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Root coverage in Miller's Class I and II gingival recession using acellular dermal matrix and subepithelial connective tissue graft: A systematic review

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Abstract

Background. Subepithelial connective tissue graft (SCTG) is considered the gold standard in the treatment of gingival recession. Donor site morbidity has led to the introduction of non-autogenous grafts such as acellular dermal matrix (ADM). This systematic review compared SCTG with ADM to treat root coverage in Miller's Class I and Class II gingival recession.

Methods. Articles in PubMed (11), Scopus (1), Ebsco (2), and Google Scholar (1) were incorporated in this study. The studies included randomized controlled trials from 1st January 2011 to 31st December 2022. Studies that compared root coverage and reduction in recession depth using SCTG and acellular dermal matrix grafts were included in the review. Fourteen RCTs (randomized control trials) were included in this systematic review following the PRISMA guidelines. The risk bias assessment was assessed using the ROBINS-2 tool.

Results. Of the 14 included studies, 11 articles concluded that ADM is as effective as SCTG for treating root coverage in Class I and Class II gingival recession. However, 3 studies showed a statistically significant difference between SCTG and ADM results, indicating better root coverage achieved with SCTG than with ADM.

Conclusion. ADMs may be an alternative treatment in cases where multiple areas of recession where SCTGs harvested from the palate area would be insufficient.

Key words: Acellular dermal graft tissue, allografts, connective tissue, gingival recession.

Introduction

Displacement of the gingival margin apical to the cementoenamel junction (CEJ), leading to root surface exposure, is known as gingival recession.[1] Various etiologic factors can result in gingival recession, such as tooth brushing trauma, restorations invading the biological width, improper brushing technique, plaque-induced inflammatory lesions, and surgical periodontal interventions. Gingival recession can lead to root hypersensitivity, root caries, and unpleasant esthetics, particularly in the anterior regions of the jaws.[2] Subepithelial connective tissue graft (SCTG) is considered the gold standard in the treatment of gingival recessions for root coverage.

It provides long-term stability of complete root coverage (CRC) in Miller's Class I and Class II gingival recession. However, the main disadvantage of this technique is the need for a second surgical area, a limited amount of graft, low patient tolerance, and high complication rates at the donor site.[3]

To overcome the limitations, new biomaterials, such as acellular dermal matrix, have been introduced as an alternative to SCTGs.[4] Acellular dermal matrix is an allograft tissue devoid of epidermal and dermal cells. It is chemically processed to remove the cellular components while preserving the remaining bioactive dermal matrix. This matrix consists of collagens, elastin, blood vessel channels, and bioactive proteins that induce revascularization, cell repopulation, and tissue remodeling. The collagen fibrillar network allows ADM to maintain its structural integrity, thereby giving it characteristics of a feasible soft tissue graft material.[5]

Various acellular dermal matrix (ADM) materials are available on the market, such as Alloderm (LifeCell.Biohorizon INC), Puros dermis allograft, Perioderm, Oracell, Surederm, and Mucoderm, which can be effectively used to treat gingival recession and achieve root coverage.[5]

Al Hamdam[6] assessed the long-term predictability of ADM in root coverage procedure with a follow-up of three years. The study showed that ADM combined with a coronally advanced flap could improve the width of keratinized tissue and provide root coverage in teeth with gingival recession.

Considering the various advantages of ADM, this systematic review compared root coverage in Miller's Class I and II gingival recession using ADM and SCTG.

Methods

This systematic review was registered under PROSPERO (CRD42022362523) and conformed to PRISMA guidelines.[7] The research question was based on patient/population, intervention, comparison, and outcomes (PICO). The research question of this systematic review was whether acellular dermal matrix (I) is as effective as connective tissue graft (C) in root coverage (O) of Miller's Class I and Class II gingival recession (P).

The systematic review was performed for articles published in English in Scopus, PubMed, EBSCO, and Cochrane from 1st January 2011 to 31st December 2022. The terms were combined using suitable Boolean operators (AND, OR, NOT). The keywords used were acellular dermal graft tissue, allografts, autografts, connective tissue, gingival recession, and systematic review. The search strategy used was: "gingival recession" [MeSH terms] OR ("gingival" AND "recession" OR "gingival recession" AND ("acellular dermis" [MeSH Terms] OR ("acellular" AND "dermis" OR "acellular dermis" OR ("acellular" AND "dermal" AND "matrix" [all fields]) OR "acellular dermal matrix" AND (clinical trial) OR randomized controlled trial OR systematic review.

The inclusion criteria were randomized controlled trials comparing root coverage using acellular dermal matrix and subepithelial connective grafts to treat Miller's Class I and Class II gingival recession. In vitro studies, animal models, case reports, reviews, abstracts, and unpublished articles were excluded.

According to the inclusion and exclusion criteria, one reviewer investigated the titles

and abstracts of the studies, based on which two experts screened extracted articles from the database. Disagreements were resolved by discussion. The final step included all full-text articles for the study. The main outcome was to assess whether the acellular dermal matrix was better in improving root coverage in Class I and Class II gingival recession compared to connective tissue grafts.

Microsoft Word was used for organizing data extraction, which included the name of the author, year, study design, study duration, participants, parameters, surgical method, postoperative instructions, results, and conclusion (Table 1). Two entries were used for blinding: (1) operators and (2) outcome assessors. Assessment risk of bias using ROBINS-2 for randomized studies and used as per Revised Cochrane risk-of-bias tool RevMan 5.4.1 for systematic review.

Two review authors independently undertook the risk of bias assessment. Any disagreements were resolved by discussion. The outcome of the trial was noted when the operator assessed it. The response options were Yes/Probably yes/Probably no/No/No information. There was good reliability between the two reviewers with a high kappa coefficient ($k>0.89$).

