# Treatment of Infrabony Defects by Open Flap Debridement with or without Diode Laser

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## ABSTRACT

**Background**

Periodontitis is the common oral condition which affects the periodontium of the teeth that leads to destruction of periodontal ligaments and alveolar bone. Open flap debridement is the surgical procedure which provides access and visibility of the site, application of laser as an adjunct has various advantanges.

**Objective**

To compare clinical outcomes after open flap debridement with or without diode laser.

**Method**

Patients aged 25-45 years diagnosed with infrabony defect ≥ 5 mm visiting Department of Dental Surgery, Bir Hospital. Control group sites were treated with open flap debridement alone, whereas test-groups were treated with Open flap debridement with diode laser. Various parameters like Plaque index, Gingival index, Pocket depth and Clinical attachment level were assessed and compared between groups at baseline, 3 and 6 months.

**Result**

The mean plaque and gingival scores improved in both the control and test groups at 3 and 6 months follow up as compared to baseline and was statistically non-significant between two groups. Open flap debridement with or without diode laser in the treatment of periodontal intrabony defects did not produce significant reduction in pocket depth and gain in clinical attachment level.

**Conclusion**

There was no significant differences in the clinical parameters were seen in the surgical flap debridement of infrabony pocket with and without diode laser. Diode laser can be used safely as an adjunct. However, long-term, multicentric, histologic and microbial studies are required.

## KEY WORDS

*Attachment loss, Diode laser, Gingival recession, Periodontitis, Periodontal pocket*

## INTRODUCTION

Periodontitis is the common oral condition which affects the periodontium of the teeth which leads to destruction of periodontal ligaments and alveolar bone.[1] Periodontitis is highly prevalent oral disease (42%) among US adults as reported in the National Health and Nutrition Examination Survey 2009-2014.[2] Pradhan et al. and Rajkarnikar et al. showed higher prevalence of periodontitis in Nepalese population.[3,4]

Elimination of various etiological factors and regenerations of periodontal tissues is the goal of non-surgical and surgical periodontal therapy.[1] Open flap debridement (OFD) is the surgical procedure which provides accessibilty and visibility of the sites.[5]

In 1985, first documentation of application of laser was reported for phenytoin gingival hyperplasia removal. Various other periodontal therapies can be done with the application of laser.[6] In the pocket therapy, application of laser is explored for its bactericidal effects, removing calculus deposits and diseased pocket lining.[7] Application of laser leads to minimal gingival recession, integrity of mucosa is preserved, and tissue margins are defined, it also has various other advantages.[8-10]

Various studies have shown the beneficial effects of the laser whereas other showed no differences in the clinical parameters when laser was used as an adjunct.[11-16]

Since the prevalence of periodontitis is high and DL as an adjunct with OFD has enhanced the wound healing and elimination of pocket with minimum recession, this study was aimed to compare the clinical outcomes of OFD with or without DL in the treatment of periodontal intra-bony defects.

## METHODS

A comparative cross-sectional study was conducted in patients with infrabony defects attending Department of Dental Surgery, Periodontology and Oral implantology unit, Bir hospital, Kathmandu, Nepal from July 2017 till July 2018. Ethical approval was obtained from Institutional Review Board, Ethical Committee of National Academy of Medical Sciences. Sample size was calculated to be 14 per group (total of 28 patients) under the predetermined level of significance (< 0.05) and was collected on convenience basis.

Patients of age 25-45 years17 undergoing periodontal therapy with interproximal probing depth ≥ 5 mm following phase I therapy (scaling and root planing) in vital and asympotomatic maxillary and mandibular teeth, who gave consent were included in the study. Patients with systemic disease, having smoking/ tobacco chewing habit, taking antibiotics within 6 months, undergoing orthodontic treatment and with traumatic occlusion, pregnant and lactating females were excluded from the study.

The clinical parameters recorded before surgical procedures included site-specific plaque index (PI), gingival index (GI), pocket depth (PD), clinical attachment level (CAL), gingival recession (GR) using acrylic stent and UNC-15 probe [figure 1(a) and 2(b)]. All parameters were evaluated at baseline, 3 months and 6 months postoperatively. Measurement values of PI and GI were analyzed post-operatively.

