

# Comparison of Tissue Substitutes with Subepithelial Connective Tissue Graft by Tunnel or Modified Technique in Root Coverage: A Systematic Review

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## ABSTRACT

**Aim:** To evaluate the efficacy of soft tissue substitutes, namely acellular dermal matrix (ADM), collagen matrix (CM), and titanium-prepared platelet-rich fibrin (T-PRF) in comparison to subepithelial connective tissue graft (SECTG) by tunnel or modified coronally advanced tunnel technique (MCAT) in root coverage.

**Materials and methods:** A literature search on MEDLINE, PubMed, Cochrane Libraries, Embase and hand-searched journals were covered from January 1999 to August 2020, which investigated the efficacy of soft tissue substitutes in comparison to SECTG by tunnel technique (TUN) or MCAT for root coverage procedures. Only randomized control trials (RCTs) were considered for the comparison.

**Results:** Seven studies were included for qualitative synthesis. SECTG, ADM and T-PRF were more effective for complete/partial root coverage (CRC) which was considered as the primary outcome according to Miller's classification. SECTG showed better results when secondary outcomes were considered.

**Conclusion:** The clinical efficacy of SECTG seemed to be higher in tunnel or MCAT for root coverage. Hence, SECTG can be a better option compared to other substitutes.

**Clinical significance:** Clinicians should be aware that SECTG can be considered as the first choice in root coverage when compared to other soft tissue substitutes. Nevertheless, these substitutes should be considered when there are anatomical variations or in situations where SECTG cannot be opted.

**Keywords:** Gingival recession, Subepithelial connective tissue graft, Tooth root, Tunnel technique.

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## INTRODUCTION

Gingival recession is an esthetically challenging periodontal defect. This leads to dentin sensitivity, esthetic concern, root caries and cervical wear. If untreated, it can compromise the prognosis of the tooth in question. The etiology of gingival recession is multifactorial which includes inflammation, faulty toothbrushing, habits, high frenum attachment, inadequate attached gingiva, occlusal trauma, and lip piercing.

In order to meet the esthetic demands of patients, surgical procedures that preserve the integrity of the papilla by TUN have been proposed by Allen. He used the supraperiosteal envelope technique, which comprises partial-thickness dissection at the recipient area without vertical incisions.<sup>1</sup> The SECTG was then inserted into the tunnel, partly exposed over the recessions and sutured in this position. Since the amount of root coverage depends on the size of the graft which survives over the root surface, necrosis of the exposed parts of the SECTG limits the predictability of this original technique. To overcome this problem, it has been suggested to coronally advance the pouch and the tunnel. This modification has been described by Azzi R and Etienne D.<sup>2</sup> It requires a mucoperiosteal dissection beyond the mucogingival junction and under each papilla. The strategy of this technique is that it preserves the continuity of gingival papillae and optimizes lateral blood vessels. It also intimates the contact of the graft with the recipient site.<sup>3</sup> Thereby resulting faster rate of healing with satisfying aesthetic results.

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A subepithelial connective tissue graft is the gold standard for localized recession defects due to its predictability in increasing the width of keratinized gingiva and in obtaining root coverage.<sup>4</sup> The drawback of this autogenous graft is the need for a second surgical site for harvesting donor tissue. This procedure increases patient morbidity, prolongs surgical time and could result in postoperative complications. Since the amount of tissue harvested can be limited due to tissue thickness in the palate and anatomical limitations, its predictability is less. These shortcomings of SECTG led to the introduction of soft tissue substitutes.

Root coverage with soft tissue substitutes has proved an alternative to SECTG owing to its ease of management and material availability. Hence the objective of this systemic review is to evaluate

the efficacy of soft tissue substitutes namely, ADM, CM and T-PRF in comparison to SECTG by TUN or MCAT in root coverage.

