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A Clinical Comparison of Root coverage in Coronally Advanced Flap Technique (Zucchelli Method) with Free Connective Tissue Transplantation and Modified Tunnel Surgery Technique in Candidate Patients for Root Coverage

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Abstract

Introduction: Because of the high frequency of gingival resorption, a variety of therapies have been created to treat it, and many attempts have been made to obtain the greatest clinical results, greater attractiveness, and least invasiveness in these treatments. Two connective tissue transplantation procedures, using a gradual coronal flap and a modified tunneling technique, have lately been examined by surgeons. However, it is yet to be determined if one approach is preferable to another. The current study was conducted with the goal of comparing clinical outcomes and the quantity of root canal in patients with root canal candidates using the Coronally Advanced flap technique (Zucchelli method), free connective tissue transplantation, and modified tunnel surgical techniques.

Materials and methods: The current clinical investigation included 20 patients with Miller class I and II gingival resorption, who were split into two groups of ten individuals at random. Connective tissue grafting with coronal progressive flap (CAF) was employed in one group, whereas modified tunnel method was used in the other. Probing depth, analysis height, analysis breadth, keratinized tissue width, clinical adhesion limit, gingival biotype and root coverage %, and gingival thickness were assessed in both groups in the time periods before the study, one month, three months, and six months. Following that, the results of the study will be evaluated using SPSS software and Chi-square, Mann-Whitney, and Friedman tests.

Findings: The percentage of root coverage in the CAF group was 73.9±28.7%, which was substantially lower than the percentage of root coverage in the MST group, which was 89.1±18.5 percent (P = 0.280). In addition to evaluating each of the clinical indicators of gingival resorption improvement, it was found that both techniques performed similarly in terms of reducing the depth of the probe, reducing the width of the analysis, and reducing the height of the analysis, with no

distinction between the two. However, the MST group had a much higher increase in keratinized gingival breadth than the CAF group.

Conclusion: Generally, bare root covering with MST and CAF techniques in patients with gingival resorption produces essentially the same outcomes, and both procedures are appropriate. When comparing the breadth of keratinized gingiva, there were substantial variations in the parameter, and the MST technique was more successful than the CAF method. However, further research in this area is required before a definitive judgment can be reached.

Keywords: root canal, connective tissue transplantation, progressive coronal flap, modified tunnel surgery technique.

Introduction

The displacement of the gingival border towards the apical, as well as the emergence of CEJ and root surface in the oral environment, is referred to as gingival resorption (1). It is, more specifically, an examination of marginal tissue, since when there is no keratinized margin tissue, the deteriorated portion of the alveolar mucosa becomes part of the alveolar mucosa. Gingival resorption is a frequent periodontal condition that affects virtually every one of all ages and levels (2). Gingival resorption is one of the most frequent adult lesions, and its frequency rises with age (3). The frequency of gingival resorption has been documented in both populations with high (4) and low (5) oral health standards. Periodontal disease, mechanical pressures such as incorrect brushing (6), iatrogenic factors such as uncontrolled orthodontic motions (7), and poor restorations, fillings, and veneers are all causes of gingival resorption and subsequent root surface exposure. Anatomical issues such as improper tooth position and abnormal fernum connection (9) have also been mentioned (10). Gingival degeneration is caused by the nature and type of gingival tissue, which might have a hereditary component. Gingival resorption can be caused by a variety of factors, including bruxism and gingival tissue injury (11). However, several clinical features of gingival resorption have heightened its significance as a clinical issue (12-14). Because bare tooth root surfaces are exposed to the oral environment, they increase the risk of dental decay and wear, as well as tooth sensitivity, which is also an aesthetic issue for most patients. Furthermore, it appears that following gingival resorption, the risk of sticky gingiva loss, pulp hyperemia, endodontic difficulties, and problems with restorative procedures increases, and root rot occurs more quickly, according to some research (15). According to certain research, 58 percent of persons over 30 years old in the United States had gingival resorption of 1 mm or greater (3,16). In an Iranian study of patients sent to Tabriz University of Medical Sciences' School of Dentistry, 45.9% of patients showed signs of gingival resorption (18). Basic flaps such as rotating flaps, progressive flaps, and the tunnel method (14,19) or free soft tissue grafting can be used to treat gingival resorption (20). Gingival resorption treatments can be prescribed for a variety of reasons, including increasing beauty (21), preventing and treating dental allergies (16), preventing and controlling root surface caries (16), improving prosthetic results, and preventing disease progression due to plaque buildup in He pointed to the area in question (16,22). In most cases, however, gingival resorption is treated with free soft tissue grafting using one of the progressive flaps. The outcomes of various treatment approaches for Miller class I and II gingival resorption lesions have been evaluated, with varied degrees of clinical effectiveness reported (23,24).

