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EVALUATION OF EFFICACY OF DIODE LASER FOR LASER ASSISTED PERIODONTAL REGENERATION IN CHRONIC PERIODONTITIS PATIENTS WITH HORIZONTAL BONE DEFECTS

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Abstract

Background: Chronic periodontitis is a prevalent dental condition characterized by the progressive loss of periodontal tissues, including alveolar bone. Conventional treatments have limitations in achieving complete periodontal regeneration, especially in cases with horizontal bone defects.

Objective: This study aimed to evaluate the efficacy of diode laser therapy for periodontal regeneration in chronic periodontitis patients with horizontal bone defects.

Methods: A prospective study was conducted at a Tertiary Care Center, involving 50 participants diagnosed with chronic periodontitis and horizontal bone defects. Diode laser therapy was administered, and clinical parameters (periodontal probing depth and clinical attachment level) were assessed pre- and post-treatment. Radiographic evaluation of bone fill and adverse events associated with laser therapy were also recorded.

Results: Significant reductions in periodontal probing depth and gains in clinical attachment level were observed post-diode laser therapy ($p < 0.001$). Radiographic assessment revealed substantial bone fill in the horizontal defects (mean fill: 47.5% to 50.0%). Adverse events associated with laser therapy were minimal, with 80% of participants reporting no adverse events.

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Conclusion: Diode laser therapy demonstrates efficacy in promoting periodontal regeneration and osseous fill in chronic periodontitis patients with horizontal bone defects. These findings support the integration of diode laser therapy as an adjunctive treatment modality in periodontal therapy protocols.

Keywords: Diode laser, Periodontal regeneration, Chronic periodontitis, Horizontal bone defects, Tertiary care center.

Introduction

Chronic periodontitis is a prevalent inflammatory disease affecting the supporting structures of teeth, characterized by periodontal pocket formation, clinical attachment loss, and alveolar bone resorption [1]. Traditional periodontal therapy aims to arrest disease progression and maintain periodontal health through mechanical debridement and antimicrobial agents [2]. However, these modalities have limitations in achieving complete regeneration of periodontal tissues, particularly in cases with horizontal bone defects [3]. Laser therapy has emerged as a promising adjunctive treatment for periodontal regeneration, owing to its bactericidal effects and ability to stimulate tissue healing [4]. Among various laser types, diode laser has gained attention for its wavelength specificity, deep tissue penetration, and minimal thermal damage [5]. Despite its potential, there is a scarcity of literature evaluating the efficacy of diode laser for periodontal regeneration in chronic periodontitis patients with horizontal bone defects. Hence, this study aimed to assess the effectiveness of diode laser therapy in promoting periodontal regeneration and osseous fill in such cases.

Materials and Methods

This prospective study was conducted at the renowned a Tertiary Care Center, a leading institution specializing in periodontal care, between January 2021 and December 2022. Ethical clearance for the study was obtained from the Institutional Review Board (IRB) of the Tertiary Care Center.

A total of 50 patients diagnosed with chronic periodontitis and presenting with horizontal bone defects were recruited for the study. The inclusion criteria comprised patients aged 18 to 65 years, with a clinical diagnosis of chronic periodontitis based on the classification proposed by the American Academy of Periodontology [6]. Horizontal bone defects were identified using radiographic assessment, specifically panoramic radiographs and intraoral periapical radiographs. Patients with systemic diseases affecting periodontal health, those on medications known to affect periodontal tissues, pregnant or lactating women, and individuals with a history of periodontal surgery in the past six months were excluded from the study.

Prior to enrollment, written informed consent was obtained from all participants after explaining the study objectives, procedures, and potential risks involved. Baseline demographic data, including age, gender, and medical history, were recorded for each participant.

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Clinical parameters including periodontal probing depth (PPD) and clinical attachment level (CAL) were measured using a standardized periodontal probe (UNC-15 probe) at six sites per tooth (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual) on all teeth present, excluding third molars. The radiographic assessment of horizontal bone defects was performed using standardized periapical radiographs or bitewing radiographs, depending on the location and extent of the defect.

Diode laser therapy was administered using a "LaserSmile" diode laser system operating at a wavelength of 810 nm with a continuous wave mode. The laser parameters were set at 1 W power output and a pulse duration of 100 milliseconds, with a fiber optic tip diameter of 400 µm. The laser irradiation was performed under local anesthesia to ensure patient comfort and safety. Following the completion of diode laser therapy, all participants were instructed to follow a standardized postoperative care protocol, including oral hygiene instructions and prescribed medications.

Participants were recalled for follow-up visits at 1-month intervals for a period of 6 months during which clinical and radiographic assessments were repeated to evaluate the treatment outcomes.

Statistical analysis was performed using appropriate statistical software (SPSS version 21). Descriptive statistics such as mean, standard deviation, and percentages were calculated for demographic and clinical variables. Paired t-tests or Wilcoxon signed-rank tests were used to compare pre- and post-treatment clinical parameters, with statistical significance set at $p < 0.05$.

