

Content available at: <https://www.ipinnovative.com/open-access-journals>

IP International Journal of Periodontology and Implantology

Journal homepage: <https://www.ijpi.in/>

Review Article

Long term efficacy of root coverage techniques

V.S.Ananya Sweta^{1,*}, Jananni Muthu¹, B Pratebha¹, R Saravana Kumar¹¹Dept. of Periodontology, Indira Gandhi Institute of Dental Sciences, Pondicherry, India

ARTICLE INFO

Article history:

Received 10-05-2021

Accepted 04-06-2021

Available online 26-07-2021

Keywords:

Gingival recession

Long term stability

Root coverage

ABSTRACT

Gingival recession is a dramatic soft tissue finding in teeth affected by periodontal disease and remains one of the most common aesthetic concerns associated with periodontal tissue. The etiology of the condition is multifactorial but is commonly associated with alveolar morphology, tooth brushing, mechanical trauma and periodontal disease. With greater understanding of the dynamics of healing along with an awareness of aesthetics various periodontal procedures have been introduced to deal with problems of gingival recession. The long-term stability of the outcomes obtained with the surgical treatment of single and multiple gingival recessions has been evaluated in a few studies. Of the vast repertoire of mucogingival procedures for gingival recession management, long term studies of more than 5 years is present only for coronally advanced flap with or without connective tissue grafts. There are many other novel techniques in literature with little or no evidence to prove its long term efficacy. Various studies published during the last 30 years were identified through a search of the PubMed/Medline, Science Direct and Cochrane Library databases. "Follow up", "root coverage", root coverage procedures, root coverage techniques were the key words used for the search. In this review we have grouped the efficacy of various root coverage techniques based on their short and long term follow up. The review emphasises the value of meticulous follow up in order to validate efficacy of root coverage techniques. It also discusses the factors responsible for stability of results.

© This is an open access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>) which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

1. Introduction

Gingival recession (GR) remains one of the most common aesthetic concerns associated with periodontal tissue.¹ A denuded root surface frequently results from an interplay between the predisposing and triggering factors.²

When recession is untreated it is associated with thermal and tactile sensitivity, compromise in aesthetics, increased tendency for formation of root caries, continuous marginal bone loss eventually leading to tooth loss.³ With greater understanding of the dynamics of healing along with an increased awareness of aesthetics various periodontal procedures have been introduced to deal with problems of gingival recession.⁴ The selection of treatment modality depends on various tooth and soft tissue related factors.

The predictability of treatment depends upon the type and severity of the recession.⁵

A number of recent systematic reviews have analysed multiple therapeutic approaches to gingival recession defects, including coronally advanced flap (CAF) alone and in combination with Sub epithelial connective tissue graft (SCTG), guided tissue regeneration (GTR), enamel matrix derivative (EMD), and acellular dermal matrix (ADM).⁶ Irrespective of the surgical approach, the ultimate goal of recession treatment technique is to achieve an optimal integration of the covering tissue with the adjacent soft tissue for a longer time period.⁷ The stability of any technique used for root coverage is determined by long term follow up. Long term stability of gingival recession management is based on numerous factors like proper elimination of aetiology, the right choice of technique, expertise of clinician, standard of oral hygiene and patient maintenance by patient.⁸

* Corresponding author.

E-mail address: ananyaswetavenkatesan@gmail.com (V. S. A. Sweta).

Though general literature evidence for root coverage procedures are abundantly available, only few vouch for the long term stability of the results. This article aims in providing an overview of various techniques available for the treatment of gingival recession and particularly probes into the literature reporting long term stability of the results.

Various studies published during the last 30 years and written in English were identified through a search of the PubMed/Medline, Science Direct and Cochrane Library databases. “Follow up”, “root coverage”, “root coverage procedures”, “root coverage techniques” were the key words used for the search.

A total of 200 Articles were retrieved from the search results. Excluding the cross references a total of 38 articles were included in the review. Articles were further grouped based on the techniques and analysed.

A total of 3 articles for FGG, 10 articles for CAF, 2 articles for SCTG, 13 articles for CAF + CTG, 6 articles for CAF along with other additional biomaterials, 2 articles for CTG along with other additional biomaterials and 2 articles for pedicle grafts were obtained with a long term follow up.