The two-part tool addressed five specific domains (namely, randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result). The possible risk-of-bias judgments were assessed as low risk of bias, some concerns, and high risk of bias. Risk of bias graph: review authors' judgments about each risk of bias item were presented as percentages across all included studies [Graph 1]. Graph 2 presents the risk of bias summary review of authors' judgments about each risk of bias item for each study.

Results

The systematic search resulted in 94 articles. After screening and removing the duplicates, the remaining 31 articles were included. A comprehensive assessment was conducted by the review team for the title of the articles and abstracts and after excluding the unrelated articles from the research objectives. Eventually, 15 articles were obtained after screening, out of which one was excluded due to the unavailability of the full text. Therefore, 14 articles were included, which is depicted in the form of a PRISMA screening flowchart (Figure 1). Based on the revised Cochrane risk-of-bias tool for randomized trials (RoB2) scoring system, all the articles had low risks of bias (Figure 2). The risk of bias for each included study was low, as shown in Figure 3. Table 1 presents the data obtained from the articles. The study included a population with more than one gingival recession site. Included articles were randomized clinical trials.

Based on the data extracted from 14 studies, 11 articles concluded that ADM is as effective as SCTG for treating root coverage in Class I and Class II gingival recession. Statistically significant results were obtained in three studies, which favored SCTG over ADM for root coverage in Miller's Class I and Class II gingival recession.[9,22,29]

Discussion

The purpose of the present systematic review was to compare root coverage in SCTG

versus ADM in treating Miller's Class I and Class II gingival recession. According to Chambrone et al.,[8] the root coverage produced by ADM was similar to those achieved by SCTG. Maluta et al.[9] conducted a comparative assessment between SCTG and ADM for root coverage. A statistically significant difference (P=0.045) was seen at 6 months between SCTG and ADM, with better root coverage results observed in the SCTG group.[9] In SCTG, preexisting blood vessels anastomose with those in the gingival connective tissue. ADM, being avascular, acts as a scaffold for cells from the surrounding tissues. The collagen fibers in the ADM membrane facilitate root coverage by stimulating platelet attachment, enhancing fibrin linkage, and having a chemotactic effect on nearby fibroblasts.[10] The crosslinking of the ADM helps increase the tensile strength, stiffens the matrix and bulk of the graft, and reduces the porosity of the matrix. As healing proceeds, ADM is fully integrated into the host tissues. It completely depends on the recipient bed, which is eventually degraded and replaced by the host cell.[11] Because of its elastic matrices and undamaged collagen fibrils, ADM can be used as a substitute for CTG in root coverage procedures. However, the disadvantages of using ADM include lack of vascularity, longer healing time, cost of the material, and postoperative management.[11,12] Therefore, better root coverage results were in favor of SCTG than in the test group. Inductive properties of ADM graft are determined by the percentage of colonization of non-vital graft and host cells inducing keratinization. Connective tissue grafts are entirely made up of host cells and, hence, can induce epithelium keratinization.[12]

Owens et al.[13] reported increased resident fibroblasts and blood vessels gradually within the first few weeks and reduced inflammatory infiltrate. The graft material showed degradation of the collagen matrix at the fourth week. By six weeks there was formation of basement membrane with complete re-epithelialization of gingiva. Traces of ADM were also seen after 10 weeks.[14-15] The present systematic review is consistent with a study by Wei et al.[16] The study reported that an increase in the width of attached gingiva was observed with SCTG than with ADM graft, which could be attributed to the considerable shrinkage of ADM during the healing phase. SCTG harvested from the palate resulted in more postoperative pain, discomfort and ulceration of the flap because of the more extensive procedure. Hence, ADM can be used as an alternative to avoid multiple tissue harvesting, morbidity, and patient discomfort.[17-19]

In the present systematic review, both SCTG and ADM were equally effective in reducing the gingival recession depth and accomplishing root coverage. Moselmi et al.[20] evaluated root coverage using SCTG and ADM with a follow-up of 5 years. The study reported that mean root coverage was improved using both grafts at 6 months but decreased significantly over 5 years. The relapse of SCTG and ADM was attributed to the improper toothbrushing technique of the participants.[20]

Quality of the Evidence

RCT was assessed as low risk of bias. A more patient-centered outcome can be evaluated using a visual analog scale (VAS), a tool to assess the levels of discomfort and pain after different periodontal treatment modalities. This resource can help evaluate various esthetic and functional outcomes of an individual. A recent study

using a VAS showed that pain and discomfort were more significant in the control group than in the test group. Postoperative bleeding, as well as soft tissue necrosis, was observed on the donor and recipient sites of the control group.[21,22] While in the test group, no signs of allergy, infection, or other complications were seen, indicating that ADM was well tolerated and accepted by the participants.[23,24]

According to Mathuraj et al.,[25] acellular dermal matrix showed better color matching as it provides a scaffold for the ingrowth of native cells from the recipient bed, giving a better esthetic result and inhibits the effect of the underlying connective tissue which influences epithelial cells by secretion of keratinocyte growth factor, reducing melanin pigmentation.

Some studies applied root modification agents (e.g., tetracycline solution, EDTA, and citric acid) in recession defects. Nevertheless, these RCTs suggested no significant clinical benefit of root conditioning in conjunction with root-coverage procedures.[26-28]

Overall, the results of this systematic review demonstrated a statistically significant reduction in the extent of GR and an associated gain in the clinical attachment level with or without improvements in the width of keratinized tissue in both control (SCTG) and test (ADM) groups. However, ADM has successfully emerged as an alternative for correcting multiple Class I and Class II gingival recession defects for functional and esthetic purposes.

