"Comparative evaluation of open flap debridement with and without intra-marrow penetration in the treatment of horizontal defects in Stage II and Stage III Grade B Periodontitis- A Randomized Controlled Trial"

[1]Dr. Tulsi Tarase, [2]Dr. Nupur Sah, [3]Dr. Prashasti Sarode

[1]Periodontist, [2]Professor, Department of Periodontology, [3]Post graduate student YMT Dental College and Hospital, Kharghar, Navi Mumbai.

[1]tulsitarase00@gmail.com, [2]sahnupur02@gmail.com

Abstract

Background: Periodontal horizontal bone loss remains a challenging entity in regenerative therapy. Open Flap Debridement (OFD) is an established surgical modality; however, its outcomes in horizontal defects are often limited. Intra Marrow Penetration (IMP) has been proposed as an adjunct to enhance bone regeneration through stimulation of the regional acceleratory phenomenon.

Aim: To evaluate and compare the clinical and radiographic outcomes of Open Flap Debridement with and without Intra Marrow Penetration in the treatment of horizontal bone defects in Stage II and Stage III Grade B Periodontitis patients.

Materials and Methods: A randomized, split-mouth clinical trial was conducted on 10 systemically healthy subjects aged 30-60 years, involving 30 bilateral sites exhibiting horizontal bone loss. Site A received OFD with IMP, and Site B received OFD alone. Clinical parameters including Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL) were evaluated at baseline, 3 months, and 6 months. Radiographic defect depth and defect fill percentage were assessed using standardized intraoral periapical radiographs at baseline and 6 months.

Results: Both groups exhibited significant improvements in clinical parameters over time. However, Site A (OFD + IMP) demonstrated greater reductions in PPD, greater CAL gain, and a higher percentage of radiographic defect fill compared to Site B (OFD alone), with statistically significant differences at 6 months.

Conclusion: Intra Marrow Penetration as an adjunct to Open Flap Debridement significantly enhances clinical and radiographic outcomes in the treatment of horizontal defects in Stage II and III Grade B Periodontitis. This simple and cost-effective technique could offer improved therapeutic predictability for horizontal periodontal bone defects.

Keywords: Horizontal bone loss, Open Flap Debridement, Intra Marrow Penetration, Periodontitis, Defect Fill, Clinical Attachment Level.

I. INTRODUCTION (HEADING 1)

Periodontitis is a multifactorial inflammatory disease characterized by the progressive destruction of the supporting structures of the teeth, often leading to alveolar bone loss. Horizontal bone defects, the most prevalent osseous defects in periodontitis, present a significant challenge in periodontal therapy due to their unpredictable regenerative potential. Open Flap Debridement (OFD) has long been established as a gold standard for surgical management, facilitating better access for debridement and reducing probing depths. [1] However, its limitations in regenerating lost alveolar bone, particularly in horizontal defects, necessitate the exploration of adjunctive techniques to enhance healing outcomes. Intra Marrow Penetration (IMP), also known as decortication or bone tapping, is a technique aimed at perforating the cortical bone to stimulate the regional acceleratory phenomenon, promoting the influx of progenitor cells and vascular elements essential for regeneration. [2] Although IMP has shown promise in conjunction with regenerative procedures, limited evidence exists regarding its efficacy when combined solely with OFD in horizontal defects.

This study aims to comparatively evaluate the clinical and radiographic outcomes of OFD with and without the adjunctive use of Intra Marrow Penetration in the treatment of horizontal bone defects in Stage II and Stage III Grade B Periodontitis, thereby exploring a potential means to enhance conventional surgical outcomes.

Materials and Methods

Study Design and Population:

This randomized, split-mouth clinical trial was conducted on 10 systemically healthy patients (aged 30–60 years) diagnosed with Stage II and Stage III Grade B Periodontitis. A total of 30 bilateral sites exhibiting horizontal bone defects were selected based on clinical and radiographic criteria. Ethical clearance was obtained prior to study commencement, and informed consent was secured from all participants.