2. Discussion

2.1. Coronally Advanced flap

This technique was described first by Bernimoulin et al which involve's the coronal repositioning of the gingival tissue which lies apical to the recession defect.⁹ This technique along with Subepithelial connective tissue graft is considered the gold standard technique for recession coverage. Based on the biotype of the gingiva and the presence of keratinized tissue it can either be carried out as a single stage surgery or as a two stage surgery in combination with free gingival grafts to increase the width of attached gingiva.¹⁰

The coronally advanced flap provides great esthetic results, because of the match of colour, texture and thickness blends with the gingiva in-situ. It is also of great reliability for the treatment of Millers Class I and II gingival recession. It achieves a mean root coverage of 55-99% and a complete root coverage of 24-95% of sites.¹¹ Various modifications and combinations with different materials along with CAF is used for better results

The long term efficacy over a time period of more than 5 years of coronally advanced flap were analysed by various authors. Zuchelli et al¹² in 2005, stated that CAF produced an increased in keratinized tissue in 5 years. Leknes et al¹³ in 2005, proposed that CAF showed significant gain in root coverage and improvement in clinical parameters irrespective of the placement of biodegradable membrane over a period of 6 years. DeSanctis M¹⁴ in 2007 concluded that a modified form of CAF was effective in treating isolated recession over a 3 year period. Nickles.K¹⁵ et al in 2010 & Pini Prato¹⁶ in 2011 also stated that CAF proved

to be an effective technique for obtaining root coverage in comparison with GTR and various other techniques over a period of more than 8 years. Michel. K.Mcguire⁶ et al in 2012 concluded that CAF in combination with EMD and CTG resulted in better esthetic results in 10 years, and in 2014¹⁷ stated that CAF along with CTG showed reduction in recession defect in 5 years. Buti J¹⁸ et al in 2013 concluded that CAF with CTG ranked highest in effectiveness for recession reduction and CAL gain. Shula et al¹⁹ and Karin Jespen²⁰ et al in 2017 stated that CAF+CTG and CAF + CMX provided better root coverage in 5 years and 3 years respectively. Improvement's in recession depth was noted over a period of 20 years by Pini Prato²¹ in 2018 when treated with CAF. (Table 1)(Table 2)

2.2. Connective tissue graft

The subepithelial connective tissue graft described by Langer & Langer in 1985,²² is a bilaminar procedure designed to maximise the gingival & supra periosteal blood supply. It was provide as an alternative for free gingival grafts since it provided with great esthetic results, lower morbidity of donor site due to its healing by primary intention.

Along with root coverage it also helps in increasing the thickness of gingival tissue. Various combinations and modifications of connective tissue graft like the usage of an envelope or tunnel flap or the use of epithelial collar along with CTG has also been used to provide better results.²³ A mean root coverage of 97% was reported by Harris. J. Randal in 1992 with the use of CTG.²⁴

Various authors such as Rossberg²⁵ et al n 2008 reported that with the use of CTG a recession in reduction depth was observed over a time period of 22 years, whereas over a span of 5 years, it was reported that CAF + CTG showed better root coverage in comparison with CAF alone by Pini Prato²⁶ et al in 2010. The gingival width was found to be stable with CTG in comparison with ADM when analysed by Moslemi²⁷ in 2011 & CTG+CAF was found to be superior in the treatment of Gingival recession by Davor Kuis²⁸ in 2013 in 5 years. Zuchelli²⁹ and Cairo³⁰ et al in 2014 & 2015 respectively stated that CAF +CTG showed long term better results in comparison with CAF alone. Good improvement in aesthetics and stability over 15 years was obtained with CAF and SCTG as reported by Luca Francetti³¹ in 2018. Rasperini³² et al in 2019 stated that the marginal stability of single maxillary recessions was improved with CAF + CTG in 9 years. Knut Adam³³ in 2019 reported that there was increase in keratinized tissue in gingival recession when treated with CTG+EMD in 18 years. Douglas H³⁴ in 2019 also reported that along with ADM, CTG resulted in recession depth reduction and increase in keratinized gingiva width in 15 years (Table 1).

Table 1: Compilation of various recession coverage techniques based on follow up period (≥ 5 years) and clinical effectiveness

Follow up duration	Procedure	Author	Year	Type of study	Number of cases	Parameters measured	Clinical effectiveness
25 years	FGG	Agudio ³⁵ et al	2017	Longitudinal study	74 patients (182 sites)	Recession depth Probing depth Width of keratinized tissue Recession +Keratinized Tissue	Reduced recession depth Keratinized tissue contraction Improved aesthetics
22 years	CAF+CTG	Rossberg M ²⁶ et al	2008	Case series	20 cases (39 sites)	Recession depth Complete root coverage Patient satisfaction	82% complete root coverage Reduced recession depth Negative influence of baseline recession height Positive influence of location of recession
20 years	CAFvs CAF+CTG	Pini Prato ²¹ et al	2018	Longitudinal study	94 patients (97 sites)	Recession depth Probing depth Width of keratinized tissue	Good patient satisfaction Improvements in recession depth Decrease in mean root coverage
18 years	CTG+EMD	Knut Adam ³³ et al	2019	Longitudinal study	16 patients (25 sites)	Complete root coverage Recession depth PPD CAL Width of keratinized tissue	19 sites with CRC Reduced RD,PPD and CAL Increased wKT
15 years	CAF+SCTG	Luca Franceti ³² et al	2018	Case report	1 patient (1 site)	Recession depth	Resolution of gingival recession Improved aesthetics
15 years	CTG+ADM	Douglas H ³⁶ et al	2019	Case report	1 patient (1 site)	Recession depth PPD Width of keratinized tissue	Reduced PPD and recession depth Increased width of keratinized tissue
14 years	CAF vs Root planning & polishing	Pini Prato et al ³⁷	2011	Randomized split mouth trial	10 patients (Bilateral recession)	Recession depth	Improvements in recession depth