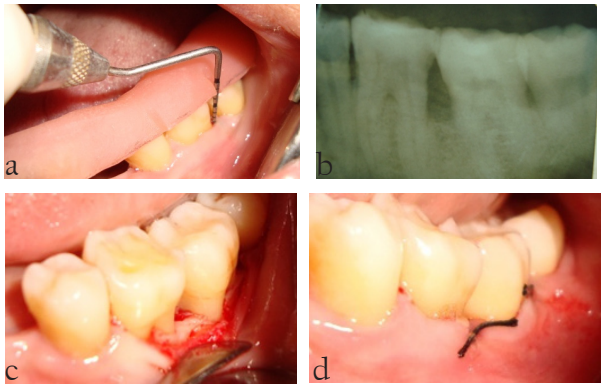


**Figure 1. Control group treated with OFD (a): PD measurement with stent, (b): IOPAR, (c): Surgical Exposure, nad (d): Suture placement**

After 1 month of phase I therapy (Scaling and root planning), the patients with interproximal pocket depth > 5 mm were planned for OFD. Chlorhexidine digluconate (0.2%) was used as pre-surgical rinse. After the administration of lignocaine 1:1,00,000 adrenaline local anesthesia, buccal and lingual sulcular incisions were made, and mucoperiosteal flaps were reflected. Root planing followed by debridement of defect using area-specific curettes (Gracey curettes, Hu-Friedy). In the control group flaps were sutured in their position without application of DL (Biolase epic™ 10) [figure 1(a) to 1(d)]. In test group, flaps were debrided with DL using fiber optic tip of 300micron diameter and 7 mm long at 1.5 watt in continuous mode for 10 seconds and repositioning of mucoperiosteal flap was done and flap was secured using a 3-0 non-absorbable silk suture [figure 2(a) to 2(f)]. Post-operative instructions and suitable analgesics were prescribed. At 1 week postoperatively, sutures were removed. Each patient was re-examined weekly up to 1 month after surgery, no sub gingival instrumentation was attempted at any of these appointments. They were then followed at 3 and 6 months, and oral hygiene instructions were reinforced at each recall visit. Soft tissue measurements were taken with previously used acrylic stents and UNC-15 probe.

The data was analyzed with the help of IBM SPSS Statistics for Windows, version 22. All the variables were tested for normal distribution with Shapiro-Wilks test. The change in all periodontal non-parametric parameters (PD, CAL, GR) at different time intervals for both test and control groups were compared with help of Mann-Whitney test and parametric parameters (PI and GI) were compared with help of independent t-test. P value was calculated under predetermined level of significance (0.05).

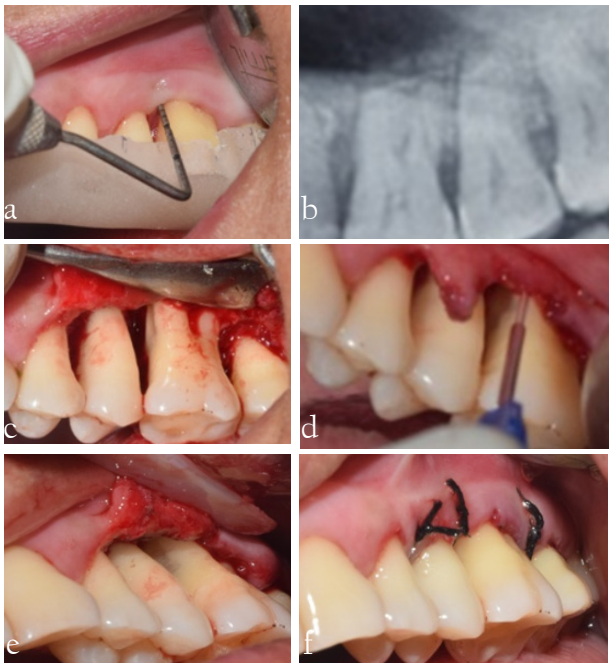


**Figure 2. Test group treated with OFD and DL (a): PD measurement with stent, (b): IOPAR, (c): Surgical exposure, (d): Application of laser in flap, (e): Flap debridement with laser, and (f): Suture placed**

## RESULTS

Total of 28 patients with mean age of 39.43 ± 6.57 years in control group and 39.36 ± 6.00 years in test group were enrolled in the study and 82.14% of patients were between 35 to 45 years. Out of 28 subjects, male: female ratio was 12:16 comprising 42.9% male and 57.1% female.

Table 1 and 2 shows mean PI and GI scores for both groups reduced from baseline to 3 and 6 months respectively and mean GI and PI scores were statistically non-significant in both groups at baseline, 3 and 6 months (p-value > 0.05).

