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# Comparative Evaluation of The Effectiveness of Different Surgical Techniques of Coronally Advanced Flap In Gingival Recession Management - A Systematic Review

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## ABSTRACT

**Background and objective** : Although coronally advanced flap has been a gold standard technique for recession management, no systematic review has exclusively addressed the effectiveness of various surgical modifications of coronally advanced flap. A single technique addressing almost all the recession defects within a single visit, that is operator-friendly, time-efficient, no requirement for a second surgical site, and, most importantly, meeting the patient's esthetic demands is always a preferable option. Coronally advanced flap (CAF) technique is the gold standard technique indicated for the management of Miller's class I and class II gingival recession defects.

**Aim:** The aim of this systematic review was to appraise the effectiveness of different surgical modifications in coronally advanced flap techniques in the management of Gingival recessions.

Material and Methods : Randomized clinical trials with at least 3 months of follow-up comparing at least two techniques of coronally advanced flap for treatment of Miller Class I and II gingival recessions were identified. The primary outcome variable being the percentage of root coverage (%RC). The secondary outcomes were recession depth, recession width, clinical attachment gain, keratinized tissue gain, mean root coverage, complete root coverage, aesthetic satisfaction, tooth sensitivity, post-operative patient discomfort

**Results:** A total of 503 Millers class I and II gingival recessions in 264 subjects from 10 RCT's included in this systematic review, which compared different techniques show that irrespective of the technique, there was a significant improvement in clinical outcome as compared to baseline. Comparison of the CAF with vertical releasing incisions and Tunnel technique, Coronally advanced flap showed better results. Whereas, CAF with and without vertical incisions had not shown significant difference except for the patient-related parameters favouring flap without vertical incision. Comparison of triangular CAF with trapezoidal CAF showed that triangular CAF had better results. Between CAF with tension and without tension, CAF without tension had favorable results. Long-term maintenance of the obtained recession coverage was not observed irrespective of the technique used except for one study.

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**Conclusion:** CAF with vertical releasing incisions is better compared to CAF without vertical incisions when root coverage is the major outcome. Aesthetics and patient-related outcome parameters were significantly better for CAF without vertical releasing incisions. More clinical trials are needed to confirm these results as there was heterogeneity in the included studies and the number of studies comparing each technique were very few.

**Keywords:** *complete root coverage; gingival recession; mucogingival surgery; root coverage; randomized controlled trial; minimally invasive flap; modified coronally advanced flap; coronally advanced flap; systematic review*

## INTRODUCTION

Most often occurring gingival recession defects are brought on by traumatic tooth brushing, misaligned teeth, ectopic frenum and muscle attachment insertion1, and plaque-associated chronic inflammatory periodontal disease2. Gingival recession(GR) is prevalent in adults at a rate of 20% to 100%. Dental sensitivity, root caries, an unsightly gingival appearance, and loss of periodontal attachments can all result from gingival recession. Treatment for multiple gingival recessions is more difficult than for single recessions. The depth of the recession, the type and amount of keratinized tissue next to the defect, length and width of the interdental soft-tissue, the vestibular depth3, post-operative tissue stabilization, and the final position of gingival margin are some of the factors that influence the treatment option and the outcome of various surgical procedures. In order to achieve complete root coverage (CRC) and long-term sustainability of the recession management outcome 2,4, the gingival margin's final location is crucial. Coronally advanced flap (CAF), modified CAF technique5, minimally invasive CAF 6, CAF with orthodontic buttons7, expanded mesh technique2, vestibular incision subperiosteal tunnel access technique (VISTA)8, CAF both with and without vertical releasing incisions 8,9, and pinhole surgical technique (PST)10 are just a few of the treatment options for managing multiple recession type defects (MRTDs) that are extensively discussed in the scientific literature. It is a field of study that is always developing and growing.

A preferred solution is a surgical procedure which treats all gingival recession defects in one single surgical visit, simple, useful, quick, does not necessitate another surgical site, yet, satisfies the patient's cosmetic requirements 7,11. The anchoring and stabilization of the misplaced flap obtained within the first 2 weeks of wound healing is the most important component of every perio-plastic surgery achieving recession coverage 7. Our team has done extensive research in the field of dentistry as well as medicine12–28.

One of the most frequently utilized surgical methods for treating Miller's class I and class II gingival recession abnormalities is the CAF. Coronally advanced flap terminology was first used by Pini Prato and colleagues in 199929. In addition to reducing the necessity for an additional surgical site, CAF may produce good aesthetic benefits. Another straightforward minimally invasive method of coronal advancement of gingival edge is the semilunar coronally relocated flap (SCRF). Partsch first used it in oral surgery over a century ago.

