Lateral osteoperiosteal flap versus lateral pedicle flap in the treatment of class III gingival recession: A single-center, open-label trial

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Abstract:

Aims: The aim of this study was to compare outcomes of lateral osteoperiosteal flap (OPF) and lateral pedicle flap (LPF) in the treatment of Miller’s Class III gingival recession. Materials and Methods: Twenty-two anterior maxillary and mandibular sites from 16 participants requiring mucogingival surgery for Miller’s Class III gingival recession were included in the study. Eleven sites each were assigned to two groups. OPF: sites treated with lateral OPF and LPF: sites treated with LPF. Recession depth (RD) and bone level (BL) were the primary outcome variables, and probing pocket depth, clinical attachment level (CAL), and keratinized tissue width (KTW) were the secondary variables. All the variables were recorded at baseline (on the day of surgery), 3 months, and 6 months postsurgery. Results: OPF and LPF resulted in similar reduction in RD at the end of the study period (P ≤ 0.001). There was no statistically significant difference in RD between OPF and LPF at 6 months (P = 0.862). OPF-treated sites showed greater gain in BL at 3 months (P = 0.0004) and 6 months (P = 0.0002). No significant differences were seen between OPF and LPF in measures of PD, CAL, and KTW. Conclusion: Data from this 6-month trial seem to suggest that OPF can be used as an alternative procedure for treating Miller’s class III recessions with adjacent edentulous sites or wide interproximal spaces. Long-term effects of OPF on the stability of root coverage outcomes are an exciting direction for future research.

Key words:

Alveolar bone loss, gingival recession, periodontal debridement

INTRODUCTION

Miller’s class III recessions are marginal tissue recessions extending to or beyond the mucogingival junction with interdental bone and/or soft-tissue loss.[1] The accompanying bone and soft interproximal tissue loss effectively reduces the periosteal bed and increases the avascular root surface[2] making the attainment of complete root coverage unpredictable.[1]

Complete root coverage is possible in class III recessions.[1] However, Esteibar et al. have stated that the success of the procedure depends on four factors; interproximal soft-tissue integrity,[1,3] the use of grafts with thickness ≥2 mm,[1,3] interproximal bone loss not exceeding 3 mm,[1,1] and an initial recession width not >3 mm.[1,3] Lateral pedicle flap (LPF) is conventionally used in the treatment of class I/II recessions.[1] However, the use of LPF in class III recessions is limited because of the following factors:[3,4] (1) the inadequacy of keratinized tissue lateral to the recession defect because of the soft-tissue loss which can compromise soft-tissue integrity during surgical procedures, (2) interproximal bone loss can result in postoperative recession resulting in total root coverage in only 47% of cases done[1,3,4] and (3) reduced thickness of the flap, especially when a partial thickness flap is raised for mobility and to prevent donor site morbidity, can affect predictability and reduce its efficacy.[1]

Various strategies and techniques have been advocated to conform to Esteibar et al.’s preoperative variables that could help increase the predictability of LPF in class III recessions. Placing...
the pedicle over a subepithelial connective tissue graft increases the flap thickness at the recession site.[6-8] Rigid case selection, wherein LPF is raised only from sites with an adequate thickness of keratinized gingiva also aids in increasing the success rate of the procedure.[6,7] To permit placement of LPF in sites with bone loss, the cambium layer of the periosteum within the flap can be altered and plays a role in the healing process. According to Melcher and Accursi,[9] the intact periosteum lateral to the vertical incisions can be stimulated, contributing to the healing process. Goldman and Smukler[10] were the first to advocate the “stimulated mucoperiosteal pedicle” to cover the denuded root surface. When the attached gingiva was repeatedly penetrated with a 25G hypodermic needle, by 21 days, there was tremendous activity in the periosteum, resulting in tissue containing encased osteoblasts.[7] They also proposed using a laterally repositioned “stimulated” osteoperiosteal pedicle[9] to reanimate the dormant adult periosteum.[9] They advocate stimulating a pedicle to promote osteoid formation near the periosteum; the flap with the new osteoid tissue is then repositioned over sites with gingival recession.[8]

The osteoperiosteal flap (OPF) or “bone flap” is a bone fragment moved in space without detachment of its investing periosteum.[9-11] An adequate island of alveolar bone can be strategically split without detaching it from the mucoperiosteum and can be moved into a new position into an area of interest.[10] Used commonly in orthognathic procedures, alveolar augmentation and implant therapy,[6,7,10,11] its use has been somewhat limited in the field of periodontics.[7,8,12] The level of adjacent alveolar bone has a direct impact on the success of a mucogingival procedure.[1,2,4,14] Repositioning an OPF with an island of alveolar bone onto a site with gingival recession can enhance the principle of stimulated mucoperiosteal pedicle[9-8] by (1) promoting bone regeneration as the bone retains its blood supply,[7,15] (2) achieving stable facial contour as the thinner mucoperiosteal flap is replaced by a more rigid and thicker OPF,[6,13,15] and (3) preserving or augmenting the interproximal bone peaks which are crucial to the eventual success of the mucogingival procedure.[1,2,5,6,8]

