at 80% power and s was the standard deviation of periodontal probing depth whose value is 0.41, assuming mean difference (d) of 0.4.

Patients of age group 35 to 55 years old who had minimum 20 teeth (five teeth in each quadrant) were included in the study. The teeth selected for the study were maxillary and mandibular first and second molars with bilateral periodontal pockets in contralateral hemiarches exhibiting periodontal probing depth (PPD) of ≥5 mm-7 mm, Clinical Attachment Level (CAL) 2 mm-4 mm, Plaque Index (PI) 1-2, Gingival Index (GI) 1-2 , Oral Hygiene Index Simplified (OHI-S) ≤1.2. The data were entered into IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, N.Y., USA)

Teeth with Grade II, III mobility (Miller classification, 1938); Grade II, III, IV furcation involvement (Glickman's classification,1953);Grade II, III, IV gingival recession (Miller's classification,1985); patients who had received any known surgical or non-surgical periodontal therapy within six months of the start of study; patients with known hypersensitivity to chlorhexidine; smokers, alcoholics and drug abusers; use of antibiotics within the previous six months; systemic disease that could affect the outcome or progression of periodontal therapy; pregnant and lactating mothers; those using hormonal contraceptives; patients with fixed orthodontic appliances; teeth with endoperio lesion and third molars were excluded in this study.

PPD was measured from base of pocket to gingival margin; CAL was measured from the cementoenamel junction (CEJ) to the base of the pocket using Hu Friedy's University of North Carolina- 15 periodontal probe.

After selection of the study subjects and obtaining informed consent, impressions of the respective arches were taken. Occlusal stents were prepared.

A full mouth oral prophylaxis that is SRP was done. Intraoral periapical radiographs were taken of the respective site. Seven days after SRP, the patient was recalled and baseline clinical parameters were recorded.

In group A chlorhexidine chip placement was done and in group B laser treatment was given. The area was dried, and the chlorhexidine chip dipped in normal saline was inserted into periodontal pocket with tweezers and the curve end of the chip was first inserted into periodontal pocket (Figure 1). Periodontal dressing (Coe-pak) was placed on sites where chlorhexidine chip application was done. Patients was recalled after seven days for removal of Coe-pak.

The diode laser therapy was given with a 980 nm diode laser with power of 1.5 Watts in pulse mode at frequency of 10 Hz and 50 duty cycle. On the affected periodontal pocket site, a 320 µm fibre-optic delivery system was introduced parallel to the root surface 1 mm short of measured PPD using an endodontic stopper on the fiber in apico-coronal direction. The fibre-optic tip was moved in a sweeping motion for 20 seconds per site almost parallel to the tooth and moving from apical to coronal direction (Figure 2).

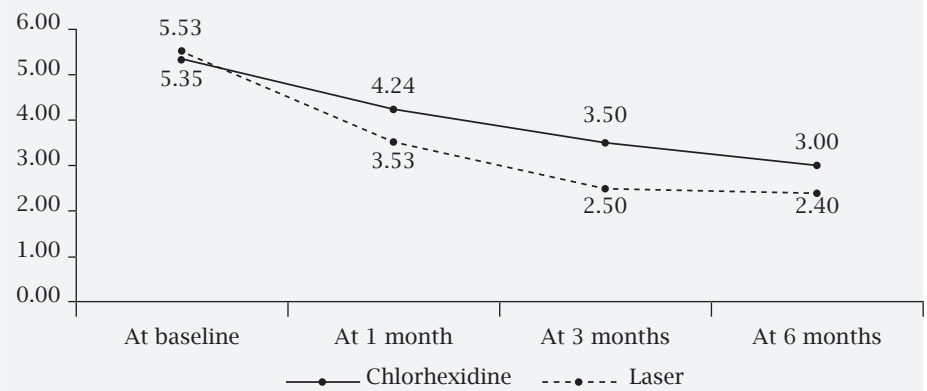

Figure 3: Mean scores of periodontal probing depths at different time intervals in group a and group b (n = 30 sites).

