Systematic Review

Clinical and Aesthetic Evaluation of Minimally Invasive Surgical Therapy for the Treatment of Gingival Recession Defects - A Systematic Review of Randomized Clinical Trials

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ABSTRACT

Background: The concept of minimally invasive dentistry has seamlessly blended into the various fields of dentistry including periodontics. The past three decades have witnessed a paradigm shift from conventional surgical procedures to microsurgery in the field of periodontal plastic surgery. This entails the integration of microsurgical principles, refined surgical skills and magnification devices along with microsurgical instruments. This systematic review of the randomized clinical trials attempts to address the clinical question whether the application of minimally invasive surgical procedures for gingival augmentation and root coverage procedures for the treatment of gingival recession translate into superior clinical and patient oriented results as compared to conventional root coverage procedures. **Materials and Methods:** Science Direct and Ovid databases, PubMed, Scopus, and Product literature were accessed to review relevant literature evaluating minimally invasive surgery for treatment of gingival recession defects (GRDs). The search covered 13 studies published in medical and dental journals in English with a relevant impact factor and had a follow up of at least 6 months, up to and including June 2023.The results were based on parameters such as complete root coverage (CRC, expressed as percentage), mean root coverage (MRC, expressed as %) width of keratinized tissue (WKT), and variables such as esthetics and pain postsurgery. **Results and Conclusion:** The 13 studies pooled in 342 patients who underwent root coverage procedures for treatment of GRDs. The test group (microsurgical) and the control group (macrosurgical group) both resulted in overall improvement in parameters like MRC and CRC, WKT etc. at least 6 months postsurgery; however, statistical difference in between both the groups in these parameters was seen in only three studies. There was marked improvement found in the test group after surgery with respect to esthetics (root coverage aesthetic score) and pain scores (Visual Analog Scale score) as compared to the control group. This compels us to infer that although both conventional and microsurgical procedures are successful as root coverage procedures, microsurgical procedures are minimally invasive and produce superior esthetic and comfort parameters for the patient and are therefore highly recommended in surgical procedures.

KEYWORDS: *Gingival recession, microsurgery, minimally invasive surgery technique, periodontal plastic surgery, perioesthetics, systematic review*

Received: 27 July 2023
Revised: 10 August 2023
Accepted: 27 August 2023
Published: 29 April 2024

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Access this article online

Quick Response Code:

Website: www.jidonline.com

DOI: 10.4103/jid.jid_40_23

How to cite this article: Sethna GD, Attar NB, Shinde SV, Machale PS, Fernandes LC. Clinical and aesthetic evaluation of minimally invasive surgical therapy for the treatment of gingival recession defects - A systematic review of randomized clinical trials. J Interdiscip Dentistry 2024;14:3-14.

Clinical Relevance to Interdisciplinary Dentistry

The comparison of microsurgical and macrosurgical techniques offers valuable insights into optimizing treatment outcomes and patient care. The systematic review can help clinicians to make informed decisions about whether to employ microsurgical or macrosurgical techniques. Microsurgical techniques are generally associated with minimally invasive procedures, which may result in reduced postoperative discomfort, faster recovery times, and preservation of healthy tissues.

Introduction

Minimally invasive periodontal therapy (MIPT) includes both nonsurgical and surgical procedures which primarily maintain the preoperative gingival architecture, minimize postoperative discomfort along with gentle handling of the tissues.[1,2]

Harrell and Rees (1995) first introduced the term minimally invasive surgery (MIS),[2] which was later re-defined as surgical procedures involving the use of microsurgical instruments and materials with the goal of obtaining regeneration of the bone and supporting tissues with better esthetic results as compared to conventional surgical procedures.[3,4]

