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Original paper

Evaluating and comparing the efficacy of the microsurgical approach and the conventional approach for the periodontal flap surgical procedure: A randomized controlled trial

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Abstract

Background. The use of the magnification approach for the periodontal flap surgical procedure helps in better visualization and better handling of soft tissues, which results in early wound healing.

Objectives. The aim of the present study was to compare the conventional macroscopic approach for periodontal flap surgery with the microsurgically modified approach in a randomized controlled clinical trial.

Material and methods. A total of 60 subjects were randomly divided into 2 groups: group A (test group), in which the subjects underwent the conventional open flap debridement procedure; and group B (control group), in which the subjects underwent open flap debridement with the use of a microsurgical loupe. The plaque index (PI), the gingival index (GI), the probing pocket depth (PPD), the clinical attachment level (CAL), and gingival recession (GR) were recorded at baseline, and at 3, 6 and 9 months postoperatively. Also, the early wound-healing index (EHI) was recorded at 10 days postoperatively.

Results. Both the conventional and the microsurgical technique provided a statistically significant reduction in PI, GI and PPD as well as gain in CAL. However, the microsurgical technique demonstrated a statistically significant decrease in postoperative GR as well as reduced pain perception and EHI scores.

Conclusions. The use of the microsurgical approach provides better clinical results with less discomfort, and thus makes the periodontal treatment more acceptable for the patient.

Keywords: chronic periodontitis, wound healing, microsurgery, periodontology

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Introduction

The treatment options for periodontitis depend on the severity of the disease and can be non-surgical, followed by a surgical intervention. To date, the non-surgical periodontal therapy has been considered as one of the most effective methods for the treatment of periodontitis.[1,2] The removal of the primary etiological factors, i.e., the microbial biofilm and plaque-retentive calculus, along with the removal of the altered cementum surface during the scaling and root planing (SRP) procedures leads to the reduction of pathogenic microbial load both at the tissue side and at the tooth side of the periodontal pocket.[3–5] However, the non-surgical periodontal therapy has its own limitations when it comes to deep periodontal pockets as well as deep intrabony defects. The outcomes of the treatment of moderate to severe periodontitis are better (a reduction in the probing pocket depth (PPD) and gain in the clinical attachment level (CAL)) when the cases are dealt with the flap surgical techniques along with the SRP therapy. Despite the meticulous efforts of the clinician to remove plaque and calculus in deep periodontal pockets, the complete eradication of local factors cannot be achieved. Periodontal flap surgery may facilitate access for the thorough decontamination of tissues, thus leading to better healing and better treatment outcomes.[6,7]

However, sometimes, the complete removal of local factors is doubtful even with the access flap (AF) surgical approach, especially when applied without using any magnification tools.[8,9] Waerhaug reported that at the depth of the periodontal pocket, deposits were found even after flap surgery.[10] It is difficult for the operator to localize plaque and calculus at the depth of the periodontal pocket due to the area being obscured by bleeding during the procedure.[10] Several in vitro studies have shown a range of 12–30% of residual calculus on the extracted teeth even after complete SRP.[11–13] Hence, it is reasonable to assume that the optical magnification of the surgical field might help in overcoming these issues.

The use of magnification in microsurgery leads to the refinement of the surgical techniques due to the enhanced visualization.[14] In microsurgery, viewing the finer details of the surgical field as well as using microsurgical instruments enable the operator to accurately and atraumatically manage the hard and soft periodontal tissues, which results in better debridement of the periodontal pocket, and thus a fully decontaminated surface, free of bacterial load, can be obtained.[15–18]

Based on these advantages, we tested the hypothesis that the improved visual acuity and better tissue debridement that result from the application of the microsurgical approach may improve the clinical outcomes of periodontal flap surgery, and thus provide less postoperative discomfort to the patient. Therefore, the objective of the present study was to compare the conventional macroscopic approach for periodontal flap surgery with the microsurgically modified approach in a randomized controlled clinical trial.