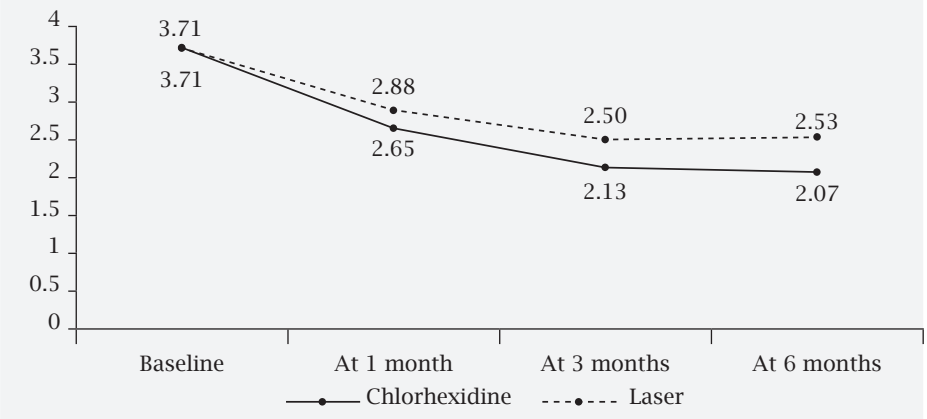

Figure 4: Mean scores of clinical attachment level at different time intervals in group a and group b (n = 30 sites).

The patient was recalled on third and seventh day and diode laser therapy was given. All clinical and outcome variables: OHI-S, PI, GI, PPD, and CAL were recorded at one month, three months and six months with previously used acrylic stents and University of North Carolina No. 15 (UNC-15) Hu Friedy periodontal probe. Patients were advised to brush with Modified Bass technique. Oral hygiene instructions was repeated in every appointment.

RESULTS

Out of 17 patients, two lost the follow-up. Thus, a total of 15 patients with 30 clinical sites were included in this study. In the current study, the average age of the study patients was 43.06±6.23 years. The maximum age of the patient was recorded to be 55 years while the lowest was 35 years, where six (35.30%) were males and eleven (64.70%) were females.

The mean PPD in clinical sites in Group A reduced significantly when baseline scores were compared to values at the follow up visits done at one month, three months, and six months with P value of <0.001. Similarly, compared to first month, there was significant decrease in the third and sixth months visits as well with P value <0.001.

The mean PPD in Group B reduced significantly when baseline scores were compared to values at follow up visits done at one month, three months, and six months with P value of <0.001. Similarly, compared to first month, there was significant decrease in the third and sixth month follow-up visits as well with P value <0.001. Furthermore, compared to third month, there was significant decline in PPD scores at the sixth month as well with P value of 0.006.

The mean PPD of Group A was higher than Group B at the baseline by 0.18 mm. However, at the subsequent follow up visits, the mean PPD of Group A were lower than Group B (Figure 3).

Comparison of mean values showed at different time intervals between Group A and Group B that PPD scores at one month and three months follow up visits were significantly lower in Group A compared to Group B with P value of 0.003 and <0.001 respectively (Table 1).

Table 1: Comparison of mean scores of periodontal probing depth between study groups at different intervals (n = 30 sites).

Mean scores of PPD	Group A (Mean±SD)	Group B (Mean±SD)	P value
PPD at baseline (in mm)	5.53±0.51	5.35±0.49	0.315
PPD at 1 month (in mm)	3.53±0.51	4.24±0.75	0.003
PPD at 3 months (in mm)	2.50±0.63	3.50±0.52	<0.001
PPD at 6 months (in mm)	2.40±0.74	3.00±1.00	0.072

Table 2: Comparison of mean scores of clinical attachment level between study groups at different intervals (n = 30 sites).

Mean scores of PPD	Group A (Mean±SD)	Group B (Mean±SD)	P value
CAL at baseline (in mm)	3.71±0.47	3.71±0.47	1.000
CAL at 1 month (in mm)	2.65±0.49	2.88±0.48	0.170
CAL at 3 months (in mm)	2.13±0.50	2.50±0.73	0.100
CAL at 6 months (in mm)	2.07±0.59	2.53±0.83	0.088

The mean CAL in Group A reduced significantly when baseline scores were compared to values at the follow up visits done at one month, three months, and six months with P value of <0.001. Similarly, compared to first month, there was significant decrease in the third and sixth month visits as well with P value <0.05.