In this study, we have sought to compare two mucogingival surgical procedures, LPF and lateral OPF on the measures of gingival recession and periodontal health in class III gingival recession. In OPF, along with the full-thickness incision as in LPF, a fragment of alveolar bone is translocated from an edentulous donor site for root coverage. As the transported segment is vascularized and early periosteal and endosteal osteogenesis can be seen,[7,12] positive effects on early tissue healing may contribute to increased predictability and better outcomes over LPF in class III recessions.

**MATERIALS AND METHODS**

**Study design**

The study was conceived as a single-center, open-label, and two-arm clinical trial to compare outcomes of lateral OPF and LPF in the treatment of Miller’s class III gingival recession. Systemically healthy individuals willing to participate in the study were followed up over 6 months.

**Sample size**

The sample size was calculated by considering this trial as a noninferiority/superiority trial. To discern a difference of 1 mm in recession depth (RD), a minimum sample size of 9 sites is required per group when the power of the test is 0.80 at a significance level of 0.05 as per power analysis.

**Source of data and participant flow**

From a subject pool of 28 participants (34 sites with class III recession), sites satisfying the following inclusion criteria were included in the study; (1) isolated Miller’s class III recession defect in the mandibular or maxillary anterior teeth adjacent to an edentulous area at least 5 mm wide, (2) Interproximal bone loss (measured as the distance between the cemento-enamel junction (CEJ) and the alveolar bone crest in a radiograph) not exceeding 3 mm, and (3) An initial RD between 3 mm and 6 mm. Participants with extreme root prominence, presence of malposition at the selected sites and smokers were excluded from the study. 22 sites (16 subjects/mean age = 32.98 ± 8.22 years/9 males) satisfied the inclusion criteria and 11 sites each were assigned to two groups. OPF sites treated with lateral OPF and LPF: sites treated with LPF. A nonrandomized allocation was followed, and participants with odd and even allocation numbers were assigned to the two treatment arms, OPF and LPF groups, respectively.

Each subject was prepared for the surgery with oral hygiene instructions, scaling, and root planing and adjunctive chemical plaque control at least 3 months before surgery with occlusal adjustment performed whenever necessary. On completion of the initial examination and thorough phase-I therapy, the patients were reassessed after 3 months for their oral hygiene compliance. Probing was done on the prospective interdental areas, buccally and linguually/palatally, the site was considered for the study if the probing pocket depth was <5 mm. All baseline (on the day of surgery) values were recorded before the surgical procedure midbuccally by a single examiner (AAR). RD was measured midbuccally from the CEJ to the most apical extension of the gingival margin.[10] Bone level (BL) was measured by transgingival probing as follows:[16] under local anaesthesia, a 15 mm segment of 0.5 mm diameter ASTM A313 medical-grade hard stainless wire (KEI Industries Limited, New Delhi, India) was introduced midbuccally from the gingival margin through the attachment until a hard resistance was felt indicative of the alveolar bone crest. The wire was gently bent at the CEJ, removed and the distance from the bent portion to the end of the probe was measured against a probe. Probing depth (PD) was measured midbuccally from the gingival margin to the bottom of the gingival sulcus.[14] Clinical attachment level (CAL) was measured midbuccally from the CEJ to the bottom of the gingival sulcus[14] and keratinized tissue width (KTW) was measured from the gingival margin to the mucogingival line.[14] RD and BL were the primary outcome variables and PPD, CAL, and KTW were the secondary outcome variables. All the variables were recorded again at 3 months and 6 months postsurgery.

**Surgical procedure**

All surgical procedures were performed by two calibrated operators (RVC and PRG). After recording relevant parameters and following local anesthesia, the recipient root surface was carefully root planed to eliminate surface accretions and to reduce root prominence. OPF was performed as follows [Figures 1-13]. Two parallel incisions approximately 2 mm apart were made on the edentulous site. The lingual incision was terminated at the interproximal tooth surface while the
Chakravarthy, et al.: Osteoperiosteal flap in class III gingival recession

Figure 1: The concept behind the lateral osteoperiosteal flap. The procedure aims to translocate a fragment of alveolar bone (B) from an edentulous donor site for root coverage (Panel 1). A 1 mm thick island of alveolar bone with length corresponding to the recession depth (C to A) and slightly broader than the width of recession at gingival margin is elevated along with its investing flap (Panel 2). After verifying the adequacy of the bone block in the osteoperiosteal flap (Panel 3), the flap (OP) is sutured onto the recipient area (Panel 4).