Results

Table 1: Baseline Characteristics of Study Participants

- The study included 50 participants with chronic periodontitis and horizontal bone defects.
- The mean age of participants was 45.2 years, with a standard deviation of 6.8 years.
- Gender distribution among participants was 60% males and 40% females.

Table 2: Pre- and Post-treatment Clinical Parameters

- Pre-treatment periodontal probing depth (PPD) was 5.8 ± 0.9 mm, which significantly reduced to 3.2 ± 0.7 mm post-treatment ($p < 0.001$).
- Pre-treatment clinical attachment level (CAL) was 7.4 ± 1.2 mm, which significantly improved to 5.1 ± 0.8 mm post-treatment ($p < 0.001$).

Table 3: Radiographic Assessment of Bone Fill

- Significant bone fill was observed in all areas of the horizontal defects post-treatment.
- The mesial defects showed an average bone fill of 47.5%, distal defects 43.2%, buccal defects 49.3%, and lingual defects 50.0%.

Table 4: Adverse Events

- Adverse events associated with diode laser therapy were minimal.

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- 10% of participants experienced gingival bleeding, 6% reported mild discomfort, and 4% presented with swelling.
- Majority of participants (80%) did not report any adverse events post-treatment.

Overall, the results indicate significant improvements in periodontal parameters and substantial bone fill following diode laser therapy, with minimal adverse events, demonstrating the efficacy and safety of this treatment approach for chronic periodontitis patients with horizontal bone defects.

Table 1: Baseline Characteristics of Study Participants

Parameter	Mean (± SD)
Age (years)	45.2 ± 6.8
Gender (Male/Female)	30/20

Table 2: Pre- and Post-treatment Clinical Parameters

Clinical Parameter	Pre-treatment (Mean ± SD)	Post-treatment (Mean ± SD)	p-value
Periodontal Probing Depth (mm)	5.8 ± 0.9	3.2 ± 0.7	<0.001
Clinical Attachment Level (mm)	7.4 ± 1.2	5.1 ± 0.8	<0.001

Table 3: Radiographic Assessment of Bone Fill

Area of Bone Defect	Pre-treatment (Mean ± SD)	Post-treatment (Mean ± SD)	Bone Fill (%)
Mesial	4.6 ± 1.2	6.8 ± 1.5	47.5%
Distal	5.2 ± 1.0	7.5 ± 1.2	43.2%
Buccal	4.8 ± 1.1	7.2 ± 1.3	49.3%
Lingual	4.4 ± 1.0	6.6 ± 1.4	50.0%

Table 4: Adverse Events

Adverse Event	Frequency (%)
Gingival bleeding	5 (10%)
Mild discomfort	3 (6%)
Swelling	2 (4%)
None	40 (80%)

Discussion

The findings of this study provide valuable insights into the efficacy of diode laser therapy for periodontal regeneration in chronic periodontitis patients with horizontal bone defects. The discussion will focus on interpreting the results in the context of existing literature, addressing the clinical implications, limitations of the study, and avenues for future research.

The significant reductions in periodontal probing depth (PPD) and gains in clinical attachment level (CAL) observed post-diode laser therapy are consistent with previous studies evaluating the effectiveness of laser therapy in periodontal treatment [1]. The ability of diode lasers to penetrate deep periodontal tissues, exert bactericidal effects, and stimulate

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tissue healing mechanisms may contribute to these favorable outcomes [2]. Furthermore, the substantial bone fill observed radiographically suggests the potential of diode laser therapy in promoting osseous regeneration in horizontal bone defects, which is crucial for achieving long-term periodontal stability [3-6].

Comparative analysis with existing literature highlights the advantages of diode laser therapy over conventional treatment modalities. While traditional periodontal therapies focus on plaque control and mechanical debridement, diode laser therapy offers additional benefits such as selective tissue interaction, reduced postoperative discomfort, and enhanced wound healing [7-9]. However, it is essential to acknowledge the heterogeneity in study designs, laser parameters, and outcome measures among published studies, which may influence the interpretation of results and generalizability of findings.

Despite the promising outcomes observed in this study, several limitations warrant consideration. Firstly, the lack of a control group limits the ability to establish causality and compare the efficacy of diode laser therapy against conventional treatments. Future randomized controlled trials with larger sample sizes and longer follow-up periods are warranted to provide more robust evidence. Secondly, the use of subjective clinical parameters such as PPD and CAL may introduce bias, necessitating the inclusion of objective measures such as histological analysis in future studies. Additionally, the short-term follow-up period in this study precludes the assessment of long-term outcomes and potential complications associated with diode laser therapy.

Conclusion

In conclusion, this study provides preliminary evidence supporting the efficacy of diode laser therapy for periodontal regeneration in chronic periodontitis patients with horizontal bone defects. The significant improvements in periodontal parameters and bone fill underscore the potential of diode laser therapy as an adjunctive treatment modality in periodontal therapy. However, further research is warranted to validate these findings, optimize treatment protocols, and explore the long-term effects of diode laser therapy on periodontal health.

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