The mean CAL in Group B reduced significantly when baseline scores were compared to values at all the follow up visits done at one month, three months, and six months with P value of <0.001. However, the mean CAL scores failed to reduce significantly at follow up visits when compared to scores at one month and three months.

The baseline CAL was same in both the study groups. However, at subsequent follow up visits, it was observed that scores in Group A decreased and remained less than that of Group B till the last follow up visit as well (Figure 4).

Comparison of mean values showed that CAL scores at baseline of both the groups are same. At subsequent visits, the CAL for Group A was lower than Group B, but the mean difference was not statistically significant (Table 2).

The comparison of mean scores of PI at different time intervals in Group A showed significant decrease in the mean plaque scores at subsequent visits when compared to baseline values with P value of <0.001 indicating improvement in oral hygiene status of the patient at follow up visits.

The comparison of mean scores of PI at different time intervals in Group B showed significant decrease in the mean plaque scores at subsequent visits when compared to baseline values with P value of <0.001 indicating improvement in oral hygiene status of the patient at follow up visits.

The mean PI scores of Group A was higher than Group B at baseline while it declined at subsequent follow up. At all the three subsequent follow up visit, till the six months, the mean PI scores of Group A was lower than Group B.

The comparison of mean values showed that mean PI and GI scores at first, third and sixth months was lower in Group A compared to Group B, however the mean difference failed to reach statistical significance (P >0.05).

The mean gingival scores of Group A were higher than Group B at baseline while it declined at subsequent follow up. At all the three subsequent follow up visit, until the six months, the mean PI scores of Group A (0.42) was lower than Group B (0.62).

Compared to the baseline values, there was a significant decrease in the mean OHI-S scores at each follow up visit with P value < 0.001 from 1.04 to 0.54 respectively. This indicates that there was an overall significant improvement in oral hygiene status of patients.

DISCUSSION

The present study was accomplished with the objective to compare and evaluate the effects of locally delivered chlorhexidine chip and diode laser as adjunctive treatment to scaling and root planing in the treatment of periodontitis. A split-mouth design was selected to avoid interindividual variability from estimates of treatment effect.[8]

Various clinical parameters like PI, GI, OHI-S, PPD, and CAL were measured at baseline, one month, three months and six months from the time of placement of chlorhexidine chip and laser therapy. Clinical assessment of local delivery systems and laser decontamination is done by the evaluation of reduction of PPD, gain in CAL and assessing the GI.[9, 10]

The results demonstrated statistically significant results for both the treatment groups, Group A (scaling, root planing and chlorhexidine chip) and Group B (scaling, root planing and laser therapy) when intragroup comparison was done. However, the results were clinically significant but statistically insignificant in terms of CAL, GI, and PI in the intergroup comparison. The PPD at one month and third month was found to test statistically lower in Group A with P value 0.003 and <0.001 respectively, indicating greater reduction of PPD in Group A as compared to that of Group B. Whereas, there was non-significant differences in rest of the clinical parameters on the inter-group comparison at one, three, and six months. Likewise, there was overall significant improvement in oral hygiene status of patient from baseline to six months with P value <0.001.

Full mouth SRP was done initially to allow disruption of the plaque biofilm. The removal of biofilm favours effectiveness of adjuncts against subgingival pathogens.[3] The 0.2% chlorhexidine mouthwash twice daily for two weeks was given after SRP due to its plaque inhibiting effect,[11] also the wound healing is enhanced when chlorhexidine rinses are used after SRP.[12]

The specific treatments were carried out seven days after the session of SRP as the presence of blood in gingival sulcus acts as an interfering factor which can elevate the peril of thermal damage due to laser therapy.[1] The thin biofilm of blood covering the root surfaces of periodontal pocket can considerably elevate the absorption of energy and may lead to thermal damage to the dental pulp.[7]

On the affected pocket site, a 320 µm fibre-optic delivery system was introduced parallel to the root surface and 1 mm less than value obtained during the clinical measurements.[6] This allows for the laser energy to penetrate the tissue and reduce the bacterial load without the fibre touching the epithelial attachment at the bottom of the pocket.[13] Multiple application of 980 nm diode laser was done targeting the subgingival microbiota until restoration of the sulcular and junctional epithelium which generally demands two to seven days.[14, 15]

The concept of controlled-release local delivery of therapeutic agents was developed into a viable concept by Dr. Goodson in 1979. Local delivery systems containing antimicrobial drugs allow the therapeutic agents to be targeted to the diseased site with minimal systemic effects. Local delivery systems when retained in the pocket can release the antimicrobial agents at levels that are ten to hundred folds higher than the levels that can be delivered by systemic antibiotics. This approach also addresses the critical concern of unnecessarily exposing the patient to large doses of systemic antibiotics, which can also result in bacterial resistance.

