Article published online: 2023-10-16

Comparing the Effectiveness of Conventional and Microsurgical Access Flap Techniques in Managing Horizontal Bony Defects in Chronic Periodontitis Patients: A Clinical and Radiographic Study

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Eur J Gen Dent 2023;12:152–159.

Abstract

Objective Periodontal microsurgery is descendant of conventional periodontal surgery to reduce surgical trauma, improve wound healing, and enhance patient compliance. This study compared the efficacy of conventional and microsurgical access flap in the management of horizontal bony defects in chronic periodontitis patients.

Materials and Methods Eight pairs of contralateral horizontal bone defects in chronic periodontitis patients were randomly allocated to control group and test group. Microsurgical access flap was carried out in test group under magnification, while control group received conventional access flap. Plaque index (PI), gingival index (GI), probing pocket depth (PPD), relative attachment level (RAL), and relative gingival marginal level (RGML) were recorded at baseline, 3 months, and 6 months. Wound healing index (WHI) was evaluated after 1 week, 2 weeks, and 4 weeks. Pain perception was evaluated using visual analog scale (VAS) post-surgery and after 24 hours. Radiographic defect depth was measured at baseline and after 6 months.

Statistical Analysis The statistical analysis was done by SPSS statistical software. The intragroup comparison was done by repeated measures analysis of variance. The intergroup difference between both groups was done by Student's *t*-test. The descriptive statistics for VAS and WHI was done by Wilcoxon signed rank test. The mean difference between clinical parameters from baseline to follow-up intervals was calculated by post-hoc least significance difference analysis.

Results There was significant reduction in PI, GI, PPD, and RAL within both the groups ($p < 0.05$). There was increase in RGML within both the groups from baseline to 6 months ($p < 0.05$). In the intergroup comparison, test group showed better WHI and better pain perception (VAS) compared to control group ($p < 0.05$). No difference was found between both the groups in terms of radiographic defect depth ($p > 0.5$).

Keywords
- chronic periodontitis
- horizontal bone defects
- conventional access flap
- periodontal microsurgery
- dental loupes

DOI https://doi.org/10.1055/s-0043-1773798.
ISSN 2320-4753.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

Conclusion Both the procedures were effective in improving the clinical parameters but the microsurgical group showed better results in terms of wound healing and less postoperative pain. Both procedures showed no significant effect on radiographic defect depth.

Introduction

Chronic periodontitis is defined as "an infectious disease affecting the supporting tissues of the teeth characterized by pocket formation and/or gingival recession resulting in progressive attachment and bone loss."[1]

The treatment of chronic periodontitis includes removal of etiological factors (plaque and calculus) by means of scaling and root planning. Surgical treatment is warranted in cases of residual pocket depth more than or equal to 5 mm after scaling and root planning along with the presence of bone defects.[2,3] Access flap surgery provides access to the inaccessible areas of deeper pockets and root surface thereby helping in reduction of pocket depth and also providing access for regenerative and resective osseous procedues.[4]

Horizontal bone loss is the most common type of bone defect observed in chronic periodontitis patients but is termed as least favourable for periodontal regeneration. Access flap for pocket depth reduction remains the only feasible option for patients with horizontal bone defects.[5] The disadvantages of access flap by conventional techniques include gingival recession, exposure of root surfaces, and opening of gingival embrasures leading to formation of black triangles and unesthetic appearance.[6]

Periodontal surgical procedures have undergone radical changes to reduce the invasiveness and maintain soft tissue integrity with novel microsurgical techniques and instrumentation.[7]

Periodontal microsurgery is the descendant of conventional periodontal surgery in an attempt to reduce surgical trauma and open the horizon for better patient care through improvement in wound healing and patient compliance. Microsurgery renders three benefits of "illumination, magnification and increased precision in delivery of surgical skills."[8] Periodontal microsurgery includes all the procedures done under magnification starting from 2.5x onwards either using dental loupes or operating microscope.[9]