## METHODOLOGY

The protocol has been registered on the International Prospective Register of Systematic Reviews (Registration number, CRD42021215426) based on the preferred reporting items for systematic reviews and meta-analyses protocol (PRISMA-P) statement guidelines.<sup>5</sup>

## PICO Questions

The criteria for considering studies by PICO are as follows:

- P: Localized or multiple gingival recession defects classified as Miller's I, II and III.
- I: Recession defects indicated for treatment with TUN or MCAT where there was root exposure
- C: Soft tissue substitutes, namely ADM, CM and T-PRF in comparison to SECTG
- O: Primary outcome was partial/complete root coverage.

Secondary outcomes were changes in gingival thickness (GT), probing depth (PD), clinical attachment level gain (CAL) and keratinized tissue width (KTW).

## Focused Questions

Are soft tissue substitutes, namely ADM, CM and T-PRF as efficacious as SECTG in TUN or MCAT in root coverage?

## Eligibility Criteria

Randomized controlled trials in systemically healthy patients with a minimum of seven gingival recession defects in each group were included. Also, studies that were limited to human trials and published in the English language were considered. The study also comprised multiple adjacent or single Miller's class I, II, and III recession defects in the maxilla or mandible. In addition, studies using graft materials in combination with biologic mediators such as bone morphogenetic proteins or enamel matrix derivative, ethylenediaminetetraacetic acid, and tetracycline were studied. Case reports, case series, animal studies and studies without control groups were excluded.

## Search Strategy

Electronic databases which include MEDLINE, Google Scholar, The Cochrane Central Register of Controlled Trials, and EBSCO were covered from January 1999 to August 2020. The search was performed independently. Additionally, a manual search of related journals were carried out to identify potential papers. Systematic reviews investigating root coverage procedures were also screened finally for article identification. For the search in PubMed combinations of medical subject headings (MeSH) terms, keywords, and free terms were utilized. The keywords include TUN, MCAT, gingival recession/therapy and treatment outcome.

The search strategies included were ["tunnel technique (TUN)" and "CM" or "ADM" or "T-PRF" or "grafts"], ("tunnel technique and root coverage"), ("tunnel technique for root coverage"), ("tunnel technique" OR "MCAT") + [gingival recession OR root coverage (MeSH terms)], (tunnel technique for root coverage and "gingival recession/therapy") (MAJOR), (tunnel technique for root coverage) and "collagen/therapeutic use" (MAJOR), (tunnel technique for root coverage) and "treatment outcome" (MeSH terms).

## Screening Process

The initial screening involved the analysis of titles and abstracts of 529 articles. All full-text articles were read that appeared to fit the inclusion criteria.

## Data Extraction

Studies were excluded by screening titles and abstracts and full text reading independently using a pre-established data extraction form to support the eligibility of each study based on the aforementioned criteria. Data were independently extracted. Entire reports were retrieved for all studies appearing to meet the inclusion criteria or in instances where there was deficient information from the title, keywords and abstract to make a clear decision. Characteristics of patients, their treatments and clinical outcomes were recorded.

## Quality and Risk of Bias Assessment

The methodological quality of the RCTs was assessed by the Jadad scale<sup>6</sup> and Cochrane risk-of-bias tool<sup>7</sup> and are outlined in Tables 1 and 2 respectively.

**Table 1:** Jadad scale for quality analysis of RCTs<sup>6</sup>

Parameters	Score	Aroca et al. <sup>3</sup>	Wegemund et al. <sup>8</sup>	Pietruska et al. <sup>9</sup>	Rakasevic et al. <sup>10</sup>	Bednarz et al. <sup>11</sup>	Fahmy et al. <sup>12</sup>	Uzun et al. <sup>13</sup>
Was the study described as randomized?	(0 or +1)	1	1	1	1	1	1	1
Was the method of randomization appropriate?	(0 or +1)	1	1	1	1	0	0	1
Was the method used for double-blindness adequate?	(0 or +1)	1	1	1	1	0	0	0
Was the method used to generate the randomization sequence appropriate?	(0 or +1)	1	1	1	1	0	0	1
Was the masking method appropriate?	(0 or +1)	1	1	1	1	0	0	0
Have the numbers and reasons for losses and dropouts been described?	(0 or +1)	1	1	1	1	1	1	1
Total		6	6	6	6	2	2	4

