



Current Treatment Modalities for Gingival Recession- A Barrier for Esthetic Maintenance: A Short Clinical Review

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ABSTRACT:

Oral health forms the basis of individual human health since mouth is the gateway to all microorganisms and eatable/non-eatable items in our body. For maintenance of oral health, oral tissues like teeth and mucosa should remain in disease-free state. Certain predisposing factors like dental plaque or caries can result in inflammation of these tissues. This inflammation if not arrested, can result in bone loss, tooth mobility and gingival recession. Among these effects of inflammation, gingival recession is a frequent periodontal pathology in present day life, which is often associated with dentinal hypersensitivity and unpleasant looks. It is regarded as a major barrier in preserving the gingival health. As society has become increasingly focused on individual beauty and preservation of oral hygiene, gingival recession has become a major treatment option for esthetic dentistry. Although, there are a variety of treatment options available for gingival recession ranging from the free gingival grafts to guided tissue regeneration, every technique has its own merits and demerits. Hence, a clinical review of 10 patients comprising of each surgical techniques is presented along with literature analysis so that every clinician, whether general practitioner or Periodontist, selects the best technique for preserving the esthetics and harmony of periodontal tissues

Introduction

Periodontal diseases affect a major component of both rural and urban population. The individuals often present with loss of alveolar bone, furcation involvement, and root exposure (gingival recession) root caries and tooth mobility. Among them, a large component of general population, whether adult or young, male or female, rich or young, is suffering from gingival recession which is exposure of the root surface by an apical migration in the position of gingiva.¹ The incidence of gingival recession is

variable and appears to be more prevalent in men as compared to the women.² Even children are also susceptible to it with a frequency of 8 %.³ The etiology associated with this clinical disease progression is localized inflammatory process, alveolar bone dehiscence, gingival quality and quantity, position of the tooth in the arch, tooth brush trauma, occlusal trauma, factitial trauma, restorations in contact with gingiva, abnormal frenum attachment, orthodontic movement of teeth and genetic pre-disposition.⁴ Presence of gingival recession can lead to



inadequate plaque control, root caries, dentinal hypersensitivity and lastly, esthetic problems. Hence, in order to restore the supporting tissues and establish gingival harmony, there is a need to obtain predictable root coverage. Several root coverage procedures have been proposed for the treatment of gingival recession which can be classified as either pedicle soft tissue graft procedures (advanced or rotational), or free soft tissue graft procedures (epithelialized graft or sub-epithelial connective tissue graft). The rotational flap procedures involve the laterally sliding flap, double papilla flap and oblique rotated flap while the advanced flap procedures include the coronally advanced flap and semilunar coronally advanced flap.⁵ Besides these procedures, treatment modalities like guided tissue regeneration (GTR) and alloderm (along with Platelet-rich fibrin and Platelet-rich plasma as an adjunct) have also been used to obtain coverage of partially denuded root surface.⁶⁻⁸ An ideal outcome of a root coverage procedure can be achieved only if the environment is plaque free (on tooth surface) and adequate periodontal support is present. Another important clinical entity which is associated with the root coverage procedures is the amount of keratinized gingiva. The aim of this clinical review is to describe the objectives, indications and factors for the success of root-coverage procedures and to discuss the results obtained from different studies as well as various clinical trials.

History

Younger (1902), Harlan (1906) and Rosenthal (1911) were the pioneers who discovered the use of pedicle or free soft tissue grafts to cover the denuded root surfaces.⁹ The earliest surgical procedures which came into existence were single layered lateral pedicle or coronally positioned muco-periosteal flap procedures.¹⁰ These procedures had the advantage of being simple and produced minimal strain on the patients. Later, there was the advent of double layered techniques in which there was a combination of surgical procedures with grafts. It started from the combination of Connective tissue graft (CTG) with Coronally advanced flap (CAF).¹¹⁻¹² These techniques not only covered the recession by flap but also employed grafts for additional benefits. There was also a third group also which emphasized on the principles of regeneration of periodontal tissues for recession coverage. So, the work on Guided tissue regeneration (GTR) started to progress in 1990.⁷

1. Lateral Sliding Flap

The credit for introducing the lateral pedicle flap goes to Grupe & Warren (1956) who performed a sliding operation by raising a full thickness flap to cover the exposed root surface.¹³ However, this procedure was with increased chances of recession and dehiscence (due to buccal bone plate exposure), so modifications were done.¹⁴⁻¹⁶

Staffileno in 1964 recommended the use of a partial-thickness pedicle flap while modifications were done by Grupe (1966), Pfeifer & Heller (1971) and Zucchelli et al (2004) regarding the type of incisions.^{7,9,14,16} The double papilla flap was introduced by Cohen & Ross (1968) which was later modified by Rubleman in 1977 & Harris (1992).^{9,16} This procedure has been outlined in figures 6-11.

Another variation of lateral pedicle flap i.e. transposition flap was introduced by Bahat et al (1990).¹⁷ Besides these procedures, there were two more variations of pedicle flap i.e. the oblique rotational flap and the rotation flap.