According to the Glossary of Terms from the American Academy of Periodontology, gingival recession refers to the exposure of the root surface by an apical shift in the position of the gingiva in relation to the cementoenamel junction.[5] Gingival augmentation and root coverage procedures for the treatment of gingival recession belong to the domain of periodontal plastic surgery (PPS)[6] where periodontal microsurgery and MIS go hand in hand to incorporate refined surgical techniques which are enhanced by magnification. Cortellini and Tonetti modified the original MIS procedure and renamed it the "MIS technique." It differed from the MIS procedure by incorporating the papilla preservation flaps and visualization of the bony defects through a microscope.[7] Based on clinical and histological findings, some studies had concluded that microsurgical procedures lead to superior esthetics with less postoperative discomfort and morbidity.[8-11] However, a systematic review (SR) by Goyal and Chawla which included 10 randomized controlled trials showed that on comparison of clinical parameters, the microsurgical and macrosurgical procedures did not show any statistically significant differences between them.[12] The goal of this SR was therefore, to summarize the evidence from the randomized clinical trials (RCTs) about the root coverage procedures and critically discuss the benefits of a minimally invasive surgical approach incorporating the microsurgical triad, i.e., magnification, illumination, and refined surgical skills by microsurgical techniques and instruments.[13]

Materials and Methods

Protocol development and focused question

The protocol of this SR was registered at the National Institute for Health Research PROSPERO, International Prospective Register of Systematic Reviews (http://www.crd.york.ac.uk/PROSPERO, registration number CRD42023434607. The protocol was prepared in accordance with Cochrane Handbook for systematic reviews of Interventions[14] and the guidelines of preferred reporting items for systematic reviews and meta-analysis (PRISMA).[15]

Focused question

Do refined surgical techniques, use of microsurgical instruments, and magnification with loupes and microscopes have superior root coverage over conventional macrosurgical procedures without magnification in terms of clinical and esthetic outcomes?

PICO question:

- *Population*: The population of the studies included in the present SR satisfied the following inclusion criteria:
  1. Patients with Miller's Class 1, II, or III or (Cairo) RT1 or RT2, single or multiple marginal tissue recession requiring treatment with gingival augmentation and root coverage
  2. Follow-up after surgery of at least 6 months.
- *Intervention*: Periodontal plastic surgery incorporating microsurgical approach for root coverage for the treatment of gingival recession
- *Comparison*: Conventional macrosurgical approach for root coverage procedures
- *Outcome*: The following outcomes were included:
  a. Mean root coverage (MRC), expressed as percentage (%)
  b. Complete root coverage (CRC), expressed in percentage (%),
  c. Keratinized tissue width (WKT), expressed in mm
  d. Pain assessed by the Visual Analog Scale (VAS)
  e. Esthetics (root coverage esthetic score [RES]) either assessed by examiner or the patient.

Search strategy

Literature search

An electronic literature search was conducted on Science Direct and Ovid databases, MEDLINE (via

PubMed), EMBASE via OVID, CENTRAL (for the Cochrane Central Register of Controlled Trials); product literature were accessed to review relevant literature evaluating MIS periodontal therapy for treatment of gingival recession. The following combination of search terms and Boolean operators: "(Gingival recession OR root coverage OR gingival augmentation)." Filters "randomized clinical trial" and "controlled clinical trial" were used.

The search covered 13 studies published in medical and dental journals in English with a relevant impact factor over a period up to June 2023; relevant studies that met the inclusion criteria were identified and included.

Article selection

Inclusion criteria

The eligibility criteria for the inclusion of articles in the SR were as follows:

(1) Randomized prospective clinical trials, (2) surgical treatment of gingival recession defect (GRD) with any root coverage procedure, (3) a follow-up of at least 6 months, (4) a baseline sample of at least 5 patients in each group, and (5) using a microsurgical protocol in at least one group of treatment. There was no restriction on the type of the surgical techniques used for the root coverage procedures, (coronally advanced, pin hole surgery, vestibular incision sub-periosteal tunneling technique (VISTA), the lateral sliding, or tunneling flaps, use of autogenous soft-tissue graft (connective tissue graft [CTG], free gingival graft [FGG], none), and use of collagen-based substitutes or biologics. The papers that fulfilled all inclusion criteria were processed for the data extraction.