Inclusion Criteria:

- Systemically healthy individuals.
- Sites with probing pocket depth (PPD) ≥5 mm associated with horizontal bone loss.
- Radiographic evidence of horizontal bone defects.

Exclusion Criteria:

- Smokers and tobacco users.
- Pregnant or lactating women.
- Patients under medications influencing periodontal healing.
- Sites requiring regenerative materials.

Randomization and Group Allocation:

Selected sites were randomly assigned into two groups:

- **Group A (Test Group):** Open Flap Debridement with Intra Marrow Penetration.
- **Group B (Control Group):** Open Flap Debridement alone.

Clinical and Radiographic Parameters:

Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL) were recorded at baseline, 3 months, and 6 months. Standardized intraoral periapical radiographs were taken at baseline and 6 months to assess defect depth and defect fill.

Surgical Procedure:

Following local anesthesia, crevicular incisions were made, and full-thickness mucoperiosteal flaps were elevated. Thorough debridement was performed in both groups. In Group A, after debridement, multiple perforations were created in the cortical bone using a round bur to achieve intra marrow penetration. Flaps were repositioned and sutured in both groups. [3].

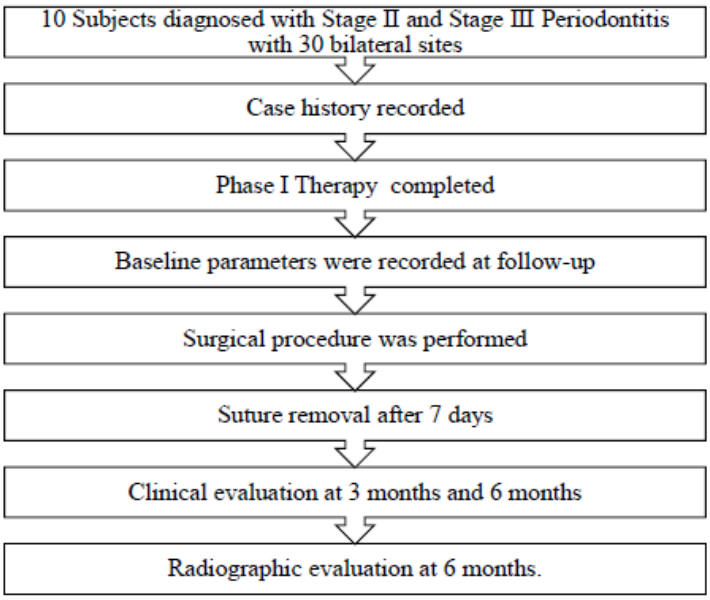
Postoperative Care:

All patients received standardized postoperative instructions, antibiotics, analgesics, and 0.12% chlorhexidine rinses for 2 weeks. Sutures were removed after 10 days.

Statistical Analysis:

Data were analyzed using appropriate statistical tests, with p-values <0.05 considered statistically significant.

Flowchart for methodology:



Results

All 10 patients completed the study without any postoperative complications. Healing was uneventful at all sites.

Clinical Outcomes:

Both groups showed significant reductions in Plaque Index (PI) and Gingival Index (GI) scores from baseline to 6 months, with no statistically significant intergroup differences, indicating effective plaque control.

At 6 months:

- **Probing Pocket Depth (PPD):** Both groups demonstrated significant reductions compared to baseline. However, Group A (OFD + IMP) exhibited a greater mean reduction in PPD compared to Group B, with the difference being statistically significant ($p < 0.05$).
- **Clinical Attachment Level (CAL):** Group A showed a greater mean gain in CAL than Group B at 6 months, with statistically significant differences ($p < 0.05$).

Radiographic Outcomes:

- Radiographic analysis revealed significant defect fill in both groups at 6 months.
- Group A demonstrated a higher mean percentage of defect fill compared to Group B, with statistically significant differences ($p < 0.05$).

Summary of Key Findings:

- Greater PPD reduction in OFD + IMP group.
- Higher CAL gain in OFD + IMP group.
- Enhanced radiographic defect fill in OFD + IMP group.

