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Review Article

The Modified Coronally Advanced Flap for the Treatment of Multiple Gingival Recessions Defects

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Abstract

Gingival recessions commonly affect multiple adjacent teeth, requiring efficient and comprehensive treatment strategies. The Modified Coronally Advanced Flap (CAF) technique, introduced by Zucchelli and De Sanctis, provides a predictable approach for addressing multiple recession defects, particularly when combined with a connective tissue graft (CTG). This article reviews the surgical technique, including key modifications to enhance flap stability, and evaluates outcomes related to root coverage, keratinized tissue increase, and aesthetic results. Understanding these factors can guide clinicians in achieving optimal treatment outcomes for patients with multiple gingival recessions [1,2].

Keywords: Modified Coronally Advanced Flap; Gingival Recession; Connective Tissue Graft; Root Coverage, Keratinized Tissue

Abbreviations

CAF: Coronally Advanced Flap; CTG: Connective Tissue Graft; CRC: Complete Root Coverage; KT: Keratinized Tissue; CEJ: Cementoenamel Junction; ADM: Acellular Dermal Matrix

Introduction

Gingival recessions are rarely localized to a single tooth but they often affect multiple adjacent teeth. Therefore, to minimize the number of procedures and enhance patient comfort, it is recommended to treat all recessions in a single surgical session.

The coronally advanced flap (CAF) is a widely used procedure for treating gingival recessions, particularly Miller Class I and II (1985) [1]. To address multiple recession defects (more than two), Zucchelli and De Sanctis (2000) [2] introduced a modification of the CAF. A connective tissue graft (CTG) can added to the CAF in order to increase the thickness and the quantity of keratinized tissue, enhancing thus the long-term stability of root coverage (Cairo 2008) [3].

Materials and Methods

This review focuses on the Modified CAF technique as applied to multiple gingival recession defects. It analyzes key surgical principles, including flap design, root preparation, and grafting, while referencing clinical studies that assess its efficacy. Studies included compare outcomes of CAF alone versus CAF combined with CTG or other biomaterials

Results and Discussion

Surgical technique

Flap elevation

In 2000, Zucchelli and De Sanctis [2] evaluated the efficacy of a novel surgical approach to treat multiple recession defects in 22 young patients with good systemic and periodontal health, each

presenting at least two recession defects on adjacent teeth in aesthetic zones (Miller Class I or II recessions). The aim was to evaluate the extent of root coverage and keratinized tissue one year post-surgery [4]. (Figure 1).

This modification involves a modified envelope flap designed with partial-thickness oblique incisions and no sulcular incisions at the papillae. The marginal gingiva over the recessions is left intact and elevated using a periosteal elevator. According to the authors, this approach reduces the risk of damage to the marginal area, thereby minimizing inflammation and additional recession risk (Figure 1).

Figure 1: Design of the modified technique of the CAF (3).

The flap design includes a full-thickness approach apical to the recessions, near the avascular root surface, elevated at a 45° angle to protect the underlying bone. The peripheral areas near the surgical papillae are elevated with a partial-thickness incision, maintaining the blade parallel to the tooth's long axis [4]. This elevation follows a « split-full-split » pattern in a corono-apical direction:

- **Split-thickness** in the surgical papillae to preserve tissue thickness.
- **Full-thickness** over the recessions to ensure root coverage with thicker tissue and to preserve the periosteum.
- **Split-thickness** apically to facilitate coronal displacement of the flap (Figure 2-5).

This approach preserves the connective tissue layer, supporting flap vascularization and ensuring good postoperative stability. The partial-thickness elevation maintains periosteal structures, enhancing flap stability post-repositioning. De-epithelialization of interdental anatomical papillae is necessary to create a connective tissue bed that stabilizes the surgical papillae. Furthermore, verti-

Figure 2: Recession class I of Miller, RT 1 of Cairo.