Further RCTs are required to evaluate primarily in terms of esthetics, relapse, and secondary outcomes between different procedures. The inclusion of the recession defect type should have been balanced, and the difference in the treatment response of Class I and Class II recession sites should be considered. Limited data is available on the long-term follow-up of the patients treated for gingival recession. Meta-analyses could have given a definitive conclusion regarding the superiority of one graft over the other.

Conclusions

1. Both SCTG and ADM for treating Miller's Class I and Class II gingival recession can achieve better root coverage and gain in the width of keratinized tissue.
2. ADM may be an alternative treatment in cases where multiple areas of recession are seen, where SCTGs harvested from the palate area would be insufficient.
3. Most cases produced significant gains in the clinical attachment level and width of keratinized tissue with differences in the percentages of CRC and mean root coverage.
4. SCTG might be considered a gold standard for treating recession-type defects; however, the incidence of discomfort and pain was directly related to donor sites of SCTG.

Within this study's limitations, SCTG and ADM are equally effective for root coverage in Class I and Class II gingival recession. However, it is the clinician's decision depending upon the clinical skills, patients' willingness to undergo surgical procedures involving a donor site, and the cost required for the surgery.

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Authors' Contribution

Conceptualization: Aaesha Khan and Sujeet Khiste
Methodology: Aaesha Khan
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Investigation: Aaesha Khan, Sujeet Khiste, and Vineet Kini
Resources: Aaesha Khan
Data curation: Aaesha Khan
Project administration: Aaesha Khan
Supervision: Sujeet Khiste
Validation: Aaesha Khan and Sujeet Khiste
Visualization: Aaesha Khan, Sujeet Khiste, and Vineet Kini
Writing–original draft: Aaesha Khan and Sujeet Khiste
Writing–review and editing: Aaesha Khan and Sujeet Khiste

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Availability of Data

The data are available upon request from the corresponding author.

Ethics Approval

Not applicable.

Consent for Publication

Not applicable.

Competing Interests

No competing interests.

References

1. Mostafa D, Fatima N. Gingival recession and root coverage up to date: a literature Review. Dent Rev.2022;2(1):100008. doi:10.1016/j.dentre.2021.100008 .
2. Imber JC, Kasaj A. Treatment of gingival recession: when and how? Int Dent J. 2021;71(3):178-187. doi:10.1111/idj.12617.
3. Pini-Prato G. The Miller classification of gingival recession: limits and drawbacks. J Clin Periodontol. 2011;38(3):243-5. doi: 10.1111/j.1600-051X.2010.01655.
4. Petrie K, Cox CT, Becker BC, MacKay BJ. Clinical applications of acellular dermal matrices: A review. Scars Burn Heal.2022;19(8);1-32 .doi:10.1177/20595131211038313.
5. Fosnot J, Kovach SJ, Serletti JM. Acellular dermal matrix: general principles for the plastic surgeon. Aesthet Surg J. 2011; 31(7): 5–12. doi:

10.1177/1090820X11417576.
6. Hamdan K. Long-term predictability of allogenic dermal matrix for root coverage: Three years observation period on 15 consecutive cases. The Saudi Dental Journal. 2021; 33(2):99-104. doi:10.1016/j.sdentj.2020.01.001.
7. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. J Clin Epidemiol. 2009; 62(10):1-34. doi: 10.1136/bmj.b2700.
8. Chambrone L, Ortega AS, Sukekava F, Rotundo R, Kalemaj Z, Buti J et al. Root coverage procedures for treating single and multiple recession-type defects: An updated Cochrane systematic review. J Periodontol. 2019 ; 90(12),1399–1422. doi:10.1002/JPER.19-0079.
9. Maluta R, Monteiro MF, Peruzzo DC, Joly JC. Root coverage of multiple gingival recessions treated with coronally advanced flap associated with xenogeneic acellular dermal matrix or connective tissue graft: a 6-month split-mouth controlled and randomized clinical trial. Clin. Oral Investig. 2020; 25(10): 5765–5773. doi:10.1007/s00784-021-03879-8.
10. Neiva R, Giannobile WV. Mucosal and gingival tissue engineering. J Maxillofac Oral Surg.2011:305-326. doi:10.1533/9780857092427.3.305.
11. Ayub LG, Ramos U, Reino DM, Grisi MF, Taba M, Souza SL, Palioto DB, Novaes AB. A Randomized comparative clinical study of two surgical procedures to improve root coverage with the acellular dermal matrix graft. J Clin Periodontol.2012;39(9):871–878.doi:10.1111/j.1600 051X.2012.01915.x
12. Karring T, Lang NP, Löe H. The role of gingival connective tissue in determining epithelial differentiation. J Periodontal Res. 1975;10(1):1-11. doi:10.1111/j.1600-0765.1975.tb00001.
13. Owens JL, Cordell KG, Amornporncharoen M, Palaiologou AA. Histologic evaluation of acellular dermal matrix allografts in humans. Clin Adv Periodontics. 2017 ; 7(3):122-7. doi:10.1901/cap2017.160057.
14. Wang HL, Romanos GE, Geurs NC, Sullivan A, Suárez DA, Eber RM. Comparison of two differently processed acellular dermal matrix products for root coverage procedures: A prospective, randomized multicenter study. J Periodontol.2014; 85(12),1693-1701. doi:10.1902/J.Periodontol.2014.140198.
15. Silc JT, Petrungaro PS. Acellular dermal matrix grafts for root coverage procedures: review of products and introduction of a new technique. Compend Contin Educ Dent. 2013;34(6), 408–14.PIMD:25162386.
16. Wei PC, Laurell L, Geivelis M, Lingen M, Maddalozzo D. Acellular dermal matrix allografts to achieve increased attached gingiva. Clinical study. J.Periodontol.2002;73(3):257-65. doi:10.1902/J. Periodontol.2000.71.8.1297
17. Chambrone L, Sukekava F, Araújo MG, Pustiglioni FE, Lima LA. Root-coverage procedures for the treatment of localized recession-type defects: a Cochrane systematic review. J Periodontol.2010; 81(4),452–78. doi:10.1902/J. Periodontol.2010.090540.
18. Harris RJ. A short-term and long-term comparison of root coverage with an acellular dermal matrix and a subepithelial graft. J. Periodontol.