The scientific community and periodontists have developed numerous treatment strategies for gingival resorption lesions in order to get the greatest clinical results, greater attractiveness, and minimum invasion. One of these approaches, known as modified coronal progressive flaps or CAF (25,26) or the modified tunnel technique, is to try to advance the pedicle flaps without using vertical release incisions (19). When all sub-epithelial connective tissue grafts are utilized, however, the predictability of CAF and tunneling methods improves considerably (27). In addition, using microsurgery instruments with ocular magnifications improves the odds of treatment success in the

clinic (28). At the same time, these technologies minimize surgery's invasiveness and, in addition to lowering patient morbidity and operation time, they improve wound and soft tissue stability (29,30). As a consequence of the scarcity of studies and the discrepancy of the results gained in this sector, it appears that more research is required. As a result, the goal of this study was to compare the quantity of root coverage achieved by connective tissue transplantation with Coronally Advanced flap (CAF) to that achieved by modified tunnel surgery.

Materials and methods

The ethical code for this study is IR.MUI.RESEARCH.REC.1400.213, and it is a randomized clinical trial. Twenty persons were chosen at random from patients with gingival analysis referred to the periodontology department of Isfahan University of Medical Sciences (10 people (5 men + 5 women) for the CAF group and 10 people (5 men + 5 women) for the MST group. The research included patients with gingival resorption who had the following conditions: Applicant for gingival resuscitation treatments in each of the anterior teeth and maxillary or mandibular premolars, Miller type I or II, age 18-65 years, no need for orthodontic treatment, no decay or restoration in the targeted tooth, and at least one region requiring root canal The interproximal region bone in the decaying tooth is healthy, there is no pathological envelope in place, and the patient agrees to engage in the intervention. If any of the following conditions were present, the participants were excluded from the study: Uncontrolled diabetes, immunodeficiency diseases, systemic or localized bone diseases, history of alcohol use, addiction, smoking (current), pregnancy, taking immunosuppressive or anticoagulant drugs, poor cooperation, and specimens with untreated active periodontal disease, inability to maintain oral health, or unwillingness to maintain oral health. The samples were initially treated with scaling/root planning and full brushing using a rubber cup and mild abrasive pastes following a comprehensive assessment of the patients and oral health education. The patients were informed about the type of therapy, its advantages, and any potential adverse effects before giving their signed consent to participate in the study. Williams probe was used to determine and record the quantity of analysis. In addition, using a Williams probe, the following indices were assessed and recorded before treatment, in the third week, and in the third and sixth follow-up months after mid-buccal surgery:

- The probing depth (PD) was calculated by measuring the distance between the gingival margin and the sulcus depth.
- The distance between the CEJ and the gingival border was used to calculate the analysis height (RH).
- The distance between the two edges of the analysis transversely in CEJ was used to calculate the analysis width (RW) (maximum area).
- From the gingival border to the MGJ, the width of keratinized tissue (WKT) was measured.
- The total probing depth + recession height was used to calculate the clinical adhesion limit (CAL).
- The prop was put inside the gingival border, which is a gingival biotype. If prop shadow is visible, thin biotype is seen; if prop shadow is not visible, thick gingival biotype is shown.

CAF technique treatment method by Zucchelli method: It is in the shape of an envelope flap that conducts a lateral shift and rotational movement at the same time as the surgical coronation of the papillae, which is in line with the flap's axis, for the treatment of various regions of gingival resorption, which includes the canine tooth (canine tooth). Oblique submarginal incisions with surgical papillae formed between the teeth to be surgically removed are made with a c15 razor. To ensure sub-marginal inclined incisions, the depth of the defect analysis must be measured, and this measurement must

begin at the tooth situated in the flap's rotation axis. The apico coronal depth of analysis must be measured to identify the end point of the oblique submaginal incision, which begins at the gingival edge of the neighboring tooth (10, 21, 25, 31). This endpoint reflects the surgical papilla tip, which is equivalent to the depth of analysis plus one millimeter from the anatomical papilla tip. The surgical papilla tip coverages the matching anatomical papilla without losing keratinized tissue, and the gingival border is one millimeter more coronal than the CEJ at the conclusion of the surgery (Figure 1,2). The incisions are then created in the buccal area of the teeth by intracellular incisions, and the incisions are extended to accommodate an additional tooth on either side of the surgical site. The dental papilla is diepithelialized to provide a connective tissue bed, and root debridement is done using sharp incisions up to 1 mm from the bone crest. To relieve remaining muscle tension and cause coronal displacement of the flap, split incisions are performed into the MGJ. A 3 mm periosteum alveolar is used to cut the surgical papilla as a split thickness (razor tip parallel to the bone) and expose it to the bone in the apical portion of the analysis region in full thickness. The tissue is also sliced in partial thickness in the apical area of the exposed bone so that the muscles may be detached from the flap's end and the envelope flap can become passively coronal (32,26,31). All of the muscles are removed from the inside of the flap with a razor held parallel to the mucosal surface. It should be noted that when the tissue is passively coronalized and decomposes without stress in the top part of the cementoenamel of the tooth, the degree of coronalization of the flap is sufficient. After full anesthesia of the region, the surgical process for the remaining half of patients using the Modified Tunnel Surgical technique is as follows:

The salicular incision is created on the buccal side, along the region of analysis, with a surgical razor number c15, although it should be noted that the incision does not contain papillae. The buccal flap side is then produced as a partial thickness with the surgical blade number c15. To maintain appropriate flap movement and decrease the danger of therma and perforation, we make two superficial and supra-periosteal incisions beyond the partial-thick muco-gingival junction line in the alveolar mucosa to separate the muscles. Due to the papilla's fragility and fineness, as well as the mobility required to coronalize the gingival complex, the interdental buccal papilla is gradually reduced to full thickness up to the base of the papilla. The breadth of the gingival resorption in the CEG is then marked using a periodontal probe, somewhat beyond the size of the sac supplied. c15 to be produced from connective tissue). Connective tissue (CTG) is passed through the tunnel with horizontal matrix sutures and sutures 0-6 or 0-5, and the connective tissue is fixed to the superficial part of the partial flap and maintained with a new suture (double cross suture) to maintain and stabilize the coronal displacement of the entire gingival-papillary complex (CTG + buccal flap + motile papilla) and ultimately creasing. The goal is to enhance wound stability, blood feeding, and metabolic connection to the surgical site, as well as the suture's adjuvant impact to speed wound healing and improve survival predictability. The suture needle is entered from the apical buccal side, travels through the interdental area through the connective tissue obstruction, exits the epithelium in the lingual portion, and then enters the joint again in the area more apical than the implanted epithelium. In the coronal section of the suture, which escapes for the first time in the lingual, the moist apical departs the epithelium as a vertical matrix and enters the connective tissue. It exits the epithelium in the buccal (19). The patient will be told to rinse their mouth with 0.12 percent chlorhexidine on a regular basis. The stitches are then totally open 14 days following surgery, and patients can resume their normal dental hygiene routine, with the exception of the surgical region. Finally, the data was input into SPSS software version 25 and descriptive statistics were calculated using indicators such as mean, standard deviation, frequency, and frequency. For anomalous data distribution, the Chi-square

test, Mann-Whitney test, and Friedman test were employed, with a significance threshold of less than 0.005 considered in all analyses(Figure 3,4).

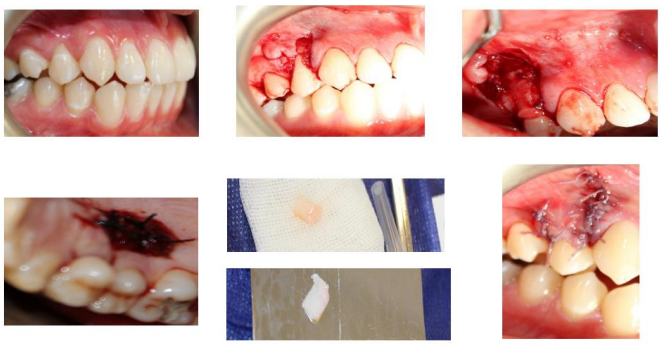

Figure 1 - Case No. 1: Coronal flap treatment (Zucchelli method) + connective tissue resection

Figure 2 - Case No. 1: Coronal flap treatment (Zucchelli method) + connective tissue resection

Figure 3- Case No. 1: Treatment method of modified tunnel surgery technique

Figure 4- Case No. 2: Treatment method of modified tunnel surgery technique

Findings

In Figures (1) and (2), the variables of analysis height, analysis width in CEJ, sticky gingiva, probe depth, CAL, and analysis width of 1 mm below CEJ are ranked by number, mean, standard deviation, median, and mean (mm). For the investigated timeframes and statistical test results, the CAF and MST groups are provided individually. With the exception of sticky gums, the mean of each of the variables was substantially different at various periods (p 0.001 for each) as can be seen in both graphs. At 3 weeks,

3 months, and 6 months, the mean variables of analysis height, analysis width in CEJ, CAL, and analysis width of 1 mm below CEJ were substantially lower than at the start, but the difference between 3 weeks, 3 months, and 6 months was not significant.