2. Coronally Advanced Flap

This technique was first described by Norberg in 1926 which had a lot of modifications later by Kalmi et al (1949); Nordenram & Landt (1969), Harvey (1965, 1970), Sumner (1969), Ward & Simering (1973), Bernimoulin et al (1975), Brustein (1979) & (Wennström, 1994).^{7,9,18} This procedure as based on the coronal shift of soft tissue apical to the denuded root surface.⁹ Restrepo (1973) used full-thickness flap for coronally advanced flap while Allen & Miller (1989) utilized partial-thickness flap.¹⁹⁻²⁰ Recently, modifications were done by Wennestorm & Zucchelli (1996), Zucchelli & De sanctis (2000; 2007) and Zucchelli et al (2009).²¹⁻²⁴ This approach of the coronally advanced flap has also been used in combination with connective tissue graft (Wennström & Zuchelli, 1996), barrier membranes (Pini Prato et al, 1992), enamel matrix derivatives (Rasperini et al, 2000) & acellular dermal matrix (Harris 1998).²⁵⁻²⁸ Surgical guideline is outlined in figures 12-16. Semilunar coronally advanced flap was introduced in 1907 by Harlan but the technique that is utilized in modern periodontal surgeries was devised by Tarnow (1986).²⁸ The procedure had the advantage of being suture-less and was atraumatic. It has also had certain modifications by Haghghat (2006).²⁹⁻³⁰ This Procedure outlined in figures 17-20 (Joshi B & Gupta R-2016).³⁰



Autogenous Free Gingival Graft

The free gingival graft was introduced by Björn (1963) & Nabers (1966) while the principles of surgical outline were given by Sullivan & Atkins (1968).⁹ The main objective of this graft was to increase the width of keratinized gingiva. Because this graft retains none of its own blood supply and blood vessels, it was not originally intended to cover denuded roots. This procedure involves a two-step procedure of obtaining the graft, putting it apically to the recession defect and after proper healing, placing it coronally on the denuded root surface. Some authors (Dordick et al 1976; James & McFall 1978) advocated the placement of the graft on denuded bone, reporting less shrinkage and a firmer, less mobile graft.^{31,9} Later, modifications were done by Miller (1982), Holbrook & Ochsenein (1983), Han et al (1993) and Cohen & Baltimore (1994).¹⁶ Another way of gaining keratinized tissue was seen which was called as creeping attachment (Goldman & Cohen: 1964; Matter & Cimasoni, 1976).^{32,16} It was first noticed in auto-genus grafts. Surgical Procedures is depicted in figures 21-27.

Sub-Epithelial Connective Tissue Graft

The concept of connective tissue graft was laid down by Edel (1975) but the first work on this surgical procedure was done by Langer & Langer (1985) & Raetzke (1985).^{33,4,12} The surgical outline consists of taking the donor tissue to the wide recession defect after raising split thickness flap by giving vertical incisions. Many advancements were made in this surgical technique which started from trapdoor technique (Edel, 1974), combination of sub-pedicle connective tissue graft and double papilla (Nelson, 1987), envelope technique (Raetzke 1985; Allen, 1994), tunnel technique (Zabalegui et al, 1999) and single incision technique (Hurzeler & Weng, 1999).^{33,4,16,34} Even for determining histological analysis of root coverage, Harris (1999) & Goldstein (2001) found evidence of regenerated cementum and periodontal ligament in their case reports.³⁵⁻³⁶ Application of this type of graft for soft tissue augmentation was done by Azzi et al (2002).³⁷ This procedures (double incision technique) is outlined in figures 28-34.

Guided Tissue Regeneration

This principle was first introduced by Hurley and colleagues (1959) for the treatment of experimental spinal fusion.³⁸ In 1976, Melcher suggested that the cell type that

repopulates the root surface after periodontal surgery will determine the type of attachment that forms on the root surface.³⁷ The foundations of GTR (guided tissue regeneration) regarding root coverage were laid down by Tinti et al (1990).⁷ The procedure involves placing of a absorbable/ non-absorbable membrane on the denuded root surface, fixing it with the sutures and covering with the flap. Procedures outlined in figures 25-28. The first clinical study was conducted by Pini Prato et al (1992) which was later modified by Roccuo (1996), Trombelli (1998), Zuccheli (1998), Vincenzi et al (1998) and Wang et al (2000).³⁹⁻⁴⁴ Cortellini et al in 1993 found that root coverage was obtained with the use of an ePTFE membrane, while treating a gingival recession, led to new connective tissue attachment and new bone formation.³⁸ Procedure is shown in figure 35-41. Now trend has started with the evolution of new techniques for the surgical treatment of multiple adjacent recession type defects (MARTD)^{22,24}. These were mainly derived from the coronally advanced flap, a supra-periosteal envelope technique (SET) in combination with a sub-epithelial connective tissue graft or its evolution as a tunnel technique.^{22,24,42} Other adjuncts used were enamel matrix derivative (Ito et al 2000; Pilloni et al, 2006), platelet rich plasma (Eppley et al, 2006) and platelet rich fibrin (Aroca et al, 2009).^{45,46,47,2} Even application of orthodontic button was utilized as an additional benefit to provide more stability.⁴⁸ Enamel matrix derivative (EMD), obtained from porcine embryogenesis, is an amelogenin derivative that has been developed to promote periodontal regeneration.⁴⁵ Less recession has been found with EMD when compared to guided tissue regeneration technique for the treatment of intra-bony defects.¹⁶ Platelet Rich Plasma (PRP) is a fraction of plasma which provides a rich source of growth factors and could be effective in stabilization and revascularization of the flap or grafts. The autologous Platelet Rich Fibrin clot (PRF) was used initially in implant surgery by Choukroun et al in 2000 in order to improve bone healing.⁴⁹ In spite of a lack of scientifically proven clinical benefit, the homogeneous fibrin network that is obtained is considered as an excellent healing biomaterial and has immense potential for bone regeneration and soft tissue wound healing.⁵⁰ The use of acellular dermal connective tissue allograft (ADMA) instead of CTG (connective tissue graft) has been proposed to support the gingival margin and change the gingival biotype (Henderson et al 2001; Mahn, 2001) Tal,