2004;75(5):734–43. doi:10.1902/J. Periodontol.2004.75.5.734.
19. Kroiss S, Rathe F, Sader R, Weigl P, Schlee M. Acellular dermal matrix allograft versus autogenous connective tissue grafts for thickening soft tissue and covering multiple gingival recessions: A 5-year preference clinical study. Quintessence Int. 2019;50(4):278–85. doi:10.3290/j.qi.a42160
20. Moslemi N, Mousavi M, Haghighati F, Morovati SP, Jamali R. Acellular dermal matrix allograft versus subepithelial connective tissue graft in treatment of gingival recessions: A 5-year randomized clinical study. J Clin. Periodontol. 2011; 38(12): 1122–29. doi:10.1111/j.1600-051X.2011.01789.x
21. Suzuki KT, Jesus C, Suemi MI, Palioto DB, Messora MR, de Souza LS et al. Root coverage using coronally advanced flap with porcine-derived acellular dermal matrix or subepithelial connective tissue graft: a randomized controlled clinical trial. Clin Oral Investig.2020;24(11): 4077–87. doi:10.1007/s00784-020-03280-x.
22. Jenabian N, Mohadese Y, Aski PH, Bijani A. Comparison of acellular dermal matrix allograft (ADMA) and a subepithelial connective tissue graft (SCTG) for the treatment of gingival recession. J adv periodontol implant dent. 2020; 12(1): 11–17. doi:10.34172/japid.2020.004.
23. Rakasevic DL, Milinkovic IZ, Jankovic SM, Soldatovic IA, Aleksic ZM, Nikolic NS. The use of collagen porcine dermal matrix and connective tissue graft with modified coronally advanced tunnel technique in the treatment of multiple adjacent type I gingival recessions: A randomized, controlled clinical trial. J Esthet Restor Dent. 2020 ;32(7): 681–90. doi:10.1111/jerd.12624.
24. Fahmy RA, Taalab MR. Modified tunnel technique for management of gingival recession in esthetic zone using acellular dermal matrix versus connective tissue graft. utur Dent J. 2018;9(1):11. doi: 10.1016/j.fdj.2018.12.001.
25. Muthuraj TS, Bagchi S, Bandyopadhyay P, Mallick S, Ghosh P, Renganath, MJ. A randomized split mouth clinical study to compare the clinical outcomes of subepithelial connective graft and acellular dermal matrix in Miller's Class I recession coverage therapy. J Indian Soc Periodontol. 2020 ;24(4), 342–47. doi:10.4103/jisp.jisp_609_19.
26. Sumana SZ, Lelyati S, Lessang R. Root coverage using the subepithelial connective tissue graft or the acellular dermal matrix for the treatment of gingival recession: A clinical study. International J Appl Pharm. 2017; *9*(2): 20-23. doi:10.22159/ijap.2017.v9s2.06.
27. Gholami GA, Saberi A, Kadkhodazadeh M, Amid R, Karami D. Comparison of the clinical outcomes of connective tissue and acellular dermal matrix in combination with double papillary flap for root coverage: A 6-month trial. J Dent Res. 2013; 10(4): 506–13.PMID:24130587.
28. Gürlek Ö, Gümüş P, Nizam, N, Buduneli N. Coronally advanced flap with connective tissue graft or xenogeneic acellular dermal matrix in the treatment of multiple gingival recessions: A split-mouth randomized clinical trial. Journal of esthetic and restorative dentistry. J Esthet Restor Dent .2020; 32(4): 380–88. doi:10.1111/jerd.12547.

29. Vincent S, Laurent J, Naman E, Charbit M, Borie G. Treatment of multiple gingival recessions with xenogeneic acellular dermal matrix compared to connective tissue graft: a randomized split-mouth clinical trial. J Periodontal Implant Sci. 2021; 51(2): 77–87. doi:10.5051/jpis.2002400120.
30. Ali BT, Shapeen IM, Ahmed HB, Javed F. Efficacy of acellular dermal matrix and autogenous connective tissue grafts in the treatment of gingival recession defects among Asians. J Investig Clin Dent.2015;6(2):125–32. doi:10.1111/jicd.12085
31. Shori T, Kolte A, Kher V, Dharamthok S, Shrirao T. A comparative evaluation of the effectiveness of subpedicle acellular dermal matrix allograft with subepithelial connective tissue graft in the treatment of isolated marginal tissue recession: A clinical study. J Indian Soc Periodontol. 2013 ;17(1), 78–81. doi:10.4103/0972-124X.107479.