Discussion

The present randomized controlled trial evaluated the additional benefit of Intra Marrow Penetration (IMP) when combined with Open Flap Debridement (OFD) in the management of horizontal bone defects associated with Stage II and III Grade B Periodontitis. Results demonstrated that the adjunctive use of IMP led to significantly greater reductions in probing pocket depth (PPD), higher clinical attachment level (CAL) gains, and greater radiographic defect fill compared to OFD alone.

OFD remains the gold standard for surgical periodontal therapy, primarily aiming at reducing pocket depths and facilitating plaque control. However, its regenerative potential, especially in horizontal bone loss, remains limited. [4]. The concept of IMP, based on the regional acceleratory phenomenon, enhances wound healing by promoting bleeding, angiogenesis, and recruitment of osteoprogenitor cells. [5]. Our findings align with previous studies where cortical bone perforations have been shown to stimulate a more favorable environment for periodontal regeneration. [6].

The statistically significant improvements observed in the test group (OFD + IMP) indicate that even without the use of biomaterials, the biological stimulation offered by IMP can significantly enhance periodontal healing outcomes. [7]. This suggests that IMP is a simple, cost-effective, and minimally invasive adjunct that can improve clinical predictability, particularly in resource-constrained settings. [8].

Despite the promising results, certain limitations must be acknowledged. The relatively short follow-up period of six months, small sample size, and reliance on two-dimensional radiographic assessment may affect the generalizability of the findings. [9]. Further long-term studies with larger cohorts and advanced imaging modalities such as CBCT are warranted to confirm the benefits observed. [10].
Nevertheless, the findings of this study provide important clinical insights and suggest that incorporating intra marrow penetration into conventional OFD procedures could offer a valuable strategy for managing horizontal periodontal defects.

Conclusion
Within the limitations of this study, it can be concluded that the adjunctive use of Intra Marrow Penetration (IMP) with Open Flap Debridement (OFD) significantly enhances clinical and radiographic outcomes in the treatment of horizontal bone defects associated with Stage II and III Grade B Periodontitis. The simple, cost-effective nature of IMP makes it a promising adjunct to conventional periodontal therapy. Further long-term studies with larger sample sizes and three-dimensional imaging are recommended to validate these findings.

References

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Table 1 : Intra group comparison of Clinical Attachment Level at Site A

	N	Mean	Std. Deviation	Median	Mean rank	Chi-Square value	p value of Friedman Test
CAL BL	30	6.67	.922	7.00	2.85	43.979	.000**
CAL 3M	30	5.30	.915	5.00	1.80		
CAL 6M	30	4.73	.583	5.00	1.35		

Table 2: Intra group comparison of Clinical Attachment Level at Site B

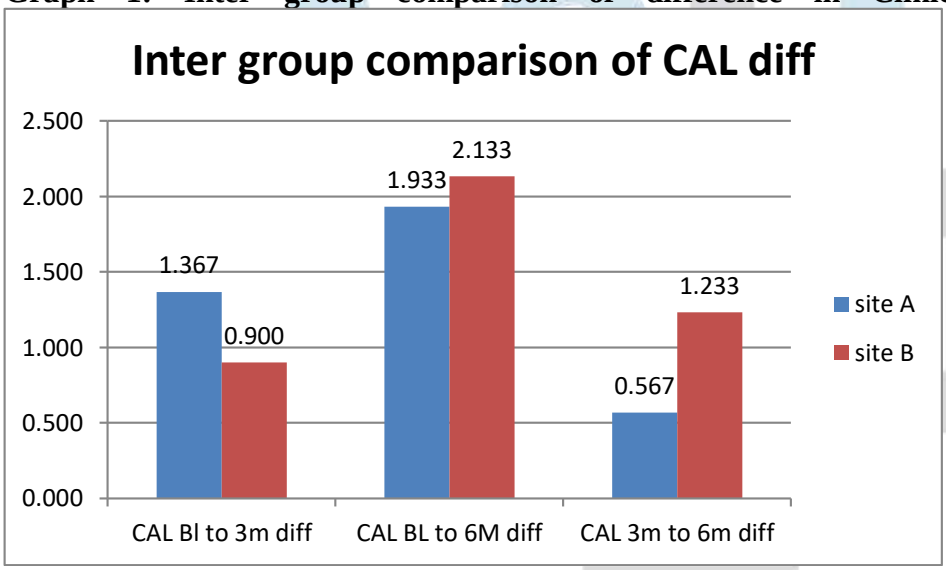
	N	Mean	Std. Deviation	Median	Mean rank	Chi-Square value	p value of Friedman Test
CAL BL	30	7.03	.615	7.00	2.92	54.531	.000**
CAL 3M	30	6.13	.507	6.00	2.02		
CAL 6M	30	4.90	.607	5.00	1.07		

