Long Term Evaluation Of Modified Mucogingival Flap Technique With Novel Fish Derived Collagen Matrix And Connective Tissue Graft In Treatment Of Multiple Mandibular Class III Gingival Recession Defects- A Retrospective Study

Research Article

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Abstract

Introduction: Achievement of root coverage in advanced gingival recession defects involving multiple mandibular anterior teeth is often challenging. Long-term outcomes of xenogeneic collagen matrices and their effectiveness in comparison to connective tissue grafts need to be explored.

Aim: To assess and compare the long-term outcomes of xenogenic collagen matrix or connective tissue grafts in conjunction with the modified mucogingival flap procedure (MMGF) in the treatment of multiple mandibular gingival recession defects.

Materials and Methods: 38 systemically healthy patients presenting with multiple mandibular Miller's class III gingival recession were treated using MMGF along with either connective tissue graft (n=20) or xenogenic collagen matrix(n=18). Subjects were followed up for 3 years post intervention. At the end of 3yrs, 30 subjects were examined for assessment of the changes in recession height (RH), keratinized tissue width (KT), attached gingiva (AG), relative vestibular depth (RVD) and root coverage percentage (RC%).

Results: Statistically significant improvement in all clinical parameters were noted in both test and control subjects at the end of 1 and 3 years (p< 0.05). MMGF + CTG treated sites demonstrated a significantly greater RC% of 67.10 ± 22.90% than MMGF +XCM sites (35.51 ± 16.14%) at the end of 3 years (p<0.05).

Conclusion: Xenogenic collagen matrix along with MMGF yielded short term improvement in terms of root coverage than when compared to the connective tissue graft while treating advanced multiple recession defects.

Keywords: Gingival Recession; Mandible; Collagen Matrix; Connective Tissue Graft; Retrospective Study.

Introduction

Gingival recession is a composite phenomenon often associated with other mucogingival conditions complicating therapeutic outcome [1]. The anterior mandible is a challenging area for clinicians especially when multiple gingival recessions are present. Association of frenal pull, shallow vestibule, thin gingival biotype and inadequate attached gingiva adversely influences the outcome of conventional root coverage procedures [2]. There is significant literature evidence indicating that mucogingival surgeries in recession sites without interdental bone loss are more predictable in achieving complete root coverage (Cairo et al. 2008, 2014, Chambrone et al. 2012) [3, 4]. Inter-dental bone loss has been identified as a major impediment in achieving complete root coverage (Miller 1985 & Wennstorm 1996) [5, 6]. Furthermore, a recent systematic analysis by Fernandez et al 2021 revealed that long-term root coverage stability is not guaranteed while treating Miller's Class III recession and suggested the lack of insufficient clinical trials with follow up beyond 12 months [7].

Subepithelial connective tissue graft CTG is considered as the gold standard graft in mucogingival surgeries. However, procuring an adequate dimension of graft is technically difficult in management of multiple recessions especially in patients with a thinner biotype. To overcome these limitations, newer biomaterials have

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been studied widely. Clinical trials employing xenogeneic collagen biomaterials showed promising results as barrier membranes, as a carrier for growth factors, in socket augmentation and also to enhance keratinized tissue around implants [8]. Xenogenic collagen matrix derived from marine origin, had been used previously in socket augmentation and as an apical barrier in the management of open apex [9-12]. This minimally cross linked type I collagen matrix enhances wound healing and formation of granulation tissue, thereby providing an ideal scaffold for regeneration and soft tissue augmentation.

The scientific evidence on the long-term clinical effects of surgical treatment of multiple recession defects in the anterior mandible is limited. The aim of this retrospective study was to determine the long-term clinical outcomes of the modified mucogingival flap technique MMGF along with the use of connective tissue graft (CTG) or xenogenic collagen matrix (XCM) in the treatment of multiple mandibular Miller's Class III gingival recession defects.