Periodontal dressing (Coe-pak) was placed in the site where chlorhexidine chip placement was done and the dressing was removed after seven days as the chip biodegrades in seven to ten days and in an in vitro study, the release profile of chlorhexidine was found to be about 40–45% within 24 hours and afterward in linear fashion for seven to eight days.[16] These results are close to those shown in the study carried out by Caruso et al.[17] and Mizrak et al.[18]

The GI scores also reduced in both the groups with mean value of 0.41±0.33 in Group A and 0.62±0.26 in Group B at six months. A significant reduction occurred in both the groups, however the mean difference failed to reach statistical significance (P = 0.08). Soskolne et al.,[19] Heasman et al.,[20] Rodriguez et al.,[21] Grover et al.,[22] Paolantonio et al. [23] in their studies have shown that the use of CHX chip as the adjunct to SRP have led to a significant reduction in the value of GI one and three months after the baseline compared to the baseline, which is in accordance with the results of this study. Similar results have been shown by study of Azmak et al.[10]. The reduction was also significant in Group B in accordance with the study done by Lin et al.[24] The reduction in the gingival index scores represents reduced inflammation that may be attributed to lowered prostaglandin E2 levels due to the effects of laser treatment.[17] The GI scores in both the groups had no significant difference after treatment. These results were similar to the study conducted by Birang et al.[3]

A remarkable reduction in PPD was seen in Group A (2.40 ± 0.74) and in Group B (3.00 ± 1.00) with greater reduction in PPD in Group A, with no significant difference in reduction of PPD between the groups at sixth month (P value 0.072). This is similar to the results presented by Crispino et al.[25] The comparison of mean values showed that PPD scores at one month and three months follow up visits were significantly lower in

Group A compared to Group B with P values of 0.003 and <0.001 respectively.

The mean CAL at baseline in both the group was found to be 3.71 ± 0.47. At the end of six months, the CAL in Group A was found to be 2.07 ± 0.59 and Group B was found to be 2.53 ± 0.83. The greater gain in CAL was found in Group A with no statistically significant difference. Similar results have been shown in the study conducted by Grover et al.[22] The greater gain in CAL in Group A could be due to the absence of bacterial challenge, caused by retained antimicrobial agent, during the critical initial phase of healing following SRP.

All the clinical parameters reduced significantly from baseline to six months in both the groups. The clinical parameters improved in intragroup comparison but no significant differences were found in intergroup comparison except for the statistically significant results in PPD at one month and third month.

However, the results were better for Group A. Higher improvements in the clinical parameters in Group A as compared to Group B can be attributed to chlorhexidine, which is known to inhibit microbial proteases from potent periodontal pathogens that destroy periodontal tissues during the progression of disease. This is in accordance with the results obtained by Grisi et al.[26]

Adjunctive therapies using antimicrobials like chlorhexidine chip or laser therapy, appreciably improve the benefits of SRP. The results of this study bring to the forefront that most periodontal cases can be managed non-surgically with the use of adjunctive therapies.

CONCLUSION

Within the limit of this study, the data from this study suggest that Group A (SRP and CHX chip) and Group B (SRP and diode laser) showed significant improvements of PPD and CAL compared with baseline. However, the difference in the improvement of the PPD and CAL between the groups was not significant. Hence, further research with a larger sample size along with microbiological studies is necessary to be conducted in future.

ACKNOWLEDGEMENT

The authors would like to thank and acknowledge Dr. Shreeya Aryal, Dr. Shilu Shrestha, Dr. Reshu Aggrawal for their help and guidance. The authors would also like to thank colleagues for their support and help during this research.

Conflict of interest: None.

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