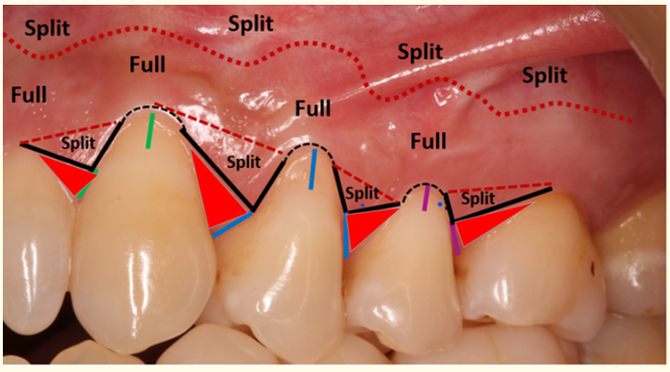

Figure 3: The flap design of the CAF Split-full-split.

Figure 4: Recession class I of Miller, RT 1 of Cairo.

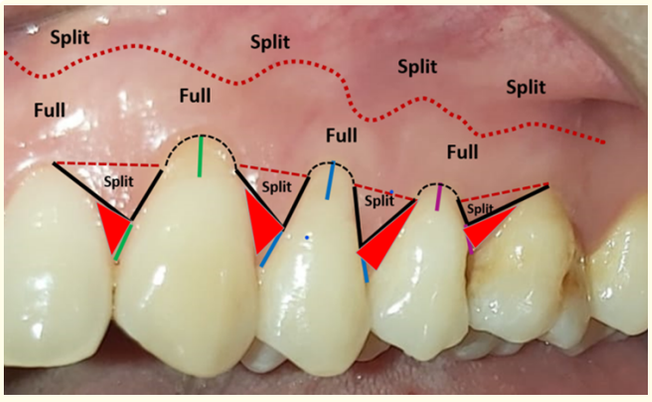

Figure 5: The flap design of the CAF "split-full-split".

cal incisions are avoided to preserve blood supply to the flap and to prevent visible postoperative scars that patients often find unpleasant or unesthetic [2].

Another key principle is ensuring adequate vascular support for the flap, particularly over the denuded root surface. Vascularization is essential for healing and connective tissue attachment to the root [2]. Additionally, the technique emphasizes eliminating muscular insertions in the flap to enable greater coronal displacement, improving the predictability of root coverage [4] (Figure 6).

Figure 6: Flap elevation and eliminating muscular insertions.

Root preparation

Various root conditioning techniques have been explored to promote tissue regeneration and enhance periodontal tissue adhesion. Several approaches and products have been investigated to improve the outcomes of gingival recession treatments, but their effectiveness remains variable. Traditional mechanical instrumentation, including root planing, plays an important role in the treatment of gingival recession. More conservative approaches, such as polishing, can be equally effective, particularly in specific sites.

Certain methods, such as the use of enamel matrix derivatives (EMD), appear promising, while others, such as the use of lasers or chemicals for root surface conditioning, have not shown significant payoffs. The choice of method will depend on the specificities of each clinical case, with growing interest in simpler and less invasive approaches [4].

Flap release

One of the main concerns in periodontal surgical procedures is the management of residual flap tension after its placement. When tight sutures are used to compensate for this tension, they can damage the remaining vascular system, reducing vessel permeability and hindering neovascularization (Cortellini and Pini Prato, 2012) [5]. Excessive tension on the flap can impair healing by compromising blood circulation, which may negatively impact the healing process.

An angiographic study in humans demonstrated that the best clinical results in terms of root coverage were obtained when the flaps were passively adapted and sutured without tension on the exposed roots (Mormann and Ciancio, 1977) [6]. This observation was confirmed by a randomized controlled trial (Pini Prato 2000) [7], which compared the CAF procedure with or without tension before suturing. The results showed that

- Less tension (ranging from 0.0 to 0.4g) favored a higher percentage of root coverage (RC),
- More tension (ranging from 4 to 7g) was associated with a lower percentage of RC.

Thus, flap release is a crucial factor in the treatment of gingival recession, particularly in RC techniques. (Figure 7).

Figure 7: Flap release.

Addition of a connective tissue graft

Zucchelli and De Sanctis in 2000 [2] observed a CRC in 88% of the treated recessions with a mean coverage of 97 % of the root surface, after one year.

They also observed a significant increase in keratinized tissue (0.6 mm) which was inversely correlated with the pre-surgical amount of keratinized tissue. The mean clinical attachment gain was 2.6 mm, suggesting new connective tissue attachment (Figure 8).