2006), eventually in combination with the bio-absorbable membranes (Cangini et al, 2003) Improved outcomes have also been claimed with the use of microsurgical techniques, vertical releasing incisions, an extension of the CTG and full coverage of the grafted soft tissue or substitute.^{50,28} Most of the procedures are mentioned in figures 42-60. The main goal of these plastic periodontal surgery procedures was not only to obtain root coverage and optimal aesthetic appearance but also blending of the mucosa or gingiva.

Classification

Miller’s Classification (1985) (Fig.61)^{28,51}

- **Class I:** Marginal tissue recession which does not extend to the muco-gingival junction. There is no periodontal loss (bone or soft tissue) in the interdental area and 100% root coverage can be anticipated.
- **Class II:** Marginal tissue recession which extends to or beyond the muco-gingival junction. There is no periodontal loss (bone or soft tissue) in the interdental area, and 100% root coverage can be anticipated.
- **Class III:** Marginal tissue recession which extends to or beyond the mucogingival junction. Bone or soft tissue loss in the interdental area is present or there is malpositioning of the teeth which prevents the attempting of 100% root coverage. Partial root coverage can be anticipated.
- **Class IV:** Marginal tissue recession which extends to or beyond the mucogingival junction. The bone or soft tissue loss in the interdental area and/or malpositioning of teeth is so severe that root coverage cannot be anticipated. Some modifications were done by Mahajan et al (2010) and Kumar and Massamatii (2013).⁵²⁻⁵³

Case-1: Combination of Connective Tissue Graft & Bridge Flap



Fig.-1. Pre-operative view showing gingival recession with respect to tooth no. 31&41



Fig.-2. Incisions given and recipient site prepared



Fig.-3. Sutures given at recipient site



Fig.-4. Post –operative view-3 months showing partial coverage



Fig.-5. Post –operative view-3 months at donor site

Case-2: Coronally Advanced Flap Alone With Vertical Incisions



Fig.-6. Pre-operative view showing gingival recession with stent with respect to tooth no. 23

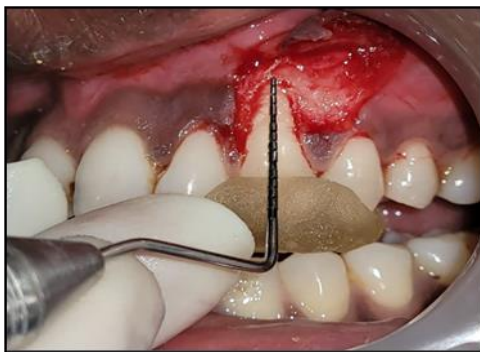


Fig.-7. Incisions given and flap raised



Fig.-8. Sutures given at recipient site



Fig.-9. Post-operative view-6 months showing complete coverage

Case-3: Coronally Advanced Flap with Multiple Recessions



Fig.-10. Pre-operative view of multiple recession at tooth no.12 &13



Fig.-11. Flap raised and new papillae created



Fig.-12. Sutures given at recipient site



Fig.-13. Post-operative view-3 months showing Complete coverage



Results

Among the 10 cases, except free gingival graft and lateral pedicle graft all the surgical procedures showed nearly complete root coverage with best results in Semilunar flap and connective tissue graft cases. One patient of GTR membrane could not follow up while for multiple

recession Coronally advanced flap case (accurate incision), mixed results were observed with partial root coverage and increase in gingival thickness (GT). However, there was exceptional increase in keratinized tissue (KT) width especially in free gingival graft case and PRF cases.

Table.-1. Showing various root coverage procedures and their shortcomings and benefits