Table 3: Inter group comparison of CAL and PPD and Defect Depth at baseline, 3 months and 6 months

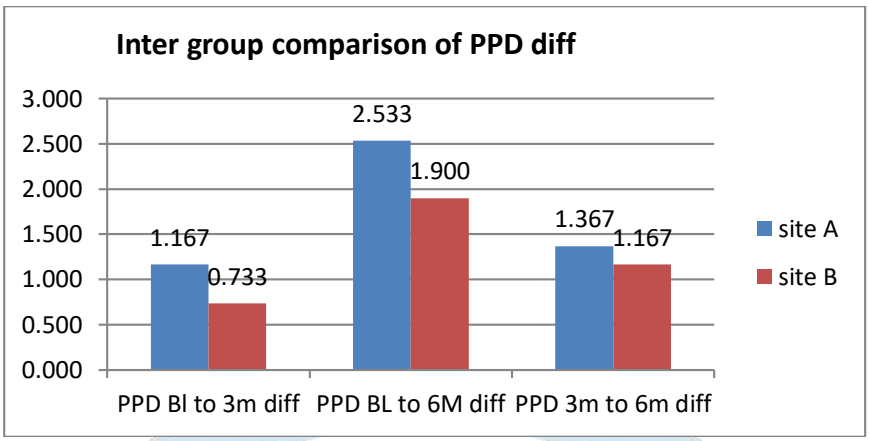
		Site	N	Mean	Std. Deviation	Mann-Whitney U value	p value of Mann-Whitney U test
PPD BL		A	30	6.57	.971	425.500	0.700#
		B	30	6.47	.819		
PPD 3M		A	30	5.40	.814	346.000	0.091#
		B	30	5.73	.583		
PPD 6M		A	30	4.03	.765	263.500	0.003**
		B	30	4.57	.568		
PPD Bl to 3m diff		A	30	1.16667	.592093	302.000	0.006**
		B	30	.73333	.583292		
PPD BL to 6M diff		A	30	2.53333	.937102	284.500	0.010*
		B	30	1.90000	1.061879		
PPD 3m to 6m diff		A	30	1.36667	.718395	355.500	0.102#
		B	30	1.16667	.698932		
CAL BL		A	30	6.67	.922	327.500	0.049*
		B	30	7.03	.615		

CAL 3M		A	30	5.30	.915	219.000	0.000**
		B	30	6.13	.507		
CAL 6M		A	30	4.73	.583	388.000	0.287#
		B	30	4.90	.607		
CAL Bl to 3m diff		A	30	1.36667	.927857	316.000	0.027*
		B	30	.90000	.547723		
CAL BL to 6M diff		A	30	1.93333	1.080655	399.000	0.425#
		B	30	2.13333	.730297		
CAL 3m to 6m diff		A	30	.56667	.897634	261.500	0.003**
		B	30	1.23333	.678911		
Defect depth baseline		A	30	5.10000	.528205	435.000	0.824#
		B	30	5.08000	.528205		
Defect depth at 6 months		A	30	4.37833	.365524	299.500	0.026*
		B	30	4.70967	.620942		
Defect difference		A	30	0.7583	32.92	377.500	0.284#
		B	30	0.6343	28.08		

Graph 1: Inter group comparison of difference in Clinical Attachment Level (CAL)



Graph 2: Inter group comparison of difference in Probing Pocket Depth (PPD)



Graph 3 : Inter group comparison of Defect Fill (%)