Materials And Methods

The research protocol was approved by the institutional ethical committee and review board. The treatment was carried out in accordance with the principles of the declaration of Helsinki. All the surgical procedures were carried out by a single experienced periodontist between Jan 2015 and April 2017. 38 subjects presenting with multiple miller's class III gingival recession in mandibular anterior teeth were treated using MMGF along with either connective tissue graft (n=20) or xenogeneic collagen matrix (n=18). Baseline details of subjects were retrieved from records of the department of Periodontics. All the included subjects had acceptable oral hygiene compliance during or after phase I therapy and were non smokers. Treated sites had periodontal probing depth < 4mm, with absence of tooth mobility, caries, cervical abrasion/restorations.

Clinical parameters such as recession height (RH), probing pocket depth (PPD), clinical attachment level (CAL), width of attached gingiva (AG), width of keratinized tissue (KT), relative vestibular depth (RVD) were measured by using customized acrylic stent with UNC 15 periodontal probe and expressed in nearest mm. Recession height (RH) was measured as the distance from cemento-enamel junction to gingival margin at the mid buccal position of each site. Probing pocket depth (PPD) was defined as the distance from gingival margin to base of the gingival sulcus at the mid buccal position. Clinical attachment level (CAL) was recorded as the distance from the cemento – enamel junction to the base of the gingival sulcus. Keratinized gingiva (KT) was noted as the distance from the gingival margin to the mucogingival junction (evaluated using a chemical method –Lugol's Iodine). Attached gingiva (AG) was calculated by subtracting the probing depth from the width of keratinized tissue. Relative vestibular depth (RVD) was measured as the distance from base of stent to the deepest position of the vestibule. Root coverage percentage (RC%) was calculated according to the following formula.

Root coverage = [preoperative vertical recession height - postoperative vertical recession height]/preoperative vertical recession height] x 100

At baseline, a single investigator was calibrated with intra exam-

iner agreement (k=98%), and all clinical parameters were tested by the same researcher at all time points.

Intervention

After completion of cause related therapy study participants were randomly treated with modified mucogingival flap (MMGF) technique along with either connective tissue graft or xenogenic collagen matrix (Control group), BIOFIL SPONGE® type I collagen (Test group). The modified mucogingival flap technique MMGF employed in this study was adapted from Marggraf's coronally repositioned flap with a vestibuloplasty incision, modified from Edlan & Mejcher technique to deepen the vestibule[13].Under local anesthesia, horizontal crevicular incisions were made with the help of scalpel using #15 C blade at the marginal gingiva of involved teeth and laterally extended to one tooth on either side. A full thickness mucoperiosteal flap was elevated beyond the mucogingival junction relieving frenal/muscle attachments. Root planning was carried out using curettes and recipient site dimensions were measured using graduated periodontal probe. In the control sites, connective tissue graft was harvested from the palate using the single incision technique and the obtained graft was trimmed to remove the fatty glandular tissue if present. In the test group, sterile collagen matrix was trimmed in such a way that the graft extends 2mm laterally and apically beyond the defect. The CTG/XCM was placed on to the prepared root surfaces and was firmly adapted to the recipient bed with finger pressure in order to minimize the dead space. Flap margins were approximated using independent sling absorbable sutures(5-0 polyglactin 910). A superficial relieving incision was made approximately 7mm apical to the marginal gingiva in order to release the tension at the base of the flap. Two weeks following surgery, a vestibular incision was made from 33 to 43 using diode LASER (3w power in continuous mode). This procedure aided in prevention of muscle reattachments in healing tissue during the remodelling period of the CTG/CM. Periodontal dressing (coe-pak) was placed in order to protect the surgical site.

Post operative instructions and home care

Patients were prescribed with Amoxicillin 500mg 8hrly and Paracetmol 500mg 8hrly for five days. Patients were advised not to brush in the surgical area for 4 weeks post-surgically in order to avoid trauma to the surgical site and prescribed to use chlorhexidine mouthwash for 6 weeks. The periodontal dressing, sutures were removed at the end of two weeks.

