Original Article

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Dentistry Section

Comparison of Laser-assisted and Conventional Flap Surgery with Hydroxyapatite Crystals in the Treatment of Intrabony Defects under Magnification- A Randomised Clinical Trial

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ABSTRACT

Introduction: Achieving regeneration of the lost periodontal structures after surgical approach plays a major role. This healing can be interrupted due to the presence of invasive bacteria which is present in the periodontal tissues.

Aim: To compare laser-assisted and conventional flap surgery using microsurgical instruments and under surgical operating microscope with hydroxyapatite graft in the treatment of intrabony defects.

Materials and Methods: This prospective randomised split-mouth clinical study was conducted in Department of Periodontology at Vishnu Dental College, Bhimavaram, Andhra Pradesh, India, from June 2020 to December 2021. A total of 24 bilateral intrabony defects were selected for the study. Control sites (n=12) received the graft after conventional open flap debridement. In the test group (n=12), graft placement was done followed by laser irradiation with diode laser (980 nm, power: 3.0 W; frequency 2.5 KHz) for 30 seconds. The entire flap surgery procedure was performed under Surgical Operating Microscope (SOM). Clinical parameters such as plaque index, gingival index, probing depth, relative attachment level, were assessed at 3 months and 6 months. Healing index was assessed after 7 days of surgery. Radiographic parameters were assessed at baseline and 6 months using Cone Beam Computed Tomography (CBCT). Descriptive statistics, Independent samples t-test, repeated measures analysis of variance and paired t-tests were used in data analysis. Data were analysed using Statistical Package for Social Sciences (SPSS) version 20.0 software.

Results: Intragroup comparison showed statistical significance in all clinical and radiographical parameters (p-value <0.001). Intergroup comparison between the test and control group did not show any statistical significance in terms of plaque index, gingival index, relative clinical attachment level, probing depth (p-value ≥0.05). Intragroup comparison of the depth of defect was statistically significant in both test (p-value=0.011) and control groups (p-values=0.002). Intergroup comparison did not show any statistical significance in linear bone fill (p-value=0.1). Intergroup comparison did not show any statistical significance in defect angle (p-value=0.773). No statistical significance was obtained in percentage fill (p-value=0.074). Intergroup comparison did not show any statistical significance in the clinical and radiographical parameters.

Conclusion: The additional laser irradiation at the test site did not exhibit any significant benefits in the bone regeneration. All the outcomes were similar in test and control group.

Keywords: Bone graft, Healing, Periodontitis, Regeneration, Surgical operating microscope

INTRODUCTION

Periodontal disease is the inflammation of supporting tissues of the teeth, leading to progressive attachment loss and bone loss around the teeth leading to pocket formation or recession. Patterns of bone destruction in a periodontal disease can be seen in various forms but not all the defects are regenerable [1].

The drawback of conventional mechanical therapy in its inability to remove periodontal pathogen especially from inside pocket wall and deep pockets, has paved the way for the adjunctive use of lasers in the treatment of chronic periodontitis [2]. Many studies have evaluated the use of diode laser as an adjunctive method in Non Surgical Periodontal Therapy (NSPT) for chronic and aggressive periodontitis patients and have concluded with the superior healing and better treatment outcomes in the laser intervened sites [3-5]. In the treatment of periodontitis and peri-implantitis, diode lasers are being used for reduction of bacterial load and removal of pocket lining, thereby decreasing the endotoxins leading to enhanced periodontal tissue healing [6].

Not only the proper sanitisation of the defect site, but also an adequate and appropriate placement of graft material is required for the regeneration of the lost components of the alveolar bone. One of the successful ways to attain reconstruction of lost attachment apparatus in intrabony defects (>3 mm) is grafting of bone substitute biomaterials [7,8]. Vertical or angular defects can be regenerated to a greater extent with the use of bone graft materials, which includes autografts, xenografts, and alloplastic materials [9].

Hydroxyapatite (HA) graft biomaterials are complex calcium phosphates that resemble bone minerals in their chemical component {Ca10(PO4)6(OH)4}, with calcium-to-phosphate ratio of 1.67 [10]. HA scaffolds can also serve as delivery vehicles for cytokines with a capacity to bind and concentrate Bone Morphogenetic Proteins (BMPs) in-vivo [11]. Synthetic HA demonstrates good biological properties including biocompatibility, bioactivity, osteoconduction, and osteoinduction, immunity reactions, and a relatively high bioresorbability. Many authors have concluded it as a suitable bone graft material in the periodontal regeneration after evaluating the clinical and radiographical parameters [12-14].

