Systematic Review

Enhanced Outcomes with Modified Tunneling Techniques for Managing Multiple Gingival Recession Defects: A Systematic Review

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ABSTRACT

Background: Gingival recession, the exposure of tooth roots due to gingival tissue displacement, poses aesthetic and periodontal challenges. This systematic review explores the effectiveness of the modified tunneling techniques in managing multiple gingival recession defects, aiming to inform clinicians about their advantages and limitations for evidence-based decision-making.

Materials and Method: A comprehensive literature search was conducted using electronic databases (e.g., PubMed, Embase) and relevant journals. Studies published up to 2024 were included. Eligible studies were selected based on predetermined inclusion and exclusion criteria. Data extraction and quality assessment were performed independently by two reviewers.

Results: The search yielded 617 articles, of which 4 met the inclusion criteria. Modified tunneling techniques included modified vestibular incision subperiosteal tunnel access (m-VISTA), modified coronally advanced tunnel (MCAT), and tunnel coronally advanced flap (TCAF). The study revealed favorable outcomes with modified tunneling techniques for multiple gingival recession defects. Notably, recession depth (RD) was reduced by 1.8mm (p Value= 0.01), while clinical attachment level (CAL) showed a gain of 1.84mm (p= 0.003). KT (keratinized tissue) and mRC (percentage reduction in recession) exhibited significant increases (p< 0.0001), suggesting the technique's efficacy. These quantitative improvements underscore the potential of the modified tunneling approach in effectively managing multiple gingival recession defects.

Conclusion: In summary, the systematic review assessing modified tunneling techniques for multiple gingival recession defects reveals promising outcomes. With an average mean root coverage of 86.5%, these techniques demonstrate notable efficacy. However, the review highlights the importance of considering the inherent risk of bias in the studies, emphasizing the need for standardized reporting and robust methodologies in future research to ascertain the true efficacy and long-term stability of these techniques.

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Introduction

In the realm of contemporary dentistry, the management of gingival recession has transcended mere functional concerns to become an integral component of aesthetic dental care. Gingival recession is characterized by the exposure of the tooth root surfaces due to the apical displacement of the gingival margin, not only poses challenges to periodontal health but also significantly

impacts the overall visual harmony of a patient's smile [1]. Multiple gingival recession defects can lead to aesthetic concerns, dentin hypersensitivity and compromised periodontal health.

As individuals increasingly prioritize not only oral health but also the aesthetic aspects of their smiles, the management of gingival recession has evolved to include techniques aimed at achieving optimal gingival contours and symmetry. The aesthetic considerations associated with gingival recession management extend beyond the restoration of periodontal health to encompass the enhancement of smile aesthetics, contributing to a more visually pleasing and confident appearance [2].Addressing gingival recession within the context of aesthetics involves a comprehensive approach that integrates periodontal expertise with principles of cosmetic dentistry [3]. Gingival recession, beyond its aesthetic impact, is associated with dental hypersensitivity, reduced resistance to pathogenic stimuli, and compromised plaque control [4]. Non-invasive interventions should be considered before invasive surgical treatments. Identifying the underlying cause is crucial, with attention to oral hygiene habits and products [5]. Dental restorations, if improperly positioned or unpolished, can contribute to gingival recession [6]. Alveolar bone loss from periodontal disease can affect attached tissue, but evidence suggests gingival health can be maintained [7]. The primary goal of surgical approaches for treating gingival recession defects is achieving complete root coverage (CRC). However, CRC may not always be attainable, and patients should be informed of realistic expectations [4].

Commonly used techniques include pedicle flap surgeries like the coronally advanced flap (CAF) and its modifications [8]. The trapezoid-designed CAF is preferred for single gingival recession defects, involving vertical releasing incisions and a split-full-split approach [9]. Zucchelli *et al.* [10] introduced a modified CAF for multiple gingival recession defects, eliminating the need for vertical incisions, maintaining good blood supply.