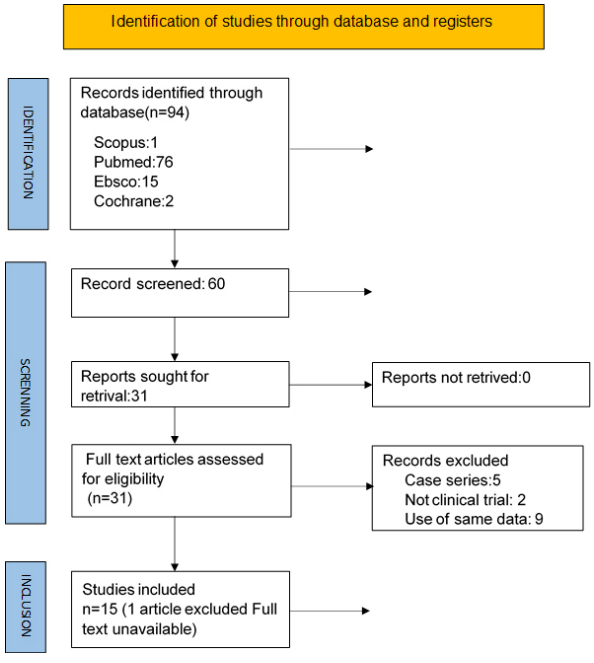

Figure 1: PRISMA flowchart.

Risk bias assessment

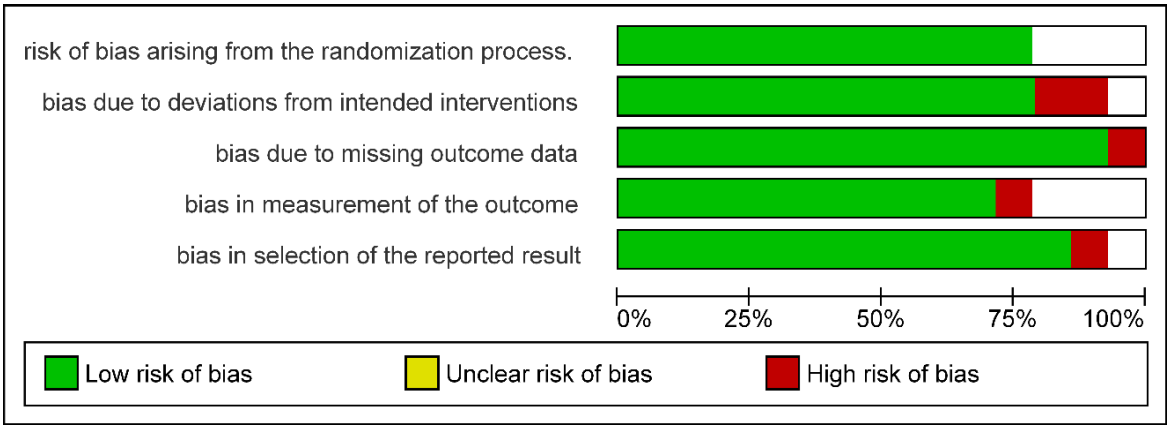

Figure 2. Review authors' judgments about each risk of bias item presented as percentage across all included studies.

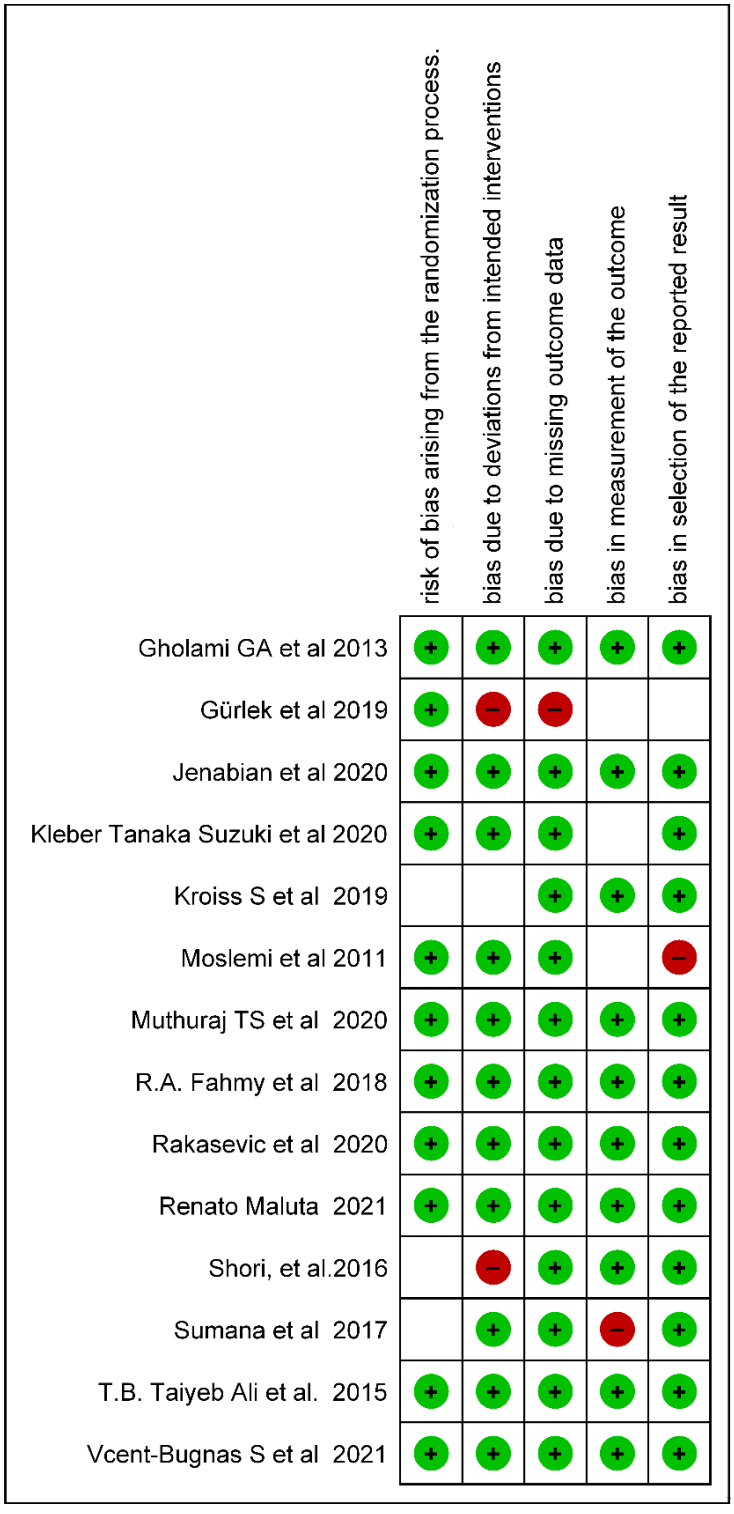

Figure 3: Risk of bias summary: Review authors' judgments about each risk of bias item for each included study.