Dental loupes/operating microscope along with specifically designed microsurgical instruments allow a more accurate and atraumatic manipulation of the soft tissues and hard tissues, improve the surgical access, and avoid the unnecessary removal of tissues.[10]

Minimally invasive surgery, as introduced by Harrel and Rees in 1995, aims to handle the soft and hard tissues with care, minimum refection of flap leaving behind few scars and ultimately less post-surgical wound. The term "minimally invasive surgery" refers to the use of surgical operations that are smaller and more precise and are made feasible by the use of magnifying tools like operating microscopes and microsurgical tools and materials.[8]

Cortellini and Tonetti[9] recommended the use of an operating microscope in periodontal regenerative surgery, citing better potential for primary wound closure from an average 70% of cases acquired with standard surgery to an exceptional 92% obtained with microsurgery. Using operating microscopes, Wachtel et al[10] demonstrated improved clinical outcomes in a variety of periodontal surgical settings, including flap surgery and mucogingival surgery.

Considering the aforementioned literature findings, this study is designed to evaluate and compare the clinical and radiographic efficacy of conventional and microsurgical access flap for the management of horizontal bony defects in chronic periodontitis patients.

Materials and Methods

Study Design and Population

This study was a single-center, split mouth randomized clinical trial of 6 months follow-up duration. This study was approved by the Institution Ethics Committee, Dr. D. Y. Patil, Vidyapeeth, Pune, Maharashtra, India. This study population consisted of 16 sites from 8 chronic periodontitis patients with contralateral horizontal bone defects, within the age group of 30 to 55 years (5 males and 3 females) reporting to the outpatient section of Department of Periodontology, Dr. D. Y. Patil Dental College and Hospital, Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune, India. This study procedure was explained and a written informed consent was obtained from the participants prior to this study.

Inclusion and Exclusion criteria

The patients were selected after initial screening based on following inclusion criteria -

1. Age group of 30 to 55 years from both genders (equal sex ratio).
2. Probing pocket depth (PPD) $\geq$ 5 mm, clinical attachment loss (CAL) $\geq$ 3 mm following phase I therapy (scaling and root planning) in at least two contralateral quadrants.
3. Radiographic evidence of horizontal bone loss in the associated contralateral quadrants.
4. Vital and asymptomatic teeth in the associated contralateral quadrants.
5. Patients who agreed to give informed consent and were willing to undergo the treatment.
6. Patients who demonstrated acceptable oral hygiene prior to surgical therapy

The exclusion criteria were as follows: -

1. Patient with history of aggressive periodontitis.
2. Vertical bone defects/ furcation defects requiring periodontal regeneration.
3. History of known systemic diseases like hypertension, diabetes, human immunodeficiency virus, bone metabolic disorders, radiation therapy, immunosuppressive therapy, cancer, blood disorders.
4. Patients with abnormal blood pattern.
5. Medications known to affect the outcomes of periodontal therapy.
6. Patients who had undergone any periodontal therapy in the preceding 6 months.
7. Pregnant or lactating mothers.
8. Use of tobacco in any form.
9. Presence of gingival recession at the surgical sites.
10. Mobility of teeth at surgical sites.

Sample Size Estimation and Randomization

A total of 16 sites from 8 chronic periodontitis patients with contralateral horizontal bone defects were selected for this study. Sample size was determined based on 80% power of study at a confidence interval of 95% ($p < 0.05$).

In each patient one pair of horizontal bone defects was randomly divided into two groups using toss of coin method namely control group treated by access flap surgery using conventional approach and **t**est group treated by access flap surgery using microsurgical approach

Study Measurements and Outcomes

All the study measurements were taken by a single examiner (S.M). Intraexaminer calibration was carried out by clinical measurement of eight chronic periodontitis patients on two separate occasions. The calibration was successful if the examiner attained 90% agreement on measurement of (PPD) and (CAL) within a range of 1 mm on separate occasions.

