

Review Article

Comparison of Coronally Advanced Flap Techniques with or Without Connective Tissue Graft: A Systematic Review

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Abstract

Background: Gingival Recessions (GR) are a common condition in the oral cavity of adults, with an etiology that may be related to physiological, environmental or pathological factors. They are defined as the apical displacement of the gingival margin relative to the Cementoenamel Junction (CEJ), resulting in the exposure of the root surface to the oral environment. This condition may be associated with dental hypersensitivity, aesthetic concerns and an increased risk of root caries. There are multiple surgical techniques for the treatment of this condition, such as the Coronally Advanced Flap (CAF). Since the introduction of this technique, several systematic reviews have compared CAF alone to CAF combined with Connective Tissue Graft (CTG). Therefore, the aim of the present systematic review was to investigate the predictability of the CAF + CTG procedure compared to CAF alone.

Methods: Scientific literature published between 2019 and 2025 was analyzed. The search was conducted in the PubMed, Wiley Online Library and ScienceDirect databases, including only articles written in English.

Results: A total of 1,219 articles were identified across the selected databases: PubMed (565 articles), Wiley (613 articles) and ScienceDirect (41 articles). Of these, 604 were removed based on relevance, along with 544 duplicates. After applying the inclusion criteria, an additional 52 articles that did not meet the requirements were excluded. Ultimately, 19 articles were selected for full-text review. There was no significant difference between the two procedures; nevertheless, the CAF + CTG technique was found to be more effective for the treatment of GR, as results showed an increase in the thickness of keratinized gingiva.

Conclusion: This systematic review concludes that both the Coronally Advanced Flap (CAF) alone and in combination with Connective Tissue Graft (CTG) are effective for treating

gingival recessions, achieving Complete Root Coverage (CRC) in RT1-type cases. However, the addition of CTG provides further benefits, including increased width and thickness of keratinized tissue and reduced hypersensitivity particularly in cases of deep or RT3-type recessions. Nevertheless, aesthetic outcomes may be compromised due to increased tissue thickness.

Keywords: Gingival Recession; Root Coverage y Coronal Advanced Flap y; Conective Tissue Graft

Introduction

Gingival Recessions (GR) are a common condition in the oral cavity of adults, with an etiology that may be related to physiological, environmental or pathological factors. They are defined as the apical displacement of the gingival margin relative to the Cementoenamel Junction (CEJ), resulting in the exposure of the root surface to the oral environment. This condition may be associated with dental hypersensitivity, aesthetic concerns and an increased risk of root caries [1,2]. In most cases, GR are