Surgical Operating Microscope (SOM) provides the greatest flexibility and comfort in optical magnification and is very superior to magnifying loupes. With proper instructions and practice, operating the microscope becomes easy. It is characterised by binocular viewing system that protects against eyestrain and fatigue. It is also characterised by high resolution lenses and high

contrast stereoscopic vision which provides the ease to access of debridement during periodontal surgeries [15].

Laser application in periodontal surgery has showed promising results in the literature [5,6]. Limited research is available in the published literature with the conjunctive application of low level laser in the treatment of intrabony defects and use of SOM in periodontal surgeries [2,3,15]. Therefore, this clinical study aimed at the evaluation of clinical and radiographic parameters of laser-assisted and conventional flap surgery using microsurgical instruments under surgical operating microscope with hydroxyapatite graft (SybograftM) in the treatment of intrabony defects.

MATERIALS AND METHODS

This prospective randomised split-mouth clinical study was conducted in Department of Periodontology at Vishnu Dental College, Bhimavaram, Andhra Pradesh, India, from June 2020 to December 2021. Patients who attended Outpatient Department of Periodontology were enrolled. The study was approved and ethical clearance was obtained from the Institutional Ethical Committee (Ref No: IECVDC/19/PG01/PI/IVV/50) and also approved under Clinical Trials Registry-India REF/2020/02/031968. All the procedures were followed according to the Consolidated Standards of Reporting Trials (CONSORT) guidelines and were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975 that was revised in 2013 [16].

Sample size calculation: Sample size of 14 bilateral intrabony defects, including two dropouts was obtained using G Power software [17].

INPUT: t-tests-Means: Difference between two independent means (two groups)

Analysis: A priori: Compute required sample size

Input: Tail (s)= Two

Effect size d=1.241350 [2]

α err prob=0.05

Power (1-β err prob)=0.80

Allocation ratio N2/N1=1

Output: [17] Non centrality parameter δ=3.0406741

Critical t=2.0738731

Df=22

Sample size group 1=12

Sample size group 2=12

Total sample size=24

To compensate 20% drop outs: 12+2=14 per group.

Inclusion and Exclusion criteria: Patients within the age group of 20-65 years, presence of atleast one tooth either on bilateral or ipsilateral sides of the mouth with persistent probing depth (PD) ≥5 mm even after non surgical periodontal therapy and radiographic evidence of intrabony defects with depth ≥3 mm with three wall defects were included in the study. Pregnant or lactating women, chronic smokers and patients with uncontrolled systemic diseases such as diabetes were excluded.

Clinical Parameters

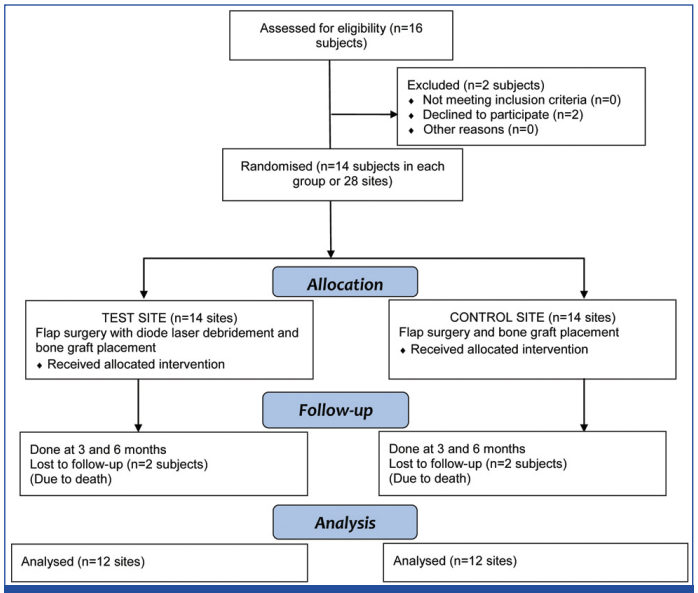
The clinical parameters evaluated were as follows:

- Plaque Index (PI) according to Loe H [18],
- Gingival Index (GI) according to Loe H [18],
- Probing Pocket Depth (PPD) [2],
- Relative-Clinical Attachment Level (R-CAL) [2],
- Early Healing Index (HI) according to Wachtel H et al., [19].