## RESULTS

After screening 468 articles, 441 articles were excluded based on inclusion and exclusion criteria as well as on titles and abstracts. Out of 441, 27 full-text articles were assessed for comparison between different soft tissue substitutes without SECTG, different surgical techniques and treatment of gingival recessions with noncarious cervical lesions. Out of 27 full-text articles, 20 articles were excluded. Finally, seven studies were included for qualitative synthesis.

Figure 1 shows the search results based on the PRISMA guidelines. A total of seven randomized controlled trial articles on 694 recessions treated with TUN/MCAT with a mean follow-up of 6–12 months were included in the present systematic review.

Four RCTs compared TUN/MCAT + SECTG vs TUN/MCAT + CM.<sup>3,8–10</sup> Two RCTs compared MCAT + SECTG vs MCAT + ADM.<sup>11,12</sup> One compared MCAT + SECTG vs MCAT + T-PRF.<sup>13</sup> The general characteristics and type of intervention of the included studies are outlined in Table 3.

## Results of Analysis

A total of 694 Miller class I and II gingival recessions in 172 patients from seven RCTs were evaluated in this systematic review.<sup>3,8–13</sup> The clinical parameters are outlined in Table 4.

## Primary Outcome

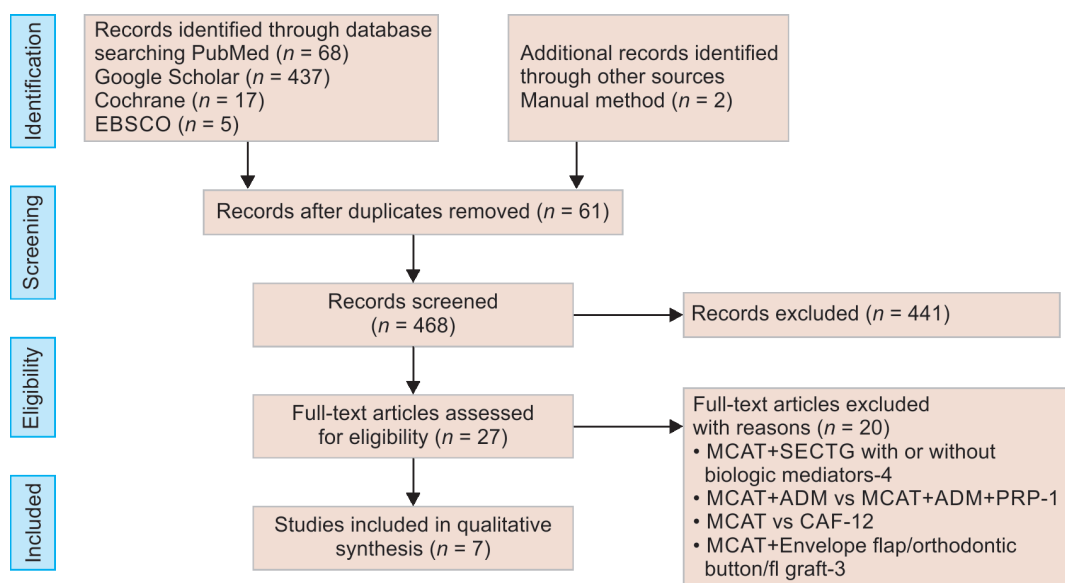
The primary outcome was complete/partial root coverage. The comparison between MCAT/TUN + SECTG versus MCAT/TUN + CM showed complete/partial root coverage in control group.<sup>3,8–10</sup> The comparison between MCAT + SECTG vs MCAT + ADM showed CRC in the control group (94.87%) compared to the test group (94.24%), which showed statistically no difference.<sup>11</sup> Fahmy et al. demonstrated more root coverage for ADM ( $84.4 \pm 22.9$  mm) than SECTG ( $79.8 \pm 25.9$  mm) though no statistical difference was observed.<sup>12</sup> The comparison between MCAT + SECTG vs MCAT + T-PRF showed CRC more in the test group (76.57%) when compared to the control group (72.54%), with no significant difference between groups.<sup>13</sup> Therefore, the SECTG, ADM and T-PRF were more effective for complete/partial root coverage.