The following clinical parameters were recorded at baseline, 3 and 6 months post-therapy using a standardized University of North Carolina – 15 Periodontal Probe: Plaque index (PI),[11] Gingival index (GI),[12] PPD, relative attachment level (RAL), and relative gingival margin level (RGML). The relative measurements were recorded from a fixed reference point using customized acrylic stent.[13]

Patient-centric measurements recorded were wound healing index (WHI),[14] which was evaluated after 1 week, 2 weeks, and 4 weeks post-surgery and patient's pain perception that was evaluated using visual analog scale (VAS)[15] postoperative and after 24 hours.

For all the selected sites, radiographic images were taken at baseline and after 6 months. Paralleling angle technique was used and all the parameters like X ray angulation, exposure time and voltage were kept the same for better standardization of radiovisiography (RVG) images during follow-up visits. Radiographic interpretations were done using radiographic grid and linear measurements calculated using Adobe Photoshop software for better standardization of RVG images.

The following measurements were recorded at baseline and after 6 months.

C_{0-} Distance from cementoenamel junction to alveolar crest (CEJ-AC) (baseline) CEJ-AC

C_6-Distance from CEJ-AC (6 months postoperatively)

Arithmetic determination used was as follows:

CHANGE IN ALVEOLAR CREST: Initial distance from CEJ to alveolar crest—6 months post-surgical distance from CEJ to alveolar crest (C_O-C_6).

Clinical Procedure

After selection of the patients, a detailed clinical examination, case history, and informed consent were obtained from all the patients. A full-mouth phase I therapy was performed that included full mouth scaling and root planning and removal of all predisposing factors. Each patient was given instructions regarding proper oral hygiene measures. A periodontal re-evaluation was done after 4 to 6 weeks of phase I therapy to confirm the desired sites for this study. The selected sites were randomly divided into test group and control group. All the clinical procedures were performed by a single-skilled operator (S.T.)

Control Group

An intraoral antisepsis was ensured with a preprocedural rinse of 0.2% chlorhexidine gluconate, and povidone-iodine solution was used to ensure extraoral antisepsis. After the administration of local anesthesia, intracrevicular incisions were placed with BP handle and no 12 surgical blades. Buccal and lingual mucoperiosteal flaps were elevated using periosteal elevators. Surgical debridement was carried out to remove subgingival plaque and calculus. Granulation tissue adherent to the root surface and along the crestal surface of the bone defect was removed with the help of curettes to provide full access and visibility to root surfaces. The surgical site was irrigated with sterile saline. Simple interrupted sutures were placed using 4-0 nonresorbable Mersilk suture (►**Fig. 1**).

Test Group

An intraoral antisepsis was ensured with a preprocedural rinse of 0.2%chlorhexidine gluconate, and povidone-iodine solution was used to ensure extraoral antisepsis. In test sites, microsurgery was carried out with 2.5X optical magnification dental loupe. After local anesthesia, sulcular incisions were placed with microsurgical ophthalmic blades. Buccal and lingual mucoperiosteal flaps were elevated using microperiosteal elevators. Granulation tissue adherent to the root surface and along the crestal surface of the bone defect was removed with the help of minicurettes to provide full access and visibility to root surfaces. Granulation tissue adherent to the inner surface of the flap was removed with the help of minicurettes or microtissue cutting scissors. Simple interrupted sutures were placed using 6-0 silk sutures (►**Fig. 2**).

Post-Therapy Care and Follow-Up

Patients were prescribed analgesics (paracetamol 500 mg SOS) and betadine (2%) mouthwash twice daily for 4 weeks. Patients were recalled after 1 week for suture removal.