Material and methods

The present randomized controlled clinical trial comprised 64 patients who were affected by chronic periodontitis. The patients were selected at the Outpatient Department of Periodontology and Implantology in the Institute of Dental Sciences, Bareilly, India. The study protocol was reviewed and approved by the Institutional Ethics Committee (No. of approval: IDS.BIU/243/2019). After the evaluation of phase I (the non-surgical therapy), patients with a minimum of 20 natural teeth, exhibiting PPD ≥ 5 mm and CAL ≥ 5 mm were included in the study. Patients with known systemic diseases, allergies or drug use, pregnant or lactating mothers, and/or those who had undergone the periodontal therapy in the past 6 months were excluded from the study. After selection, the patients were informed about the purpose and duration of the study, and the written informed consent was obtained from them. As this was a parallel group study, the subjects were randomly divided into 2 groups, using the coin toss method. The group A (test group) subjects underwent open flap debridement with the use of a microsurgical loupe, whereas the group B (control group) subjects underwent the conventional open flap debridement procedure without any magnification tool. The patients were blinded to the type of local treatment they received.

The plaque index (PI),[19] the gingival index (GI),[20] PPD, CAL, and gingival recession (GR) were recorded at baseline (Fig. 1A,2A), and at 3, 6 and 9 months postoperatively with a UNC-15 graduated periodontal probe (Hu-Friedy, Chicago, USA). Additionally, the patient's pain perception was assessed with the use of the visual analog scale (VAS) and the healing of tissues was also evaluated by means of the early wound-healing index (EHI) at 10 days postoperatively.

Surgical procedure

Group A (test group)

At the test sites, a dental loupe of ×3.5 optical magnification was used to carry out the microsurgical flap procedure. After profound anesthesia was achieved with an anesthetic agent (2% lignocaine hydrochloride with adrenaline – 1:80,000), crevicular incisions were performed on the facial/buccal and lingual/palatal sides, reaching the tip of the interdental papilla with the use of microsurgical blade No. 15C (Hindustan Syringes & Medical Devices, New Delhi, India) (Fig. 1B). The buccal and lingual mucoperiosteal flaps were elevated with a micro periosteal elevator. Due to the enhanced visualization of the site, the unnecessary exposure of the bone tissue was avoided. Complete degranulation was done along with root planing with the use of a microsurgical curette (Hu-Friedy) (Fig. 1C). Flap approximation was achieved by using 5-0 monofilament polypropylene sutures (Centenial Surgical Suture, Murbad, Thane, India) (Fig. 1D).

Group B (control group)

Under proper aseptic conditions, the surgical site was anesthetized using 2% lignocaine hydrochloride with adrenaline (1:80,000). Using a Bard–Parker (BP) knife with blades No. 12 and 15 (Hindustan Syringes & Medical Devices), intracrevicular incisions were made on both the buccal and lingual/palatal sides (Fig. 2B). The full-thickness mucoperiosteal flaps were elevated, and the surgical debridement of the infected tissue and root planing were done, using appropriate Gracey curettes (No. 1–14) and 2R-2L, 4R-4L curettes (Hu-Friedy) (Fig. 2C). Flap approximation was done with 3-0 silk sutures (Centenial Surgical Suture) (Fig. 2D).

In both groups, a periodontal dressing was placed (Fig. 1E,2E), and the patients were prescribed a non-steroidal anti-inflammatory medication for 2 days and a systemic antibiotic for 5 days. The patients were instructed to rinse their mouths with 0.2% chlorhexidine gluconate twice daily for 2 weeks and to avoid any undue trauma to the treated site. The EHI was assessed 10 days postoperatively for both groups (Fig. 1F,2F).

Fig. 1. Surgical procedure for the test group

A – preoperative measurement of the probing pocket depth (PPD) (at baseline); B – incision marking; C – after flap reflection and debridement; D – 5-0 suture placement; E – periodontal dressing placement; F – early healing after 10 days; G – postoperative measurement of PPD (at 9 months).