observed in patients with good oral hygiene, as they are often linked to traumatic brushing and overly aggressive hygiene techniques [2-4]. The prevalence of GR in the global population varies depending on several factors such as age, socioeconomic status, oral hygiene habits, smoking and the presence of systemic conditions. According to data from the National Health and Nutrition Examination Survey (NHANES), conducted in the United States between 2009 and 2012, approximately 57% of adults presented at least one site with a gingival recession of 1 mm or greater [5]. Gingival recession is a frequent clinical finding and a common manifestation of periodontal disease in this population [6]. In 2011, Cairo, et al., proposed a classification system for gingival recessions based on the level of interproximal clinical attachment, dividing them into three types: RT1) gingival recession without interproximal attachment loss; RT2) interproximal attachment loss equal to or less than buccal site; and RT3) interproximal attachment loss greater than at the buccal site [2,7]. Several procedures have been developed for the root coverage of areas affected by gingival recession. This condition not only compromises dental aesthetics but may also lead to root hypersensitivity and favor the accumulation of dental plaque, thus justifying the need for treatment. Over time, numerous surgical techniques have been introduced, varying in complexity, indications and clinical outcomes [4,6]. The Coronally Advanced Flap (CAF) technique, described by Zucchelli and De Sanctis in 2000 for the treatment of multiple recessions, is one of the most widely used methods in clinical practice [8]. The indications for the adjunctive use of Connective Tissue Grafts (CTG) in the treatment of gingival recession include: 1) insufficient height and/or thickness of keratinized tissue in the apical or lateral direction, making it difficult to properly perform a coronally or laterally advanced flap; 2) prominent and/or buccally displaced roots; 3) presence of root abrasions; and 4) recessions associated with prosthetic crowns or dental implants [9,10]. The absence or insufficiency of apical Keratinized Tissue (KT) is one of the main reasons to employ a Connective Tissue Graft (CTG) in combination with the Coronally Advanced Flap (CAF) technique. In this surgical approach, a full-thickness flap is created up to the alveolar crest, while the apical 3 mm are maintained as partial thickness, allowing adequate integration of the CTG. The partial-thickness dissection of the surgical papillae facilitates nutritional exchange between the anatomical papillae and the underlying de-epithelialized papillae. To achieve coronal advancement, the flap must be designed in a split–full–split manner, enabling detachment of the periosteal and muscular fibers and ensuring flap positioning coronal to the CEJ [8]. It is essential to maintain a minimum distance of 2 mm between the Gingival Margin (GM) and the Mucogingival Junction (MGJ) to ensure postoperative flap stability after suturing [3]. The combination of the Coronally Advanced Flap (CAF) with a Connective Tissue Graft (CTG) is considered the gold standard in cases of thin, scalloped periodontal phenotype, as it effectively enhances both the quantity and quality of the marginal soft tissue [3,11]. The objective of this review is to compare and analyze two coronally advanced flap techniques in order to determine which provides greater root coverage.

Materials and Methods

PICO Question (Problem, Intervention, Comparison, Outcome)

P (Problem): Patients with single or multiple gingival recessions

I (Intervention): Coronally advanced flap with or without connective tissue graft

C (Comparison): Most effective technique

O (Outcome): Greater root coverage

Search Protocol

The first step in this systematic review process involved applying the PICO methodology to formulate a clinical or research question. Articles were included from the following databases: PUBMED, WILEY ONLINE LIBRARY and SCIENCE DIRECT.

Research Question

Which technique provides better outcomes in terms of root coverage?

Literature Search Strategy

Based on the research question, scientific articles published between 2019 and 2025 were analyzed. The search was conducted in the PUBMED, WILEY ONLINE LIBRARY and SCIENCE DIRECT databases, including only articles written in English. A rigorous search of the retrieved scientific literature was performed using MeSH terms such as:

“(Gingival recession) AND (Coronal advanced flap)” “(Connective tissue graft AND Coronal advanced flap)” “(Gingival recession AND Root coverage)”

Inclusion Criteria

Human studies, Patients with single and/or multiple gingival recessions, Articles published between 2019 and 2025, Articles written in English.

Exclusion Criteria

Letters to the editor, animal studies, clinical opinions, *in-vitro* studies, systematic reviews, meta-analyses, literature reviews.

Elimination Criteria

Studies in which ethical guidelines were not followed.

Data Collection and Analysis

Relevant studies were analyzed and reviewed individually by two reviewers. For each study, a data collection form was used, including the title, author, year, study design, sample size, treatment and corresponding results.

Results

During the bibliographic search, a total of 505 articles were identified in the selected databases, including PubMed (20), Wiley Online Library (350) and ScienceDirect (135). Of these, 96 duplicate articles were removed. After applying the inclusion criteria, 373 articles that did not meet the criteria were also excluded. Finally, 23 articles were selected for a thorough reading, as illustrated in Fig. 1. In the analysis, only human studies were considered. The characteristics of the included studies were categorized by author, year, study design, sample size in each group, treatment and results, as presented in Table 1.