## Secondary Outcome

The comparison between MCAT/TUN + SECTG vs MCAT/TUN + CM showed gain in GT in the control group,<sup>3,9</sup> whereas, in another study, GT gain was seen in the test group.<sup>10</sup> The comparison between MCAT + SECTG vs MCAT + ADM has not evaluated GT.<sup>11,12</sup> The comparison between MCAT + SECTG vs MCAT + T-PRF showed GT more in the control group.<sup>13</sup> Therefore, the SECTG showed more gain in GT than in test groups.

**Table 2:** The Cochrane risk of bias tool for the included RCT<sup>7</sup>

Studies	Sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessors	Incomplete outcome data	Selective outcome reporting	Other sources of bias	Overall risk of bias
Aroca et al. <sup>3</sup>	L	L	L	L	L	L	L	Low
Wegemund et al. <sup>8</sup>	L	L	L	L	U	L	L	Moderate
Pietruska et al. <sup>9</sup>	L	L	L	L	L	L	L	Low
Rakasevic et al. <sup>10</sup>	L	L	L	L	L	L	L	Low
Bednarz et al. <sup>11</sup>	L	H	U	U	L	L	L	High
Fahmy RA et al. <sup>12</sup>	L	U	U	U	L	L	L	High
Uzun et al. <sup>13</sup>	L	L	L	L	L	L	L	Low



**Fig. 1:** Study selection record with PRISMA flowchart

**Table 3:** General characteristics and type of intervention in the study

<i>Author study design</i>	<i>Age, patients, and recessions</i>	<i>Periodontal status and smoking habit</i>	<i>Recession type and location</i>	<i>Preoperative operation</i>	<i>Treatment in control and test group</i>	<i>Technique</i>	<i>Author's conclusion</i>
Aroca et al. <sup>3</sup> RCT, split mouth	Age ≥ 18 years Patients n = 22 Recessions n = 156	Healthy or treated, nonsmoking patients FMPS < 25%	Multiple GRs Miller class I and II Maxilla & mandible (Incisor, canine, premolar, and molar)	OHI + full-mouth supragingival scaling and polishing 1 month before surgery	*C-MCAT + SECTG (78 sites) *T- MCAT + CM (78 sites)	Azzi and Étienne, 1998 MCAT	XCM may be considered an alternative to CTG, however, MCAT + CTG was better than MCAT+ XCM
Wegemund et al. <sup>8</sup> RCT, parallel	Age: 18–60 years Patients n = 28 Recession n = 106	Healthy or treated, nonsmoking patients	Multiple GRs Miller Class I and II Maxilla & mandible (Incisor, canine, premolar, molar)	OHI and prophylaxis	*C-TUN + SECTG (47 sites) *T- TUN + XCM (59 sites)	Blanes and Allen, 1999 Modification of original TUN where bilateral pedicle flaps are used to completely cover the graft. This approach offers better blood supply to the graft which could enhance the predictability of technique.	TUN + XCM achieved satisfactory results but lower than TUN + CTG
Pietruska et al. <sup>9</sup> RCT, split mouth	Age: 20–56 years Patients n = 20 Recession n = 91	Healthy or treated, nonsmoking FMPS and FMBOP <20%;	Multiple GRs Miller class I and II Recession ≥ 1 mm Mandible (single rooted teeth)	NR	*C-MCAT + SECTG (45 sites) *T- MCAT + CM (46 sites)	Zuhr, 2007 MCAT Modifications involve converting full thickness into a partial thickness flap in the buccal region. This ensures better nutrition for the grafted tissue. The mucosal preparation is performed by tunneling instruments which minimize the risk of perforations.	MCAT + CTG is more efficient than MCAT + CM for root coverage and aesthetic
Rakasevic et al. <sup>10</sup> RCT, split mouth	Age > 18 years Patients n = 27 Recession n = 114	Nonsmokers and light smokers <10 cigarettes per day FMPS <20% and FMBOP <20%	Multiple GRs Miller class I Recession ≥ 2 mm Maxilla & mandible (Incisor, canine, premolar, molar)	NR	*C-MCAT + SECTG (52 sites) *T-MCAT + CM (62 sites)	Sculean, 2014 MCAT Modification was done by using microsurgical blades and tunneling knives.	XDM considered an alternative to CTG