Fig. 2. Surgical procedure for the control group

A – preoperative measurement of PPD (at baseline); B – incision marking; C – after flap reflection and debridement; D – 3-0 suture placement; E – periodontal dressing placement; F – early healing after 10 days; G – postoperative measurement of PPD (at 9 months).

Statistical analysis

The IBM SPSS Statistics for Windows software, v. 22.0 (IBM Corp., Armonk, USA) was used for the statistical analysis. The intragroup comparison was done using the Friedman test, with a p-value <0.05 considered as statistically significant. The post hoc analysis was performed using the Wilcoxon signed rank test and $p < 0.0008$ was considered as statistically significant (after applying the Bonferroni correction). The intergroup comparisons were done using the Mann–Whitney U test, with a p-value <0.05 considered as statistically significant.

Results

A total of 64 patients initially participated in this study, but 4 patients were lost to follow-up and excluded from the analysis. The remaining 60 patients suffering from chronic periodontitis were finally analyzed. The patients were divided into test group A (n = 30) and control group B (n = 30). Figure 3 summarizes the phases of the study.

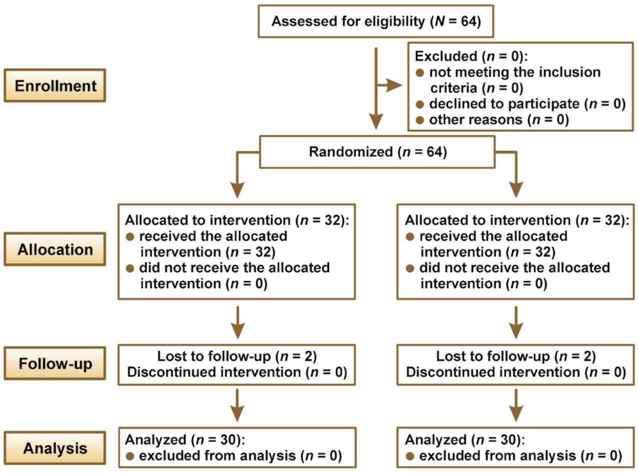

Fig. 3. Flow diagram of the randomized controlled clinical trial

In the present study, for both the test group and the control group there was a statistically significant decrease in the PI and GI scores from baseline to 9 months (Table 1). For the test group, a reduction in PPD was observed from the baseline value of 4.33 +0.36 mm to 2.81+0.40 mm at the recall visit at 9 months; for the control group, the values were 4.19 +0.40 mm and 2.99 +0.28 mm, respectively. The mean CAL value for the test group at baseline was 4.25 +0.36 mm and at 9 months, it was reduced to 2.75 +0.43 mm, whereas for the control group, it was 4.16 +0.39 mm at baseline and 3.00 +0.32 mm at 9 months. The gain in CAL and the reduction in PPD were statistically significant for both groups. When the position of the gingival margin was compared, the test group showed no statistically significant difference between the baseline and 9-month follow-up period values ($p = 0.06$), whereas the control group showed a statistically significant increase in the apical migration of gingiva during this time period ($p = 0.00$) (Table 1).

Table 2 shows the intergroup comparison between the test and control groups from baseline through every 3-month recall time period until 9 months. A greater reduction in PPD at 9 months was noted for the test group (2.81 +0.40 mm) as compared to the control group (2.99 +0.28 mm). When the CAL gain was considered, significant gain was recorded for the microsurgery group

Table 2. Intergroup comparison of the periodontal parameters at different time intervals