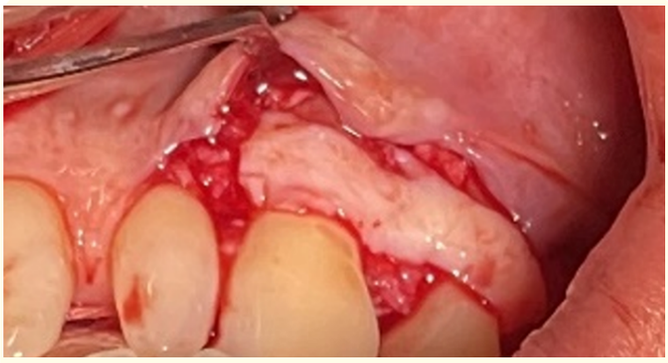

Figure 8: Addition of a connective tissue graft.

Figure 9: Complete root coverage of recession class I of Miller, RT 1 of Cairo treated with CAF + CTG.

In this study, the modified CAF technique was highly effective for treating multiple gingival recessions, achieving CRC in most cases, regardless of the number of recessions treated. The technique also led to a significant increase in keratinized tissue and was particularly effective in addressing the aesthetic concerns of patients, regardless of the initial amount of keratinized tissue [2].

In 2014, Zucchelli's study [8]. compared the short-term (6 months and 1 year) and long-term (5 years) effectiveness of the CAF alone and with CTG for the treatment of multiple gingival recessions. Fifty patients were included, divided into two groups. A control group treated with CAF alone and a test group treated with CAF + CTG.

This study showed

- A significant reduction in recession depth in both groups at 6 months, 1 year, and 5 years. However, at 5 years, the CAF + CTG group showed a greater reduction in recession compared to the CAF alone group.
- Complete root coverage in the CAF + CTG group was achieved long-term (5 years) compared to the CAF alone group, with a probability of CRC more than three times higher in the CTG group.
- A significant increase in the height of keratinized tissue was observed in both groups, with higher values in the CAF + CTG group.
- Subjective aesthetic evaluation of both groups showed high aesthetic satisfaction scores at both 1 and 5 years. However, CAF alone showed better color evaluations at both 1 and 5 years, while the CAF + CTG group showed superior results in contour at 5 years. Formation of keloids was significantly more frequent in the CAF + CTG group (28% at 1 year, 44% at 5 years), primarily due to graft exposure.

According to this study, both techniques, CAF alone and CAF + CTG, are effective for treating multiple gingival recessions, with similar results in the short term. The addition of CTG improves long-term root coverage but is associated with greater keloid formation and higher post-operative discomfort. CAF alone may be recommended for its simplicity and post-operative comfort, while CAF + CTG is preferable when superior aesthetic results or more predictable CRC is needed [8] (Figure 2, 4, 9, 10).

Other studies have shown that adding CTG significantly improves CRC and reduction of gingival recession (Da Silva 2004) [9]. Furthermore, surgical techniques, particularly those using CTG, reduce post-operative root sensitivity. (McGuire and Nunn, 2003) [10].

The graft dimensions also play a crucial role in the healing process. Voluminous grafts may impede vascular exchange between the flap and the recipient bed, thereby increasing the risk of flap dehiscence or aesthetic exposure of the graft. Recently, the use of thinner and reduced-thickness grafts has been advocated to facilitate coverage of the graft by the flap, enhance aesthetic outcomes, and decrease post-operative morbidity while maintaining a high predictability of root coverage [11].

The graft position is also an important factor that can affect the result of the surgery. Zucchelli and., *et al*. (2003) [12] concluded that the CTG should meet the following criteria

Figure 10: Complete root coverage of recession class I of Miller, RT 1 of Cairo treated with CAF + CTG.

- **In the mesio-distal dimension**: It should exceed the mesio-distal width of the recession by 6 mm.
- **In the apico-coronal dimension**: Its size should correspond to the distance between the cementoenamel junction and the bone crest, minus the amount of initial (preoperative) keratinized tissue.