Continued on next page

Table 1 continued

10 years	CAF+ EMD Vs CAF+SCTG	Michael .K. Mcguire ⁶ et al	2012	Split mouth RCT	17 Patients	Gigival recession depth Probing depth CAL Width of KT Percentage of root coverage Colour, texture, contour of treated sites Dentinal hypersensitivity	Increased PD Increased wKT in EMD EMD-Marginal tissue contour was similar to adjacent teeth SCTG- Higher than adjacent teeth Similar aesthetic outcomes in both groups
10 years	Periosteal pedicle graft	Ajay Mahajan ³⁸ et al	2018	Sytematic review	17 publications		Minimal side effects
10 years	CAF+CTG vs CAF+GTR	Nickles.K ¹⁵ et al	2010	RCT	15 patients	Root coverage Recession depth	CTG Stability of root coverage Reduction of recession depth
9 years	CAF+CTG vs CAF	Rasperini Giulio ⁷ et al	2018	RCT	25 recessions	recession depth Keratinized tissue width Dentinal hypersensitivity	CTG Increased keratinized tissue Both techniques- Stability over time
8 years	CAF+CTG	Pini Prato et al ¹⁶	2011	Longitudinal study	60 patients	Root coverage Recession reduction Amount of keratinized tissue	Recession relapse Reduction of Kertainized tissue
6 years	CAF vs CAF + Biodegradble membrane	Leknes et al ¹³	2005	RCT	20 patients (20 sites- CAF) (20 sites CAF+biodegradable membrane)	Apical extent of recession Width of defect at CEJ Width of Keratinized tissue CAL PPD	CAF alone 10 sites exhibit complete root coverage Improvement in clinical parameters
6 years	LPF	AM Norudeen ³⁹ Et al	2013	Case report	1 site (46)	CAL Width of attached gingiva	Gain in CAL Increased width of attached gingiva
5 years	CAF+SCTG Vs CAF+ADM	Shula Zuleika ¹⁹	2017	RCT	11 sites- SCTG 11 sites-ADM	Gingival recession Width of attached gingiva CAL	SCTG was better than ADM

Continued on next page

Table 1 continued

5 years	CAF	Zuchelli et al ¹²	2005	Experimental study	22 patients (73 sites)	Height of keratinized tissue Recession depth	Increased keratinized tissue Increase in recession depth Successful root coverage
5 years	Surgical/Non Surgical	Lindhe ⁸ et al	1984	Longitudinal study	15 patients	Probing depth CAL Gingival conditions Oral hygiene	Oral hygiene has influence on long term results Sites with initial pocket depth more than 3mm also responded well
5 years	CAF+CTG	Zuchelli ²⁹ et al	2014	RCT	G1- (25)CAF+CTG G2-CAF (25)	Recession height Complete root coverage Width of attached gingiva	CAF+CTG Greater recession reduction Increased width of attached gingiva Complete root coverage
5 years	CAF vs CAF+CTG	Davor Kuis ²⁸ et al	2013	RCT	37 patients (114 sites)	Recession length Keratinized tissue width Complete root coverage Percentage of root coverage	CAF+CTG Better Recession length reduction, CRC &PRC Increased Keratinized tissue width
5 years	CAF+ Platelet derived growth factor Vs CAF+CTG	McGuire et al ¹⁷	2014	Split mouth RCT	G1- CAF+ Growth factor(10 pts) G2- CAF + CTG (10pts)	Recession depth Probing depth CAL Height of keratinized tissue Percentage of root coverage	CAF+PGF Improved recession Percentage of root coverage Increased Keratinized tissue height Both groups 100% root coverage CAL changes
5 years	FGG	Jacques Matter ⁴⁰ et al	1980	Observational study	10 patients	Recession length Width of exposed root surface	Increase in attached gingiva Initial extension of recession by 1mm
5 years	CAF vs CAF+CTG	Pini prato ²⁶ et al	2010	Longitudinal study	13 patients (49 sites –CAF 44-CAF+CTG)	Recession depth Probing depth CAL	CAF+CTG resulted in better results than CAF
5 years	ADMA vs SCTG	Moslemi ²⁷ et al	2011	Split mouth RCT	16 patients	Probing depth Recession depth Recession width Gingival width	Improvement in clinical parameters in both the groups Gingival width did not increase in ADMA group More relapse observed in patients with horizontal tooth brushing habit