In the treatment of MRTD, the coronal stabilization of advanced flaps, composite stops for stabilizing sutures, and a coronally advanced flap with button all outperformed CAF alone7. It has been demonstrated that higher root coverage may result from the gingival margin's postoperative advanced displacement 4,29. The absence of vertical releasing incisions (VRIs), that would limit the revascularization of the operative area and might result in an unsightly visible scar, is the ostensible benefit of the envelope type of flap in such places (keloids).

The clinical and aesthetic results of the root-coverage surgical intervention have not been assessed or compared to determine whether VRIs genuinely have a negative effect. Better vascularity and aesthetics will result from a procedure that does not require VRI’s whilst

retaining the unification of the interdental papilla. Increasing CRC is made possible by using a suturing procedure to anchor and stabilize the displaced flap. There have been reports of better root coverage results when flap anchoring was created via suturing 30,31.

The present understanding of evidence-based medicine (EBM) promotes the idea that every therapeutic intervention must be chosen based on trustworthy and objective data produced through a scientific approach. As a result, systematic reviews have drawn a lot of attention as a useful tool for locating and evaluating the best evidence that is currently available. As of yet, there are no systematic reviews comparing the effectiveness of different surgical modifications of CAF. The aim of this systematic review(SR) was to assess the effectiveness of different surgical modifications of CAF technique in the treatment of gingival recessions.

## MATERIAL AND METHODS

### *Study Design*

This review was reported based on the standards of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) Statement.

In this systematic review, only randomized-controlled clinical trials (RCTs), of at least 3 months' duration were considered.

### *Structured Review Question*

Which surgical modification in a coronally advanced flap would result in better outcome for gingival recession management?

### *Eligibility Criteria*

### *Inclusion Criteria*

Only randomized controlled trials reporting on different surgical modifications of the coronally advanced flap, and their effectiveness in management of gingival recession with a minimum follow-up duration of 3 months, studies comparing the results of at least 2 of the investigated surgical techniques of CAF in patients with Miller Class I or II gingival recession defects.

### *Exclusion Criteria*

Studies involving patients with systemic diseases such as diabetes mellitus, hypertension etc were excluded from this study. As the main inclusion criteria was comparison of different modifications, influence of biomaterials was excluded as much as possible based on the literature available.

### *Selection*

For the criteria in this review PICO method was considered (Glossary of Evidence-Based Terms 2007):

PICO (Population, Intervention/Exposurement, Comparison, Outcomes)

P- Participants

Patients who have been clinically diagnosed with a localized Miller Class I or II gingival recession defect.

-I/E- Interventions

The surgical technique of coronally advanced flap was considered for the treatment of gingival recessions

C- Comparison between interventions (modifications of surgical techniques of CAF procedures)

The following comparisons were the selected techniques that were compared:

CAF with and without VRI's, Semilunar CAF with conventional CAF, Triangular CAF with Trapezoidal CAF, Minimally invasive CAF with Modified CAF, CAF with and without tension, Tunnel coronally advanced flap with conventional CAF, Pouch technique of CAF with conventional CAF, Envelop type of CAF with conventional CAF.

O- Outcome measures

The following are the considered outcome measures:

Clinical and patient-related parameters -

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Primary outcome -

Mean root coverage (MRC).

***Secondary outcomes***

Changes such as recession reduction in mm at the follow-up visit (ReRed), clinical attachment level (CAL) expressed as CAL gain in millimeters at the follow-up visit (CAL gain), width of keratinized tissue (KT) expressed as KT gain in millimeters at the follow-up visit (KT gain), percentage of root coverage, biological or physiological complications during the post-operative healing period (Complications)

***Patient-related outcomes***

Post-operative pain, Patient's discomfort during the post-operative healing period, Patient preference in terms of esthetic result at the follow-up visit (esthetic satisfaction), Patient perception of root sensitivity at the follow-up visit (Root sensitivity) measured with visual analog scale.

***Search strategy and information sourcing***

***Literature Search Protocol***

Comprehensive search algorithms created for MEDLINE [for Medical Literature Analysis and Retrieval System Online] were used to conduct the searches. Using MeSH (for Medical Subject Headings) terms, keyword phrases, and other free terms, searches were conducted in databases up to and including July 30, 2020. Also, the databases of four periodontal publications (namely, Journal of Clinical Periodontology, J Periodontol, Journal of Periodontal Research, and International Journal of Periodontics and Restorative Dentistry) and reference lists of any potential papers were manually searched. Only clinical studies on humans were included in the search. There was no restriction placed on the publication date. Only English was allowed as the language.