Parameters	Time periods	Test group	Control group	*p*-value
PI	baseline	1.10 +0.18	1.04 +0.24	0.23
	3 months	0.60 +0.21	0.54 +0.18	0.98
	6 months	0.79 +0.23	0.62 +0.18	0.01*
	9 months	0.90 +0.16	0.81 +0.21	0.11
GI	baseline	61.77 +21.71	63.44 +21.93	0.68
	3 months	23.60 +10.69	26.16 +13.32	0.41
	6 months	24.70 +11.38	28.41 +12.30	0.24
	9 months	30.06 +11.91	33.03 +13.88	0.35
PPD [mm]	baseline	4.33 +0.36	4.19 +0.40	0.08
	3 months	2.90 +0.35	2.97 +0.28	0.48
	6 months	2.80 +0.34	2.96 +0.29	0.04*
	9 months	2.81 +0.40	2.99 +0.28	0.05
CAL [mm]	baseline	4.25 +0.36	4.16 +0.39	0.24
	3 months	2.85 +0.36	2.94+0.28	0.31
	6 months	2.74 +0.35	2.94 +0.29	0.02*
	9 months	2.75 +0.43	3.00 +0.32	0.02*
GR [mm]	baseline	0.00 +0.00	0.00 +0.00	1.00
	3 months	0.00 +0.00	0.03 +0.18	0.31
	6 months	0.03 +0.18	0.43 +0.62	0.00*
	9 months	0.10 +0.30	0.80 +0.76	0.00*

* statistically significant (Mann–Whitney *U* test).

Table 1. Intragroup comparison of the periodontal parameters at different time intervals

Groups	Parameters	Baseline (*n* = 30)	3 months (*n* = 30)	6 months (*n* = 30)	9 months (*n* = 30)	*p*-value	Mean change [%]
Test group	PI	1.10 +0.18	0.60 +0.21	0.79 +0.23	0.90 +0.16	0.00*	18.18
	GI	61.77 +21.71	23.60 +10.69	24.70 +11.38	30.06 +11.91	0.00*	51.34
	PPD [mm]	4.33 +0.36	2.90 +0.35	2.80 +0.34	2.81 +0.40	0.00*	35.10
	CAL [mm]	4.25 +0.36	2.85 +0.36	2.74 +0.35	2.75 +0.43	0.00*	35.29
	GR [mm]	0.00 +0.00	0.00 +0.00	0.03 +0.18	0.10 +0.30	0.06	100.00
Control group	PI	1.04 +0.24	0.54 +0.18	0.62 +0.18	0.81 +0.21	0.00*	22.12
	GI	63.44 +21.93	26.16 +13.32	28.41 +12.30	33.03 +13.88	0.00*	47.94
	PPD [mm]	4.19 +0.40	2.97 +0.28	2.96 +0.29	2.99 +0.28	0.00*	28.64
	CAL [mm]	4.16 +0.39	2.94 +0.28	2.94 +0.29	3.00 +0.32	0.00*	27.88
	GR [mm]	0.00 +0.00	0.03 +0.18	0.43 +0.62	0.80+0.76	0.00*	100.00

PI – plaque index; GI – gingival index; PPD – probing pocket depth; CAL – clinical attachment level; GR – gingival recession; * statistically significant (Friedman test).

(2.75 +0.43 mm) as compared to the conventional flap surgery group (3.00 +0.32 mm) at 9 months. For the conventional flap surgery group, a statistically significant increase in the apical migration of gingiva was observed at both the 6-month (0.43 +0.62 mm) and 9-month (0.80 +0.76 mm) recall intervals as compared to the test group.

Table 3 shows the assessment of the patients' pain perception with the use of the VAS scores. A statistically significant reduction in the VAS scores was found for the test group (1.56 +0.77) as compared to the control group (4.23 +0.77), showing less postoperative pain for the microsurgical group. When healing was compared between the groups with EHI, significantly better results were found for the test group (1.53 +0.57) as compared to the control group (3.16 +0.46.) (Table 4).

Table 3. Intergroup comparison of the visual analog scale (VAS) scores

Parameter	Test group (*n* = 30)	Control group (*n* = 30)	*p*-value
VAS	1.56 +0.77	4.23 +0.77	0.00*

* statistically significant (Mann–Whitney *U* test).