2021	Tonetti, et al., [22]	Multicenter Randomized Clinical Trial (36-month follow-up)	125 patients with a total of 307 gingival recessions	Gingival recessions on multiple adjacent teeth treated with CAF + SCTG	After 36 months, the autogenous graft showed an average root coverage of 2.0 ± 1.0 mm.
2022	Fernández-Jiménez, et al., [23]	Randomized Clinical Trial	24 patients with multiple RT2/class III GR	Test group: m-VISTA (=12); Control group: CAF (=12)	The 84 recessions treated achieved 61% CR in both groups after 6 months. Recession type was found to be unpredictable.
2022	Weinberg, et al., [24]	One-Year Retrospective Study	15 patients with GR associated with Class III orthodontic treatment	Surgical approach: CAF + SCTG	CAF + SCTG was effective in reducing Class III GR on mandibular incisors post-orthodontics.
2022	Turer, et al., [24]	Randomized Controlled Clinical Study	38 patients with RT1 GR	Test group: CAF + SCTG-ALMG (=19); Control group: CAF + SCTG-LMG (=19)	Single gingival recessions can be successfully treated regardless of LMG location.
2022	Emilov, et al., [26]	Comparative Clinical Trial: Surgical vs. Non-surgical treatments for recession with hypersensitivity	60 patients with Miller Class I and II recessions: 20 with CAF + SCTG, 10 with FGG	Soft tissue graft procedures were applied to cover recessions; gel was used to treat hypersensitivity	Surgical treatments with SCTG achieved full or partial coverage and reduced hypersensitivity. The IL group only showed partial sensitivity reduction.
2022	Potharaju, et al., [17]	Split-Mouth Randomized Clinical Trial	15 patients, 30 sites with Miller Class I and II recessions	Group A: CAF only; Group B: CAF + resorbable	Both groups showed significant improvements: 73.13% for CAF alone and 71.60% for CAF + GBR.

				membrane	The membrane provided no significant additional benefits.
2023	Blasi, et al., [27]	Case Series Using Digital Methods	20 patients with RT1 GR	Surgical root coverage intervention	An increase in marginal tissue thickness from 1.5 to 3 mm was observed and correlated with CRC percentage.
2023	Carcuac, et al., [28]	Randomized Clinical Trial	30 patients with RT1 GR in mandibular incisors	Root coverage with different surgical techniques: IL vs. m-IL	The m-IL approach proved to be suitable and effective for RT1 GR in lower anterior teeth.
2023	Yamashita, et al., [29]	Case Report	1 patient (34 years old) with hypersensitivity at GR sites	Miller Class II GR at #45. MCACTUN technique	Changes in periodontal phenotype were observed after intervention.
2023	Di Domenico, et al., [18]	Prospective Clinical Trial with 3-Year Follow-up and Histological Analysis	20 patients with CAF on multiple recessions and selective SCTG application	SCTG used at specific sites. Measures like CRC, recession reduction and CT thickness were evaluated	86% complete root coverage in sites without SCTG and 81% in sites with SCTG.
2024	Do Nascimento, et al., [30]	Preliminary Study	Douleur Neuropathique 4 (DN4) Questionnaire and Qualitative Sensory Test (QualST). Descriptive statistics, Kruskal Wallis test	Qualitative sensory testing showed no significant differences to touch, pressure or thermal stimuli	Somatosensory variations were observed in donor and recipient sites with no painful sensations, only numbness and electric shock-like sensations.
2024	Bhatavadekar, et al., [31]	7-Year Retrospective Study	22 patients	Teeth with contiguous recessions (13 with CAF and 9 with e-CAF)	The envelope-type coronally advanced flap was better than CAF with vertical incisions.
2025	Santamaria, et al., [32]	Clinical Case Report	1 patient with single recession defect	Guided CAF treatment using digital workflow and surgical guide fabrication	Digital workflow may improve CAF predictability and aesthetic outcomes.

Table 1: Characteristics of the included studies.