***Article Selection***

A total of 10 articles were selected by the same author (BG) based on the article abstracts, titles, and full texts. The following issues were observed and recorded: (i) citation, (ii) year of publication, (iii) main characteristics of participants, (iv) type of interventions (v) comparison of the interventions, (vi) clinical follow-up time period and (vii) patient related outcome measures.

***Risk of Bias assessment in included RCTs***

The risk included in the RCTs was assessed by the factors included in the Cochrane Collaboration's approach for measuring bias (Cochrane Handbook for Systematic Reviews of Intervention). The included studies' risk of bias was rated as low, uncertain, or high (Table 1).

***Data Management***

One reviewer (BG) has extracted the data into excel spreadsheets and then double checked by an additional reviewer (SV). Data/Information/Summary of study characteristics such as conclusions, interventions, populations, comparisons were then transferred to the evidence tables, to provide an overview of the data available and included studies. The excel spreadsheets' contents were examined to determine whether any data should be used in a meta-analysis. In order to prepare for a quantitative analysis, data were then imported into Stata (Stata Statistical Software: Release 15, StataCorp LLC). For the linear regression model, when a P value of 0.05 was deemed statistically significant, the coefficient was calculated along with its standard error (SE) and confidence intervals (CI) of 95%.

## RESULTS

***Results of Literature Selection Process***

Figure 1 gives the flow-chart of the articles that were screened during the process of review.

930 articles were found after a preliminary search of the electronic database, of which 187 were from PubMed, 294 were from Cochrane, and 449 are all from Google Scholar. 34 non-duplicate papers were evaluated after a preliminary screening of these inclusion criteria research articles, and 20 articles were immediately rejected due to the biomaterial comparison rather than the technique. Only 10 of the 14 remaining

studies were used in this systematic review. There were 503 recession defects in all of the examined studies.

Among 10 studies, CAF was the treatment of choice and its possible combinations (Caf+Tun; Caf+Adm; Tun+Pouch; Caf+Vertical Incisions; Caf+Tension Free Flap, etc) were compared with it. In 10 studies, all the studies have assessed the clinical and patient-related parameters. All the studies have shown that there was a significant increase in the root coverage and recession reduction when compared to baseline values.

4 studies have compared CAF i.e, with vertical releasing incisions with pouch or envelope technique (without vertical releasing incisions), 1 study has compared the CAF flaps with tension and without tension 3 studies compared TUN+CAF and 1 study compared semilunar versus CAF. All 4 studies concluded that CAF without vertical incisions( pouch or envelope) technique showed better results in root coverage. 3 studies compared CAF+TUN, two studies concluded that CAF was better than TUN technique, whereas the other had shown that between the two techniques, there was no significant difference.

In one of the studies, where CAF + TUN was compared in which Trapezoidal CAF was compared to Tunnel technique, Trapezoidal has shown better results compared to tunnel technique. When comparing the trapezoidal CAF and Triangular CAF, the latter has shown promising results as compared to trapezoidal CAF.

All included RCTs reported the CRC either in number or percentage.

In one trial32, data from the number of 33,34 and the percentage of defect sites (7) with CRC were not given. The percentage of CRC ranged from 29, 30 to 100% at 3, 6, and 12 months after surgery in the other included trials.

The pertinent data analysis from 503 gingival recession revealed that, altogether, there weren't any statistically significant areas for sites exhibiting CRC while surgically modified CAF when comparing to those where the gold standard CAF approach was employed in 4 investigations 35,36,37 out of 7, which provided the answer to the question. However this result was based on the minimally invasiveness of the modification. The other three studies showed that CAF alone was not significantly better 38399.