Tunnel techniques (TUNs) provide an alternative approach to treating gingival recession defects. The tunneling technique (TUN), an increasingly favored surgical approach in periodontal and gingival recession treatment, stands out for its remarkable advantages [11]. Its foremost attribute lies in its minimally invasive nature, ensuring less trauma to surrounding tissues compared to conventional methods. This characteristic translates into reduced postoperative discomfort, faster healing times, and minimal disruption to the patient's daily activities. Additionally, the TUN excels in preserving the blood supply to the graft, promoting heightened viability and integration, thus minimizing the risk of graft failure [12]. The procedure also exhibits a notable benefit in procedures using autogenous grafts, as it diminishes the need for a secondary surgical site, alleviating patient discomfort and sidestepping complications associated with graft harvesting. Furthermore, the meticulous placement of graft material facilitated by the TUN contributes to enhanced esthetic outcomes, fostering optimal gingival contours and coverage for a more natural and pleasing appearance [13]. Its reliance on a single surgical site simplifies the procedure, reducing complexity and potentially elevating overall patient satisfaction. Postoperatively, patients undergoing the TUN often experience less pain and swelling, adding to the appeal of this approach. Notably, the technique has demonstrated high predictability in achieving root coverage, especially in the context of treating gingival recession [11]. Finally, its minimally invasive nature and the potential for reduced postoperative discomfort make the TUN more palatable for patients who may otherwise be hesitant about undergoing periodontal surgery [14]. In summary, the TUN emerges as a valuable and patient-friendly advancement in periodontal and gingival recession management, promising both clinical success and enhanced patient satisfaction. The tunnel can be crafted as a full-thickness or split-thickness design, contingent upon the dimensions of the soft tissue. Given that tissues are often thin in most cases, opting for a full-thickness flap design is deemed the safer choice to prevent perforations and ruptures [15]. Modified coronally advanced tunnel (MCAT) technique has proven effective in addressing both single and multiple gingival recession defects [16]. Notably, recent modifications to the technique involve the lateral closure of the tunnel using simple sling or double sling sutures, a modification particularly beneficial for deep and narrow gingival recession defects [17].

Though selecting the appropriate TUN for gingival recession management poses challenges due to diverse patient factors (biotype, tissue quality), recession char-

acteristics, operator skill, graft material choices, and aesthetic considerations [12]. Clinicians must navigate these complexities, balancing the minimally invasive nature of tunneling with the need for successful outcomes tailored to each patient's unique circumstances.

The aim of this systematic review is to critically evaluate and synthesize the existing body of literature on the efficacy of modified TUNs in treating multiple gingival recession defects. Modified TUNs represent a contemporary approach that combines principles of tunnel preparation and subepithelial connective tissue grafting (SCTG) to achieve improved outcomes in terms of root coverage and overall esthetics [18].

Understanding the nuances of each modified TUN, such as variations in tunnel design, graft materials, and surgical protocols, is crucial for clinicians seeking evidence-based guidance in their decision-making process. Additionally, this systematic review aims to identify gaps in the existing literature, paving the way for future research directions and improvements in clinical practice.

Ultimately, a thorough examination of the efficacy of modified TUNs in the management of multiple gingival recession defects will contribute to the advancement of periodontal care, providing clinicians with a robust foundation for informed decision-making and enhancing the overall quality of patient outcomes.

Hence, this systematic review sought to: a) assess the reliability of the modified tunneling in addressing multiple gingival recession defects; b) examine the effects of each procedure on various Miller gingival recession classifications (Classes I, II, and III) and c) explore factors influencing the ultimate mean root coverage (mRC) and CRC; and d) compare the results between TUNs and CAF when employed in the treatment of localized or multiple gingival recession defects.

Materials and Method

This systematic review adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 guidelines to ensure transparent and methodologically rigorous reporting. A systematic literature search was conducted to identify relevant peer-reviewed articles published from January 2000 to September 2024. The following databases were searched: PubMed, PubMed Central, Cochrane Library, Scopus, and Google Scholar, supplemented by manual searches of the institute's library resources and reference lists of included studies.

A combination of clinical and methodological keywords was used, including: “gingival recession”, “modified tunneling technique”, “multiple recession defects”, “root coverage”, “connective tissue graft”, “periodontal plastic surgery”, “systematic review”, “randomized controlled trial” and “evidence-based dentistry”. Boolean operators (AND, OR) and relevant MESH terms (e.g., “Gingival Recession”, “Surgical Flaps”, “Systematic Reviews as Topic”) were applied to enhance the sensitivity and specificity of the search.