**Table 1. Mean Plaque Index Scores for both control and test groups.**

| | Group (Mean ± SD) | | p value |
|---|---|---|---|
| | Control | Test | |
| Baseline | 1.41±0.32 | 1.50±0.47 | 0.584 |
| 3 months | 1.22±0.27 | 1.27±0.31 | 0.707 |
| 6 months | 1.07±0.19 | 1.06±0.17 | 0.921 |

**Table 2. Mean Gingival Index Scores for both control and test groups.**

| | Group (Mean±SD) | | p value |
|---|---|---|---|
| | Control | Test | |
| Baseline | 1.30 ± 0.29 | 1.42 ± 0.40 | 0.398 |
| 3 months | 1.10 ± 0.19 | 1.19 ± 0.24 | 0.269 |
| 6 months | 0.96 ± 0.18 | 1.01 ± 0.16 | 0.455 |

The mean PD values for control group at baseline, 3 and 6 months were 6.93 ± 1.26 mm, 3.36 ± 1.15 mm and 2.86 ± 0.77 mm respectively and for test group at baseline, 3 and 6 months were 6.71 ± 0.72 mm, 3.29 ± 0.72 mm and 3.32 ± 0.94 mm respectively and was statistically non-significant between both groups at baseline, 3 and 6 months (p-value > 0.05).

The mean CAL score for control and test group at baseline were 7.64 ± 2.73 mm and 6.86 ± 2.65 mm, at 3 months were 5.21 ± 2.08 mm and 4.93 ± 2.40 mm and at 6 months were 4.79 ± 1.67mm and 4.64 ± 2.40 mm respectively and shows statistically non-significant differences between both groups at baseline, 3 and 6 months (p-value > 0.05).

Table 3 and 4 shows the mean PD reduction and CAL gain for control and test group at 3 and 6 months of treatment respectively. Table 5 shows the mean values of GR for control and test groups at baseline, 3 and 6 months which was non-significant statistically (p value > 0.05).

**Table 3. Comparison for decrease in Pocket Depth and Gain in Clinical Attachment Level (In Millimeters) between control and test groups after 3 months.**

| Parameter | Group | Mean ± SD | p value |
|---|---|---|---|
| PD (Reduction) | Control | 3.57± 1.08 | 0.702 |
| | Test | 3.42±0.85 | |
| CAL (Gain) | Control | 2.42±1.74 | 0.415 |
| | Test | 1.92± 1.43 | |

**Table 4. Comparison for decrease in Pocket Depth and Gain in Clinical Attachment Level (In Millimeters) between control and test groups after 6 months.**

| Parameter | Group | Mean ± SD | p value |
|---|---|---|---|
| PD (Reduction) | Control | 4.07±1.20 | 0.452 |
| | Test | 3.78±0.69 | |
| CAL (Gain) | Control | 2.85 ± 1.74 | 0.282 |
| | Test | 2.21 ± 1.31 | |

**Table 5. Gingival recession score (in millimeters) for control and test groups.**

| | Group (Mean±SD) | | p value |
|---|---|---|---|
| | Control | Test | |
| Baseline | 1.29 ± 1.13 | 1.14 ± 1.29 | 0.733 |
| 3 months | 1.86±1.35 | 1.93±1.59 | 0.888 |
| 6 months | 1.93±1.32 | 2.00 ±1.51 | 0.869 |

## DISCUSSION

The present study evaluated the clinical effectiveness of DL as an adjunct to OFD in treating infrabony defects. The results of the present study indicate that the DL can be safely used as an adjunct to conventional therapy. DL is the soft tissue laser, used for various periodontal therapies as an alternative and adjunctive. It's base

compound composition determines the wavelength and operates in continuous or pulsed mode.[18] DL is absorbed by haemoglobin, melanin and other chromophores and also target granulation tissue which are present in periodontal disease.[19] The bactericidal effect of diode laser documented by various studies is advantageous for application of laser in periodontal therapy.[20-22] Studies have shown that DL enhances periodontal wound healing by promoting the proliferation of gingival and periodontal ligament fibroblasts and induces growth factors for mRNA expressions.[23,24]

Oral hygiene status of the patients was determined by recording PI which helped in motivating patients in each visit whereas the gingival condition was evaluated clinically by recording GI. In the present study, the mean PI and GI scores did not reveal any statistically significant differences between both groups. This finding is consistent with results of study done by Lobo et al. where PI significantly improved in intragroup comparison but no significant differences in intergroup comparison was found.[14] In the same study, however, GI was significantly reduced in laser group compared to control at all follow up visits showing decreased inflammation, this being in contrast to the result of present study. The reason for this difference may be attributed to procedural differences with use of lasers and to patient based factors. Study conducted by Sculean et al. supports the finding of the present study showing nonsignificant differences in mean gingival index.[25]