The exclusion criteria

Reviews *in vitro* studies, animal studies, cross-sectional studies, and retrospective studies were excluded in the selection process.

Data extraction methodology and description of studies

The electronic databases were searched using the following terms:

Screening was performed independently and simultaneously by two calibrated examiners (GS and SS) using Medical Subject headings terms, keywords like and other free terms and Boolean operators (AND, OR). The results were based on parameters such as complete root coverage (CRC, expressed as %), mean root coverage (MRC, expressed as %) keratinized tissue width (WKT), and variables such as esthetics (RES) and pain postsurgery (VAS Score). The flow chart of data extraction is shown in Figure 1; 13 articles were included. Since the data were heterogeneous incorporating different surgical procedures, experimental design and observation intervals, we chose to summarize the data as a narrative style rather than a meta-analysis.

Methodology an quality assessment

The quality of the included studies and risk of bias was assessed according to the CONSORT guidelines and Cochrane collaboration's tool.[14,15] The domains assessed for risk of bias of each study included in this SR were random sequence generation (selection bias), allocation concealment, performance bias, detection bias,

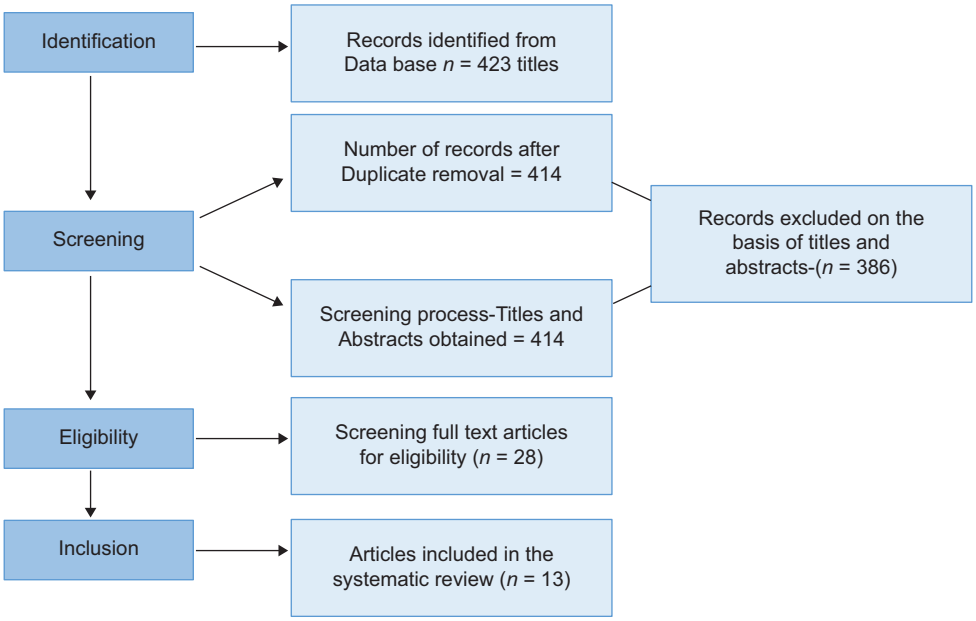

Figure 1: PRISMA flowchart for screening process

incomplete outcome bias, selective reporting bias, and other bias [Table 1 and Figure 2]. Quality assessment was performed independently and simultaneously by two calibrated examiners (GS and SS). In case of disagreement, a third examiner (NA) was included to resolve the dispute through a discussion. The parameters were assessed as adequate, inadequate, and unclear.