Radiographic parameters: Radiological parameters were evaluated with CBCT were [20]:

- Linear amount of bone Fill (LF)
- Depth of Defect (DD)
- Percentage of bone Fill (PF)
- Defect Angle (DA)

All the subjects in the study were subjected to phase 1 therapy i.e, Non Surgical Periodontal Therapy (NSPT), which included scaling, root planing. Following NSPT, periodontal re-evaluation was performed after 1 month. Subjects were randomly divided into two groups by the coin toss method as test and control sites. Coin toss method used to assign the quadrant/site. There were two dropouts in the study due to death after being infected by COVID-19 [Table/Fig-1]. Twelve out of 14 patients completed the study. A total of 12 bilateral intrabony defects i.e, 24 sites were finally included in the study. Out of which 12 sites were given HA graft following laser irradiation and other 12 sites were given HA graft without any laser irradiation. A total of 10 mandibular and 14 maxillary intrabony defects sites were included.



[Table/Fig-1]: CONSORT diagram.

Test sites (n=12): Laser-assisted (DenLase) flap surgery followed by placing of hydroxyapatite graft (Sybograf™) in the intrabony defects.

Control sites (n=12): Conventional flap surgery followed by placing of hydroxyapatite graft (Sybograf™) in the intrabony defects.

Study Procedure

All the clinical parameters that were evaluated in the study were recorded with UNC-15 (Hu-Friedy) probe (University of North Carolina) to the nearest millimetre. Plaque index, gingival index, relative clinical attachment level, probing depth was assessed at baseline, 3 months and 6 months. Wound healing was evaluated on 7th day postoperatively using Early Wound Healing Index (HI) (Wachtel H et al., 2003) [19].

The CBCT evaluation was done at the site of intrabony defects as baseline recordings. Three reference points were considered in the radiographic analysis. They are Cementoenamel Junction (CEJ) of the involved tooth, Alveolar Crest (AC) and Base of the Defect (BD). The intrabony DD was measured by subtracting from the value of CEJ of the involved tooth to the base of the defect with the value from CEJ from the alveolar crest of the uninvolved tooth. This linear measurement is considered as the baseline DD. The radiographic parameters measured at baseline for both the test site and control site prior to the surgical procedure. Similarly, the DD was considered after 6 months of evaluation. The bone fill within the defect after 6 months was considered as LF. Defect angle was considered as the angle that is formed by the two lines that represent the root surface of the tooth involved and the surface of the bone defect. Percentage fill was calculated by dividing linear bone fill at 6 months by defect depth at the baseline multiplied by 100 [2].

Surgical intervention: Local anaesthesia with 2% lignocaine containing adrenaline at a concentration of 1:2,00,000 under aseptic conditions was administered intraorally to the patients. At least three teeth were involved in the flap incisions. Kirkland flap or access flap surgery [2,9] in both test and control sites was performed with microsurgical instruments under 0.4X magnification in SOM (Labomed® Microscopes). According to the coin toss method the type of surgical procedure for the quadrant/site were selected to start therapy and after 1 week interval other surgical procedure was done.

In the test site, after a thorough conventional instrumentation, Diode laser, DenLase (980 nm, power: 3.0W; frequency: 2.5 KHz) was used to remove the inflammed soft tissue lining of the pocket for about 30 seconds thereby ensuring proper pocket sanitisation [21]. Later presuturing of the flap was done with NW018 Prolene (Ethicon, Johnson and Johnson) 4-0 sutures. HA (Sybograf™) was placed into the defect site. Following the proper adaptation of the bone graft, flap was approximated and closed using simple interrupted sutures using the same suture material. In the control site, following the conventional flap surgical procedure-incision, elevation, debridement and presuturing, where HA (Sybograf™) was placed into the defect site and flap was approximated and sutured using simple interrupted sutures with prolene 4-0 suture material [Table/Fig-2,3].