Studies were included based on specific criteria: only randomized controlled trials (RCTs) and controlled clinical trials (CCTs) involving human participants of any age, gender, or ethnicity were considered. Eligible studies focused on participants with multiple gingival recession defects and evaluated modified TUNs for managing these defects. These modified TUN techniques included various adaptations, such as TUN procedures with or without the use of grafts or substitute materials. The primary outcomes measured were the efficacy of modified TUNs in terms of root coverage and reduction of gingival recession, which was defined as the change in gingival recession height (in mm) from baseline to follow-up, measured clinically from the cementoenamel junction (CEJ) to the gingival margin. Where applicable, mRC was also reported. Secondary outcomes included changes in clinical parameters such as PD, CAL and patient-reported outcomes. A minimum follow-up period of six months was required to assess long-term effectiveness.

Exclusion criteria included case reports, case series, letters to the editor, reviews, and studies without full-text availability, as well as studies on animal models or *in vitro* experiments. Additionally, studies that did not specifically address modified TUNs for managing multiple gingival recession defects or focused solely on conventional periodontal surgical techniques without modification were excluded. Studies lacking specific and relevant data on the efficacy of modified TUNs for gingi-

Table 1: This represents a PICO framework for a clinical research question

P	Patients with multiple recession
I	Modified tunnel techniques
C	Coronally advanced flap
O	Complete recession coverage, mean recession coverage

val recession management were also omitted. For data extraction and management, the PICOS (Population, Intervention, Comparison, Outcomes, and Study Design) approach was utilized. An initial screening of titles and abstracts was conducted by a single investigator, with full texts reviewed in cases where abstracts did not provide sufficient information for inclusion or exclusion. The population (P) focused on patients with multiple gingival recession defects, the intervention (I) was modified tunnel techniques, the comparator (C) was the coronally advanced flap, and the outcomes (O) included complete recession coverage and mean recession cover age (Tables 1-2).

The search was performed from January 08 to January 22, 2024. The following flow-chart (Figure 1) which was prepared in accordance with the PRISMA guidelines 2020.

Results

Risk of Bias Assessment

The Risk of Bias 2 (ROB 2) tool is designed to assess the risk of bias in randomized trials as mentioned in the Figure 2. It consists of five domains: randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome and selection of the reported result [20].

Table 2: Study characteristics of the included studies

Sr. No.	Author, year of study, and study design	Sample size, groups-G1 and G2	Outcomes assessed	Method of assessment	Results	Inference
1	Aitziber Fernandez-Jimenez, a randomized clinical trial [21]	24 Patients G1= m-VISTA G2= CAF	(RD), (PD, (CAL= REC + PD), (KGW), (GRW) (RxBL)	CRC% (CRC x 100/number of recessions) and the MRC% (Mean preoperative REC-mean postoperative REC/mean preoperative REC 100)	RD (mm): - 1.8 (0.81) with *p* Value 0.01 mRC (%): - 61.59 (25.24) with no *p* Value specified. PD (mm): - (-0.04) (0.51) with *p* Value 0.81. CAL (mm): - (-1.84) (1.07) with *p* Value 0.003 GRW (mm): - (-2.17) (1.25) with *p* Value 0.003 KGW (mm): - 0.85 (1.19) with *p* Value 0.06	There were no statistically significant differences regarding the MRC% achieved in the treatment of multiple Miller class III/RT2 recessions with both surgical techniques
2	Molnar B a randomized clinical trial [22]	16 patients G1= MCAT + CM G2= MCAT+CTG	CRC, mRC, PD, KTW, KGT	Clinical assessments were performed at baseline at 1,3,6,12 months and 9 years	mRC= 23.0±44.5% (*p*= 0.179), KTW and KGT = 2.0±0.7 to 3.1±1.0 mm (<0.0001)	The present results indicate that a treatment of MAGR using MCAT in conjugation with wither CM or CTG is likely to show relapse over a period of 9 years
3	A. Stähli, a randomized clinical Trial [23]	24 patients G1= MCAT+ CTG + EMD, G2= MCAT+ CTG	CRC, mRC, KT	The measurements were performed by two calibrated examiners who were masked to the group assignment. Calibration of the two examiners	mRC revealed no statistically significant differences. KT increased (1.24±0.92mm to 3.02±1.55 mm)	Treatment of single and multiple RT 1 and 2 recessions by means of MCAT and CTG with or without EMD yielded comparable clinical improvements which could be maintained over a period of 5 years
4	Umberto D Ramos, a randomized clinical Trial [24]	20 patients G1= MECAF G2= TUN	PD, CAL, GR, KTW, KT	Clinical parameters were assessed at baseline and 6 months, with pain evaluated weekly using a visual analog scale	Both MECAF and TUN effectively reduced gingival recession and achieved partial root coverage (MECAF: 61.24%, TUN: 56.07%) without significant differences between techniques	Both MECAF and TUN are effective techniques for treating multiple gingival recessions, with MECAF offering slightly better root coverage and reduced ADM exposure risk