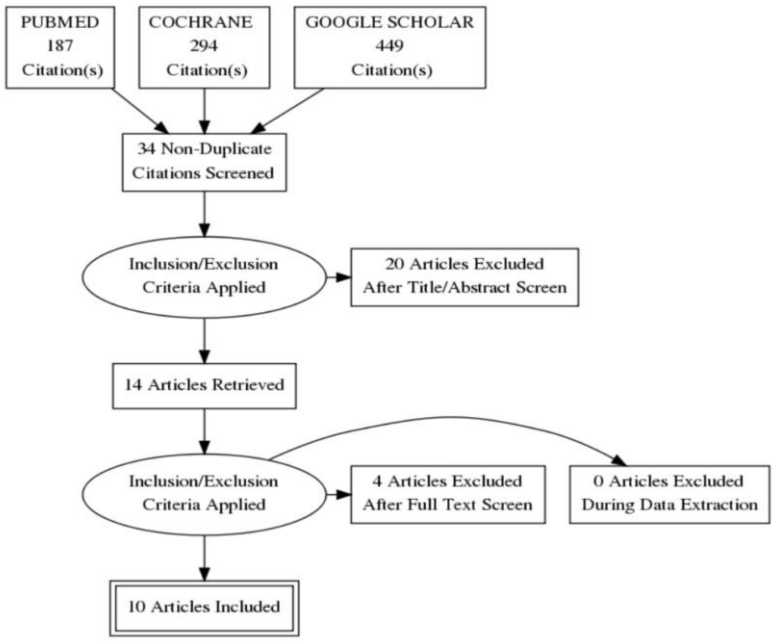


**FIG 1**: Flowchart of article selection.

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***Level Of Evidence***

| Author and year | Study design | Level of evidence |
|---|---|---|
| Giovanpaolo Pini Prato et al, 2000 | RCT | II |
| G. Zucchelli et al, 2009 | Randomised Controlled Trial | II |
| Hala Albonni et al,2020 | RCT | II |
| Leila Salhi et al, 2014 | Randomised Controlled Trial | II |
| Ilknur Ozenci et al, 2015 | Randomised Controlled Trial | II |
| Giovanni Zucchelli et al , 2016 | Randomised Controlled Trial | II |
| Mauro Pedrine Santamaria et al, 2017 | Randomised Controlled Trial | II |
| Valliammai Rajendran et al, 2018 | Randomised Controlled Trial | II |
| Lorenzo Tavelli et al, 2019 | Randomised Controlled Trial | II |
| Cavid Ahmedbeyli et al, 2019 | Randomised Controlled Trial | II |

(According to Oxford Centre for Evidence-Based Medicine 2016 Levels of Evidence)

## DISCUSSION

The present review has evaluated the influence of surgical modifications of coronally advanced Flap (CAF) on various clinical and patient-related outcome parameters. Ten studies are included in the analysis due to inclusion and exclusion criteria. According to all studies, root coverage & recession reduction have significantly improved as compared with baseline values. This systematic review confirms that in periodontal plastic surgery, the CAF treatment is a safe and dependable method that is consistently linked to recession reduction and often to CRC.

Different techniques compared in these 10 studies are-

CAF with and without vertical releasing incisions, Semilunar CAF with conventional CAF, Triangular CAF with Trapezoidal CAF, Minimally invasive CAF with Modified CAF, CAF with and without tension, Tunnel CAF with conventional CAF, Pouch technique of CAF with conventional CAF, Envelop type of CAF with conventional CAF.

Among the 10 studies, 6 studies have been done on Miller's class I and 4 studies on classes I and II recessions. Duration of evaluation varied from a minimum of 3 months to 12 years.

4 studies have compared CAF, with vertical releasing incisions, with and without vertical releasing incisions (Minimally invasive CAF, Modified CAF, Pouch)9,34,37,39,40,33, 1 study has compared the CAF flaps with tension and without tension 32, 3 studies compared Tunnel technique (TUN)383635 and CAF and 1 study compared semilunar versus CAF40.

Out of the three studies, where CAF was compared with TUN, 2 of them have concluded that CAF was better than TUN whereas one study had reported no significant difference between both groups. All the recession sites in these 3 studies have shown a significant increase in root coverage from baseline. For the 2 studies, they followed, an intrasulcular incision and the mucoperiosteal flap extended beyond the mucogingival junction for TUN technique and with vertical releasing incisions (VRI's) for CAF technique and a Split-full-split thickness flap was elevated with the flap margin being placed coronal to CEJ (cementoenamel junction) and sutured. Two studies used ADM (Acellular Dermal Matrix)38,35 and another study has used CTG36 as an adjunctive material. Reasons for Tunnel Technique to show lesser root coverage might be due to the limited flap mobility, easy visibility, and coronally advancement of the marginal gingiva, caused by missing vertical incisions. In both the studies, irrespective of the duration of follow-up (6 months and 12 months), CAF showed better results. On the contrary, a study done by Tavelli et al38 couldn't find any difference between TUN and CAF. In this study they have followed up the cases for 12 years and

found that there was an improvement in both groups regarding the outcome parameters at 6 months but significant decrease in all the parameters except for gingival thickness (GT) at 12-year follow-up. This study, based on their regression analysis demonstrated that the width of keratinized tissue and gingival thickness are significant predictors for the stability of the root coverage from 6 months to 12 years. One more long-term evaluation study by Pini Prato et al41, concluded that over 20 years with conventional CAF and CTG, there was a positive reduction in the recession depth and increased keratinised tissue gain but only for short-term.