[Table/Fig-2]: Surgical procedure at test site (Sub-Images 1-10). a) Microsurgical instruments Blade-Opthalmic blade, Periosteal elevator Glickman- 6 (P24G), GDC Micro Castroviejo Needle holder straight Tc- 18 cm (NHM5024R), Tissue holding forceps-GDC Instruments; b) Preoperative view of showing probing pocket depth of 6 mm irt 14; c) Pocket debridement done using diode laser; d) Flap elevation and debridement done; e) Intrabony defect depth of 3 mm irt 14; f) Laser irradiation of defect site; g) Presuturing and Hydroxyapatite graft placement done irt 14; h) Simple interrupted sutures place; i) Suture removal done; j) Postoperative image showing pocket reduction of 4 mm.

Postoperative care: Postoperative instructions were given. All the subjects received postoperative antibiotics (amoxicillin 500 mg thrice daily) and analgesics (diclofenac 50 mg twice daily) for 5 days. The subjects were instructed to refrain from tooth brushing at the surgical site for 1 week and were instructed to rinse with 0.2% chlorhexidine gluconate mouthwash twice daily for 1 week. After 1 week, periodontal dressing and the sutures were removed and subjects were reinforced with oral hygiene instructions. Comparison of clinical parameters between two groups was done at baseline, 3 months, 6 months except for healing index which was done after one week. Radiographic parameters were done at baseline and 6 months using CBCT.

[Table/Fig-3]: Surgical procedure at control site (Sub-Images 1-8). a) Pre-operative view of showing probing pocket depth of 5 mm (upper limit was considered) irt distal surface irt 25; b) Incision and Pocket debridement done using microsurgical blades; c) Flap elevation and debridement done (minimally invasive method followed as three teeth were clearly visible under magnification); d) Intrabony defect depth of 3 mm irt 25; e) Presuturing and Hydroxyapatite graft placement done irt 25; f) Simple interrupted sutures place; g) Suture removal done; h) Postoperative picture showing pocket reduction of 3 mm; current probing depth=2 mm.

STATISTICAL ANALYSIS

Data were analysed using Statistical Package for Social Sciences (SPSS) version 20.0 software (IBM SPSS, IBM Corp., Armonk, NY, USA). Descriptive statistics, Independent samples t-test, repeated measures Analysis of Variance (ANOVA), and Paired t-tests were used in data analysis. For all the analysis, p-value<0.05 was considered statistically significant.

RESULTS

Demographic variables: The age of the patients was ranging between 20-65 years with the mean age of 35±11.36 years. The study group comprised of 6 males and 6 females constituting male to female ratio was 1:1.

Clinical parameters: The values of the clinical parameters were depicted in [Table/Fig-4,5].

Plaque index: The mean plaque index scores for the test sites was 0.84±0.29 at baseline which reduced to a mean score of 0.62±0.20 after 3 months and which was reduced to a mean score of 0.48±0.19 at 6 months. Control sites showed mean plaque score of 0.98±0.48 at baseline which reduced to a mean plaque score of 0.66±0.49 at 3 months and 0.51±0.42 at 6 months. The intragroup comparison showed statistical significance (p-value <0.001) [Table/Fig-4]. No statistical significance was observed in the baseline, 3 months and 6 months in the intergroup comparison (p-value >0.05) at all intervals [Table/Fig-5].

Gingival index: The mean GI scores for the test sites was 1.22±0.30 at baseline which reduced to a mean score of 0.99±0.39 after 3 months and which was reduced to a mean score of 0.91±0.38 at 6 months. Control sites showed mean GI of 1.37±0.32 at baseline which reduced to a mean gingival score of 1.18±0.38 at 3 months and 0.96±0.44 at 6 months. The intragroup comparison showed statistical significance (p-value <0.001) [Table/Fig-4]. No statistical significance was observed in the baseline, 3 months and 6 months in the intergroup comparison (p-value >0.05) at all intervals [Table/Fig-5].