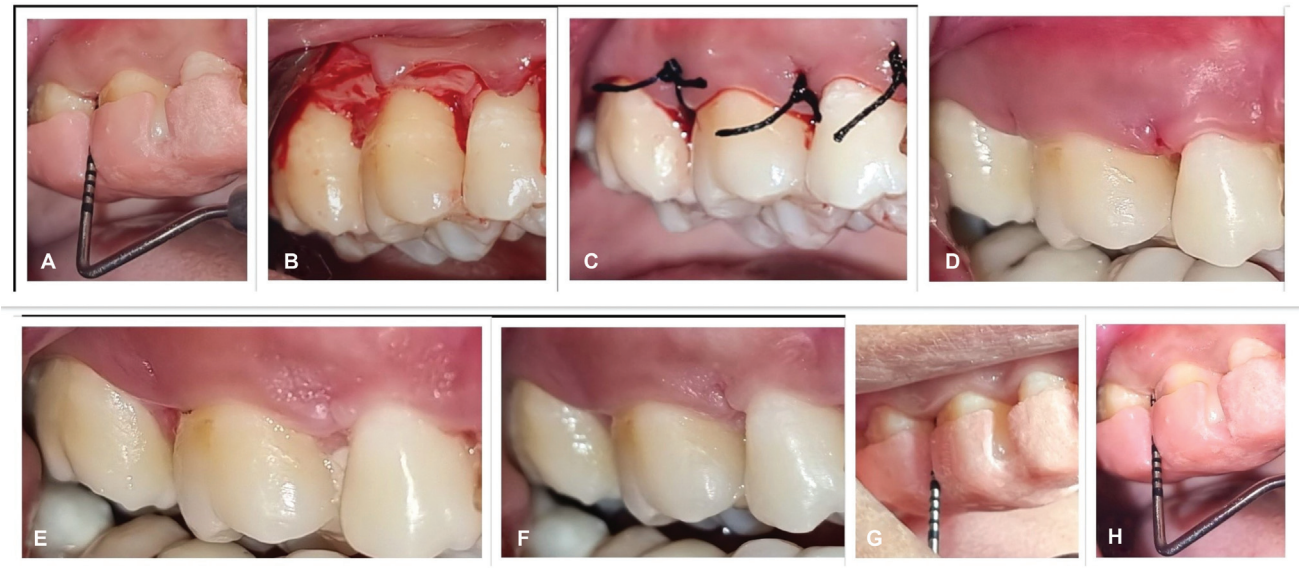

Fig. 1 Control group. (**A**) Preoperative clinical picture showing probing pocket depth (PPD) of 5 mm. (**B**) Elevation of mucoperiosteal flap. (**C**) Conventional 4-0 Mersilk suture (postoperative). (**D**) Wound healing after 1 week. (**E**) Wound healing after 2 weeks. (**F**) Wound healing after 4 weeks. (**G**) Clinical evaluation showing PPD reduction after 3 months. (**H**) Clinical evaluation showing PPD reduction after 6 months.