From an aesthetic perspective, when the flap still includes keratinized gingiva and the CTG is fully covered, the resulting tissue demonstrates superior quality in terms of color, texture, and volume. Conversely, when the flap consists solely of mucosal tissue, the resulting tissue is characterized by its shine and distinct color.

It is important to note that the presence of keratinized gingiva apical to the recession can facilitate the complete coverage of the graft by the flap and reduce the risk of flap dehiscence (Zucchelli 2003) [12].

Addition of allograft and replacement biomaterials

Cairo., *et al*. in 2008 [3], carried out a systematic review, including RCTs on Miller's class I and II gingival recessions. The authors sought to answer the following question: "What is the clinical benefit of adding CTG, barrier membranes (BM), enamel matrix derivative (EMD), acellular dermal matrix (ADM), platelet-rich plasma (PRP), or human fibroblast-derived dermal substitute (HF-DDS) to the CAF in the treatment of localized Miller class I and II gingival recessions?"

The CAF was selected as the reference treatment, and possible combinations (CAF+CTG, CAF+EMD, CAF+BM, etc.) were compared to it, although no multiple combinations were evaluated due to difficulties in detecting interaction effects.

Studies selected for this systematic review had complete root coverage (CRC) as treatment goal, and the meta-analysis showed that only two combinations (CAF+CTG and CAF+EMD) provided better outcomes than CAF alone.

CAF+CTG led to better clinical outcomes for CRC (OR = 2.49) and recession reduction (10.49 mm) compared to CAF alone, while no other therapy surpassed CAF+CTG. Moreover, CAF+EMD appears to be a simpler procedure than CAF+CTG and does not require a donor site for the connective tissue graft, which generally reduces any postoperative discomfort during the first month following treatment (McGuire & Nunn, 2003). However, the cost-benefit ratio of CAF+EMD should be carefully evaluated.

Meta-analyses did not show any statistically significant difference between CAF+ADM and CAF alone in terms of CRC, recession reduction (RecRed), or keratinized tissue width (KT). These results suggest that ADM does not provide additional benefits compared to CAF alone.

Similarly, the comparison between CAF+ADM and CAF+CTG showed no statistically significant difference for CRC (p = 0.06, OR = 0.49) and RecRed (p = 0.24, mean difference = 0.40 mm), although a favorable trend towards CTG was observed for both variables. In contrast, statistically significant differences in favor of CTG were found regards to KT gain (p = 0.004, mean difference = 0.90 mm).

Concerning, the use of BM in conjunction with CAF (CAF+BM), didn't seem to improve CAF outcomes in terms of CRC and recession reduction. When comparing CAF+BM and CAF+CTG, statistically significant differences favoring CAF+CTG were detected for RecRed (p = 0.008, mean difference = 0.38 mm) and KT gain (p = 0.004, mean difference = 1.18 mm). Therefore, the use of BM for root coverage procedures appears to be discouraged, particularly because of the high incidence of complications (membrane exposure) associated with its use [2].

Sutures and final flap position

When a modified CAF approach is used to treat multiple recessions, the initial sutures stabilize the peripheral areas of the flap, particularly the distal and mesial surgical papillae. Sutures are then continued toward the center of the area. The final marginal suture allows for precise adaptation of the buccal flap to the exposed root surface and stabilizes each surgical papilla on the inter-dental connective tissue of the anatomical papillae.

At the end of surgery, well positioning the gingival margin of the flap is an important factor for achieving complete connective tissue regeneration. Most authors recommend positioning the gingival margin of the flap 1 mm (Zucchelli and De Sanctis, 2000; Zucchelli and 2004; De Sanctis and Zucchelli, 2007) [2,13,14]. or 2 mm (Pini Prato, 1999; Pini Prato, 2005) [15,16] coronally relative to the cementoenamel junction (CEJ) to compensate for tissue retraction after surgery (Figure 11, 12).

Figure 11: Sutures and final flap position.