S. No	Individual & year	Procedure	Results	Conclusion
1.	Grupe HE & Warren RF (1956) ¹³	Treated three cases of isolated gingival recession defects with lateral positioned flap (lateral sliding operation) in combination with frenotomy.	After 30 days, there was satisfactory root coverage along with gain of keratinized tissue in all the three cases.	They concluded that sliding flap procedure was useful for root coverage in isolated gingival recessions where there was lack of attached gingiva..
2.	Sumner CF (1969) ¹⁸	Performed treatment of gingival recession (5mm) on maxillary left cuspid(23). Free gingival graft along with incisal repositioning was done.	No evidence of any gingival lesion or recession (18months post- operative)	It was concluded that the gingival tissue remained intact for 18 months.
3.	Restrepo OJ (1973) ¹⁹	performed full thickness coronally repositioned flap in twelve cases of gingival recessions	There was decrease in root sensitivity and good root coverage was achieved	He found that this procedure was useful for improving the functional and hygienic aspects of the teeth & surrounding structures and cosmetic aspects were also improved.
4.	Edel A (1974) ³³	treated fourteen gingival recession sites in eight subjects .Three methods were used to provide gingival connective tissue for grafting which facilitated primary closure at the donor site.	.The results showed that statistically significant increase in width of keratinized attached gingiva .	It was concluded that these methods were useful in increasing the width of keratinized gingiva along with no increase in pocket depth.
5.	Smukler H (1976) ⁵⁴	Treated twenty one isolated recession defects in 15 patients by using lateral positioned flap with modifications.	He found that on an average, only 20% of grafted tissue was lost by shrinkage, slippage, or postoperative recession, whereas "creeping attachment" or marginal proliferation occurred in only	He concluded that the grafts endure very well over a 9-month period of observation.



			three of the 21 cases treated.	
6.	Irwin RK (1977) ⁵⁵	Treated two cases of gingival recessions with a combination of full thickness lateral pedicle graft and free gingival graft.	In first case after 24 months, results showed adequate root coverage and reattachment over the associated tooth. In the second case also, covering of donor site and the adjacent cuspid with a free gingival graft again served to establish adequate gingiva.	It was concluded from these case reports that combination of free gingival graft and lateral pedicle graft helps in overcoming the deficiencies of both the procedures.
7.	Maynard JG (1977) ⁸⁴	treated two cases of gingival recessions present on right maxillary canine and mandibular 1st premolar by the combination of free gingival graft and coronally advanced flap.	Results revealed that there was significant root coverage on the tooth.	It was concluded that this technique was quite better than the original technique given by Sullivan & Atkins (1968) .
8.	Patur B (1977) ⁵⁶	treated two cases of isolated gingival recessions present on right maxillary canine and mandibular lateral incisor by using single /double rotation flap .	Postoperative results after several weeks revealed successful coverage of the denuded root surfaces in 1st case	.It was concluded that this procedure was useful for minimizing the danger of alveolar bone loss, prevention of exposure of fenestrations / dehiscence.
9.	Guinard EA & Caffesse RG (1978) ⁵⁷	conducted a study to evaluate biometrically the changes occurring on the recipient as well as the donor tooth with regard to gingival recession, sulcus depth and width of keratinized gingiva following a coronally repositioned flap with a free gingival graft and a lateral sliding flap.	It was observed that a mean gain of 2.71 mm of soft tissue coverage over the denuded root was recorded 6 months postoperatively following both procedures. It was observed that healing was delayed in two cases due to accidents.	It was concluded that the lateral sliding flap and the coronally repositioned flap provided a satisfactory solution in the treatment of localized gingival recessions.
10.	Langer B & Langer L (1985) ¹²	Performed treatment of four cases with a new technique of sub-epithelial connective tissue graft.	It was observed by the clinicians that postoperative probing depths ranged from 1 to 3 mm even in cases of 5 mm of root coverage, with no recurrence of recession.	It was concluded that this procedure provided less postoperative discomfort as compared to free gingival graft.
11.	Raetzke PB (1985) ⁴	Treated 12 areas of Miller's class I gingival recessions by envelope technique of Sub-epithelial connective	After 8 months, average result of root coverage was 80 % among total sites treated.	It was concluded that this technique was beneficial as it caused minimal surgical trauma at recipient site and there



		tissue graft.		was good healing.
12.	Caffesse RG et al (1987) ⁵⁸	compared biometrically the amount of root coverage, clinical attachment, and keratinized tissue obtained with lateral sliding flaps along with citric acid demineralization as an adjunct.	It was seen that an average gain of 2.62 mm soft tissue coverage was achieved on recipient teeth six months after performing both surgical techniques. Oral hygiene and gingival inflammation showed consistent improvement for both techniques	it was concluded that the lateral sliding flap revised technique provided satisfactory root coverage of localized gingival recessions with or without citric acid.
13.	Allen EP & Miller PD (1989) ²⁰	performed treatment of 28 patients who presented with shallow gingival Miller's class I recessions (depth \leq 4mm) at 37 recession sites.	Results revealed the mean gain of root coverage to 3.17 mm after 3 months and 3.18 mm at 6 months post-operatively.	It was concluded that this technique was simple to perform and was most successful in treating shallow recession defects (depth \leq 4mm).
14.	Borghetti A & Gardella JP (1990) ⁵⁹	performed a biometric study to evaluate after one year, the root coverage obtained by thick gingival grafts obtained by a specific technique.	The results of this study showed that a certain coverage by bridging was possible with the use of a thick graft.	It was concluded that thick gingival auto-graft resulted in substantial coverage of 85.2% of the root surfaces.
15.	Harris RJ (1992) ¹⁵	did a clinical study in which he treated 20 patients (30 defects) with a combination of connective tissue and partial thickness double pedicle graft.	After 12 weeks, it was observed that there was mean root coverage of 3.5 mm, or a 97.2% of total exposed root covered.	It was concluded from this study that the esthetics, both color match and tissue contours were acceptable to all the patients
16.	Sonick M (1992) ⁶⁰	treated five patients (one was having generalized recessions) with two different procedures namely free gingival auto-graft and sub-epithelial connective tissue graft.	Results revealed that there was an uneventful healing along with excellent root coverage and decreased root sensitivity.	It was concluded then free gingival graft was a better choice as compared to sub-epithelial connective tissue graft when esthetics are not concerned
17.	Bouchard P et al (1994) ⁶¹	did a comparative study of 2 procedures i.e. combination of connective tissue graft (CTG) and coronally repositioned (CR) flap together with application	Results revealed that after 6 months, the mean percentage of root coverage was 69.2%.	The results of this study indicated that partial success could be expected with sub-epithelial connective tissue grafting in Miller's Class I or Class