Healing was uneventful without any wound dehiscence at all the treated sites. Patients were enrolled in a stringent post-operative supportive care regimen and the clinical parameters were recorded at the end of 1 year and at 3 years for retrospective analysis.

Statistical analysis

SPSS version 22.0 was used to analyze the data. Subject level statistical analysis was carried out. Thirty of the 38 patients were regularly monitored and examined for three years after surgery. The statistical analysis was limited to the data of participants who had completed a three-year follow-up. The descriptive parameters were expressed in terms of mean and standard deviation. Kolmogorov – Smirnov test and Shapiro – Wilks tests showed that the current study data followed a parametric distribution. To com-

pare the mean values between groups independent t-test was used and to compare the mean values between time points paired t-test was used. Chi-Square analysis was used to compare proportions between groups. Significance level was fixed as 5% (p < 0.05).

Results And Discussion

MMGF+CTG was used to treat 64 recession defects in 15 participants with a mean age range of 39.53 ± 8.17yrs. MMGF+XCM was used to treat 67 recession defects in 15 participants with a mean age range of 40.20 ± 9.84yrs. Table 1 showed the mean descriptive values of all the clinical parameters measured across various time points. There was no statistical significant difference between test and control subjects at baseline (p>0.05). At both follow-up intervals, intergroup analysis revealed that control subjects had a statistically significant reduction in gingival recession, a higher percentage of root coverage, and a gain in clinical attachment compared to test subjects. Further, significant improvement in VD was noted in the control subjects at 3 years follow up (p<0.05). Intra group analysis showed that both the interventions resulted in significant improvement in all clinical parameters from baseline to 1 and 3yrs time period (p < 0.001) (table 2)

The definitive goal of mucogingival therapy is not only aimed at achieving root coverage, but also to gain a healthy and stable mucogingival complex. Conventionally, management of advanced recession defects associated with other mucogingival deformities such as high frenal attachment and or shallow vestibular depth,

involves a two stage surgical protocol, where the initial procedure targets to correct frenal adhesion/augment the vestibular depth and keratinized tissue followed by root coverage. The MMGF technique used in current study, aimed to deepen the vestibule simultaneously augmenting the mucogingival complex. The vestibular relieving incision neither exposed the deeper tissues nor compromised the vascularity explaining the uncomplicated rapid healing which occurred across all the subjects. The minimally invasive laser assisted vestibular incision given during the early healing period resulted in tension free remodeling of tissues which aided in maintaining the deepened vestibule is in concordance with study by Eftal et al 2014 [14].

The objectives of this retrospective study were primarily to assess the changes in linear parameters such as RH, RC%, KT, and VD. From baseline to 3 years, the MMGF + CTG group had a significant reduction in mean RH of 1.76 ± 0.59mm, whereas the MMGF+XCM patients had a significant mean variation in recession height of 0.98 ± 0.43mm (p<0.05). However, intergroup analysis revealed that the MMGF+CTG group had significantly better outcomes than the test subjects at both 1 and 3 years. (p<0.05).

In the current study, the mean root coverage percentage achieved was 61.02±20.77%, 43.31±14.59% at 1 year and 67.10±22.90%, 35.51±16.14% at 3 years in control and test groups respectively. There was a transient increase in root coverage percentage in the control group from 1 to 3 years. This could be attributed to the phenomenon of creeping attachment, described as postoperative

Table 1. Mean clinical parameters at baseline, 1yr and 3yr time intervals in the study groups.