Probing pocket depth: The baseline mean PPD was found to be 6.08±1.44 in test site and it was found to be reduced to 4.67±1.61 at 3 months and 4.08±1.44 at 6 months, was not statistically significant [Table/Fig-4]. The baseline mean PPD was found to

Groups	Parameters	Time point	Mean	Std. Deviation	p-value
Test group	Plaque index	Baseline	0.843	0.296	<0.001*
		3 months	0.62	0.203	
		6 months	0.48	0.191	
	Gingival index	Baseline	1.2242	0.306	0.001*
		3 months	0.99	0.394	
		6 months	0.91	0.389	
	R-CAL	Baseline	6.583	2.39	<0.001*
		3 months	5.16	2.51	
		6 months	4.58	2.39	
	Probing depth	Baseline	6.08	1.44	<0.001*
		3 months	4.67	1.61	
		6 months	4.08	1.44	
Control group	Plaque index	Baseline	0.986	0.48	<0.001*
		3 months	0.66	0.491	
		6 months	0.51	0.421	
	Gingival index	Baseline	1.3747	0.326	<0.001*
		3 months	1.18	0.381	
		6 months	0.96	0.445	
	R-CAL	Baseline	7.75	2.17	<0.001*
		3 months	6.167	2.32	
		6 months	5.67	2.42	
	Probing depth	Baseline	6.75	1.2	<0.001*
		3 months	5.167	1.33	
		6 months	4.67	1.37	

[Table/Fig-4]: Intragroup comparsion of clinical parameters.
Repeated measures ANOVA for significant difference p≤0.05 considered statistically significant; *Denotes statistical significance; p-value ≤0.05 considered statistically significant

Time interval	Parameters	Group	N	Mean	Std. Deviation	p-value
Baseline	Plaque index	Test	12	0.843	0.296	0.391
		Control	12	0.986	0.48	
	Gingival index	Test	12	1.2242	0.306	0.257
		Control	12	1.3747	0.326	
	Clinical attachment level	Test	12	6.583	2.39	0.225
		Control	12	7.75	2.17	
	Probing depth	Test	12	6.08	1.44	0.245
		Control	12	6.75	1.2	
	Healing index at 7th days	Test	12	1.083	0.28	0.143
		Control	12	1.33	0.49	
3 months	Plaque index	Test	12	0.62	0.203	0.772
		Control	12	0.66	0.491	
	Gingival index	Test	12	0.99	0.394	0.248
		Control	12	1.18	0.381	
	Clinical attachment level	Test	12	5.16	2.51	0.323
		Control	12	6.167	2.32	
	Probing depth	Test	12	4.67	1.61	0.418
		Control	12	5.167	1.33	
6 months	Plaque index	Test	12	0.48	0.191	0.839
		Control	12	0.51	0.421	
	Gingival index	Test	12	0.91	0.389	0.804
		Control	12	0.96	0.445	
	Clinical attachment level	Test	12	4.58	2.39	0.282
		Control	12	5.67	2.42	
	Probing depth	Test	12	4.08	1.44	0.321
		Control	12	4.67	1.37	

[Table/Fig-5]: Intergroup comparsion of clinical parameters.
Independent samples t-test; p≤0.05 considered statistically significant

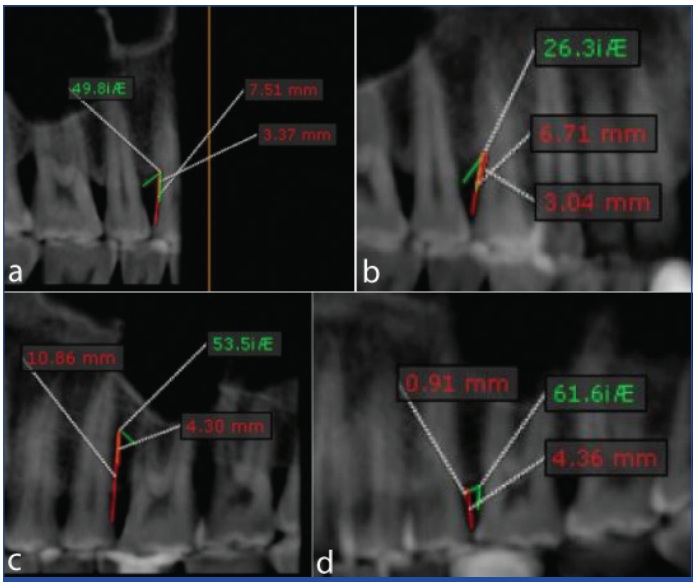
be 6.75±1.2 in control site and it was found to be reduced to 5.16±1.33 at 3 months and 4.67±1.37 at 6 months. Intergroup comparison between the test and control group did not show any statistical significance (p-value≥0.05) [Table/Fig-4]. The intragroup comparison of the PPD values where baseline, 3 months and 6 months was suggested to be statitically significant between both the test and control groups (p-value <0.001) [Table/Fig-4].