Table 4. Intergroup comparison of the early wound-healing index (EHI) scores

Parameter	Test group (*n* = 30)	Control group (*n* = 30)	*p*-value
EHI	1.53 +0.57	3.16 +0.46	0.00*

* statistically significant (Mann–Whitney *U* test).

Discussion

This study compared the conventional macroscopic approach for the AF surgery technique with the microsurgically modified approach in a randomized controlled clinical trial and considered the hypothesis that the improved visual acuity and better soft tissue handling through the application of the microsurgical approach might improve the predictability of the clinical outcomes and provide less postoperative discomfort to the patients suffering from chronic periodontitis. The only variable of the study was the use of surgical loupes, microsurgical instruments and microsurgical suture material.

Irrespective of the procedure used for open flap debridement, there was significant improvement in the PI and GI scores from baseline to 9 months.

Similar to this, a statistically significant reduction in PPD was observed in both groups at 9 months (Fig. 1G,2G), though the improvement in the test group was slightly greater than in the case of the control group. As stated in previous studies, even after the non-surgical periodontal therapy or open flap debridement, residual calculus can be noticed on the root surfaces.[21] Microsurgery can lead to better clinical outcomes. Better visualization of the area increases the mechanical efficiency of SRP, and thus helps to eliminate the microbial etiological factors of periodontal disease, which results in better healing. Several studies have demonstrated the improved treatment outcomes with the use of the microsurgical technique when compared with the macrosurgically performed flap surgery.[18,22] In the present study, statistically significant gain in CAL was observed in the test group as compared to the control group. Although unwanted, gingival recession can occur post-surgically after the conventional flap surgical procedures.[23] In their studies, Becker et al. and Kaldahl et al. reported statistically significant post-surgical recession after applying several surgical treatment modalities, such as flap debridement, osseous surgery and root planing.[24,25] The periodontal pocket depth has been found to be directly correlated to gingival recession, i.e., deeper pockets may show more gingival shrinkage and more recession.[24] Various explanations for postoperative recession have been suggested, including the lack of bone support for the flap, thin gingival tissue with limited blood supply and the postoperative shrinkage of the flap. Esthetically unacceptable to the patient, this can also lead to dentinal hypersensitivity, and thus it should be controlled or kept at a minimal level.[24,26]

The present study shows significantly less gingival recession postoperatively in the cases treated with the microsurgical approach as compared to the conventional flap surgery approach. It is reasonable to assume here that the microsurgical approach may be related to a more predictable outcome because of the magnified vision of the surgical field. The unnecessary cutting and removal of tissues during surgical debridement is avoided, and hence trauma to tissues is reduced. This might lead to lesser gingival shrinkage. The vascular supply of the flap is improved, and there is a greater possibility of better flap adaptation, and also of better wound stabilization and healing.[27]

Using the microsurgical approach, better pain perception scores as well as better EHI scores were obtained for the test group as compared to the conventional flap surgery group. It might be due to the use of microsurgical instruments and micro-sutures.[28] Today, the patients envisage and expect an ideal form of periodontal therapy that is not only limited to the elimination of the bacterial component of the disease, but also improves the patient's appearance as well as function. The comfort of the patient increases if such treatment is provided with minimal trauma. The use of microsurgery does not change the periodontal therapy, but it increases the clinician's ability to accurately and gently handle tissues as well as the patient's acceptance of the treatment.

Every dental professional is at a potential risk for developing an occupational musculoskeletal injury. Magnifying loupes do play a major role in visualizing the minute details of the area without straining the eye muscles. The reported primary benefits of loupes refer to ergonomics and the proper posture, better evaluation/detection of the area, and thus overall, better treatment quality.[29] There are some disadvantages that limit the use of loupes by dentists, i.e., the lack of fixed position (the fine movements of the dentist's head disturb the image of the magnified surgical field) and the need to change loupes to achieve different magnification.