	Study	Study design	Study duration	Participants	Parameters	Surgical method	Postoperative care/instructions	Results	Conclusion
1.	**Gholami GA et al., 2013**	A split-mouth randomized clinical trial Parallel design clinical trial.	6 months	Sixteen patients, each contributing at least 1 pair of Miller's class I or II /ns	Probing depth; height ; (CAL); KTW using acrylic stent	**Test group:** ADM graft (Alloderm, life cell, Branch, NJ) + double papillary flap **Control group:** received the sub-pedicle CTG+ double papillary flap vertical releasing incision given;	Periodontal dressing was given. Acetaminophen tablets 325 mg tid for 7 days Amoxicillin capsules (500 mg tid) for 7 days. Suture removal after 10 days 0.12% chlorhexidine digluconate solution 3 times daily for	Probing depth P=0.860 ; (CAL) P=0.711; KTW P=0.12	There were no statistically significant differences between the test and control groups in terms of recession reduction, clinical attachment gain, and reduction in probing depth. The control group had a statistically significant increased area of KT after 6

						Root conditioning with 50 mg/ml tetracycline solution	10 days. mechanical tooth cleaning of the treated areas using a soft toothbrush with a modified Stillman technique.		months compared to the test group. Both ADM and SCTG are effective in root coverage ADM can be used as a substitute for root coverage
2.	**Gürlek et al., 2019**	A split-mouth randomized clinical trial	18 months	Twelve participants; Age: >18 years old l Miller class I or II	(PD;RD;KTW using a periodontal probe (UNC 15 Probe, Hu-Friedy, Chicago, Illinois) and CAL was calculated as the sum of PD and RD	**Test group:** XADM (Mucoderm, Botiss Gmbh, Berlin, Germany)+ MCAF; **Control group:**	No periodontal dressing used; Nonsteroidal anti-inflammatory medication Twice daily 5 days; Suture removal on day 14	CRC month, the difference between the groups was not statistical	Recession depth; Both ADM and SCTG are effective in reduction of recession depth

						connective tissue graft (CTG)+MC AF; No vertical releasing incision given; Root conditioning with 24% EDTA		ly significant (P>0.05) KTW (P=0.009), PD (P=0.027), RD (P=0.044),	CRC percentage Both ADM and SCTG are effective in root coverage the difference between the groups was statistically non significant. KTW Increased in the control group than test group at 18 months PD, RD were higher in the

									test group and control group
3.	**Jenabian et al., 2020**	Randomize d double-blind controlled split-mouth study.	6 months	Nine participants Age:> 18 years	GRD; PPD;CAL;KTW; GT; Using Michigan "O" probe Esthetic index	**Test group**: ADM(Cenoderm,Tissue Regeneration Corporation, Iran) + CAF, **Control group:** (SCTG + CAF) Vertical releasing incisions given; No root conditioning	Periodontal dressing given Non-steroidal anti-inflammatory ory (Ibuprofen 400mg, Q.I.D for seven days) Systemic antibiotics (penicillin VK 500 mg Q.I.D for seven days) 0.12% chlorhexidine gluconate Suture removal after 14 days	GRD, P=0.40 the thickness of attached gingiva P=0.17, (ppd), P=0.86 CAL P=0.19; KTW P=0.06 GT P=0.42 percentage average root coverage was	percentage average root coverage was less in the test group than the control group significantly, improved PD, RD, and KTW CAL were in the test group than the control group

								p=0.009	
4.	**Kleber Tanaka Suzuki et al., 2020**	split-mouth, double-masked, randomized, controlled clinical trial.		Eighteen adult patients (9 males and 9 females, Age: 24 to 50 years; mean age, 34.5 ± 7.5) type 1	(PD);CAL); (GR);(KTH); (KTT)	**Test group:** XADM (Mucoderm Botiss Dental Berlin, Berlin, Germany) + eCAF **Control group:** SCTG+ eCAF (partial-thickness flap); vertical releasing incision given;	Non-steroidal anti-inflammatory ibuprofen (600 mg) three times daily for 5 days, and dipyrone sodium (500 mg) four times daily for 3 days Amoxicillin (500 mg) three times daily for 7 days—0.12% chlorhexidine gluconate solution mouthwash	RH P=0.428: RW P=0.141; KTT P=0.1934	Thepresent clinical results showed no significant differencesin the efficacy of ADM and sCTG in the treatment of GR defects. There was no significant difference in the clinical parameters measured at the 3- and 6- 6-month intervals.