Study design and follow-up

Of the selected studies, all were RCTs (Bittencourt *et al.*,[8] Pandey *et al.*,[11] Patel *et al.*,[16] Rajendran *et al.*,[17] Ucak *et al.*,[18] Mansouri *et al.*,[19] Shrivastava *et al.*,[20] Karmakar *et al.*,[21] Savithri *et al.*,[22] Tavelli *et al.*,[23] Carcuac *et al.*,[24] and Zeytinci *et al.*,[25] Andrade *et al.*,[26]); with a follow-up periods which ranged between baseline, 1 month, 3 months, 6 months, and 12 months.

Search results

The results of the search from the databases provided 423 studies. After examination of the records, nine duplicate papers were eliminated. Three hundred and eighty-six abstracts and titles were excluded since they were irrelevant to our study. Ultimately, the SR consisted of 13 RCTs.

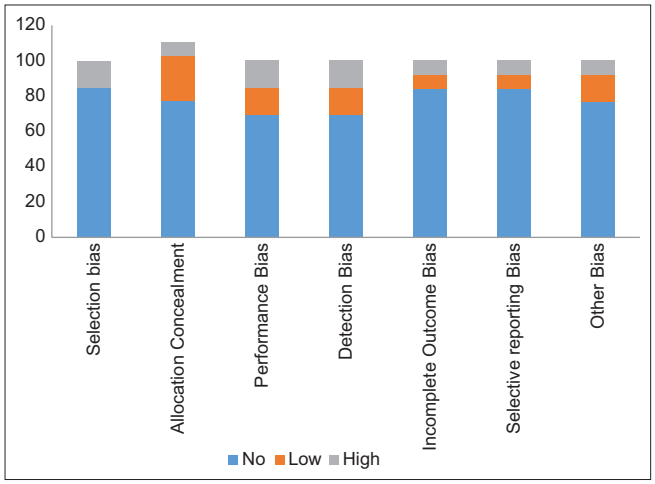

Figure 2: Risk of bias included in the study

Study population

Table 2 presents the diagnosis, design of the study with the intervention carried out, relevant methodological aspects, clinical results of the evaluated studies, esthetic results of the intervention, postoperative morbidity, study limitations, and follow-up time of each clinical trial. Briefly, the studies enrolled a number of patients ranging from 10[8,11,16-18,20-26] to 50 patients.[19] Gender distribution was another variable mentioned in a few studies;[11,12,17,20-24] however, none showing gender-matched case and control groups. Age as a variable was mentioned as >18 years in few studies;[11,12,17,20-24] however, no cognizance was given in the others.[16,18,19,21,25]

Recession types, intervention, and magnification types

The 13 included studies contributed to a total of 343 patients who underwent MIS therapy for the treatment of GRD. Most of the treated sites were Miller's Class 1and II GRD, RT1 (Cairo) except two studies which included Miller's class III GRD.[18,26] Different treatment protocols were used for the treatment of gingival recession. Most of the authors used coronally advanced flaps (CAFs) and it's modifications, except for one by Carcuac *et al.* which used a FGG.[24] Root surface conditioning and measurement of gingival thickness were largely undocumented except in three studies.[16,23,26] Some of the studies used CTGs as an adjunct to the surgical procedure.[8,20,22,23,26] Andrade *et al.*[26] used Enamel Matrix Derivatives with the CAF, while Patel *et al.*[16] used platelet-rich fibrin with the CAF. Pandey and Mehta[11] implemented the free rotated papilla autograft combined with the CAF. Ucak *et al.*[18] performed the laterally moved, coronally advanced flap