Contd...

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Author study design	Age, patients, and recessions	Periodontal status and smoking habit	Recession type and location	Preoperative operation	Treatment in control and test group	Technique	Author's conclusion
Bednarz et al. <sup>11</sup> RCT	Age: 18–60 years Patients <i>n</i> = 30 Recession <i>n</i> = 97	Healthy, nonsmoking patients	Multiple GRs Miller class I and II Recession ≥ 2 mm Maxilla & mandible (Incisor, canine, premolar, molar)	NR	*C-MCAT + CTG (40 sites) *T-MCAT + FL (97 sites)	Azzi and Etienne, 2002 MCAT Modification was made by tunneling beneath the interdental papillae to be corrected and creating a pouch-like space beneath the buccal flap and a portion of palatal tissue to free connective tissue from the root surface. Thus, producing better stabilization when coronally positioned.	FL allograft is a viable alternative to CTG for root coverage procedure based on MCAT
Fahmy et al. <sup>12</sup> RCT	Patients <i>n</i> = 11 Recession <i>n</i> = 16	Healthy, nonsmoking patients	Miller class I and II Recession ≥ 2 mm Maxilla & mandible (Incisor, canine, premolar)	NR	*C-MCAT + CTG (8 sites) *T- MCAT+ ADM (8 sites)	MCAT	ADM can be used as alternative to CTG
Uzun et al. <sup>13</sup> RCT	Age: 25–69 years Patients <i>n</i> = 34 Recession <i>n</i> = 114	Healthy, nonsmoking patients	Multiple GRs Miller class I and II Maxilla & mandible (Incisor, canine, premolar)	OHI and prophylaxis	*C-MCAT + CTG (51 sites) *T- MCAT + T-PRF (63 sites)	MCAT	T-PRF is effective for multiple gingival recession defects

\*C, control; T, test

The comparison between MCAT/TUN + SECTG vs MCAT/TUN + CM showed a decrease in PD in the control group.<sup>10</sup> Rest of the three studies showed no difference in mean PD.<sup>3,8,9</sup> The comparison between MCAT + SECTG vs MCAT + ADM showed a decrease in PD in the control group,<sup>11</sup> and no evaluation was done on the study by Fahmy et al.<sup>12</sup> MCAT + SECTG vs MCAT + T-PRF showed no significant difference.<sup>13</sup> Therefore, the SECTG showed a decrease in PD in two studies<sup>10,11</sup> and in other studies, no significant difference was observed.<sup>3,8,9,13</sup>