To overcome this, the surgical microscope guarantees a more ergonomic working posture, the optimal lighting of the operation area and freely selectable magnification levels. Since microscopes are external to the body, clinicians who use them are not affected by the weight of the instrument or the challenge of maintaining the stabilized field of vision. However, these advantages are countered by an increased cost of the equipment, and the extended learning phase for the surgeon and their assistant.

Conclusions

Both the conventional and the microsurgical techniques provided a statistically significant reduction in PPD as well as gain in CAL. However, the microsurgical technique demonstrated also a statistically significant decrease in postoperative GR as well as reduced pain perception and EHI scores. The variable of the study was the use of surgical loupes, microsurgical instruments and microsurgical suture material. Thus, these better results can be attributed to the use of the microsurgical approach for open flap debridement.

Ethics approval and consent to participate

The study protocol was reviewed and approved by the Institutional Ethics Committee at the Institute of Dental Sciences, Bareilly, India (No. of approval: IDS.BIU/243/2019). The patients were informed about the purpose and duration of the study, and the written informed consent was obtained from them.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

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References

1. Hirschfeld L, Wasserman B. A long-term survey of tooth loss in 600 treated periodontal patients. *J Periodontol*. 1978;49(5):225–237. doi:10.1902/jop.1978.49.5.225
2. Lindhe J, Westfelt E, Nyman S, Socransky SS, Haffajee AD. Long-term effect of surgical/non-surgical treatment of periodontal disease. *J Clin Periodontol*. 1984;11(7):448–458. doi:10.1111/j.1600-051x.1984.tb01344.x
3. O'Leary TJ. The impact of research on scaling and root planing. *J Periodontol*. 1986;57(2):69–75. doi:10.1902/jop.1986.57.2.69
4. Hatfield CG, Baumhammers A. Cytotoxic effects of periodontally involved surfaces of human teeth. *Arch Oral Biol*. 1971;16(4):465–468. doi:10.1016/0003-9969(71)90170-1
5. Aleo JJ, De Renzis FA, Farber PA, Varboncoeur AP. The presence and biologic activity of cementum-bound endotoxin. *J Periodontol*. 1974;45(9):672–675. doi:10.1902/jop.1974.45.9.672
6. Heitz-Mayfield LJ, Trombelli L, Heitz F, Needleman I, Moles D. A systematic review of the effect of surgical debridement vs non-surgical debridement for the treatment of chronic periodontitis. *J Clin Periodontol*. 2002;29(Suppl 3):92–102;discussion 160–162. doi:10.1034/j.1600-051x.29.s3.5.x
7. Hung HC, Douglass CW. Meta-analysis of the effect of scaling and root planing, surgical treatment and antibiotic therapies on periodontal probing depth and attachment loss. *J Clin Periodontol*. 2002;29(11):975–986. doi:10.1034/j.1600-051x.2002.291102.x
8. Caffesse RG, Sweeney PL, Smith BA. Scaling and root planing with and without periodontal flap surgery. *J Clin Periodontol*. 1986;13(3):205–210. doi:10.1111/j.1600-051x.1986.tb01461.x
9. Buchanan SA, Robertson PB. Calculus removal by scaling/root planing with and without surgical access. *J Periodontol*. 1987;58(3):159–163. doi:10.1902/jop.1987.58.3.159
10. Waerhaug J. A method for evaluation of periodontal problems on extracted teeth. *J Clin Periodontol*. 1975;2(3):160–168. doi:10.1111/j.1600-051x.1975.tb01738.x