RD = Recession Depth, PD = Probing Depth, CAL = Clinical Attachment Level, KGW = Keratinized Gingival Width, GRW = Gingival Recession Width, RxBL = Radiographic Bone Level, CRC = Complete Recession Coverage, MRC = Mean Recession Coverage, MCAT = Modified Coronally Advanced Tunnel, CTG = Connective Tissue Graft, CM = Collagen Matrix, KTW = Keratinized Tissue Width, KGT = Keratinized Gingival Thickness, EMD = Enamel Matrix Derivative, MECAF = modified extended coronally advanced flap mRC = Mean Recession Coverage, mKTW = Meaneratinized Tissue Width, meanGT = Mean Gingival Thickness, VAS = Visual Analog Scale

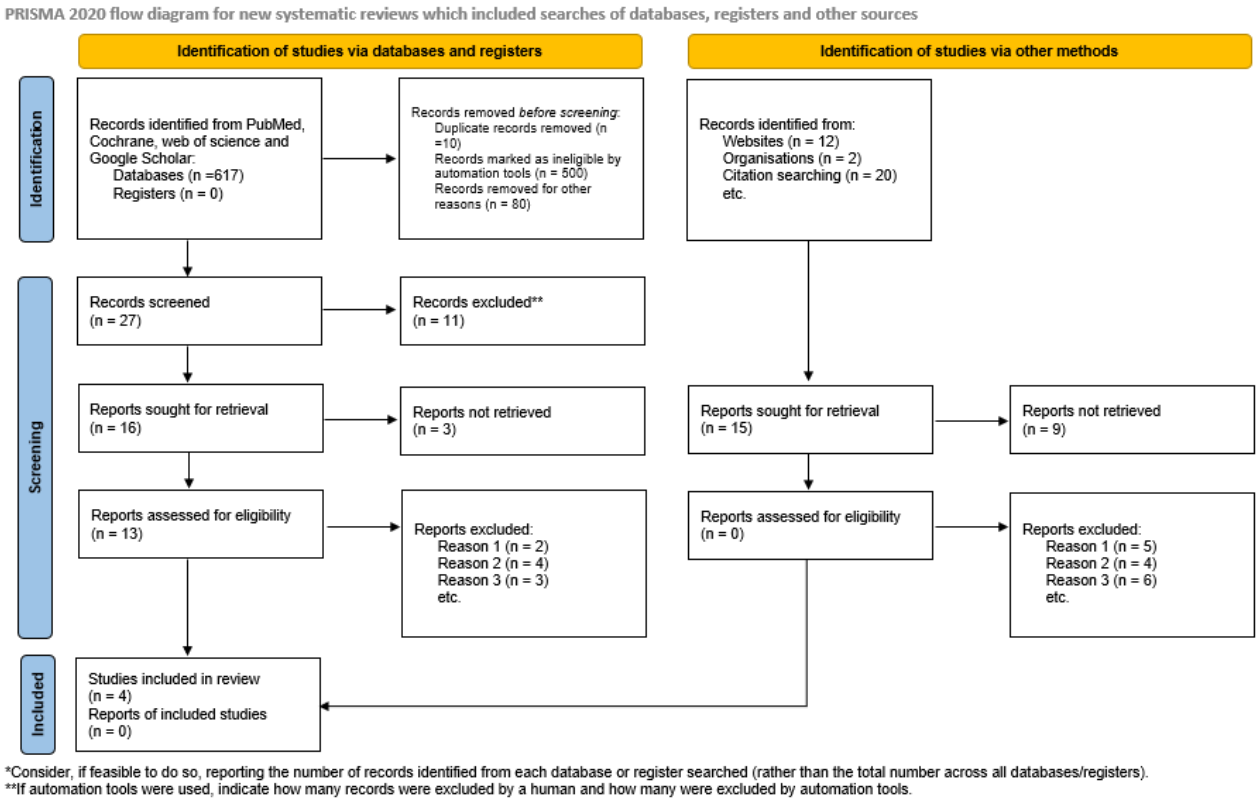

Figure 1: PRISMA flow-chart of selected criteria for the included studies. (Reason 1 = Short follow-up time, Reason 2 = No outcome of interest, Reason 3 = non-human studies) This work is licensed under CC BY 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/)

Here is an assessment of the risk of bias in each domain based on the information provided:

1. Randomization Process:

The study lacks detailed information on the randomization process, making it challenging to assess the adequacy of the random sequence generation and allocation concealment. Without a clear description of these procedures, there is a moderate risk of bias in this domain.

2. Deviations from Intended Interventions:

Information regarding deviations from the intended interventions is not explicitly provided. This lack of transparency raises concerns about the potential for bias due to deviations from the planned interventions. The risk of bias in this domain is assessed as moderate.

3. Missing Outcome Data:

The study mentions no statistically significant differences in mRC, yet it does not provide sufficient information about the handling of missing outcome data. Without details on how missing data were addressed, there is a moderate risk of bias in this domain.

4. Measurement of the Outcome:

The measurement of outcomes, particularly in terms of recession depth (RD), mRC, CAL, gingival recession width (GRW), keratinized gingival width (KGW), and other parameters, appears to be well-defined and standardized. However, the lack of information on calibration

Study ID	Experimental	Comparator	D1	D2	D3	D4	D5
Aitziber	m-VISTA	CAF	+	+	+	+	!
Molnar B	MCAT+CM	MCAT+CTG	+	+	+	+	!
A Stahli	MCAT+CTG+EMD	MCAT+CTG	+	+	+	+	!