						Root conditioning with 24% EDTA	twice a day for the first 15 days; suture removal after 7 (palate) and 15 (recipient area) days and patients were instructed to clean the surgical area with cotton swabs soaked in chlorhexidine solution twice a day for 15 days .		
5.	**Kroiss et al, 2019**	Controlled clinical trail	Five years	Thirty-two Age >18 years	(GR); Probing pocket depth (PPD);	ADM (Puros dermis, Zimmer	Non-steroidal anti-inflammat	(GR) P=0.015,	The present clinical results showed no

		Parallel design		Miller Class I or II recession defects	(CAL); Width of keratinized tissue (KTW);	Dental) + CAF; SCTG single-incision technique described by Hürzeler and Weng) + CAF; No Vertical releasing incisions given; No root conditioning	ory (Ibuprofen 400mg 0.12% chlorhexidine gluconate for 14 days Suture removal after 14 days; mechanical tooth cleaning of the treated areas using a soft toothbrush using the roll technique	Probing pocket depth (PPD) P=0.762, (CAL) P=0.512, width of keratinized tissue (KTW) P=0.678 Gingival thickness (GT) P=0.498	significant differences in the efficacy of ADM and sCTG there was no significant difference in the clinical parameters measured at 6-month interval and five years. GR defects, there was a significant difference in the clinical parameters measured at 6-month intervals

									in CTGS but on long-term follow-up there was no significant difference between the two groups.
6.	**Muthurj et al., 2020**	randomized split-mouth clinical study, which comprised	6 months	15 systemically healthy patients (8 males and 7 females) with an age range of 23–42 years (mean ± standard deviation: 29.67 ± 3.26 years) who had thirty Miller's Class I recession.	depth (GRD); probing pocket depth (PPD); (CAL); width of keratinized tissue (KTW)	**Test group:** ADM +CAF **Control group:** SCTG + CAF vertical releasing incisions given; Root conditioning with 24% ethylenediamine	Periodontal dressing was used. Standard postoperative instructions and medications were given.	depth (GRD) P=0.21 (CAL) P=0.57 apico-coronal width of keratinized tissue (KTW) P=0.002	there were no statistically significant differences in the recorded clinical parameters, such as probing pocket depth, clinical attachment loss, and GR depth. ADM group showed a

						inetetraacetic acid for 3 min			better color match than the SCTG group, while SCTG group achieved more than ADM group.
7.	**Moslemi et al., 2011**	The present split-mouth randomized controlled clinical trial	5 years	16 Participants Age: 24–45 years (mean age at baseline: 39.4 ± 5.2 years); Miller Class I/II .	Probing depth (PD); Recession depth(RD); Gingival width (GW),	ADM(Alloderm; Life cell, The Woodlands, TX, USA) + pedicle flap; CTG (Langer and Langer technique) + pedicle flap Vertical releasing incision given;	Non-steroidal anti-inflammatory medication was prescribed for pain relief; Chlorhexidine rinse twice daily for 2 weeks; Mechanical tooth cleaning of the treated areas using roll technique with	Probing depth P= 0.08 Recession depth P=0.153 Gingival width P=0.069	Percentage of root coverage: At 5 years, CRC decreased significantly in both groups: 20% (3 sites) and 13.3% (2 sites) in ADM- and SCTG. Both ADM and SCTG are effective in root coverage

						No root conditioning	a soft toothbrush after 6 weeks. Suture removal not specified	Percentage of root coverage p = 1.000	ADM can be used as a substitute for root coverage Recession depth; Both ADM and SCTG are effective in reduction of recession depth. When categorizing relapse as a parameter, 12 sites in the ADM group and 9 sites in the SCTG group showed relapse from 6

									months to 60 months Gingival width: Both are effective in increasing gingival width. The mean change of GW from 6 months to 60±2 months was statistically higher in the ADM group than in the SCTG group ADM is as effective as SCTG and can be used as a

									substitute in Miller's Class I and Class II
8.	**Fahmy et al., 2018**		Six months	11 subjects Miller Class I or II recession defects	(GR); (CAL); (KTW.)	**Test group** ADM (Alloderm; Biohorizons, Birmingham, AL) + modified tunnel technique; **Control group** Connective tissue graft using trap door procedure+ modified	Non-steroidal anti-inflammatory drugs: Diclofenac potassium 50 mg tablets (Cataflam 50 mg every 8 h for 5 days, Antibiotics: (Augmentin 1 gm, once every 12 h for 5 days; chlorhexidine HCL (0,12%)	(GR) P=0.511; (CAL) P=0.865; (KTW) P=0.828.	Thepresent clinical results showed no significant differencesin the efficacy of ADM and sCTG in treating GR defects. There was no significant difference in the clinical parameters measured at the

						tunnel technique; No Vertical releasing incisions were given; No root conditioning	mouthwash three times daily for 14 days; Sutures were removed after 14 days		baseline and 6-month ADM is as effective as SCTG and can be used as a substitute in Miller's Class I and Class II
9.	**Rakasevi et al., 2020**	split-mouth, single-center, prospective randomized controlled clinical trial	Twelve months	Twenty participants Age: >18 years old; Type 1 GRs	depth (GRD); width (GRW);KTW;CAL; Probing depth (PD), Mean root coverage	**Test group:** XADM (Mucoderm m, Botiss dental GmbH, Berlin, Germany) combined +MCAF	Non-steroidal anti-inflammatory Ibuprofen 600 mg for 7 days T.D.S Systemic antibiotics Amoxicillin, 500 mg T.D.S for 7 Days 0.12% chlorhexidine solution twice a	GRD P=0.206 GRW P=0.348 CAL P=0.884 PD P=0.929 KTW P=0.922 GT P=0.058	No statistically significant differences were observed in all clinical parameters between the treatment groups, 6 and 12 months postoperatively Use of porcine-derived dermal