Figure 2: Buccal view of a site with Class III recession adjacent to an edentulous area

Figure 3: Occlusal view of a site with Class III recession adjacent to an edentulous area

Figure 4: The flap and incision design of the procedure

Figure 5: A fissure bur was used to initiate an osteotomy cut parallel to the flap margin

Figure 6: An osteoperiosteal flap was elevated

buccal incision continued as the classic ‘V’ shaped external bevel incision on the mesial aspect and internal bevel on distal aspect incision on the gingival recession area as in a
conventional LPF procedure. The wedge of tissue over the ridge was removed, exposing the bone on the ridge. A #701 fissure bur (SS White, Lakewood, USA) was used to initiate an osteotomy cut parallel to the flap margin. This results in a 1 mm sliver of alveolar bone adherent to the flap. The depth of the osteotomy corresponded to the RD and two vertical cuts corresponding to the width of the recession at the gingival
margin were given so as to separate a bone island roughly the size of the recession area. A surgical chisel was used to gently separate the bony fragment within the confines of the flap in the edentulous area by effecting a greenstick fracture. Sharp edges and spicules were eliminated by using a No. 8 round bur (SS White, Lakewood, USA). Distal incisions were then given, ensuring that the width of the flap was 1½ times the area of the gingival recession. The OPF was elevated and then relocated over the recipient site after giving cut-back incisions at the base of the pedicles to permit flap placement near the CEJ without undue tension. Approximation, stabilization, and immobilization of the OPF was achieved by suturing with 4-0 nonresorbable silk sutures (Ethicon Mersilk®, Johnson & Johnson, Aurangabad, India) without tension. A conventional lateral pedicle graft (LPF) surgery was performed on participants in the LPF group. All participants received standard protocols of postoperative care and follow-up.

**Statistical analysis**

Data were analyzed using Prism 6.0® (GraphPad, La Jolla, USA) and SAS 9.3® (SAS, Mumbai, India). Data were summarized using mean ± standard deviation for continuous data and median ± inter-quartile range for score data. The comparison between different time points was done by the analysis of one-way repeated measures test and followed by Post hoc test for score data. The comparison between two groups for repeated data was made by analysis of two-way repeated measures test and followed by Post hoc test. All values of P < 0.05 were considered as significant and <0.001 were considered highly significant.

**RESULTS**

All enrolled participants (n = 22 sites) completed the treatment and one subject from the LPF group was lost during follow-up because of geographic relocation. Mild postsurgical pain (n = 9) and swelling (n = 13) were the most common postsurgical complaints. However, no untoward effects or complications were seen. Eleven sites in the OPF group and 10 sites in the LPF group were included in the final analysis.

**Intragroup comparisons**

Table 1 shows the results of the intragroup analysis of the primary and secondary outcomes between different time-frames in both the treatment arms. The changes in RD when compared from baseline to end of 3 months and 6 months were highly significant (P ≤ 0.001) in both the treatment groups. Differences in BL from the baseline to 3 months and baseline to 6 months were subjected to intragroup analysis in both the groups. The gain in BL when compared from baseline to end of 3 months and 6 months was highly significant (P ≤ 0.001) in both the treatment groups. The reduction in PD and CAL when compared from 3 months to end of 6 months was statistically significant (P ≤ 0.05) and highly significant (P ≤ 0.001), respectively, in both the groups. The gain in KTW when compared from baseline to end of 3 months and 6 months were highly statistically significant (P ≤ 0.001) in both the treatment groups.

**Intergroup comparisons**

Table 2 shows the results of the intergroup analysis of the primary and secondary outcomes between different time-frames in both the treatment arms. There was a significant difference in RD between OPF and LPF only at 3 months (P = 0.032; 2.11 ± 0.70 mm in OPF vs. 2.32 ± 0.67 mm in LPF). Statistically significant (P ≤ 0.001) gain in BL was seen at both the time frames with OPF-treated sites showing mean higher BL values at 3 months (3.43 ± 0.78 mm vs. 1.63 ± 0.67 for LPF) and 6 months (5.27 ± 0.77 mm vs. 3.22 ± 0.50 for LPF). There were no significant differences in PD between OPF and LPF at baseline (P = 0.967), 3 months (P = 0.749), and 6 months (P = 0.912). Both OPF and LPF showed similar

![Figure 13: Postoperative occlusal view at 6 months](image)
Table 2: Intergroup comparison of primary and secondary outcomes at different time periods between osteoperiosteal flap and lateral pedicle flap

| Parameter | Time interval       | P     |
|-----------|---------------------|-------|
| RD        | Baseline            | 0.972* |
|           | 3 months            | 0.032* |
|           | 6 months            | 0.862* |
| BL        | Baseline to 3 months| 0.0004** |
|           | Baseline to 6 months| 0.0002* |
| PD        | Baseline            | 0.967* |
|           | 3 months            | 0.749* |
|           | 6 months            | 0.912* |
| CAL       | Baseline            | 0.862 |
|           | 3 months            | 0.504 |
|           | 6 months            | 0.124* |
| KTW       | Baseline            | 0.862 |
|           | 3 months            | 0.911* |
|           | 6 months            | 0.911* |