Relative-clinical attachment level: The baseline mean R-CAL in test site was observed to be 6.58±2.39 which was reduced to 5.16±2.51 at 3 months and to 4.58±2.39 at 6 months. The baseline mean R-CAL in control site was observed to be 7.75±2.17 which was reduced to 6.16±2.34 at 3 months which was not statistically significant and to 5.67±2.42 at 6 months [Table/Fig-4]. Intergroup comparison between the test and control group did not show any statistical significance where p value was found to be ≥0.05 [Table/Fig-5]. The intragroup comparison of the R-CAL values where baseline, 3 months and 6 months was suggested to be statistically significant between both the test and control groups (p-value <0.001) [Table/Fig-4].

Healing index: In the present study, healing index was used to study the additional benefit in terms of flap closure with the adjunctive use of diode laser. Both the groups were evaluated in difference in the soft tissue closure and healing patterns. In this study, almost similar type of healing pattern was appreciated among the groups. The mean HI at 7th day after surgery in test sites and control sites were 1.08±0.28 and 1.33±0.49, respectively, which was not statistically significant (p-value=0.143). Though the adjunctive use of lasers had satisfactory healing at test sites when observed after a week, there was no statistical significance obtained when compared within intergroups.

Radiographic Analysis

The values of the radiographical parameters were depicted in [Table/Fig-6]. Radiographic assessment was done using the following reference points in the CBCT.



[Table/Fig-6]: a) Test site baseline CBCT wrt 14 defect angle was 49.8 degrees; 3.37 mm intrabony defect depth from alveolar crest to base of the defect. Distance from CEJ to base of the defect was 7.51mm; b) Test site 6 months CBCT wrt 14 defect angle was 26.3 degrees; Intrabony defect depth from alveolar crest to base of the defect is 3.04 mm. Distance from CEJ to base of the defect was 6.71 mm; c) Control site baseline CBCT wrt 25 defect angle 53.5 degrees, Intrabony defect depth from alveolar crest to base of the defect was 4.30 mm. Distance from CEJ to base of the defect was 10.86 mm; d) Control site 6 months CBCT wrt 25 defect angle 61.6 degrees; Intrabony defect depth from alveolar crest to base of the defect was 0.91 mm. Distance from CEJ to base of the defect was 4.36 mm.
Red line: indicates the linear measurement from CEJ of the involved tooth to the base of the defect; Orange line: indicates the linear measurement from the level of alveolar crest (by drawing a perpendicular line from the crest of the uninvolved tooth) to the base of the defect; Green line: indicates the defect angle

Depth of the defect: Intragroup comparison of the DD was statistically significant in both test and control (p-values=0.011 and p-value=0.002, respectively) [Table/Fig-7]. On intergroup comparison, the baseline DD

in test and control groups was 4.84±1.16 and 4.66±1.28 respectively, p-value=0.143 which was not statistically significant [Table/Fig-8]. At 6 months, the DD values were 3.64±1.28 in test group and 4.16±1.12 in control group (p-value=0.296) [Table/Fig-8].

Group	Parameters	Group	N	Mean	Std. Deviation	p-value
Test	Depth of defect (mm)	Baseline	12	4.84	1.168	0.011*
		6 months	12	3.64	1.28	
	Linear amount of fill (mm)	Baseline	12	0	0	0.01*
		6 months	12	1.201	1.35	
	Defect angle (degrees)	Baseline	12	50	11.45	0.01*
		6 months	12	46.25	10.76	
	Percentage linear fill	6 months	12	18.11	11.95	0.074
Control	Depth of defect (mm)	Baseline	12	4.66	1.28	0.002*
		6 months	12	4.16	1.12	
	Linear amount of fill (mm)	Baseline	12	0	0	0.002*
		6 months	12	0.498	0.415	
	Defect angle (degrees)	Baseline	12	48.5	4.7	<0.001*
		6 months	12	47.25	4.99	
	Percentage linear fill	6 months	12	10.16	8.49	0.074

[Table/Fig-7]: Intragroup comparsion of radiographic parameters.
Paired t test; p≤0.05 considered statistically significant; *denotes statistical significance