2.3. Free Gingival Graft

Free gingival graft was first described by Bjorn in 1963.³⁶ It was initially used as a means to increase the width of attached gingiva and increase the vestibular depth, and was later used for root coverage. It can be used in treating root coverage either as one stage or two stage procedure where the free gingival graft is placed apical to the recession and later, post healing a pedicle flap was raised to cover the tooth.²³ Pagliaro⁴¹ et al stated that the mean root coverage achieved by free gingival graft varies between 9-87% and the complete root coverage varies between 9-72% sites. The success of these grafts are influenced by various factors like thickness and immobilization of the graft, adequate blood supply from adjacent sites and smoking habits of the patient. Despite of various advantages of the technique like its simple technique and ability to increase the width of attached gingiva, various disadvantages of the technique such as increased discomfort, colour mismatch and large donor site wound are also evident.⁴²

Ratietschack⁴³ in 1979 stated that FGG along with vestibuloplasty, resulted in root coverage without recurrence of recession along with gain in vestibular depth in 4 years. 70% root coverage was obtained in patients with a recession depth less than 3 mm over a span of 5 years as stated by Jacques Matter⁴⁰ in 1980. Agudio³⁵ et al in 2017 reported that in 25 years the treatment of gingival recession with FGG promoted favourable keratinized tissue and improved the marginal tissue recession.(Table 1)

2.4. Rotational Pedicle Grafts

Pedicle grafts was the periodontal plastic surgery proposed in 1956. The pedicle graft retains its blood supply through its attachment to the base and facilitating revascularisation with the recipient site. Pedicle grafts provide long term aesthetic results in the presence of adequate width of attached gingiva. Pedicle flaps are contraindicated in sites with shallow vestibule, less width of keratinized tissue and with high frenal attachment.²³

The Laterally positioned flap is the first pedicle flap used in 1956, introduced by Grupe and Warren. Various modifications of the original technique were given by several authors to overcome recession in adjacent tooth. The success rate of lateral pedicle graft is evaluated to be 69-72% by Zuchelli.G⁵⁰ in 2004.

One of the modifications of laterally positioned flap to overcome its limitations is the Double papilla flap by Cohen and Ross. It can be used in cases with insufficient attached gingiva, and provides excellent aesthetic results and colour match. The only drawback of the technique is, it can be used for treatment of single tooth recessions only.⁵¹

Several authors have used the rotational pedicle flaps for root coverage and reported its long term stability, Only few studies are available with a follow up of more than 5 years as

of rotational pedicle flaps are considered. Ajay Mahajan³⁸ et al in 2018, in his systematic review of periosteal pedicle grafts stated that it has minimal side effects and improved clinical parameters when compared to other root coverage techniques in over a period of 10 years, which is the longest follow up period available in the literature assessing the efficacy of pedicle graft. Luiz Armando⁵² et al in 2009 stated that, treatment of gingival recessions with LPF showed significant improvement in all clinical parameters, whereas gain in width of keratinized tissue was more in maxillary defects when compared with mandibular defects in 2 years. Thiago Machi in 2010 reported that with LPF, gingival recessions showed complete root coverage, increased keratinized tissue, absence of dentin hypersensitivity and very good aesthetic outcomes in a span of 1 year. A.M.Noorudien³⁹ in 2013 reported that, LPF showed keratinized tissue gain and 8mm attachment gain in 6 years. Root coverage of 83% was obtained in a span of 1 year and 3 years with LPF along with CTG, as reported by Awadesh Kumar⁴⁷ and Chun Tee Lee⁴⁴ in 2014 respectively. Pallavi⁴⁶ in 2014 and Sunil⁴⁸ in 2017 treated gingival recessions with Double papilla flaps and reported aesthetically satisfying results in 3 months and 1 year respectively.(Tables 1 and 2)

3. Summary of Findings

This review aimed to evaluate all the available literature reporting long term outcomes of techniques for treatment of gingival recession. Literature search revealed that only few articles presented long term findings of root coverage techniques. Of all the studies 3 studies reported long term follow up for FGG as 25 years, 19 studies reported a long term follow up for CAF in combination with CTG,EMD,ADM etc, with the longest follow being 22 years, Whereas 3 studies reported the longest follow up of CTG being 18 years. Minimum evidence was found for pedicle grafts out of which most of them were only case reports with a maximum follow up of 6 years and a systematic review with a follow up of 10 years. The longest long term follow up available was 25 years which was for FGG

On analysing the collected literature:

1. Apart from CAF+CTG there is a lack of evidence for long term clinical outcomes and stability of results for other techniques of root coverage
2. All the studies used complete root coverage, Height and width of keratinized tissue, absence of periodontal pocket and bleeding on probing and presence of clinically healthy gingiva of the treated sites as the primary outcome
3. Very few studies have analysed other parameters like height of the interdental tissue, status of dentinal hypersensitivity and patient satisfaction

Table 2: Compilation of various recession coverage techniques based on follow up period (≤ 5 years) and clinical effectiveness

4 years	SCTG	Langer ²² et al	1985	Longitudinal study	50 patients	• Root coverage • Vestibular depth	• 2-6mm root coverage has been achieved • Increase in vestibular depth • Vestibule depth decrease up to transplant margin • Graft shrinkage up to 25% • Improvement in recession depth • Reduced /hypersensitivity
4 years	FGG+ Vestibuloplasty	Rateitschak ⁴³ et al	1979	Longitudinal study	12 patients (42 teeth)		CAF+CMX • 91.7% root coverage • Increased thickness and width of attached gingiva
3 years	LPF+ SCTG	Chu tee lee ⁴⁴ et al	2014	Case report	3 recession sites	• Recession depth • Hypersensitivity	
3 years	CAF Vs CAF+CMX	Karin Jepsen ²⁰ et al	2017	RCT	18 patients (36 sites)	• Percentage of root coverage • Complete root coverage • Thickness of attached gingiva • Width of attached gingiva	
3 years	CAF+CTG vs CAF	Cairo, F ³⁰ et al	2015	RCT	24 patients (13 CAF- 11 patients)	• Recession depth • Probing depth • Distance from incisal margin to CEJ • Distance from incisal margin to Gingival margin • Distance from incisal margin to MGJ • Keratinized tissue • Dental hypersensitivity	• CAF+CTG was better in terms of complete root coverage & higher KT gain • No difference between the groups in recession depth, probing depth and CAL
3 years	LPF vs CAF	Raul G. Caffesse ⁴⁵ et al	1980	Observational study	26 recession sites	• Pocket depth • Gingival recession • Width of attached gingiva	• No significant changes between two groups • Clinical parameters remained stable
3 years	CAF	de Sanctis M et al ¹⁴	2007	Longitudinal study	40 patients	• Recession depth • Pocket depth • CAL • Height of keratinized tissue	• Improvement in recession depth • Gain in CAL • Reduced probing depth • Increased keratinized tissue
2 years	LPF	Luiz Armando Chambrone ⁴⁵ et al	2009	Longitudinal study	32 patients	• Recession depth • Keratinized tissue width • Probing depth • CAL	• Decrease in recession depth • Decreased CAL • Decrease in probing depth • Increased keratinized tissue width
1 year	Double papilla flap	Pallavi samantha ⁴⁶ et al	2014	Case report	1 patient (1 site)	• Recession length • Recession width • Width of attached gingiva • Probing depth	• Complete root coverage • Good aesthetics
1 year	LPF+CTG	Avadesh ⁴⁷ et al	2014	Case report	1 patient (1 site)	• Recession depth • PPD • Gingival height	• Predictable root coverage achieved
1 year	Double papilla flap+ CTG	Sunil ⁴⁸ et al	2017	Case report	1 patient (1 site)	• Recession depth • Recession width • Width of keratinized tissue	• Root coverage • Increased width of keratinized gingiva
1 year	LPF+CTG	Thiago Machi ⁴⁹ et al	2010	Case report	1 patient (1 site)	• Recession depth • Width of keratinized tissue • Dentin hypersensitivity	• Complete root coverage • Increased keratinized tissue • Absence of dentin hypersensitivity • Good aesthetic outcome

ADM- Acellular Dermal Matrix, ADMA – Acellular Dermal Matrix Allograft, CAF- Coronally Advanced Flap, CTG-Connective Tissue Graft, CAL- Clinical Attachment Level, CMX- Xenogenic Collagen Matrix, CEJ- Cemento Enamel Junction, FGG- Free Gingival Graft, KT- Keratinized Tissue, LPF- Laterally Positioned Flap, MGJ- Mucogingival Junction, PPD- Probing Pocket Depth, PGF- Platelet Derived Growth Factor, RD- Recession Depth, RCT- Randomized Control Trial, SCTG- Subepithelial Connective Tissue Graft, wKT – Width of Keratinized Tissue

4. In cases of recession with inadequate keratinized tissue or shallow vestibule FGG appears to provide long term stable results in terms of increase in width of keratinized tissue. But evidence for complete root coverage is moderate.
5. In cases with adequate amount of keratinized tissue CAF appears to be the treatment of choice and long term evidence supports the same. CAF along with additives like GTR, AMD, PRF etc does not prove to be better over CAF alone over long term
6. CAF + CTG is the most extensively reported technique with long term results. This seems to be the most promising technique in terms of complete root coverage, gain in keratinized tissue, esthetics, over long term and is rightly considered the “Gold Standard”

4. Conclusion

Treatment of gingival recession has gained therapeutic importance over years due to increased aesthetic concern among patients and advent of new promising surgical techniques. Though CTG is considered as the gold standard it is not the only best surgical option in all cases. Careful analysis of patient related factors, defect related factors, clinician's expertise should be the key considerations in selecting appropriate technique.