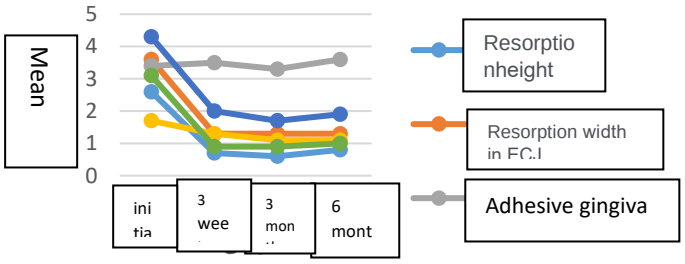

Figure 1. Mean of variables by study times in the CAF group

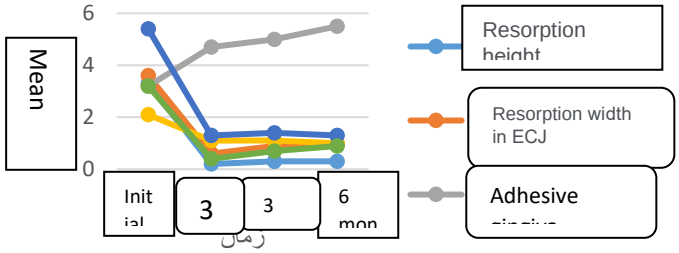

Figure 2. Mean of variables by study times in MST group

The quantity and percentage of each type of biotype by time and group, as well as the results of statistical tests, are shown in Table 1. As can be observed, the MST group had 50 percent thin biotype and 50 percent medium biotype at the start, which had changed to 50 percent medium biotype and 50 percent thick biotype after 3 weeks, 3 months, and 6 months. These modifications were statistically significant (p0.001). At the start, 90% of the CAF group had thin biotypes and 10% had moderate biotypes, which had changed to 60% medium biotypes and 40% thick biotypes after 3 weeks, 3 months, and 6 months. These modifications were statistically significant (p0.001).

Table 1. Comparing the biotype variables between and within groups

biotype / group	Initial time		3 weeks later		3 months later		6 months later		Friedman test result
	Thin-frequency (%)	Medium-frequency (%)	Medium-frequency (%)	Thick-frequency (%)	Medium-frequency (%)	Thick-frequency (%)	Medium-frequency (%)	Thick-frequency (%)	
MST	5(50)	5(50)	5(50)	5(50)	5(50)	5(50)	5(50)	5(50)	χ2=27.00 P<0.001
CAF	9(90)	1(10)	6(60)	4(40)	6(60)	4(40)	6(60)	4(40)	χ2=30.00 P<0.001
Total	14(70)	6(30)	11(55)	9(45)	11(55)	9(45)	11(55)	9(45)	

Mann test result	Z=1.90 P=0.143	Z=0.44 P=0.739	Z=0.44 P=0.739	Z=0.44 P=0.739	

Table (2) displays the number of MST and CAF groups, as well as the average, standard deviation, mean, minimum, and maximum coverage percentages and statistical test results.

Table 2. Comparison of coverage percentage between groups

Group	Number (people)	Standard deviation ± mean	Maximu (%)m	Minimum (%)	Average rating	Mann-Whitney U test
MST	10	89.1±18.5	100	50	12	**Z=1.28 P=0.280**
CAF	10	73.9±28.7	100	33	9	

Discussion

Table (3) shows that the difference in adipose tissue and keratinization between the initial time (before surgery) and the follow-up time after surgery was statistically significant in both groups, with a greater rise in the MST group. In other words, both methods increased keratinized tissue, but the MST group outperformed the others. Salem et al. conducted a research comparing 4-year clinical results (CAF + CTG) with the method (TUN + CTG) in 2020, in accordance with the current study. Forty patients were randomly assigned to one of two groups: CAF + CTG or CTG + TUN. The rate of keratinized tissue growth and the percentage of complete root coverage (CRC) were both assessed. The CRC parameter indicated no statistically significant difference between the two groups, however the rate of growth in keratinized and sticky tissue was substantially greater in the group (CTG + TUN) than in the group (CAF + CTG) (33). Many prior studies have assessed various approaches in the treatment of gingival resorption that may differ from our study in terms of the kind of methodology or indicators analyzed, and thus may not be entirely comparable to what was done in this study. Santa Maria et al., for example, conducted a research in 2017 to evaluate the clinical outcomes of two techniques (CTG + CAF) and (CTG + TUN). Both groups exhibited a substantial decrease in analysis height, as well as a rise in keratinized gums and tissue thickness, after six months. As a result, the percentage of full root coverage for the group (CTG + CAF) is 71.4 percent, whereas the percentage of complete root coverage for the group CTG + TUN is 28.6 percent. CAF + CTG was shown to be more effective than TNU CTG + in the treatment of maxillary gingival resorption. The difference between the results of this study and the current study might be attributable to the Santamario study's larger sample size and use of anterior maxillary gingival examination (34).