Umberto	TUN	MECAF	+	+	+	+	+

Figure 2: Risk of bias assessment using ROB2 tool [25] of the included studies (The table uses symbols to indicate risk levels: green (+) for low risk, yellow (!) for some concerns, and red (-) for high risk. D1 (Randomization process), D2 (Deviations from the intended interventions), D3 (Missing outcome data), D4 (Measurement of the outcome), and D5 (Selection of the reported result).Study ID refers to the included studies mentioned in the Table 2) m-VISTA - vestibular incision subperiosteal tunnel access; CAF- coronally advanced flap; MCAT- modified coronally advanced tunnelling flap; CTG- connective tissue graft; EMD- enamel matrix derivative; TUN- tunelling flap: MECAF- modified envelope coronally advanced flap

of measurements and potential blinding of outcome assessors introduces a moderate risk of bias in this domain.

5. Selection of the Reported Result:

The study provides comprehensive reporting of various clinical parameters and outcomes. However, the absence of a specified *p* Value for mRC (percentage) and the trend towards increased KGW raise concerns about selective reporting. The risk of bias in the selection of the reported result is considered moderate.

The risk of bias assessment reveals that most domains across studies are at low risk, with some concerns about the selection of reported results (D5) in all studies. However, one study shows a high risk in the randomization process (D1), indicating potential methodological limitations. Overall, these results suggest generally reliable outcomes but highlight areas for improvement in reporting and randomization practices.

Discussion

The findings of this systematic review shed light on the effectiveness of modified TUNs in managing multiple gingival recession defects. The selected studies, conducted by Aitziber Fernández-Jiménez *et al*. [21], Molnar B *et al.* [22], A. Stähli *et al.* [23] and Ramos UD *et al.* [24] provide valuable insights into the outcomes and efficacy of various techniques, allowing for a comprehensive understanding of the advantages and limitations associated with these approaches. Collectively, these studies suggest that TUN approaches offer predictable outcomes, particularly in cases of multiple recessions, and often perform as well as or better than conventional CAF procedures.