		of citric acid and connective tissue graft(CTG) alone .		II recession therapy.
18.	Wennstrom JL & Zucchelli G (1996) ²¹	conducted a study by combining free connective tissue graft with a coronally advanced flap procedure.	Complete root coverage was observed at 72 % of the test sites and 74% of the control teeth.	It was concluded that the 2 surgical procedures resulted in similar degree of root coverage.
19.	Harris RJ (1997) ⁶²	compared two techniques for obtaining a connective tissue graft.	Root coverage of 100% was obtained in 84.2% of the cases treated with the free gingival graft knife method and in 93.37% of the cases treated with the parallel incisions method..	It was concluded that the parallel incision method met more of the goals of an ideal technique.
20.	Harris RJ (1997) ⁶³	compared two techniques of obtaining root coverage.	It was observed after 26 weeks that the connective tissue with partial-thickness double pedicle graft had a mean root coverage of 97.1%, and the guided tissue regeneration procedure produced a mean root coverage of 75.1%.	The results demonstrated that root coverage is possible with both procedures.
21.	Trombelli L et al (1998) ⁶⁴	conducted a clinical study to evaluate the effect of guided tissue regeneration (GTR) in comparison to sub-pedicle connective tissue graft (SCTG) in the treatment of gingival recession defects.	Results revealed that mean RD significantly decreased from 3.1 mm pre-surgery to 1.5 mm at 6 months post-surgery for the GTR group (48% root coverage), and from 3.0 mm to 0.5 mm for the SCTG group (81% root coverage).	It was concluded from the results that: 1) treatment of human gingival recession defects by means of both GTR and SCTG procedures results in clinically and statistically significant improvement of the soft tissue conditions of the defect.
22.	Zucchelli G et al (1998) ⁶⁵	compared the clinical efficacy of 3 surgical approaches in the treatment of deep recession type defects i.e. guided tissue regeneration (GTR) procedure using a bio-absorbable membrane, with non-resorbable membrane and the last was a muco-gingival surgical approach consisting of connective tissue graft combined with a coronally	Results indicated after 1 year postoperative that 1) all treatment approaches resulted in clinically significant root coverage and attachment gain	It was concluded that the muco-gingival bilaminar technique was equally effective as GTR procedures in the treatment of gingival recessions



		advanced flap (bilaminar technique).		
23.	Jepsen K et al (1998) ⁶⁶	compared barrier membrane therapy with connective tissue grafts in the treatment of recession defects.	Gingival recession decreased from 3.6 ± 0.7 mm to 0.5 ± 0.5 mm for membrane treated defects and from 3.6 ± 1.0 mm to 0.5 ± 0.5 mm following use of grafts.	The results demonstrated that both titanium reinforced barrier membranes and connective tissue grafts could be successfully used to treat periodontal recession defects.
24.	Harris RJ (1999) ⁶⁷	evaluated a successfully treated root coverage case histologically.	The results revealed areas of regeneration, with new bone, cementum and connective tissue attachment coronal to the original gingival margin.	It was concluded that regeneration was possible with sub-epithelial connective tissue graft. Also, there was complete root coverage.
25.	Baldi C et al (1999) ⁶⁸	Did a study to determine the effect of thickness of the flap on root coverage when gingival recessions were associated with traumatic tooth brushing.	It was found that when the flap thickness was greater than or equal to 0.8mm, then there was 100 % root coverage in the teeth. When the flap thickness was 0.7mm, then there was significant reduction in the recession depth but the amount of root coverage was less than 100 %.	Hence, it was concluded from the result that there is a direct relationship between the flap thickness and recession reduction especially in case of coronally advanced flap.
26.	Allen EP & Lorenzana ER (2000) ⁶⁹	Used single palatal harvest technique of connective tissue grafts to treat 2 cases of gingival recession.	Results after 9 & 15 months post-surgery revealed 100% root coverage, with no inflammation or sensitivity, minimal probing depths and a favorable esthetic results.	It was concluded that this technique was associated with predictable root coverage and therefore post-operative patient comfort.
27.	Rosetti EP et al (2000) ⁷⁰	compared the sub-epithelial connective tissue graft (SCTG) and guided tissue regeneration (GTR) with a collagen membrane in the treatment of gingival recessions in humans.	The SCTG group was statistically significantly better than GTR for height of GR. GTR = 1.12 mm. P=0.02) and KT (SCTG = 4.58 mm. GTR = 2.5 mm. P<0.0001).	It was concluded that the gingival recessions treated with the SCTG group were superior for GR, RC and KT clinical parameters.
28.	Muller HP et al (2001) ⁷¹	did a study in which he compared the postsurgical outcome of two different modes of surgical root coverage of predominantly shallow, Miller's Class I or II,	At baseline, mean recession depths decreased to 2.77 ± 1.67 mm and 2.49 ± 1.07 mm for patients treated with a bio-resorbable membrane and a free connective tissue graft, respectively.	It was concluded that shallow recessions in the 1.5 to 3.5 mm range should not be treated with GTR.