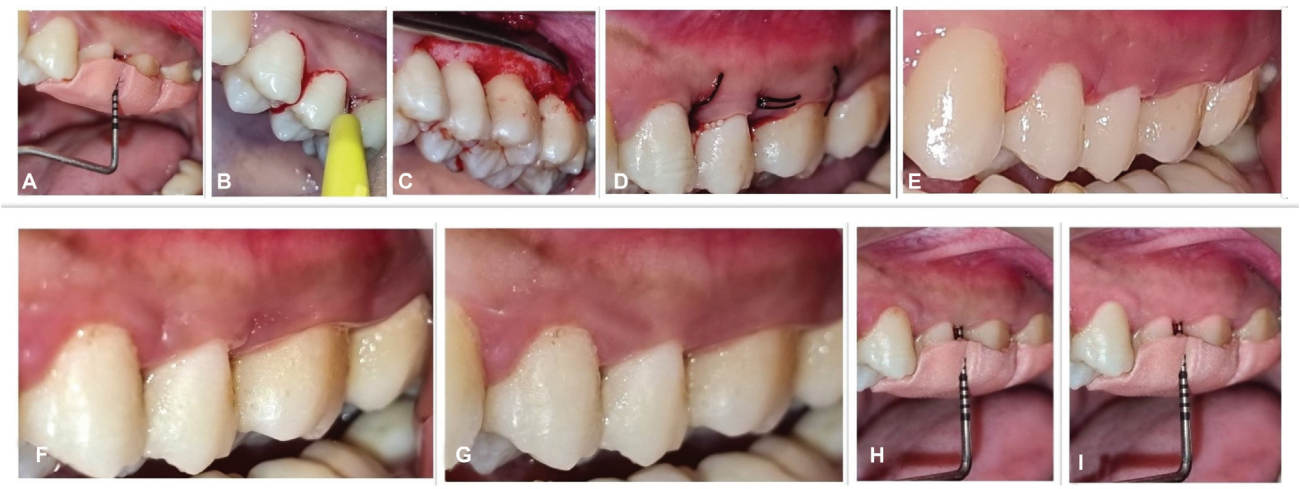

Fig. 2. Test group. (**A**) Preoperative clinical picture showing probing pocket depth (PPD) of 5 mm. (**B**) Intracrevicular incision using microsurgical ophthalmic blade (lance tip). (**C**) Elevation of mucoperiosteal flap. (**D**) Microsurgical 6-0 suture (postoperative). (**E**) Wound healing after 1 week. (**F**) Wound healing after 2 weeks. (**G**) Wound healing after 4 weeks. (**H**) Clinical evaluation showing PPD reduction after 3 months. (**I**) Clinical evaluation showing PPD reduction after 6 months.

Patients were refrained from toothbrushing and flossing in the surgical area for the first week. Post-suture removal, they were instructed to start oral hygiene procedures with a soft toothbrush and to perform supragingival interdental cleansing. Strict supportive periodontal therapy and recall appointments were scheduled for all patients till 6 months follow-up.

Statistical Evaluation

The quantitative data was tabulated as mean ± standard deviation for all clinical and radiographic parameters. The statistical analysis was done by SPSS statistical software. The comparison of intragroup data from baseline to 3 and 6 months was done by repeated measures analysis of variance. The intergroup difference of quantitative parameters between two groups at same time interval was done by Student's *t*-test. The descriptive statistics for VAS and WHI at different intervals was done by Wilcoxon signed rank test. The mean difference between clinical parameters from baseline to follow-up intervals was calculated by post-hoc least significance difference analysis; *p*-value less than or equal to 0.05 was considered statistically significant.

Results

Clinical Parameters

The PI and GI scores showed similar improvements in both test and control groups that were statistically not significant from baseline to 3 and 6 months (►**Table 1**).

Table 1 Comparison of plaque index, gingival index, probing pocket depth, relative attachment levels, and relative gingival marginal level at baseline, 3, and 6 months

		Control	Test	*p*-Value
Plaque index	Baseline	1.88 ± 0.52	1.98 ± 0.57	0.72
	3 months	0.58 ± 0.24	0.54 ± 0.16	0.68
	6 months	0.96 ± 0.27	0.94 ± 0.19	0.81
		<0.001[a]	<0.001[a]	
Gingival index	Baseline	2.05 ± 0.35	2.08 ± 0.33	0.83
	3 months	0.81 ± 0.46	0.77 ± 0.45	0.87
	6 months	1.32 ± 0.44	1.26 ± 0.76	0.84
		<0.001[a]	<0.001[a]	
Probing pocket depth	Baseline	7.00 ± 0.75	6.88 ± 0.83	0.75
	3 months	4.00 ± 0.53	3.38 ± 0.51	0.032[a]
	6 months	3.2 ± 0.46	2.25 ± 0.46	0.001[a]
		<0.001[a]	<0.001[a]	
Relative attachment levels	Baseline	11.5 ± 0.92	11.38 ± 1.18	0.81
	3 months	9.75 ± 1.03	8.5 ± 0.53	0.009[a]
	6 months	9.38 ± 0.51	8.00 ± 0.53	<0.001[a]
		<0.001[a]	<0.001[a]	
Relative gingival marginal levels	Baseline	4.5 ± 0.53	4.5 ± 0.53	1.00
	3 months	5.75 ± 0.70	5.13 ± 0.64	0.85
	6 months	6.13 ± 0.64	5.63 ± 0.51	0.10
		<0.001[a]	<0.001[a]	

[a]*p*-Value less than or equal to 0.05 is considered to be statistically significant.