Clinical parameters	Baseline			1yr			3yrs		
	MMGF+CTG	MMGF+XCM	p value	MMGF+CTG	MMGF+XCM	p value	MMGF+CTG	MMGF+XCM	p value
RH	2.66±0.46	2.94±0.62	0.169	1.07±0.64	1.72±0.72	0.015*	0.90±0.65	1.95±0.84	0.001**
PPD	1.35±0.40	1.49±0.37	0.333	1.35±0.40	1.49±0.37	0.333	1.35±0.40	1.49±0.37	0.333
CAL	4.01±0.76	4.44±0.76	0.138	2.42±0.86	3.21±0.86	0.044*	2.25±0.86	3.45±0.97	0.001**
AG	2.44±0.70	2.45±0.64	0.983	4.25±0.90	4.00±0.88	0.446	4.18±0.89	3.90±0.94	0.402
KT	3.80±0.51	3.94±0.53	0.451	5.59±0.82	5.49±0.76	0.739	5.54±0.76	5.39±0.84	0.624
RVD	9.12±0.40	9.23±0.32	0.399	10.36±0.46	10.31±0.46	0.782	10.39±0.47	9.99±0.49	0.033*
MRC%				61.02±20.77	43.31±14.59	0.012*	67.10±22.90	35.51±16.14	<0.001**

**- denotes high statistical significance p <0.001
*- denotes statistical significance p<0.05

Table 2. Mean variation of clinical parameters from baseline to 1 and 3-year time intervals among study groups.

N=30	Baseline versus 1yr		Baseline versus 3yr	
	MMGF+CTG	MMGF+XCM	MMGF+CTG	MMGF+XCM
RH	1.59±0.48**	1.22±0.36**	1.76±0.59**	0.98±0.43**
CAL	1.59±0.63**	1.22±0.36**	1.76±0.59**	0.98±0.43**
AG	1.79±0.80**	1.55±0.51**	1.74±0.57**	1.44±0.64**
KT	1.79±0.77**	1.55±0.51**	1.74±0.57**	1.44±0.64**
RVD	1.24±0.51**	1.07±0.31**	1.27±0.52**	0.76±0.56**
MRC%	61.02±20.77	43.31±14.59	67.10±22.90	35.51±16.14

**- denotes high statistical significance p <0.001

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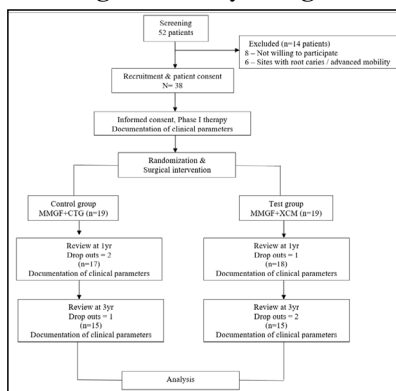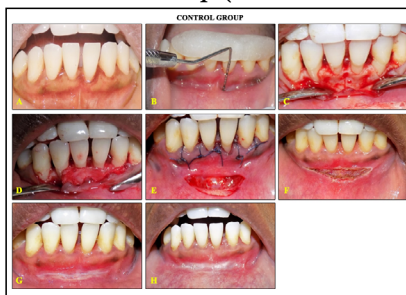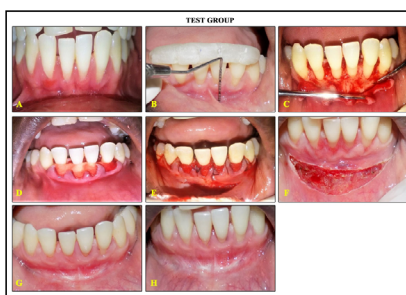**Figure 1. Study Design.**

Figure 2. Control Group (MMGF WITH CTG).

[A]: pre-operative clinical picture, [b]: standardization of measurements at baseline using acrylic stent, [c]: flap reflection, [d]: ctg placement, [e]: suturing and placement of relieving incision, [f]: laser assisted vestibular incision given at 4th week, [g]:1 yr postoperative review, [h]: 3 yr postoperative review

Figure 3. Test Group [MMGF WITH CM].