11. Moskow BS, Bressman E. Cemental response to ultrasonic and hand instrumentation. *J Am Dent Assoc*. 1964;68:698–703. doi:10.14219/jada.archive.1964.0143
12. Jones WA, O'Leary TJ. The effectiveness of in vivo root planing in removing bacterial endotoxin from the roots of periodontally involved teeth. *J Periodontol*. 1978;49(7):337–342. doi:10.1902/jop.1978.49.7.337
13. Nishimine D, O'Leary TJ. Hand instrumentation versus ultrasonics in the removal of endotoxins from root surfaces. *J Periodontol*. 1979;50(7):345–349. doi:10.1902/jop.1979.50.7.345
14. Jacobson JH II. Microsurgery. *Curr Probl Surg*. 1971;8(2):1–56. doi:10.1016/S0011-3840(71)80006-0
15. Cortellini P, Tonetti MS. A minimally invasive surgical technique with an enamel matrix derivative in the regenerative treatment of intra-bony defects: A novel approach to limit morbidity. *J Clin Periodontol*. 2007;34(1):87–93. doi:10.1111/j.1600-051X.2006.01020.x
16. Francetti L, Del Fabbro M, Calace S, Testori T, Weinstein RL. Microsurgical treatment of gingival recession: A controlled clinical study. *Int J Periodontics Restorative Dent*. 2005;25(2):181–188. PMID:15839595.
17. Cortellini P, Tonetti MS. Microsurgical approach to periodontal regeneration. Initial evaluation in a case cohort. *J Periodontol*. 2001;72(4):559–569. doi:10.1902/jop.2001.72.4.559
18. Shanelec DA, Tibbetts LS. A perspective on the future of periodontal microsurgery. *Periodontol 2000*. 1996;11:58–64. doi:10.1111/j.1600-0757.1996.tb00183.x
19. Turesky S, Gilmore ND, Glickman I. Reduced plaque formation by the chloromethyl analogue of vitamine C. *J Periodontol*. 1970;41(1):41–43. doi:10.1902/jop.1970.41.41.41
20. Silness J, Loe H. Periodontol disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontol Scand*. 1964;22:121–135. doi:10.3109/00016356408993968
21. Rabbani GM, Ash MM Jr., Caffesse RG. The effectiveness of subgingival scaling and root planing in calculus removal. *J Periodontol*. 1981;52(3):119–123. doi:10.1902/jop.1981.52.3.119
22. Burkhardt R, Lang NP. Coverage of localized gingival recessions: Comparison of micro- and macrosurgical techniques. *J Clin Periodontol*. 2005;32(3):287–293. doi:10.1111/j.1600-051X.2005.00660.x
23. Palcanis KG. Surgical pocket therapy. *Ann Periodontol*. 1996;1(1):589–617. doi:10.1902/annals.1996.1.1.589
24. Becker W, Becker BE, Caffesse R, et al. A longitudinal study comparing scaling, osseous surgery and modified Widman procedures: Results after 5 years. *J Periodontol*. 2001;72(12):1675–1684. doi:10.1902/jop.2001.72.12.1675
25. Kaldahl WB, Kalkwarf KL, Patil KD, Molvar MP, Dyer JK. Long-term evaluation of periodontal therapy: I. Response to 4 therapeutic modalities. *J Periodontol*. 1996;67(2):93–102. doi:10.1902/jop.1996.67.2.93
26. Hall WB. Gingival augmentation/mucogingival surgery. In: Nevins M; American Academy of Periodontology. *Proceedings of the World Workshop in Clinical Periodontics*. Chicago, IL: American Academy of Periodontology; 1989:VII/1–VII/21.
27. Andrade PF, Grisi MF, Marcaccini AM, et al. Comparison between micro- and macrosurgical techniques for the treatment of localized gingival recessions using coronally positioned flaps and enamel matrix derivative. *J Periodontol*. 2010;81(11):1572–1579. doi:10.1902/jop.2010.100155
28. Tibbetts LS, Shanelec D. Periodontal microsurgery. *Dent Clin North Am*. 1998;42(2):339–359. PMID:9597340.
29. Tibbetts LS, Shanelec D. Principles and practice of periodontal microsurgery. *Int J Microdent*. 2009;1:13–24. http://www.quintpub.com/journals/micro/pdf_temp/micro_1_1_Tibbetts_3.pdf. Accessed September 1, 2021.