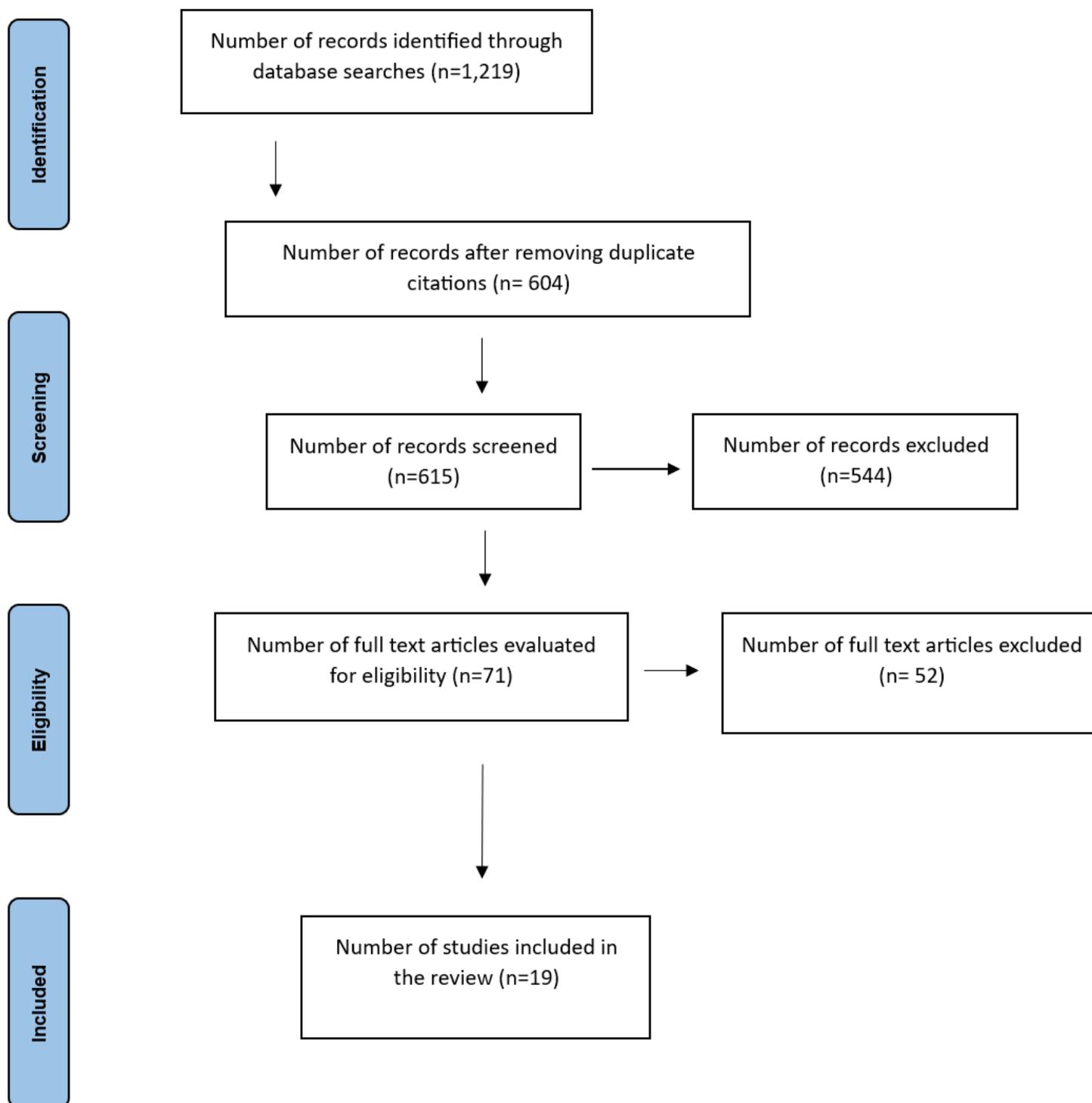


Figure 1: Inclusion and exclusion strategy.

During the literature search, a total of 1,219 articles were identified in the selected databases, including PubMed (565 articles), Wiley (613 articles) and Science Direct (41 articles). Of these, 604 articles were removed, along with 544 duplicates. After applying the inclusion criteria, 52 additional articles that did not meet the requirements were excluded. Finally, 19 articles were selected for full-text reading, as illustrated in Fig. 1. Only studies conducted in humans were considered for analysis. The characteristics of the included studies were categorized according to the author, year, study design, sample size in each group, treatment and outcomes, as presented in Table 1.