		gingival recessions.		
29.	Harris RJ (2002) ⁷²	evaluated and compared the short-term (13.0 weeks) and long-term (27.5 months) root coverage results obtained with sub-epithelial connective tissue grafts.	It was found that the mean root coverage at 13.0 weeks was 97.1% and 98.4% at 27.5 months.. There was a statistically significant decrease in recession, increase in the quantity of keratinized tissue, increase in probing depth, and increase in attachment loss between short-term and long-term results	It was concluded that the sub-epithelial connective tissue graft was an effective method to cover the exposed roots.
30.	Ito K et al (2003) ⁷³	conducted a study to compare the clinical efficacy of guided tissue regeneration with expanded poly-tetrafluoroethylene membranes to that of free gingival graft .	It was observed that statistically significant improvements were found for gingival recession, attachment level, and root coverage from baseline to 6 months and 1 year postoperatively in both groups.	It was concluded that both procedures produced the same average amount of root coverage, reduction in gingival recession and gain in clinical attachment
31.	Martins AG et al (2004) ⁷⁴	evaluated the impact of smoking on clinical outcome of root coverage following sub-epithelial connective tissue graft (CTG) surgery.	Results revealed that CTG was able to promote root coverage, increase gingival thickness, and improve clinical attachment level in both groups (P<0.05).	It was concluded from this study that cigarette consumption may present a negative impact on healing of CTG
32.	Santos A et al (2005) ⁷⁵	described the surgical technique for gingival augmentation and root coverage along with the results of 12 clinical cases by employing acellular dermal matrix allograft(ADMA).	Results of the 12 patients and the 26 denuded surfaces showed a mean root coverage of 74% with acellular dermal graft.	It was concluded that the proposed technique of root coverage with an acellular dermal matrix allograft could be a good alternative to soft tissue grafts for root coverage.
33.	De Queiroz AC et al (2006) ⁷⁶	evaluated the treatment of gingival recessions with coronally positioned flap with or without acellular dermal matrix allograft (ADM).	It was found that significant increase in the thickness of keratinized tissue was observed in the group treated with ADM as compared with the coronally positioned flap alone (p<0.05).	Hence, it was concluded that ADM may reduce the residual gingival recession observed after 24 months in defects treated with coronally positioned flap. In addition, a greater gingival thickness may be achieved when this graft is used.
34.	Bittencourt S et al (2006) ⁷⁷	compared the semilunar coronally positioned flap (SCPF) procedure with the sub-epithelial connective tissue graft	After 6 months, it was found that there was significant improvement in root coverage with the average percentages of root coverage: SCTG (96.10%) while in SCPF it was (90.95%).	It was concluded from this study that SCPF and SCTG procedures were highly effective and predictable in obtaining



		(SCTG) for the treatment of Miller's class I gingival recessions (≤ 4 mm) in 17 patients.		root coverage of gingival recessions and esthetic outcome.
35.	El-Dessouky HF et al (2007) ⁷⁸	compared the clinical effect of sub-epithelial connective tissue graft combined with Platelet-rich plasma (SCTG + PRP) and that of the collagen membrane (guided tissue regeneration) with the adjunct use of Platelet-rich plasma (CG+PRP) in root coverage procedures.	It was observed that in group 1 (SCTG+PRP) treated sites, the percentage of root coverage (Rc) achieved was about 84.4%, regarding group 2 (CG+PRP) treated sites, the percentage of root coverage achieved was 80.8%.	The results of the study demonstrated that both techniques, either an autogenous connective tissue graft (SCTG) soaked with Platelet-rich plasma (PRP) or a collagen membrane (CG) soaked with Platelet-rich plasma (PRP), were effective in the treatment of shallow gingival recession.
36.	Aroca S et al (2009) ⁴⁶	compared the clinical outcome of MCAF (modified coronally advanced flap) alone and MCAF (modified coronally advanced flap) with Platelet-rich fibrin membrane (PRF-M) for the treatment of adjacent Miller's Class I or II multiple gingival recessions.	They found that the mean root coverage after 1, 3 and 6 months was $81.0\% \pm 16.6\%$, $76.1\% \pm 17.7\%$ and $80.7\% \pm 14.7\%$, respectively, at the test sites and $86.7\% \pm 16.6\%$, $88.2\% \pm 16.9\%$ and $91.5\% \pm 11.4\%$, at the control sites.	They concluded that MCAF was a predictable treatment for multiple adjacent Miller's Class I or II recession-type defects.
37.	Joshi B & Gupta R (2016) ³⁰	They performed semilunar flap on two patients with Miller's class I gingival recession defects.	Complete root coverage was observed in both cases with increase in keratinized tissue width.	It was concluded that semilunar flap is a good technique for root coverage if recession depth ranges from 1-2mm.
38.	Joshi B (2017) ⁴⁸	Treated miller's class I gingival recession defect with a combination of PRF and orthodontic button with Coronally advanced flap.	Complete root coverage was achieved along with increase in Gingival thickness and increase in keratinized tissue width	It was concluded that PRF act as a good adjunct to Coronally advanced flap for complete root coverage. Application of orthodontic button provides additional stability for two weeks, post-operative.
39.	Azaripour et al (2018) ⁷⁹	They compared CAF with the	Clinical evaluations were performed at 3, 6 and 12 months, obtaining as a result	They found both techniques as equally