The comparative analysis of the selected studies offers a nuanced understanding of the effectiveness of modified TUNs in managing multiple gingival recession defects. Aitziber Fernández-Jiménez *et al.* [21] study highlighted the superiority of the modified TUN in achieving a significant increase in mRC% compared to the control group over a 12-month period. This emphasizes the immediate benefits of the intervention in addressing GR.

The study compared the mRC% in treating multiple Miller class III/RT2 GRs using the m-VISTA technique versus the CAF technique, both with connective tissue graft (CTG). At 6 months, both groups showed mRC of 61%, but at 12 months, the m-VISTA group (test group) demonstrated an increased mRC of 73.26%, while the CAF group (control) showed a decrease to 56.49%.

Although the differences were not statistically significant, the m-VISTA technique yielded better long-term root coverage, suggesting that its closed approach, papilla mobilization, and coronal stabilization of the CTG may improve tissue maturation and root coverage outcomes [21]. This suggests that papilla preservation, coronal stabilization of CTG, and the minimally invasive design of TUN techniques may enhance tissue maturation and stability. Similar conclusions were drawn in other reviews, underscoring the biologic and esthetic benefits of flap designs that minimize surgical trauma.

Molnar B *et al.* [22] study, conducted over a 9-year period, raised significant questions about the long-term sustainability of outcomes following interventions for gingival recession treatment. Both the test and control groups exhibited a reduction in mRC% over time, highlighting the challenges of maintaining root coverage in the long term. Despite this decline, the study provided valuable insights into the enduring impact of modified TUN techniques, particularly in terms of improvements in tissue quality and stability. One of the most notable findings was the substantial increase in keratinized tissue width (KTW) and keratinized tissue thickness (KTT) in both groups. These increases are critical, as keratinized tissue contributes to the resilience and health of gingival tissues, reducing the risk of further recession and improving overall periodontal stability. The study emphasized that while the initial cosmetic outcomes, such as root coverage, may diminish over time, the functional benefits achieved through these techniques, especially the enhancement of keratinized tissue remain significant and clinically relevant.

This dual perspective acknowledging both the reduction in root coverage and the enduring benefits in tissue quality underscores the dynamic nature of these interventions. It highlights the importance of considering both short-term aesthetic results and long-term functional outcomes when evaluating the success of gingival recession treatments. The findings reinforce the need for continuous follow-up and maintenance to optimize patient outcomes over extended periods [22]. This also reflects a broader challenge reported in periodontal plastic surgery literature: that long-term root coverage stability is influenced not only by surgical technique but

also by patient-related factors such as oral hygiene maintenance, biotype, and susceptibility to gingival recession recurrence.

The 5-year evaluation of single and multiple recession types (RT1 and RT2, Miller I–III) treated with the MCAT and CTG, with or without enamel matrix derivative (EMD), demonstrated stable and comparable outcomes in both test and control groups. CRC was achieved in 57.14% of the test group and 60.0% of the control group, while mRC showed no statistically significant differences (73.87±26.38% in the test group vs. 75.04± 22. 06% in the control group). Importantly, KTW significantly increased in both groups, with the test group showing a gain from 1.14±0.57mm to 3.07±2.27mm and the control group from 1.24±0.92mm to 3.02±1.55mm [23].

These findings highlight the effectiveness and stability of MCAT+CTG in treating gingival recession over a prolonged period, achieving both root coverage and enhanced KTW. The additional use of EMD did not significantly impact the clinical outcomes, suggesting that MCAT+CTG alone is sufficient for successful long-term results. The increased KTW across both groups underscores the functional benefits of the treatment, contributing to improved periodontal stability and reduced susceptibility to further recession. This study reinforces the reliability of these approaches in managing RT1 and RT2 gingival recession and supports their use as predictable and sustainable treatment options in clinical practice. Nevertheless, the absence of clear superiority of adjuncts like EMD highlights the heterogeneity in biomaterial use across studies, and future research should stratify outcomes based on adjunctive measures to determine their true contribution [23].