Both the techniques led to significant reductions in PPD and RAL from baseline to 3 and 6 months. Comparison of mean reduction in PPD scores between control group and test group was not statistically significant from baseline to 3 month ($p = 0.2$), but was statistically significant from baseline to 6 months ($p = 0.01$; ►**Table 1**) Comparison of mean reduction in RAL scores between control group and test group was statistically significant from baseline to 3 months ($p = 0.02$), baseline to 6 months ($p = 0.02$), and not statistically significant from 3 to 6 months ($p = 0.7$; ►**Table 1**; ►**Figs. 1** and **2**).

There was significant increment in the mean RGML from baseline to 3 and 6 months in both the groups. Comparison of mean increment in RGML scores between control group and test group was statistically significant from baseline to 3 months ($p = 0.02$), but was not statistically significant from baseline to 6 months ($p = 0.17$), and 3 to 6 months ($p = 0.70$; ►**Table 1**; ►**Figs. 1** and **2**).

Radiographic Parameters

Comparison between radiographic defect depth scores of control group and test group showed no statistical difference at baseline ($p = 0.4$) and after 6 months ($p = 0.5$; ►**Table 2**) (►**Figs. 3** and **4**).

Patient-Related Parameters

The wound healing was better in test group as compared to control group. Comparison between wound healing scores of control group and test group showed statistically significant difference at 1 week ($p = 0.001$), 2 weeks ($p = 0.009$), but was not statistically significant at 4 weeks ($p = 0.14$; ►**Table 3**; ►**Figs. 1** and **2**).

Patients pain perception was much better in test group as compared to control group. Comparison between visual analog scale of control group and test group showed statistically significant difference at 24 hours ($p = 0.001$) and after 24 hours ($p = 0.003$; ►**Table 4**).

Table 2 Comparison of radiographic defect depth (RDD) at baseline and 6 months

	Control group	Test group	*p*-Value[a]
Baseline	3.7 ± 0.16	3.6 ± 0.28	0.45
6 months	3.6 ± 0.11	3.5 ± 0.27	0.45
p-Value	0.02	0.033	

[a]*p*-Value less than or equal to 0.05 is considered to be statistically significant.

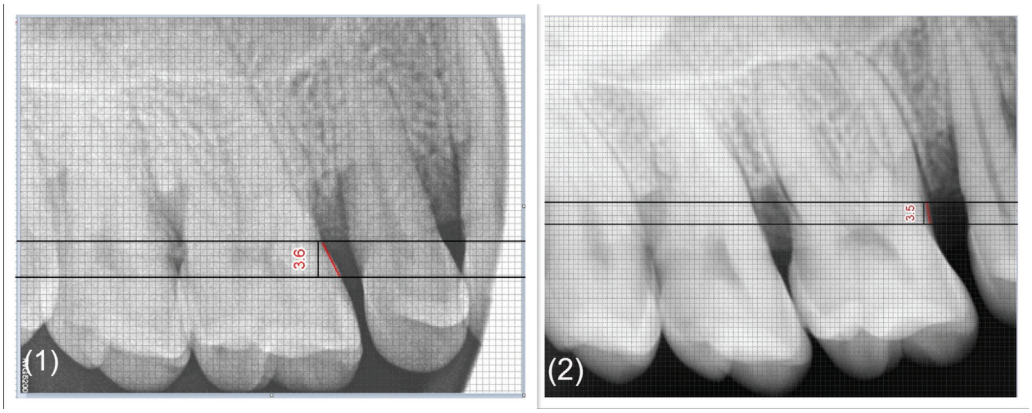

Fig. 3 RVG control group: 1. Distance from cementoenamel junction (CEJ) to the crest of alveolar bone at baseline (C0–3.6mm). 2. Distance from CEJ to the crest of alveolar bone after 6 months (C6–3.5mm).