CAF was compared with envelope type of flap in four studies and in all four studies, there was no significant difference between the groups in clinical outcome parameters except for the patient-related and operator-related outcomes. A 12-month follow-up study by Ahmedbeyli et al39, could not find any significant difference between the groups except for patient satisfaction whereas, Salhi et al37, have reported that there was a significantly better Pink Esthetic Score and improved gingival texture at 6 months follow up. Similarly, Rajendran et al34, at a 6-month follow-up could not find a significant difference between the two techniques except for pain, operating time, and esthetics favoring modified CAF. On the contrary, Zucchelli et al9,34 have reported that results of obtaining CRC were 3.6 times greater with envelope type of CAF with VRI's. Moreover, he also reported an increase in keratinized tissue height and lesser postoperative morbidity for the envelope CAF group but they could not find any significant difference in the patient satisfaction and VAS score for the color match between the groups. The probable difference in the outcome parameters could be due to the vertical incisions, and these incisions impair the vascularization and can result in fibrotic scars, jeopardizing aesthetic outcomes. In Zucchelli's study, a full-thickness flap was elevated which might have preserved the majority of the soft tissue thickness favoring the envelope type of flap. It was seen that lack of VRIs must have limited bleeding during surgery and must have helped in blood clot stabilization.

Triangular CAF and Trapezoidal CAF was compared by Zucchelli et al9,33,34, reported that there was a significant increase with the thickness of keratinized tissue as well as patient satisfaction and color match esthetic scores in Triangular CAF as compared to Trapezoidal CAF at the end of 3 months whereas, no difference was observed at 6-month and 1-year visits between the two groups. Lesser scar formation and the possibility of preservation of anatomical interdental papilla could be possible reasons for better outcomes in the triangular coronally advanced flap.

Flap with tension and without tension was compared by Giovanpaolo Pini Prato et al32. Results of this study have shown, there was a significant inverse relationship between the flap-tension and the reduction of the recession depth (the higher is the flap tension, the lower will be the recession reduction) as well as improved patient satisfaction in flap without tension as compared to flap with tension. A very minimal recession reduction at 3 months was obtained in the flap without tension group and this difference might be due to the apical shift of the flap due to tension.

Semilunar coronally positioned flap versus conventional CAF was compared by Hala albonni et al40, in which the results showed that there was a statistically significant improvement in all the clinical parameters in Semilunar coronally positioned flap (SCPF) as compared to CAF. A statistically significant difference between the two procedures was seen in the Wound healing index (WHI) for only the first week after surgery favoring the SCPF group. In this study, the recession parameters such as gingival recession height and width(GRH, GRW) were lower for the SCPF group at baseline. This could have influenced the postoperative outcome results favoring the SCPF group.

The overall analysis of the 10 included studies which compared different techniques shows that irrespective of the technique, there was a significant improvement as compared to baseline. Comparison of the CAF with vertical releasing incisions and Tunnel technique, Coronally advanced flap showed better results. Whereas, CAF with and without vertical incisions had not shown significant difference

except for the patient-related parameters favouring Flap without vertical incision. Comparison of Triangular CAF with Trapezoidal CAF showed that Triangular CAF had better results. CAF with tension and without tension, CAF without tension had favorable results. The majority of studies had a maximum of 6 months to 12 months follow-up except for one study which had the follow-up for 12 years. Maintenance of the obtained recession coverage was not observed with the type of technique used.

Despite including major electronic databases like pub-med, cochrane, google scholar, other database searches like EMBASE, science direct were not included which might be a limitation. Even though there are 10 studies included, the heterogeneity with respect to outcome parameters, follow-up duration, and technical variations prevented us from doing a meta-analysis. But the quantitative analysis of the results has been done.

## CONCLUSION

In conclusion, based on the evidences that are currently available and reported by the papers included in this review, it can be concluded that -

CAF is a safe and reliable approach for root coverage.

CAF without vertical releasing incisions is better compared to CAF with vertical incisions.

Compared with the Tunnel technique, a coronally advanced flap with vertical incisions is better in improving the results.

Aesthetics and patient-related outcome parameters were significantly better for CAF without vertical releasing incisions.

More clinical trials are needed to confirm these results as there was heterogeneity in the included studies and the number of studies comparing each technique were very few.

## CONFLICT OF INTEREST

Authors declare that they have no conflict of interest.

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