						Control group: connective tissue graft (single incision technique)+MCAF	day, 1 minute, for 3 weeks. Suture removal after 14 days of reinforcement of oral hygiene and mechanical plaque removal	MRC P=0.480 CRC P=0.584	collagen matrix resulted in satisfactory results when compared to SCTG in the treatment of MAGR when used in conjunction with MCAT.
10.	**Renato Maluta, 2021**	split-mouth design, randomized clinical trial	6 months	Fifteen patients Age: >18 years Miller's class I and II	Probing depth (PD) (GR) (CAL) reduction (GR reduction) Percentage of root coverage (%RC) and frequency of complete root coverage (CRC)	**Test group:** XADM (Mucoderm ®, Botiss Biomaterials, Berlin, Germany) + MCAF	Dexamethasone e 4 mg was prescribed 1 h before the surgical procedure. Amoxicillin 500 mg for 7 days and sodium	Percentage of root coverage (%RC and frequency of complete root	CTG and XDM produced oot coverage, with no statistical difference between groups (paired t-test, P >0.05). higher CRC was described

						Control Group: CTG (linear technique) + MCAF; No vertical releasing incision given; No root conditioning	dipyrone 500 mg T.D.S in the first 24 h 0.12% chlorhexidine, twice a day for 14 days; Suture removal after 14 days of surgery.	coverage (CRC) Probing depth (PD) (GR) (CAL) reduction (GR reduction)	for CTG compared to XDM (93.33% and 33.33%, respectively) when just considering the greater recession (McNemar test, p = 0.045).
11.	**Shori et al., 2016**	Parallel design clinical trial.	6 months	Twenty participants; Age:18 to 50 years (mean 29.7±4.35 years) Millers' Class I or II,	recession depth; (CAL); Mean root coverage	**Test group:** ADM (Alloderm: Life cell, The Woodlands, TX, USA) +CAF; **Control group:**	Periodontal dressing Non-steroidal anti-inflammatory (Ibuprofen + P aracetamol, T.D.S for five days) Systemic	Mean root coverage (REC):(p =0.409) Probing pocket depth	1. Both treatments resulted in a significant reduction in and probing pocket depth and a significant gain in and

						connective tissue graft (CTG)(Trap door approach)+ CAF; vertical incision given; No root conditioning.	antibiotics (Amoxicillin 500 mg T.D.S for seven days) 0.2% chlorhexidine gluconate twice daily, for 4-6 weeks Suture removal not specified	(PPD):(p =0.448) (CAL):(p =0.533) Width of keratinized gingiva (WKG): (p=4.02)	width of keratinized gingiva 2. Mean CAL gains and mean root coverage obtained in the ADM group were greater than the SCTG group, but the difference was not statistically significant. The Mean increase in width of keratinized gingiva was significantly greater in SCTG group

									compared to ADM
12.	**Sumana et al., 2017**	controlled split-mouth clinical study, single-centered	52 months (median recall period: 22 months)	Ten systemically healthy patients Age: not mentioned Miller's Class I and II GR	GR levels; CAL; width of attached gingiva (AG),	**Test group:** ADM **Control group:** SCTG	**Not mentioned**	GR levels P=0.56; CAL P=0.36; width of attached gingiva (AG) P=0.17	Thepresent clinical results showed no significant differences in the efficacy of ADM and sCTGin the treatment of GR defects. There was no significant difference in the clinical parameters measured at the 3- and 6- 6-month intervals

13.	**Taiyeb Ali et al., 2015**	Parallel design clinical trial.	6 Months	Six patients (three males and three females) Age:: 23–58 years (mean age of the 37.8 years); with Miller class I and II GR	Probing pocket depths (PPD); Clinical attachment loss; keratinized gingiva	**Test group:** ADM+CAF **Control group:** Connective tissue graft a (modification of the method described by Langer and Langer)+CA F vertical releasing incision given; Root surface conditioning with tetracycline	**Not mentioned**	Recession height P=0.097 Recession width P=0.67 Thicknes s of keratinize d ed gingiva P=0.331 Clinical attachment loss P=0.097	The present clinical results showed no significant differences in the efficacy of ADM and sCTG in the treatment of GR defects; there was no significant difference in the clinical parameters measured at the 3- and 6- month intervals

						solution (125 mg/mL saline			
14.	**Vincent-Bugnas et al. , 2021**	prospective single-center split-mouth randomized study	12 months	12 patients (8 women and 4 men) aged 23 to 55 years (mean, 41.2 ± 10.9 years)	probing depth (PD); KT width; and gingival thickness (GT), using a silicone marker measuring. (CAL) Mean root coverage (MRC);	**Test group:** XADM (Mucoderm ®, Botiss Dental, Straumann Group, Basel, Switzerland) + modified coronally advanced tunnel (MCAT) **Control group:** CTG (single-incision technique described by	Non-steroidal anti-inflammatory (paracetamol, 3 g/day) for 7 days; Antibiotics (Amoxicillin 1,000 mg twice for 7 days); 0.2% chlorhexidine twice daily for 14 days; sutures were removed after 14 days gentle brushing resumed.	probing depth (PD); P=0.875 KTT width; P=0.190 gingival thickness (GT), P=<0.001 (CAL) P=0.007 (MRC); *p*=0.005	(CAL) Mean root coverage (MRC) was significantly improved in the control group when compared with the test group. All the other clinical parameter were improved but not statically significant when compared

						Hürzeler and Weng) + modified coronally advanced tunnel			in both the groups.

Subepithlial connective tissue (SCTG); Alloderm (ADM); Mucoderm (MD); Puros dermis (PDAM); Complete root coverage (CRC); Mean root coverage (MRC); depth (GRD); Keratnized tissue width (KTW); Keratinized tissue thickness (KTT); Clinical attachment loss (CAL); Probing depth (PD)

TABLE 1