5. Conflicts of interest

All authors declare no conflicts of interest pertaining to the stated work.

6. Source of Funding

None.

References

1. Cairo F, Rotundo R, Miller PD, Prato GP. Root Coverage Esthetic Score: A System to Evaluate the Esthetic Outcome of the Treatment of Gingival Recession Through Evaluation of Clinical Cases. *J Periodontol*. 2009;80(4):705–10. doi:10.1902/jop.2009.080565.
2. Nguen-Hieu T, Thi BH, Thu HD, Giao HT. Gingival recession associated with predisposing factors in young Vietnamese: A pilot study. *Oral Health Dent Manag*. 2012;11(3):134–44.
3. Esteibar JR, Zorzano LA, Cundin EE, Blanco JD, Medina JR. Complete root coverage of Miller Class III Recessions. *Int J Periodontics Restorative Dent*. 2011;31(4):1–7.
4. Soren J, Jack G, Jasim M. Periodontal manifestations of systemic diseases and developmental and acquired conditions: Consensus report of workgroup 3 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. *J Clin Periodontol*. 2018;45(20):219–9.
5. Alghamdi H, Babay N, Sukumaran A. Surgical management of gingival recession: A clinical update. *Saudi Dent J*. 2009;21(2):83–94. doi:10.1016/j.sdentj.2009.07.006.
6. McGuire MK, Scheyer ET, Nunn M. Evaluation of Human Recession Defects Treated With Coronally Advanced Flaps and Either Enamel Matrix Derivative or Connective Tissue: Comparison of Clinical Parameters at 10 Years. *J Periodontol*. 2012;83(11):1353–62. doi:10.1902/jop.2012.110373.
7. Rasperini G, Acunzo R, Pellegrini G, Pagni G, Tonetti M, Prato GP, et al. Predictor factors for long-term outcomes stability of coronally advanced flap with or without connective tissue graft in the treatment of single maxillary gingival recessions: 9 years results of a randomized controlled clinical trial. *J Clin Periodontol*. 2018;45(9):1107–17. doi:10.1111/jcpe.12932.
8. 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):448–58. doi:10.1111/j.1600-051x.1984.tb01344.x.
9. Bernimoulin JP, Luscher B, Muhlemann HR. Coronally repositioned periodontal flap.. Clinical evaluation after one year. *J Clin Periodontol*. 1975;2(1):1–13. doi:10.1111/j.1600-051x.1975.tb01721.x.
10. Allen EP, Miller PD. Coronal positioning of existing gingiva: short term results in the treatment of shallow marginal tissue recession. *J Periodontol*. 1989;60(6):316–9.
11. Wennstrom JL. Mucogingival therapy. *Ann Periodontol*. 1996;1(1):671–701.
12. Zucchelli G, Sanctis MD. Long-Term Outcome Following Treatment of Multiple Miller Class I and II Recession Defects in Esthetic Areas of the Mouth. *J Periodontol*. 2005;76(12):2286–92. doi:10.1902/jop.2005.76.12.2286.
13. Leknes KN, Amarante ES, Price DE, Boe OE, Skavland RJ, Lie T, et al. Coronally positioned flap procedures with or without a biodegradable membrane in the treatment of human gingival recession. A 6-year follow-up study. *J Clin Periodontol*. 2005;32(5):518–29. doi:10.1111/j.1600-051x.2005.00706.x.
14. de Sanctis M, Zucchelli G. Coronally advanced flap: a modified surgical approach for isolated recession-type defects: Three-year results. *J Clin Periodontol*. 2007;34(3):262–8. doi:10.1111/j.1600-051x.2006.01039.x.
15. Nickles K, Ratka-Krüger P, Neukrantz E, Raetzke P, Eickholz P. Ten-Year Results After Connective Tissue Grafts and Guided Tissue Regeneration for Root Coverage. *J Periodontol*. 2010;81(6):827–36. doi:10.1902/jop.2010.090632.
16. Pini-Prato G, Franceschi D, Rotundo R, Cairo F, Cortellini P, Nieri M, et al. Long-Term 8-Year Outcomes of Coronally Advanced Flap for Root Coverage. *J Periodontol*. 2012;83(5):590–4. doi:10.1902/jop.2011.110410.
17. McGuire MK, Scheyer ET, Snyder MB. Evaluation of Recession Defects Treated With Coronally Advanced Flaps and Either Recombinant Human Platelet-Derived Growth Factor-BB Plus β -Tricalcium Phosphate or Connective Tissue: Comparison of Clinical Parameters at 5 Years. *J Periodontol*. 2014;85(10):1361–70. doi:10.1902/jop.2014.140006.
18. Buti J, Baccini M, Nieri M, Marca ML, Pini-Prato GP. Bayesian network meta-analysis of root coverage procedures: ranking efficacy and identification of best treatment. *J Clin Periodontol*. 2013;40(4):372–86. doi:10.1111/jcpe.12028.
19. Sumana SZ, Masulili SLC, Lessang R. Root coverage using the subepithelial connective tissue graft or the acellular dermal matrix for the treatment of gingival recession: A clinical study. *Int J Appl Pharm*. 2018;9(2):20–3. doi:10.22159/ijap.2017.v9s2.06.
20. Jepsen K, Stefanini M, Sanz M, Zucchelli G, Jepsen S. Long-Term Stability of Root Coverage by Coronally Advanced Flap Procedures. *J Periodontol*. 2017;88(7):626–33. doi:10.1902/jop.2017.160767.
21. Pini-Prato G, Magnani C, and LC. Long term evaluation of the outcome of coronally advanced flap in the treatment of single recession type defects. *J Periodontol*. 2018;89(3):265–74.
22. Langer B, Langer L. Subepithelial Connective Tissue Graft Technique for Root Coverage. *J Periodontol*. 1985;56(12):715–20. doi:10.1902/jop.1985.56.12.715.
23. Shkreta M, Atanasovska-Stojanovska A, Dollaku B, Belazelkoska Z. Exploring the Gingival Recession Surgical Treatment Modalities: A Literature Review. *Open Access Macedonian J Med Sci*. 2018;6(4):698–708. doi:10.3889/oamjms.2018.185.