Table 3. Mean of sticky gums (mm) gingival resorption of patients before and after the intervention in the two groups

Group	Time	Number (people)	CAF treatment (standard deviation ± mean)	standard) MST treatment (mean± deviation
Sticky gums (mm)	Instantly	10	3.4±0.8	3.2±0.9
	3 weeks	10	3.5±0.8	4.7±0.9
	3 months	10	3.3±1.1	5.0±0.8
	6 months	10	3.6±1.2	5.5±0.7

The breadth and height of gingival resorption are the most significant factors that surgeons consider while treating gingival resorption. According to Tables (4), both groups were effective in lowering gingival resorption height and width and had a substantial reduction in the passage of time from the initial time (before surgery) to 6 months (P 0.001). The rate of gingival resorption height and breadth decrease in the TUN + CTG group was higher than the CAF + CTG group, but the difference was not statistically significant. For example, in 2021, Otto Zohar et al. conducted a 5-year follow-up research comparing the techniques (TUN + SCTG) and (CAF + EMD) for treating root resorption. A 3D scan was used to evaluate full root canal coverage (CRC), analysis height (REC), and root canal percentage (RC) in 23 patients with 45 Miller class I and II analyzes. The group (CTG + TNU) has a root coverage percentage of 94 percent, while the group (CAF + EMD) has a root coverage percentage of 57.3 percent. There is a statistically significant difference between these two groups. The reduction in analysis height for the group (CTG + TNU) was 1.81 mm, whereas the drop in analysis height for the group (CAF + EMD) was 0.9 mm. Even if this study did not employ the modified tunnel surgical approach, it found that the group (CTG + TNU) had a substantial reduction in the height and width of gingival resorption (35).

Table 4. Mean height (mm) of gingival resorption of patients before and after the intervention in the two groups

Group	Time	Number (people)	CAF treatment (standard deviation ± mean)	MST treatment (standard deviation+ mean)
Resorption height	Instantly	10	2.6±1.0	3.3±1.2
	Three weeks	10	0.7±0.8	0.2±0.4
	Three months	10	0.6±0.7	0.3±0.5
	6 months	10	0.8±1.0	0.3±0.5

According to Table (5), the clinical adhesion limit has decreased significantly in each of the two groups, and this difference was evident in the sixth month after the intervention, so that the decrease in the group (TUN + CTG) was greater than the decrease in the group (CAF + CTG), but there was no statistically significant difference.

Table 5. Mean clinical adhesion limit (mm) of gingival resorption of patients before and after the intervention in both groups

Group	Time	Number (people)	CAF treatment (standard deviation ± mean)	MST treatment (standard deviation+ mean)
CAL	Instantly	10	4.3±1.3	5.4±1.3
	Three weeks	10	2.0±1.2	1.3±0.7
	Three months	10	1.7±0.8	1.4±0.7
	6 months	10	1.9±1.2	1.3±0.5

Omid Moghaddas et al. evaluated two treatments (TUN + CTG) and (CAF + CTG) for Miller class I and II gingival analyses in a comparable research published in 2019. The researchers split 92 individuals

with simultaneous gingival resorption into two groups: TUN + CTG and CAF + CTG. Clinical indicators were evaluated three months and six months following surgery during follow-up visits. Between the beginning time (before surgery) and follow-up periods, there was a statistically significant decrease in probing depth, analysis height, and clinical adhesion limit in both groups. The group (TUN + CTG) had a root coverage of 69.70 percent, whereas the group (CAF + CTG) had a root coverage of 67.22 percent. In addition, the mean increase in keratinized gingival width was 2.4 mm in the TUN + CTG group and 2.7 mm in the CAF + CTG group (36).

Conclusion

According to the findings of this study, the modified tunnel surgery approach had a substantially greater mean increase in keratinized gingival width than the CAF group, with an average keratinized gingival width of 5.6 mm after 6 months after surgery in the MST group. After 6 months of surgery, the average width of keratinized gums in CAF patients is 3.6 mm. Furthermore, each of the clinical indications of improvement was evaluated, revealing that increasing the percentage of root coverage in both approaches had the same performance and their expression could not be different.

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