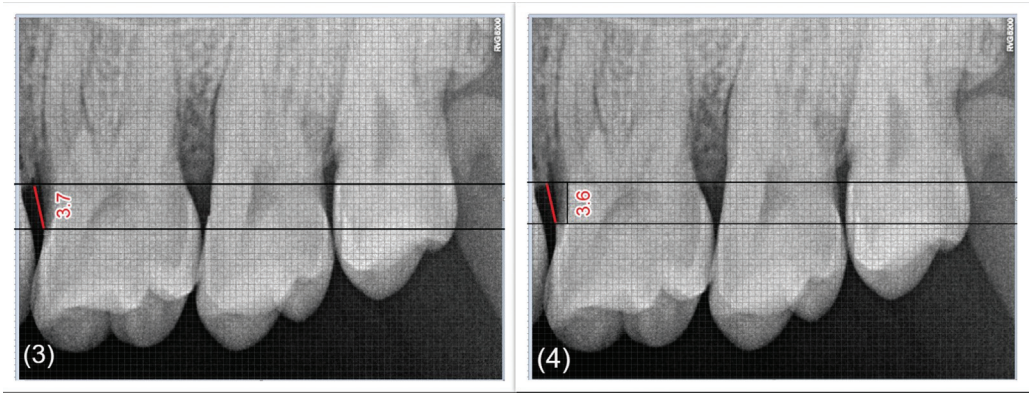

Fig. 4 RVG test group: 1. Distance from cementoenamel junction (CEJ) to the crest of alveolar bone (C0–3.7 mm). 2. Distance from CEJ to the crest of alveolar bone (C6–3.6m).

Discussion

This study was designed to compare the clinical and radiographic results in suprabony pockets treated by access flap surgery using conventional surgical technique and microsurgical technique aided by loupes, microsurgical instruments, and microsurgical sutures.

The hypothesis put forth for this study was that microsurgical approach has better clinical and patient centric outcomes as compared to conventional surgical approach in access flap surgeries for the treatment of horizontal bone loss in chronic periodontitis patients.

Periodontal microsurgery has been successfully executed in various periodontal procedures like treatment of intrabony defects[10,16] and gingival recession management.[17,18]

Wachtel et al compared efficacy of microsurgical access flap with EMD in intrabony defects and found high percentage of primary flap closure and maximum tissue preservation in microsurgical group.[10] Riberio et al successfully used minimally invasive nonsurgical and surgical approaches for the treatment of intrabony defects and achieved better results with limited morbidity and greater patient satisfaction.[16]

Ucak et al compared microsurgical and macrosurgical techniques for laterally repositioned flap in gingival recession coverage and found that microsurgical group showed better results in terms of complete root coverage, minimal morbidity and greater patient acceptance as compared to conventional surgical group.[17] Andrade et al found that microsurgical approach for coronally advanced flap in recession coverage resulted in better clinical and patient oriented parameters as compared to conventional approach.[18]

The surgical design selected in this study was access flap surgery with crevicular incision. Modified Widman flap is the choice of technique in suprabony pockets with horizontal bone defects but involves sacrificing the pocket lining and gingival collar leading to greater amount of gingival recession and unaesthetic appearance. Hence access flap was considered appropriate to avoid minimal trauma to the tissues and better patient acceptance.[19]

The PI and GI levels were improved from baseline to 3 months and 6 months in both the groups which could be attributed to the reduction in probing depths and improved oral hygiene maintenance because of continuous patient education, motivation and oral hygiene reinforcement. The PI and GI levels showed no statistically significant difference in both the groups pointing towards the strict oral hygiene maintenance protocol after phase 1 therapy and during recall visits. These results were similar to the previous studies by Riberio et al.[16]

Table 3 Comparison of wound healing index (WHI) after 1, 2, and 4 weeks

	Control group	Test group	*p*-Value[a]
1 week	2.00 ± 0.1	1.13 ± 0.35	0.001
2 weeks	1.63 ± 0.51	1.00 ± 0.1	0.009
4 weeks	1.25 ± 0.46	1.00 ± 0.1	0.143
p-Value	0.01	0.368	

[a]*p*-Value less than or equal to 0.05 is considered to be statistically significant.