24. Harris RJ. The guided tissue and partial thickness double pedicle graft: a predictable method of obtaining root coverage. *J Periodontol.* 1992;63:477–86.
25. Rossberg M, Eickholz P, Raetzke P, Ratka-Krüger P. Long-term results of root coverage with connective tissue in the envelope technique: a report of 20 cases. *Int J Period Restor Dent.* 2008;28(1).
26. Pini-Prato GP, Cairo F, Nieri M, Franceschi D, Rotundo R, Cortellini P, et al. Coronally advanced flap versus connective tissue graft in the treatment of multiple gingival recessions: a split-mouth study with a 5-year follow-up. *J Clin Periodontol.* 2010;37(7):644–50. doi:10.1111/j.1600-051x.2010.01559.x.
27. Moslemi N, Jazi MM, Haghighati F, Morovati SP, Jamali R. Acellular dermal matrix allograft versus subepithelial connective tissue graft in treatment of gingival recessions: a 5-year randomized clinical study. *J Clin Periodontol.* 2011;38(12):1122–9. doi:10.1111/j.1600-051x.2011.01789.x.
28. Kuis D, Sciran I, Lajnert V, Snjaric D, Prpic J, Pezelj-Ribaric S, et al. Coronally Advanced Flap Alone or With Connective Tissue Graft in the Treatment of Single Gingival Recession: A Long-Term Randomized Clinical Trial. *J Periodontol.* 2013;84(11):1–12. doi:10.1902/jop.2013.120451.
29. Zucchelli G, Mounssif I, Mazzotti C, Stefanini M, Marzadori M, Petracci E, et al. Coronally advanced flap with and without connective tissue graft for the treatment of multiple gingival recessions: a comparative short- and long-term controlled randomized clinical trial. *J Clin Periodontol.* 2014;41(4):396–403. doi:10.1111/jcpe.12224.
30. Cairo F, Cortellini P, Tonetti M, Nieri M, Mervelt J, GPagavino, et al. Stability of root coverage outcomes at single maxillary gingival recession with loss of interdental attachment: 3-year extension results from a randomized, controlled, clinical trial. *J Clin Periodontol.* 2015;42(6):575–81. doi:10.1111/jcpe.12412.
31. Francetti L, Taschieri S, Cavalli N, Corbella S. Fifteen-Year Follow-Up of a Case of Surgical Retreatment of a Single Gingival Recession. *Case Rep Dent.* 2018;p. 1–5. doi:10.1155/2018/3735162.
32. Rasperini G, Acunzo R, Limiroli E. Decision Making in Gingival Recession Treatment: Scientific Evidence and Clinical Experience. *Clin Adv Period.* 2011;1:41–52. doi:10.1902/cap.2011.100002.
33. Adam K, Staufienbiel I, Geurtsen W, Günay H. Root coverage using a connective tissue graft with epithelial striation in combination with enamel matrix derivatives - a long-term retrospective clinical interventional study. *BMC Oral Health.* 2019;19:148. doi:10.1186/s12903-019-0849-7.
34. Mahn DH. Long term results of grafting using an ADM. *Inside Dent.* 2014;15(5):90–5.
35. Agudio G, Chambrone L, Pini-Prato G. Biologic Remodeling of Periodontal Dimensions of Areas Treated With Gingival Augmentation Procedure: A 25-Year Follow-Up Observation. *J Periodontol.* 2017;88(7):634–42. doi:10.1902/jop.2017.170010.
36. Bjorn H. Free transplantation of gingiva propria. *Swedish Dent J.* 1963;22:684–9.
37. Pini-Prato G, Rotundo R, Franceschi D, Cairo F, Cortellini P, Nieri M, et al. Fourteen-year outcomes of coronally advanced flap for root coverage: follow-up from a randomized trial. *J Clin Periodontol.* 2011;38(8):715–20. doi:10.1111/j.1600-051x.2011.01744.x.