Time intervals	Parameters	Group	N	Mean	Std. Deviation	p-value
Baseline	Depth of defect (mm)	Test	12	4.84	1.168	0.143
		Control	12	4.66	1.28	
	Linear amount of fill (mm)	Test	12	0	0	0.729
		Control	12	0	0	
	Defect angle (degrees)	Test	12	50	11.45	0.679
		Control	12	48.5	4.7	
6 Months	Depth of defect (mm)	Test	12	3.64	1.28	0.296
		Control	12	4.16	1.12	
	Linear amount of fill (mm)	Test	12	1.201	1.35	0.1
		Control	12	0.498	0.415	
	Defect angle (degrees)	Test	12	46.25	10.76	0.773
		Control	12	47.25	4.99	
	Percentage linear fill	Test	12	18.11	11.95	0.074
		Control	12	10.16	8.49	

[Table/Fig-8]: Intergroup comparsion of radiographic parameters.
Independent samples t test; p≤0.05 considered statistically significant

Linear bone fill: The baseline LF was considered 0 in both test and control sites. After 6 months LF were 1.201±1.35 mm in test group and 0.498±0.415 in control group, respectively. Both sites showed a statistical significance (p-value=0.01) in the test sites and (p-value=0.002) in the control sites [Table/Fig-7]. Intergroup comparison did not show any statistical significance (p-value=0.1) [Table/Fig-8].

Defect angle: The DA at baseline showed a mean standard deviation of 50±11.45 in the test group at baseline and 46.25±10.76 after 6 months. It was considered statistically significant (p-value=0.01). Within the control group the mean standard deviation of 48.5±4.7 at baseline and 47.25±4.99 at 6 months was seen with p-value <0.001 showing a statistical significance. Intergroup comparison did not show any statistical significance.

Percentage fill: Intergroup comparison among the PF in the test group after 6 months was 18.11±11.95 in the test group and 10.16±8.49 in the control group, respectively. No statistical significance was obtained and p-value was 0.074.

DISCUSSION

To enhance the regenerative capacity different ways have been used to improve healing of periodontal osseous defects utilising various bone grafts, barrier membranes, growth factors, antimicrobial agents, and lasers alone and in combination [22,23]. The present study focused on the efficacy of the soft tissue laser in the defect debridement which improves the healing of osseous defects, and ultimately leading to increase in outcome of periodontal regeneration.

In the present study, Hydroxyapatite graft was used as a bone graft material in both the groups. The graft was chosen based on the ability of the graft in periodontal regeneration. Koduru S et al., compared the efficacy of (Sybograf™) with NovaboneTM in treating the intrabony defects [9]. They concluded that HA graft has shown superior bonefill over NovaboneTM over a period of 9 months. In another study, Singh VP et al., in 18 intrabony defects randomly used (SybografTM) and periocol following flap debridement [24]. Significant results were shown for the Sybograf™ group (p-value >0.05) when compared with periocol group. Better results were shown in all the radiographic parameters for the SybografTM group.

Low Level Laser (LLL) shows a positive effect on cell metabolism and stimulate gingival and PDL cell proliferation [25]. Aoki A et al., reported that it is difficult to completely eradicate Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans and Prevotella intermedia after mechanical therapy (non surgical and surgical) and their persistence is associated with poor healing of periodontal pockets [25]. Gojkov-Vukelic M et al., used real-time polymerase chain reaction analysis to evaluate the diode laser's bactericidal efficacy, and the study found a significant drop in the quantity of Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans immediately after lasing, which decreased further after 3 months [26]. Lasers stimulate greater bone growth and repair by decontaminating and detoxifying the body.

Ruertas RM et al., performed the application of a pulsed diode laser (Ezlase) of 940 nm at low energy levels in an in-vitro study. Cell proliferation was enhanced in laser-treated cells at intensities of 0.5, 1, and 1.5 W/cm.sq compared to controls after 24 hours of culture; energy density was positively connected with osteoblast cell growth, which peaked at 3 J and declined at higher fluences [27]. Along with the graft material, the adjunctive use of the diode laser did not show any statistical improvement in the regeneration. The results obtained in Kreisler M et al., study, revealed that an 809-nm LLL light had a stimulatory effect on the proliferation of PDL fibroblasts [3].