The comparison between MCAT/TUN + SECTG vs MCAT/TUN + CM resulted in statistically significant CAL gain of  $1.9 \pm 0.6$  mm and  $1.4 \pm 0.4$  mm for test and control groups, respectively.<sup>3</sup> Wegemund et al. also confirmed CAL gain in both groups but was favorably more in the control group because the mean recession depth was 0.18 mm greater in the test group, and the mean area of a recession was 0.22 mm<sup>2</sup> greater after the study period though the

differences in these parameters between groups were statistically significant.<sup>8</sup> Pietruska et al. observed a statistically significant CAL gain of about 1 mm for CM and 1.54 mm for SECTG.<sup>9</sup> Rakasevic et al. observed no statistically significant difference at 12 months between both the groups.<sup>10</sup> MCAT + SECTG vs MCAT+ allograft showed no statistically significant difference between both groups.<sup>11,12</sup> The comparison between MCAT + SECTG vs MCAT + T-PRF showed statistically significant attachment gain in both groups.<sup>13</sup> Therefore, all the studies showed CAL gain in both groups, and there was no statistical difference between these groups.

Posttreatment examination revealed a significant increase in KTW in both groups. The comparison between MCAT/TUN + SECTG vs MCAT/TUN + CM showed a statistically significant difference in the width of attached gingiva, which is  $1.38 \pm 0.68$  to  $1.91 \pm 0.84$  mm on the CM side and from  $1.28 \pm 0.72$  to  $4.06 \pm 1.59$  mm on SECTG.<sup>3,8,9</sup> MCAT + SECTG vs MCAT + ADM showed an increase in



**Table 4:** Primary and secondary outcome

Author	Primary outcome		Secondary outcome		
	CRC/PRC	KTW	GT	PD	CAL
Aroca et al. <sup>3</sup>	C: 85% (13/22) T: 42% (5/22)	C: 2.7 ± 0.8 T: 2.4 ± 0.7	C: 1.3 ± 0.4 T: 1.0 ± 0.3	C: 1.3 ± 0.3 T: 1.4 ± 0.2	C: 1.4 ± 0.4 T: 1.9 ± 0.6
Wegemund et al. <sup>8</sup>	C: 83% T: 70%	C: 3.3 ± 1.7 T: 3.4 ± 1.5			C: 1.2 ± 0.4 T: 1.4 ± 0.3
Pietruska et al. <sup>9</sup>	C: 45% (9/20) T: 10% (2/20)	C: 4.06 (1.59) T: 1.91 (0.84)	C: 1.86 (0.48) T: 1.10 (0.37)	C: 1.58 (0.64) T: 1.37 (0.58)	C: 1.98 (0.88) T: 2.33 (0.89)
Rakasevic et al. <sup>10</sup>	C: 51.9% (6/20) T: 46.8% (3/20)	C: 3.27 ± 1.03 T: 3.28 ± 0.9	C: 1.3 ± 0.38 T: 1.39 ± 0.44	C: 1.13 ± 0.1 T: 1.1 ± 0.33	C: 0.88 ± 0.92 T: 0.92 ± 1.2
Bednarz et al. <sup>11</sup>	C: 94.87% T: 94.24%	C: 2.86 T: 3.09		C: 1.05 T: 1.21	C: 1.20 T: 1.34
Fahmy et al. <sup>12</sup>	C: 79.8 ± 25.9% T: 84.4 ± 22.9%	C: 3.4 ± 1.1 T: 3.5 ± 1.2			C: 1.0 ± 1.2 T: 0.9 ± 1.1
Uzun et al. <sup>13</sup>	C: 72.54% T: 76.57%	C: 4.25 ± 2.03 T: 4.78 ± 1.66	C: 1.85 ± 0.50 T: 1.34 ± 0.3	C: 2.10 ± 0.64 T: 1.67 ± 0.47	C: 2.34 ± 0.76 T: 1.87 ± 0.69

CRC/PRC, complete/partial root coverage; KTW, keratinized tissue width; GT, gingival thickness; PD, probing depth; CAL, clinical attachment level; C, control group; T, test group

KTW in ADM but was not statistically significant.<sup>11,12</sup> The comparison between MCAT + SECTG vs MCAT + T-PRF showed statistically significant KTW in the T-PRF group vs the SECTG.<sup>13</sup>