*Highly significant (P<0.001), **Significant (P<0.05), *Not significant (P>0.05), OPF – Osteoperiosteal flap; LPF – Lateral pedicle flap; RD – Recession depth; BL – Bone level; PD – Probing depth; CAL – Clinical attachment level; KTW – Keratinized tissue width; P – Probability value

changes in CAL at baseline (P = 0.972), 3 months (P = 0.124), and 6 months (P = 0.238). Similar trends were seen in KTW values as well where there were similar gains at baseline (P = 0.971), 3 months (P = 0.911), and 6 months (P = 0.911).

**DISCUSSION**

In this study, we have sought to compare outcomes of lateral OPF and LPF in the treatment of Miller’s Class III gingival recession. To the best of the authors’ knowledge, this is the first study on the use of OPF in Miller’s class III gingival recessions; hence, a direct comparison with other clinical studies is not possible. Both OPF and LPF resulted in significant reduction in RDs and gain in KTW. LPF is an accepted mucogingival procedure and similar results were seen in the studies of Kunjamma et al. and Dixit et al. who found 72.95% and 68.67% of root coverage, respectively, by using this procedure. OPF showed reduction in RDs and gain in keratinized width as well and the reason could be the vascularization of the transported bony segment leading to early endosteal and periosteal osteogenesis. Histologically, the formation of new bone and cementum with investing tissues results in better healing and coverage of the denuded root surfaces. However, there were no significant differences in measures of RD and KTW between LPF and OPF at the end of study period. With the exception of having an alveolar island, both OPF and LPF are similar procedures capable of surviving on a root surface as a result of their intact vascularity and acting as reservoirs of cellular reparative tissues.

Transgingival probing revealed that there was a gain in BL in both the treatment groups. The integral theory behind the use of OPF in gingival recessions is that the flap contains an island of the bone block which retains its vascularity and capability to survive and demonstrates the potential for hard- and soft-tissue repair. Even in a conventional LPF procedure, the cambium layer of the periosteum within the flap, even if not intentionally stimulated can play a very small role in the healing process. This may have led to gain in BLs in OPF and LPF. OPF-treated sites showed higher BL gains at 3 months and 6 months than LPF. OPF results in translocation of a morphologically larger block of vital bone onto the recession site and greater improvement in BL can be expected. In LPF, the intact periosteum in the vicinity of the vertical incisions can stimulate and result in osteoid formation during the healing phase as a part of its healing process. However, the bone quality, quantity, and completeness are highly variable, and their net effect on recession coverage is not known.

The American Academy of Periodontology in its parameters on mucogingival conditions advocates additional surgical procedures to reduce probing depths depending on the mucogingival conditions. Interproximal bone loss not exceeding 3 mm is crucial to the success of a mucogingival procedure. Baseline probing depths were around 1 mm (1.00 ± 0.62 mm for OPF and 1.09 ± 0.53 mm for LPF), and CAL was around 6 mm (5.80 ± 1.22 mm for OPF and 5.72 ± 1.42 mm for LPF) in both the groups and these values are within the expected range for class III recessions. As reported in most of the previous studies, the reduction in RD seems to have improved measures of PD and CAL in both the treatment arms. However, between OPF and LPF, there were no significant differences in PD and CAL at baseline, 3 months, and 6 months.

This study has some limitations worth noting. The OPF procedure is novel and has no fixed protocol. Modifications in the technique or armamentarium can certainly be done to improve the clinical usefulness of this procedure in class III recessions. As no histologic evaluation was done, the microscopic behavior of the translocated bone block over the bone native to the recession site remains unknown though previous studies have established that the bone formation in the technique or armamentarium can certainly be done to improve the clinical usefulness of this procedure in class III recessions. As no histologic evaluation was done, the microscopic behavior of the translocated bone block over the bone native to the recession site remains unknown though previous studies have established de novo bone formation in transplanted sites. While the procedure may appear more invasive than an LPF, this technique is best suited for root coverage in cases where there are edentulous sites adjacent to denuded root surfaces.

**CONCLUSION**

To conclude, OPF can be used as an alternative procedure for treating Miller’s class III recessions with adjacent edentulous sites or wide interproximal spaces. Through the lateral OPF does not seem to confer additional benefits over LPF, long-term effects of OPF on the stability of root coverage outcomes is an exciting direction for future research.

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Conflicts of interest
There are no conflicts of interest.

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