In the present study, diode laser stimulation prior to the graft placement has showed a better improvement in the regeneration with time, but in comparison with the control group, not much significance statistically was achieved. Whereas, in terms of clinical parameters, this study is in accordance with Jonnalagadda BD et al., where use of DenLase laser showed no statistical significance in the intergroup comparison following laser irradiation in the test sites [28]. The present study is in accordance to the study done by Gupta RK et al., in terms of both clinical and radiographical parameters as the results of the present study correlates [2].

This suggests that the diode laser effect on this particular graft (Sybograf) may not be that effective in enhancing the regenerative outcome. This is in contrast with the study done by Ozcelik O et al., where Low Level Laser Therapy (LLLT)+Enamel Matrix Derivative in intrabony defects in the test sites and EMD alone in control sites. The EMD+LLLT had resulted in less gingival recession (p-value <0.05), less swelling (p-value <0.001) and less VAS scores (p-value <0.02) compared with EMD alone and concluded that EMD is a predictable material for periodontal regeneration [29].

Application of low level laser contains extreme variations such as dose, wavelength, amount of energy density, required time periods, and treatment intervention time. The dose applied during laser application is one of the important treatment parameters to

benefit from LLLT. However, no precisely determined dose has been determined for each indication [30]. A single application on a wound site may not be effective in the stimulation of the cells and to reach the borders of the surgical bed. Multiple irradiations therefore are more effective than a single dose. This is an important factor in bone formation and fibroblast growth according to study by AboElsaad NS et al., [30]. In the present study 810 nm diode laser at 1 W power for 30 second was used in the test sites [30].

Low level laser irradiation, when used postoperatively, is directly absorbed by the cellular structures activating the biochemical processes of the osteoblast nucleus and DNA-RNA-protein synthesis, thus accelerating normalisation of the structure of organic and inorganic bone mineral collagen, resulting in enhanced bone healing [31]. The lack of intergroup significance in our study can be attributed to the single laser irradiation, as it was performed only during the surgical intervention [32]. Second attempt of laser irradiation was not performed in the test sites during the recalls as this may lead to an altered healing in both the sites [31].

Another advantage of the present study was the use of SOM for performing the flap surgeries. Performing the surgeries under magnification has many additional advantages such as it aims to improve the quality in patient care, aids high magnification range and brilliant illumination, increasing precision, improved ergonomic benefit, improving overall dental care, documentation with videography and photography and providing an open field for surgery [33]. Limited literature studies are available with the SOM. Many practioners have used surgical loupes as a magnification aid in the periodontal surgeries [34,35]. Though the loupes can be used, the ergonomic benefit, extent of magnification will be definitely higher for a SOM than Loupes [15]. The major disadvantage with the SOM can be attributed to its higher cost and a deep learning curve.

Cortellini P and Tonetti MS, had performed surgical debridement in 26 deep intrabony defects under SOM and concluded that 92.3% cases showed satisfactory healing with minimal gingival recession [36]. Bittencourt S et al., in a split mouth study for recession coverge has performed the treatment under SOM in 24 subjects where after 12 months 98% and 88.3% of root coverage was achieved and statistical significance was seen in test group in parameters [37]. In the current study, statistical significance in clinical parameters was observed with the time intervals within the groups (p-value <0.001). In terms of healing, as a single operator was involved in performing the procedure both at the test and control sites ensuring no operator bias, there was almost an equal evidence of healing pattern clinically and statistically.

Advancements in the field of periodontics is always a benefit for both patients as well as clinicians. Lasers are one such advancement which aids in painless technique, efficient in therapeutic terms and easy to access. Magnification provides numerous benefits in terms of ergonomics, visual activity, and precision in handling the tissues. Considering the literature, controversies are still prevailing regarding effect of lasers on periodontal tissue healing because of utilisation of different parameters for delivery of laser beam and different laser systems used.

Limitation(s)

A smaller sample size of 24 sites cannot give the definitive conclusions in terms of regeneration. Lack of microbiological analysis assessing the bacterial load within the tissues stays a drawback of the study. Further, additional studies are required utilising a larger sample size and proper microbiological analysis can prevail in attaining the substantial outcome of the study.

CONCLUSION(S)

Complete debridement of the defect site plays a major supportive role in the regeneration of defects. Both conventional and laser assisted method of regeneration did not exhibit any statistical difference in the clinical and radiographical parameters in our study. Further, long-term studies with a larger sample size and repeated laser applications of laser irradiation are recommended.

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