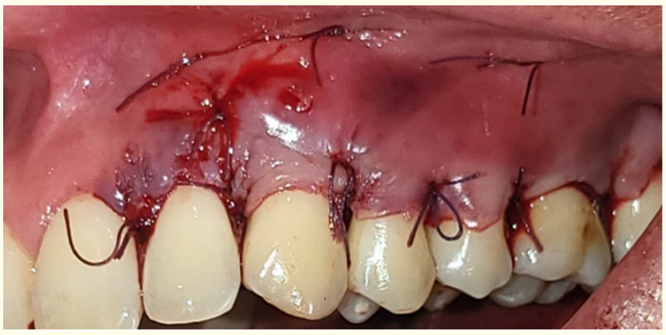

Figure 12: Sutures and final flap position.

Post-operative control

Post-operative instructions are crucial to prevent infection and ensure proper healing. They include guidance on oral hygiene, such as refraining from brushing the operated area, using antiseptics, and dietary restrictions to avoid trauma to the surgical site.

Suture removal is performed 14 days after the procedure. Resuming brushing with a surgical toothbrush should be done gradually, in line with the stage of healing [2].

Strict control of supragingival plaque is essential to maintain long-term treatment outcomes. (Leknes 2005) [17]. A rigorous post-operative follow-up contributes to maintaining long-term results by reducing recurrences. (Pini-Prato 2012) [18].

Zucchelli (2000) showed that the tissue healing after the procedure is attributed to the formation of new connective tissue attachment on the exposed root and reattachment of epithelium in the apical areas. Although the study did not include histological analysis, the clinical results indicate an average clinical attachment gain of 2.6 mm, with no deep periodontal pockets at 12 months (average depth of 1 mm) [2].

CAF vs other surgical procedures for root coverage

Radicular coverage can be achieved through several surgical approaches. Among these techniques, the tunneling technique seems to be the most documented.

Several studies suggest that both techniques (CAF and TUN) are effective for the treatment of gingival recessions, each with specific advantages. However, the results of studies comparing these two techniques sometimes show divergent findings. This divergence can be attributed to differences in surgical techniques and the type of graft used.

A recent study conducted in 2023 [20] indicates that both surgical interventions (TUN and CAF) were similarly effective in terms of root coverage, early wound healing, and aesthetic outcomes at 3 and 6 months. However, the TUN technique showed a significantly higher increase in keratinized tissue (KT) and a shorter surgical duration. Similarly, the PROMs (Patient-Reported Outcome Measures) were significantly better in patients treated with TUN during the first two postoperative weeks, although the overall and condition-specific quality of life proved similar for both treatments at 6 months.

Indeed, at 6 months, complete root coverage (CRC) was observed in 80.9% and 79.5% of teeth treated with the TUN and CAF techniques, respectively (odds ratio = 1.2; p = 0.802). No differences were observed between the groups in terms of mean root coverage (mRC) (TUN = 94.0%; CAF = 91.1%), pocket depth reduction (RD), probing pocket depth (PPD), root sensitivity, esthetic satisfaction scores (RES), and general well-being index (WHI). The increase in keratinized tissue (KT) was significantly higher in the teeth that are treated with TUN (mean difference – MD = −1.0 mm; p = 0.001).

The duration of surgery was shorter (MD = −19.3 min; p = 0.001), and patients reported a less intra-surgical pain (MD = −16.4; p = 0.028) as well as a less postoperative morbidity in the TUN group compared to the CAF group.

According to the authors, both techniques showed similar efficiency for covering exposed root surfaces, although clinicians may consider the TUN technique to be less invasive.

Another systematic review and meta-analysis [21] showed that the TUN technique did not significantly increase CRC, did not significantly reduce recession (RC), and did not improve clinical attachment level (CAL), keratinized tissue width (KTW), probing depth (PD), or recession depth (REC) compared to the CAF technique.

In short, both modalities (CAF & TUN) have produced the highest percentages of complete root coverage. However, CAF combined with a connective tissue graft appears to offer the best results [19].

Conclusion

The modified coronally advanced flap technique, designed by Zucchelli and De Sanctis, represents an effective and predictable approach for treating multiple gingival recessions with high and pleasant aesthetic demands. The addition of a connective tissue graft acts as a stabilizer for the coronally advanced flap, thereby increasing the predictability of root coverage by thickening soft tissues and ensuring better long-term stability of aesthetic results.

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Conflict of Interest

Any financial interest or conflict of interest.

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