The study by Ramos UD *et al.* [24] demonstrated that both the modified envelope coronally advanced flap (MECAF) and the supra-TUN techniques, when combined with acellular dermal matrix (ADM), were effective in reducing gingival recession and achieving partial root coverage in cases of multiple gingival recession. MECAF showed a slightly higher percentage of root coverage (61.24%) compared to TUN (56.07%), but the difference was not statistically significant. Both techniques effectively reduced gingival recession, RD, MECAF: 2.28mm; TUN: 1.93mm), with no significant differences in other clinical parameters like probing depth, gingival index, or keratinized tissue measurements. Pain assessment using a visual analog scale (VAS) revealed no differences between the two groups. While both approaches are valuable, MECAF may be preferable for treating large gingival recession defects, as its design minimizes early acellular dermal matrix (ADM) exposure, enhancing treatment predictability. The inclusion of biomaterials such as ADM introduces further heterogeneity, as clinical outcomes may vary depending on material properties, integration, and handling. These factors complicate direct comparison across studies [24].

Skierska *et al.* [25] evaluated the 2-year clinical and aesthetic outcomes of MCAT only with MCAT+SCTG for treating gingival recession in the maxilla and mandible. While mRC was similar for both maxillary (93.31 %) and mandibular (93.06%) teeth, aesthetic scores (RES) favored the maxilla due to better marginal tissue contour, muco-gingival junction alignment, and gingival color. Regression analysis showed mandibular teeth were less likely to achieve high-RES scores. Despite these differences, the technique proved equally effective in reducing gingival recession and improving gingival health in both regions. This highlights anatomical variability as another source of heterogeneity, suggesting that maxillary sites may offer more favorable esthetic outcomes than mandibular sites, even when the same technique is applied [25].

In clinical practice, these findings have significant implications. The consistent increase in mRC% indicates the reliability of modified TUNs for achieving optimal root coverage, addressing both functional and esthetic concerns. The observed improvements in keratinized tissue dimensions further contribute to periodontal health and support various dental procedures. Patient-reported minimal discomfort and soft tissue phenotype enhancements underscore the patient-centric benefits of these interventions. Looking forward, the need for further research is acknowledged, emphasizing well-designed, long-term, randomized controlled trials. These studies should consider patient heterogeneity, gingival recession characteristics, and long-term stability to provide a more robust evidence base. Clinicians are encouraged to tailor modified TUNs to individual cases, considering factors such as patient biotype, tissue quality, and aesthetic considerations for optimal outcomes.

This evidence contributes to informed clinical decision-making, reinforcing the role of these techniques in

contemporary periodontal care for the effective management of multiple gingival recession defects.

Despite the encouraging results, it is crucial to acknowledge the limitations of the reviewed studies, which include variations in study designs, patient populations, and surgical protocols. There is a need for more standardized reporting and well-designed, long-term, randomized controlled trials to establish the true efficacy and long-term stability of modified TUNs. Future research should also explore specific factors influencing outcomes, such as patient biotype, tissue quality, and recession characteristics, to provide a more nuanced understanding for tailored treatment approaches. Additionally, meta-analyses with subgroup evaluations could further clarify the influence of these variables, allowing clinicians to predict outcomes more accurately across different patient scenarios.

Conclusion

To encapsulate, the comprehensive evaluation of modified TUNs for managing multiple gingival recession defects showcases encouraging outcomes. These methods, encompassing m-VISTA, MCAT, and TCAF+ CTG, exhibit noteworthy efficacy, yielding an average mean root coverage of 86.5%. The substantial augmentations in KTW (1.40mm) and gingival thickness (0.92 mm) significantly contribute to the clinical significance of these approaches. Patients consistently reported minimal discomfort, accompanied by a perceptible enhancement in soft tissue phenotype. Nevertheless, the review underscores the imperative consideration of inherent study biases, underscoring the necessity for standardized reporting and robust methodologies in forthcoming research endeavors to authenticate the genuine efficacy and enduring stability of these modified TUNs.

Conflict of Interest

None to declare.

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