		modified microsurgical tunnel technique (MMTT) for the treatment of Miller class I and II recessions.	that both techniques are equally	successful in covering Miller class I and II gingival recessions, with high esthetic results
40.	Bajana et al (2024) ⁸⁰	They did a systemic review on 26 studies with comparison of coronally advanced flap (CAF) and the tunnel technique (TT) of CTG for treating gingival recessions.	They found that MRC(mean root coverage) for TT compared with CAF (5.73 CI95% –8.90 to 13.55; p = 0.685) but there were no significant differences statistically.	They concluded TT with CTG might offer better root coverage than CAF with CTG but biomaterial selection has to be performed wisely.
41.	Yavuj et al (2024) ⁸¹	They performed split-mouth randomized study aimed to assess efficacy of leucocyte-platelet-rich fibrin (L-PRF) versus connective tissue graft (CTG) in achieving root coverage (RC) for multiple adjacent gingival recessions MAGRs.	They found that The higher GT (gingiva thickness) and KTW (keratinized tissue width) were higher group at 12 months post operative (p < 0.05).	They concluded that L-PRF were equally effective as CTG in treating in terms of RC and CRC

Discussion

Gingival recession (GR) is a term that designates the oral exposure of the root surface due to a displacement of the gingival margin apical to the cemento-enamel junction.²⁸ Reports from diverse epidemiological surveys reveals that GR may affect most of the adult population.^{2,3} Root coverage has always been the aim for many clinicians. From early 1950, many procedures have been carried out to achieve complete or partial coverage. Historically, these procedures originated at the beginning of the 20th century, presented by Younger in 1902, Harlan in 1906 and Rosenthal in 1911 who first described the use of pedicle or free soft tissue grafts to cover denuded root surfaces.⁹ During recent decades, different surgical procedures have been proposed. Coronally advanced flaps, laterally repositioned flaps, free gingival grafts and sub-epithelial connective tissue grafts appears to be novel approaches to achieve improvements in recession depth, clinical attachment level and width of keratinized tissue.^{4,6,8,12} As evident from history and table-1, It started from Grupe and Warren (1956) with lateral positioned flap who achieved root coverage in isolated recession defects.¹³ However, because of shorter observational period, no direct

judgment of the final recession coverage was noted. Smukler (1976) used similar technique and found success for 9 months.⁵⁴ Irwin (1977) modified the technique and combined free gingival graft with pedicle graft.⁵⁵ It was found that this combination prevented the deficiencies of both the procedures namely protection of underlying of pedicle graft at donor site. Later, Sumner, proposed a new technique of free gingival graft with incisal repositioning. The procedure was successful (18 months post-operative) and no change was evident in final position.¹⁸ A modification was done by Maynard (1977) who combined the technique of free gingival and Coronally positioned flap and found that the technique was useful than original technique of Sullivan and Atkins (1968).⁸⁴ The technique of semilunar flap was proposed by Tamow (1986) was useful for narrow recession defects and it is now considered as the simplest procedure to perform.⁸⁵ Edel (1976) proposed connective tissue graft technique and succeeded in increasing the width of attached gingiva without change in pocket depth.³³ (Patur 1977) used rotational flap for root coverage and succeeded in preventing emergence of dehiscence and alveolar bone loss.⁵⁶ Langer and Langer (1985) proposed a new technique of connective tissue graft and found good root coverage with minimum post-operative discomfort.¹² Miller & Allen (1989) used