Table 4 Comparison of visual analog score (VAS) post-surgery and after 24 hours

	Control group	Test group	*p*-Value[a]
Post-surgery	4.5 ± 0.92	2.25 ± 0.7	0.001
After 24 hours	3.0 ± 1.06	0.75 ± 1.03	0.003
p-Value	0.01	0.01	

[a]*p*-Value less than or equal to 0.05 is considered to be statistically significant.

Comparison of mean reduction in PPD scores between control group and test group was not statistically significant from baseline to 3 month ($p = 0.2$), but was statistically significant from baseline to 6 months ($p = 0.01$). Comparison of mean reduction in RAL scores between control group and test group was statistically significant from baseline to 3 months ($p = 0.02$) and baseline to 6 months ($p = 0.02$). The better results in PPD and RAL obtained in microsurgery group may be attributed to the improved magnification, better handling of interdental papilla, minimal and precise reflection of the access flap, and use of microsurgical sutures (6-0) as compared to conventional group. These results were similar to previous studies done by Perumal et al[5] and Reddy et al.[20]

Comparison of mean reduction in RGML scores between control group and test group was statistically significant from baseline to 3 months ($p = 0.02$), but not statistically significant from baseline to 6 month ($p = 0.17$). The better results in RGML obtained in microsurgery group may be attributed to better handling of interdental papilla, minimal and precise reflection of the access flap, and use of microsurgical sutures (6-0) leading to less postoperative gingival recession as compared to conventional group. These results are in accordance to the previous studies done by Perumal et al[5] and Reddy et al.[20]

Comparison between radiographic defect depth scores of control group and test group showed no statistically significant difference at baseline ($p = 0.4$) and at 6 months ($p = 0.5$). Similar results were found in both the groups because no additive or substrative osseous procedures were performed during the treatment. There is no evidence of evaluation of radiographic parameters in literature comparing surgical procedures for suprabony pockets and horizontal bone defects. The radiographic parameters were standardized using radiographic grids and linear measurement software according to previous study done by Reddy et al.[21]

The WHI in microsurgery group showed better outcome at 1 and 2 weeks follow-up as compared to conventional group but was similar at the end of 4 weeks. This improved healing in initial stages of healing process could be due to minimal tissue trauma, better tissue handling, and precise flap closure by microsurgical sutures. This result is concurrent with the previous studies done by Perumal et al[5] and Reddy et al.[20]

The results of this study are in accordance with Rathore et al,[22] where microsurgical approach was found to enhance clinical and early wound healing outcomes after periodontal flap surgery. In addition to early wound healing, this study found better healing 4 weeks post-surgery.

Katariya and Rajasekar[23] found that postoperative pain and early WHI could be improved by using periodontal microsurgery as compared to conventional surgery

Kahn et al[24] evaluated early wound healing after periodontal microsurgery and found accelerated wound healing and predictable outcomes that could help in early suture removal in post-surgical period.

The pain perception as evaluated by VAS was better in microsurgery group on the day of surgery and 24 hours postoperatively as compared to conventional group. This difference could be attributed to minimal tissue trauma, better tissue handling, and use of microsurgical instruments and sutures. This is similar to the previous study by Singh et al.[25]

The inherent limitations of this study could be (1) use of magnifying loupes instead of operating microscope, (2) lack of cone-beam computed tomography evaluation for hard tissue parameters, and (3) smaller sample size.

Conclusion

Within the limitations of this study, it can be concluded that microsurgical approach could enhance clinical as well as patient-related outcomes as compared to conventional approach when used for access flap surgery in the management

of horizontal bony defects in chronic periodontitis patients. As dentistry is moving toward minimally invasive and microsurgical modalities of intervention, this study could pave way for routine use of microsurgical approach in most commonly performed access flap procedure in periodontal therapy.

Futuristic multicenter longitudinal studies should be conducted to evaluate and justify the promising role of periodontal microsurgery along with various biomaterials in management of suprabony pockets and horizontal bone defects.

Conflict of Interest
None declared.

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