The result of the present study is in contrast to study done by Aena et al. in terms of PI scores.[15] They obtained statistically nonsignificant PI scores for both groups at 6 and 9 months, inadequate oral hygiene maintenance due to lack of motivation and education may be the reason for these differences. Reduction in PD and gain in CAL are major clinical outcomes measured to determine the success of any periodontal treatment. In the present study, a significant reduction in PD and CAL gain were found in both groups when compared to baseline. OFD with or without DL in treatment of periodontal intrabony defects produced similar reduction in PD ($p > 0.05$), which may be taken as the safety features of DL as it did not change primary outcome measures without any complications. These findings are consistent with results of study done by Lobo et al. where they reported statistically insignificant PD reduction in intergroup comparison, also similar to the studies done by Aena et al. and Krohn-Dale et al. in which PD reduction was not statistically significant for intergroup comparison, however, they obtained a highly significant difference in PD reduction at 9$^{th}$ months between both groups, increase in microcirculation and anti-inflammatory cytokines may lead to this improvement.[14,15,26]

The result of present study is in contrast to study done by Gaspirc et al. where they found significantly better PD reduction for 3 years postoperatively.[12] This finding may have been obtained due to use of Er:YAG laser for de-epithelization as well as debridement of root surface and the longer follow up period in contrast to the present study. Present study contrasts to the findings of study done by Sculean et al. where they reported significant PD reduction after the Er:YAG laser therapy.[25] This might be due to use of laser for root surface and defect debridement apart from lasing the periodontal flap, which was not done in present study.

However, this finding contrasts with results of study done by Gaspirc et al. where they showed significantly increased CAL in laser treated groups.[12] This finding may have been observed due to the use of Er:YAG laser for root surface treatment as well as defect debridement. Gain in CAL in present study failed to reach statistical significance in intergroup comparisons which is similar to result of study done by Sculean et al. who reported higher tendency of CAL gain with use of lasers, however they showed non-significant differences between the groups.[25] Again findings of present study is in contrast to the results of study of Aena et al. which showed that gain in CAL was significantly greater between 6 and 9 months in laser treated group, improvement might be due the enhanced wound healing by increasing the microcirculation and cytokines as explained by author.[15]

GR was recorded to evaluate post-treatment outcome after the surgery. The mean GR score was statistically non-significant in both groups which is consistent with results of studies done by Gupta et al. and Lobo et al.[8,14] Thus, the DL did not cause additional detrimental effects in the outcome of surgery.

All the parameters were improved from the baseline to 6 months in both groups, which showed no additional benefit of use of DL during OFD which is similar to study done by Lobo et al. and Behdin et al. which reported insufficient evidence to support the use of laser as an adjunct in various surgical periodontal therapy.[14,27]

There were no inflammatory signs and related complications in the test group in the present study which may be due to antibacterial effect of DL as shown by Gokhale et al. who reported reduction in colony forming unit in the site where laser was used and Gutknecht et al. from the microbiological smears of specific microorganisms.[28,29] The present study did not observe the microbiological smears which might be the beneficial parameters for evaluation. Further, the post-operative complications during wound healing after the use of DL (not recorded in the present study) would be a useful parameter to record as done by San-moliner et al. who reported less post operative pain and edema when laser was used as an adjunct to periodontal pocket therapy which shows the beneficial effects of DL.[30] AboElsaad et al. reported that DL enhances wound healing.[31] Yukna et al. had reported periodontal regeneration can be seen through the laser assisted new attachment procedure.[32] Promotion of new bone formation through the application

of laser was reported by Mizutani et al. through histological and histometric analysis, they had also reported similar cementum formation and new connective tissue attachment with or without laser, however, this study was done in dog with experimentally induced periodontitis which might be different than in human.[33] Rossmann et al. had reported that laser enhances new connective tissue attachment by retarding the epithelium thus enhancing the healing, however they used $CO_2$ laser in their study.[34] Histological examinations were not done in present study which might be useful for determining effective use of laser for infrabony defects.

The use of DL did not cause any detrimental effect to the patients as seen in follow up clinical examinations, which is consistent with the findings shown in the histological study done by Castro et al. which reported that DL can be used in periodontal pocket without damage to the cementum tissue.[13] Thus, the use of DL in the present study was safe.

The limitations of the study are inclusion of a greater number of samples would have further positively validated the study. Host response always plays role, which may have been reduced with split mouth studies. Division of patient according to age groups to equate some confounding variables could have been done. Patient blinding regarding the type of therapy could have been done, which would have provided more robust evidence.

## CONCLUSION

Within the limitation of study, no significant differences in clinical parameters were seen in surgical flap debridement of infrabony pocket with and without DL. DL can be used safely as an adjunct. However, long-term, multicentric, histologic and microbial studies are required to determine the effects of DL in surgical flap debridement of infrabony pockets.

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