Coronally advanced flap and found the technique useful with minimum morbidity.²⁰ Combination of double papilla graft and connective tissue graft was used by Harris who found good clinical results.¹⁵ Even comparison was made between the two techniques of connective tissue graft and found the parallel incision technique better than the previous one.⁶³ Zucchelli used GTR and found similar results as compared with connective tissue graft and barrier membrane of GTR. Comparative results from meta-analyses demonstrate that sub-epithelial connective tissue grafts (SCTG) lead to a statistically significant gain in root coverage when compared to GTR-resorbable membrane procedures. The concept of guided tissue regeneration offers hope for an ideal color match of tissue without the need of taking tissue from the palate.⁹⁶ These native cells, either from the periodontal ligament space or gingival connective tissue cells, may repopulate the wound, thus producing not only adequate tissue but an ideal color match.⁹⁶ The results of many studies depict the superiority of connective tissue grafts in terms of gains in root coverage and similarities in the amount of keratinized tissue achieved. The mean root coverage is 80.9% (50 % to 97.3%) and complete root coverage is 46.6% (7.7% to 91.6%).^{86,65} Even for flap thickness, it was observed by Baldi et al (1999) that flap thickness of 0.8 mm was the threshold for complete root coverage and below that only partial coverage was achieved.⁶⁸ The advent of alloderm has marked a new era in the field of esthetic periodontal plastic surgery and excellent results were obtained and it acted as a good replacement for connective tissue graft, as evident by Bajana et al (2024).^{80,88,89} It has been observed that alloderm is not able to achieve significant amount of keratinized tissue but esthetically the results are better than free gingival grafts. Also, this procedure eliminates the need of second surgical site therefore, it is now considered as an alternative substitute to connective tissue graft. Also, various other adjuncts like Enamel matrix derivatives (EMD), Guided tissue regeneration (GTR) and advanced biomaterials like platelet concentrates (Platelet-rich plasma and Platelet-rich fibrin), Mucograft (Geistlich-mucograft-Collagen matrix), Growth factor enhanced matrix (GEM 21) and human chorion allograft have proven their potential in terms of both regeneration and root coverage.^{90,91,92,93,94,46,78,8} These are useful in increasing the vascularity of the flaps and gingival thickness when used as an adjunct and are capable of giving perfect harmony in terms of gingival texture & color. They decrease post-operative discomfort and root sensitivity associated with gingival recession.⁹⁵ A

summary with regard to the average amount of initial Miller's class I–II recession defects was assembled based in the form of systematic review by Pagliaro et al (2003) showing an average of 63–86% root coverage that was expected.¹⁰ It is quite obvious that the introduction of specific objectives, inclusion criteria and search strategies based on evidence and scientifically valid information may effectively reduce the variation in clinical outcomes, establish the application and predictability of a specific procedure and improve the effectiveness of clinical practice. Consequently, scientific evidence-based information should be achieved by well delineated systematic reviews. An overall comparison of the treatment outcome of various root coverage procedures is hampered by the fact that comparatively few studies have presented well documented clinical data and that there is substantial heterogeneity between studies.^{86,87} However, the variability in the treatment outcome for the various procedures, both within and between studies, is large. This indicates that the procedures are quite operator sensitive and are affected by that various factors like the type of defect, amount and quality of adjacent gingival tissue, sample size and the applied inclusion criteria (e.g. patients' selection, methodological quality, type of technique, devices used for measurements influencing the treatment outcome have not been adequately considered.⁸⁶ The concept of guided tissue regeneration offers hope for an ideal color match of tissue without the need of taking tissue from the palate.⁹⁶ These native cells, either from the periodontal ligament space or gingival connective tissue cells, may repopulate the wound, thus producing not only adequate tissue but an ideal color match.^{38,96} The results of many studies depict the superiority of connective tissue grafts in terms of gains in root coverage and similarities in the amount of keratinized tissue achieved. Also, there is a marked variation in the amount of root coverage achieved. The mean root coverage is 80.9% (50 % to 97.3%) and complete root coverage is 46.6% (7.7% to 91.6%).⁸⁶ Additionally, data from two long-term trials shows that both mean root coverage and complete root coverage decreases over time.^{97,98} Patients' preference for a specific periodontal plastic surgery procedure follows the same pattern as aesthetic condition change.⁴⁰ Occurrence of an early discomfort with or without pain is related to donor sites of SCTG/ (FGG).^{40,37, 99} This aspect may be related to the size of the graft obtained from the palate and the surgical approach used.⁹⁸ With respect to GTR techniques,



membrane exposure during healing is associated with primary postoperative complications.³⁸ This clinical review has emphasized that, in aesthetics, the selection of surgical techniques for root coverage should not only consider the results evaluated by millimeter and percentage data but the clinical trials should also include methods for patient's own evaluations well as professional evaluation of the overall aesthetic outcome. Consequently, patients and professionals can present different points of view regarding the performed procedures and the achieved final result. In decision-making, evaluation of general patient characteristics and evaluation of various aspects of the anatomy at the individual defect site need to be reconsidered.^{86,99} New procedures should be developed to improve complete root coverage in Miller's Class I and Class II recession defects. They should be simplified to ensure wider reproducibility and to decrease the cost-benefit ratio. Progress in the creation of gingival papillae in Miller's Class III and Class IV recession defects is desirable. The recent use of platelet concentrates have provided an additional benefit of increase gingival tissue thickness and reduction in probing defect.^{48,82} Platelet rich fibrin came in 2001 and has now the 3rd generation called A-PRF which is getting utilized with better results.¹⁰⁰ Further research is needed to evaluate the influence of soft and hard tissue attachment to the root on the stability of the results.

Conclusion

No particular procedure is perfect. There are many advantages as well as limitations associated with each procedure. However, each procedure is directed to achieve three basic purposes, periodontal regeneration, esthetic maintenance and good oral hygiene (i.e. good plaque control). Therefore, the surgeon must be knowledgeable and up to date with the literature and reported findings so that he or she will be able to select the best surgical approach indicated for the patient to improve the results and achieve a more predictable outcome.

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