## DISCUSSION

This systematic review was designed to evaluate the efficacy of soft tissue substitutes compared to SECTG in TUN or MCAT for root coverage. One of the outcomes of periodontal plastic surgery is CRC.<sup>14</sup> It results in the resolution of hypersensitivity and provides esthetic satisfaction. A variety of factors influence CRC such as anatomical factors, type of teeth included, bilateral treatment approach, operator's experience or type of study design and host condition which includes smoking habits, muscle pull, and grafts. Grafting provides a scaffold to support wound healing and an increase in the thickness of the wound area, favoring coverage.<sup>8</sup> The efficacy of the tunnel/MCAT technique is dependent on the application of connective tissue graft. Since the amount of tissue harvested from one's palate is limited, soft tissue substitutes could be useful.

The data obtained in the study showed that CM yielded a less effective reduction in clinical parameters compared to SECTG when used along with MCAT/TUN.<sup>3,8-10</sup> CM is a xenogeneic graft which is composed of type I and III collagen. Its compact layer with low porosity surface makes it less cell permeable. The porous layer consists of diffusely packed collagen fibers which can support blood clot stabilization and ingrowth of soft tissue cells.<sup>15</sup> In 6-month follow-up study, Wegemund et al.<sup>8</sup> reported an increase in the width of attached gingiva, thus ensuring optimal stabilization of CM. But the possible factor for a low outcome is the anatomical considerations, as the test group included 8.9% molars while the control group included 2.17% molars. The limitation of this graft material is the rigidity of matrix that causes flap tension resulting in inadequate root coverage.<sup>10</sup> Though CM provides good volume stability by providing adequate time for cell invasion and new tissue formation, the rapid biodegradation by enzymatic activity limits its use as an alternative to SECTG.

In light of the results of this review, almost similar efficacy was confirmed with ADM and SECTG.<sup>11,12</sup> ADM represents an allograft of human dermis. Its processing comprises the elimination of all cells, thus minimizing the probability of graft

rejection. ADM functions as an architectural scaffold to enable the migration and repopulation by the host's fibroblasts, blood vessels and epithelial cells.<sup>16</sup> As healing proceeds, ADM is replaced by and fully integrated into the host tissues. Its direct contact with the flap is important as it relies on host cells and vasculature for nutrition and repair. Thus, it requires complete coverage. SECTG healing takes place through anastomoses between the graft's vessels and those of the host tissue. Hence, complete graft coverage is not mandatory. It is also depicted that the outcome of ADM placed 1 mm apically and the flap 1 mm coronally with respect to cemento-enamel junction (CEJ) results in statistically superior widening of the keratinized gingiva than when the allograft is positioned at CEJ level.<sup>17</sup>

Uzun et al. noted better efficacy with T-PRF when compared to SECTG.<sup>13</sup> T-PRF is effective in activating platelets because of its polymerized fibrin formation with longer resorption rate in tissues. The growth factors which are released from the thrombocytes in the natural fibrin matrix result in gingival and fibroblast proliferation that are responsible for the increased amount of attached gingiva. Another reason for the increase in KTW is its creeping attachment. Increased GT can be attributed to the histoconductive effect of both grafts, which serve as space maintainers that are able to increase soft tissue in the defect areas. T-PRF can be effective as the fibrin matrix, which forms *via* natural coagulation, results longer intratissue resolution time, which is more important for keratinization and remodeling.

## Limitations

The limitations of our review include a lack of longer-term data (>12 months), which could provide a clinical and patient centered outcomes. More RCTs with various soft tissue substitutes should be researched as an alternative to SECTG.

## CONCLUSION

The complete/partial root coverage was more in the SECTG. It was also inferred that SECTG showed a better outcomes in KTW, GT, clinical attachment level gain and PD. Hence it can be concluded that SECTG can be a better option.

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