[a]:pre-operative clinical picture, [b]:standardization of measurements at baseline using acrylic stent, [c]: flap reflection, [d]: cm placement,[e]: suturing and placement of relieving incision, [f]: laser assisted vestibular incision given at 4th week, [g]:1 yr postoperative review, [h]: 3 yr postoperative review

migration of the gingival marginal tissue in a coronal direction, covering partially or totally a previously denuded root, seen commonly in narrow recession defects [15]. The mechanism of creeping attachment could be attributed to the presence of aseptic inflammation which favours an increase in the vascularization and proliferation of viable cells [15].

Scientific reports investigating the outcomes of root coverage procedures using CTG as augmentation material in miller's class III recession defects reported a mean RC% ranging from 73-83% (Aroca), 78%. (Yaman),74% (Esteibar) [20-22] and 60-83% (Moussa) [16-19]. In a recent systematic review by Fernandez et al 2021 comparing pre-twenty first century surgical techniques and twenty - first century techniques in the management of Miller's class III gingival recession, CRC was achieved at 6 months on half of the recessions (pre-twenty-frst: 57.60% vs. 21st: 51.11%), which drastically reduced for twenty-frst century techniques at the end of 12 months (pre-twenty-first: 63.82% vs. 21st: 32.87%) [7].

Since, there were no clinical trials being done evaluating the efficacy of fish derived collagen matrix in management of recession, we couldn't associate our outcomes with any other literature reports. However, AlSarhan et al and Atieh et al analyzed 353 and 427 recession defects in their systematic reviews and suggested a MRC% ofof 65.8% and 71 $\pm$ 21 to 94.32 $\pm$ 11.68%for xenogenic collagen matrix in the management of class I and II gingival recessions [20, 21].

The mean gain in KT was 1.74 $\pm$ 0.57mm and 1.44 $\pm$0.64mm in control and test subjects respectively at the end of 3 years. The gain in KT was in line with the results obtained by Cardarapoli(CAF +CTG,1.3 mm and CAF+CM, 1.2 mm) Paulo (MCAT+CTG,1.31 $\pm$ 1.23 mm) and Sato(EMD +CTG, 1.5 mm) [23, 24]. A statistically significant gain in mean vestibular depth of 1.27 $\pm$ 0.52 mm was achieved in the CTG subjects over a mean gain of 0.76 $\pm$ 0.56 mm in the XCM subjects at the 3 year follow up. Only a few study reports had reported the alterations of this parameter. In the case series by Nicole et al in 2013, the authors evaluated the use of a modified mucogingival flap with connective tissue graft

in the management of class I and II mandibular recession defects and they obtained an increase in VD of 0.9±0.5 mm which is in concordance with our study [25].

Systematic review by Cairo and meta-analysis by Chambrone substantiate the advantages of sub epithelial connective tissue grafting in mucogingival surgeries [3, 4].

Due to limitations of autogenous graft harvesting, a non autologous marine based xenogenic collagen matrix substitute had been investigated. The rationale to use collagen matrix as a scaffold for cell proliferation was based on its ability to enhance clot stability and increase fibrin linkage. It is physiologically remodeled and has a favorable effect on healing; thereby acting as a significant barrier.

The XCM used in this study was being used as an adjunct to mucogingival augmentation for the first time, it had good workable characteristics, did not require any pre soaking and stabilization sutures. At 1 year, the test subjects had a greater percentage of root coverage than at 3 years, indicating the short term benefits of MMGF+XCM. Thoma et al emphasized that inorder to establish complete healing and remodeling the collagen matrices, scaffolds should be able to remain for a longer duration [26]. Clinical outcomes achieved with XCM could be further improved by way of cross linking inorder to increase the resorption time thereby making it a suitable prospective substitute for autogenous grafts.

Conclusion

It could be ascertained that the use of MMGF with CTG enabled prolonged sustainment of the root coverage obtained along with maintenance of keratinised tissue and vestibular depth in a long term frame upto 3 years. Further studies are warranted with long term follow up using collagen matrices in minimal recession defects which may yield superior results and enhance the prospects of using xenogenic collagen matrices in the field of mucogingival surgery.

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