Discussion

Since 1989, with the introduction of the Coronally Advanced Flap (CAF) technique by Allen and Miller, it has been recognized that treatment should not only focus on reconstructing an adequate thickness of attached gingiva but also on improving the architecture of the soft tissues [12]. In a systematic review by Cairo, et al., in 2014, it was found that CAF combined with Connective Tissue Graft (CTG) was more effective than CAF alone in terms of Complete Root Coverage (CRC) and keratinized tissue gain [13]. However, in a 20-year prospective follow-up study conducted by Zucchelli, et al., in 2018, CAF + CTG was evaluated for treating Miller Class I gingival recessions. After 20 years, the results showed significant stability in CRC, demonstrating that the combination provided predictable and long-lasting outcomes [14]. Furthermore, in 2020, Cairo, et al., conducted a randomized controlled clinical trial involving 30 patients with single gingival recession and non-carious cervical lesions. Two treatments were compared: CAF with restoration and CAF + CTG also with restoration. The restorations were made using composite resin. Both treatments were effective for root coverage in RT1 recessions; however, patients treated with the CTG approach showed better outcomes in terms of width and thickness gains [15]. Several studies have confirmed that using CTG increases the predictability of root coverage and helps thicken the tissue. However, this can be controversial in esthetic zones, as shown in the study by Gil, et al., where techniques were compared in 48 patients. The control group (n = 24) received CAF alone and the test group (n = 24) received CAF + CTG. Outcomes were aesthetically evaluated using the Root Coverage Esthetic Score (RES), along with parameters such as recession reduction, root coverage and CRC. CAF alone yielded better esthetic results when treating single recessions in highly esthetic zones [16]. Similarly, Potharaju, et al., in 2022, conducted a randomized split-mouth clinical trial evaluating 30 recession sites (Miller Class I and II) in 15 patients [17]. Some sites were treated with CAF alone, while others received CAF + resorbable membrane using Guided Tissue Regeneration (GTR). Both techniques produced favorable outcomes, but CAF alone showed slightly better root coverage percentages. Thus, it was concluded that adding membranes does not offer significant differences in pocket depth reduction or root coverage. On the other hand, Di Domenico, et al., conducted a 3-year prospective clinical trial with histological analysis in 20 patients presenting with multiple recessions. CTG was used only in indicated sites [3,11]. Upon evaluation, they observed changes including root coverage improvement, recession reduction and increased keratinized tissue thickness. Moreover, a comparison between CAF alone and CAF + CTG showed CRC results of 86% and 81%, respectively [18]. It can be stated that adding CTG to CAF improves outcomes; however, the success of root coverage should not be based solely on which technique achieves CRC. Parameters such as pocket depth reduction, prevention of recession relapse and appropriate thickening of inserted gingiva must also be considered, especially in terms of esthetics, since CTG can cause excessive thickening and undesirable appearance. Additionally, it is worth noting that some patients seek treatment for root coverage due to hypersensitivity [13.] In such cases, CTG use is indicated, as it significantly reduces sensitivity reported by patients with deep recessions.

Conclusion

This systematic review concludes that both Coronally Advanced Flap (CAF) alone and in combination with Connective Tissue Graft (CTG) are effective for treating gingival recessions, achieving Complete Root Coverage (CRC) in RT1-type cases. However, the addition of CTG has shown further benefits in increasing keratinized tissue width and thickness, as well as reducing hypersensitivity particularly in cases of deep or RT3-type recessions. Nevertheless, aesthetic outcomes may be compromised due to tissue thickening. Among the limitations found in the included studies are methodological variability, small sample sizes and short clinical follow-up periods, which hinder the establishment of statistically significant and generalizable differences. Future research should focus on randomized clinical trials with greater statistical power, longer follow-up periods and joint evaluation of clinical and esthetic criteria, aiming to establish more predictable and personalized protocols for surgical root coverage procedures.

Conflict of Interest

The authors declare that they have no conflicts of interest with the contents of the article.

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Author Contributions

All authors contributed equally for this paper.

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