38. Mahajan A. A review of periosteal pedicle graft technique for the management of gingival recession defects. *Adv Surg Res.* 2018;2(1):10–14.
39. Noorudeen AM, Paul AM, Shereef M. Six year follow-up of a root coverage procedure on a lower molar tooth with lateral pedicle flap. *J Indian Soc Periodontol.* 2013;17(5):661–4. doi:10.4103/0972-124x.119289.
40. Matter J. Creeping Attachment of Free Gingival Grafts: A Five-Year Follow-up Study. *J Periodontol.* 1980;51(12):681–9. doi:10.1902/jop.1980.51.12.681.
41. Pagliaro U, Nieri M, Franceschi D, Clauser C, Pini-Prato G. Evidence-Based Mucogingival Therapy. Part 1: A Critical Review of the Literature on Root Coverage Procedures. *J Periodontol.* 2003;74(5):709–40. doi:10.1902/jop.2003.74.5.709.
42. Baker P. The management of gingival recession. *Dent Update.* 2002;29:114–20.
43. Raterrschak KH, Egli U, Fringeli G. Recession: A 4-year longitudinal study after free gingival grafts. *J Clin Periodontol.* 1979;6(3):158–64. doi:10.1111/j.1600-051x.1979.tb02195.x.
44. Lee CT, Chang PC, Touchan N, Royzman D. Root coverage with a modified laterally positioned flap combined with a subepithelial connective tissue graft in advanced recession. *J Periodontal Implant Sci.* 2014;44(6):300–6. doi:10.5051/jpis.2014.44.6.300.
45. Caffesse RG, Guinard EA. Treatment of Localized Gingival Recessions: Part IV. Results After Three Years. *J Periodontol.* 1980;51(3):167–70. doi:10.1902/jop.1980.51.3.167.
46. Yalamanchili PS, Pavithra D, Potluri S, Arunima PR. Root Coverage using Double Papilla Preservation Flap: A Case Report. *J Int Oral Health: JIOH.* 2014;6(6):82.
47. Singh AK, Kiran P. Laterally positioned double flap with the connective tissue graft for coverage of denuded root surface: A case report. *J Int Clin Dent Res Organ.* 2014;6:40.
48. Sunil S, Harsha MB. Root Coverage using Double Papilla with Connective Tissue Graft: A 13-month Report of a Successful Case. *J Health Sci Res.* 2017;8(2):77–9. doi:10.5005/jp-journals-10042-1054.
49. Machi MT, Alvaro F, Guilherme G, Sabrina F. Laterally positioned flap associated with subepithelial connective tissue graft for coverage of isolated gingival recession. *RSBO.* 2011;8(4):468–8.
50. Zucchelli G, Cesari C, Amore C, Montebugnoli L, Sanctis MD. Laterally Moved, Coronally Advanced Flap: A Modified Surgical Approach for Isolated Recession-Type Defects. *J Periodontol.* 2004;75(12):1734–41. doi:10.1902/jop.2004.75.12.1734.
51. Cohen DW, Ross SE. The Double Papillae Repositioned Flap in Periodontal Therapy. *J Periodontol.* 1968;39(2):65–70. doi:10.1902/jop.1968.39.2.65.
52. Mascarenas JL, Sarandeses LA, Castedo L, Mourino A. ChemInform Abstract: Palladium-Catalyzed Coupling of Vinyl Triflates with Enynes and Its Application to the Synthesis of 1 α ,25-Dihydroxyvitamin D₃. *ChemInform.* 2010;22. doi:10.1002/chin.199130285.

Author biography

V.S.Ananya Sweta, Post Graduate Scholar

Jananni Muthu, Reader

B Pratebha, Professor

R Saravana Kumar, Professor and Head

Cite this article: Sweta VSA, Muthu J, Pratebha B, Kumar RS. Long term efficacy of root coverage techniques. *IP Int J Periodontol Implantol* 2021;6(2):79–87.