Table 1: Risk of bias of included studies

Study ID/authors	Selection bias	Allocation concealment	Performance bias	Detection bias	Incomplete outcome bias	Selective reporting bias	Other bias
Andrade *et al.*, 2010	Adequate	Adequate	Adequate	Inadequate	Adequate	Adequate	Adequate
Bittencourt *et al.*	Inadequate	Unclear	Adequate	Adequate	Unclear	Adequate	Adequate
Pandey and Mehta, 2013	Adequate	Adequate	Adequate	Adequate	Adequate	Unclear	Adequate
Rajendran *et al.*, India 2018	Adequate	Adequate	Inadequate	Adequate	Adequate	Adequate	Unclear
Patel *et al.*, 2018	Adequate	Adequate	Adequate	Unclear	Adequate	Adequate	Adequate
Ucak, 2018	Adequate	Inadequate	Unclear	Adequate	Adequate	Adequate	Inadequate
Mansouri *et al.*, 2019	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
Shrivastava, 2021	Adequate	Adequate	Adequate	Adequate	Adequate	Inadequate	Adequate
Karmarkar, 2022	Adequate	Adequate	Adequate	Inadequate	Adequate	Adequate	Adequate
Savitri, 2022	Inadequate	Unclear	Inadequate	Adequate	Adequate	Adequate	Unclear
Tavelli, 2022	Adequate	Adequate	Adequate	Unclear	Inadequate	Adequate	Adequate
Carcuac, 2023	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
Zeytinci, 2023	Adequate	Adequate	Unclear	Adequate	Adequate	Adequate	Adequate

Table 2: Summary of studies

Study ID/ authors	Type of trial study design	Type of GRD	Intervention	Methods of clinical evaluation	MRC (%)	CRC (%)
Andrade *et al.*, 2010 (30 patients)	RCT	Millers Class I, II and III	Test group - CAF+EMD (conventional macroscopical method) control group CAF+EMD (microscope)	WKT, PD, CAL, and thickness of the KT	43.3±73.3 100% RC in seven sites and 50%–99% in eight sites; however there was no statistically significant difference between the groups in relation to the prevalence of complete root coverage (P=0.26)	Control group - 83%, test group - 92%. No statistical difference in both the groups (P=0.21)
Bittencourt *et al.*, 2012 (24 patients)	RCT, split mouth study	Miller's Class I/II	Split-mouth test group-24 patients in which sub CTG was performed with a microscope or controlled group-without a microscope/ magnification	Recession height, WKT RW, PD, CAL, and thickness of the KT	Test group 98.0% Control group 88.3%, correspondingly (P<0.05)	Test group - 87.5 Control group - 58.3
Pandey and Mehta, 2013 (10 patients)	RCT, split mouth	Millers Class I, II GRD	Test group conventional (macro-surgical) approach for the free rotated papilla autograft combined with CAF. Control group microsurgery for the free rotated papilla autograft combined with CAF	GRD, RW, CAL and WKT	Control group - 2.05 mm Test group - 2.13 mm	Not recorded
Rajendran *et al.*, India 2018 (14 patients)	RCT, split-mouth study	Miller's Class I	Split-mouth test group-7 patients were treated with a MICAF controlled group with MCAF for the treatment of multiple adjacent gingival recessions	Recession height, RW, PD CAL, WKT, and gingival tissue thickness were recorded at baseline and 6 months postoperation	Test group - 96.42±4.54 Control group - 97±5.32	Test group - 5/7 (71.4) Control group 4/7 (57.14)
Patel *et al.*, 2018 (10 patients)	RCT	Millers Class I and II GRD	Test group: CAF+PRF under microscope. Control group: CAF + PRF with the conventional technique	RD, MRC, WKT, VAS Scale	Test group - 87±17.5 Control group - 81±20.5	Not recorded
Ucak, 2018 (50 patients)	RCT	Millers Class III isolate defects	Test group - LMCAF with microsurgery and magnifying loupes (2.5X) Control group - LMCAF conventional procedure	MRC CRC, WKT, CAL	Test group - 90.48±15.06 Control group - 97.64±8.27	92% 68%
Mansouri *et al.*, 2019 (24 patients)	Single-centre, split-mouth, randomized, clinical trial	Miller's Class I and II GRD defects bilaterally in maxillary canine and premolars with detectable CEJ and full-mouth O'Leary's plaque index of ≤25%[26]	Test group VISTA + CTG control group or CAF + CTG	Parameters include RW, wKT, CAL, PD	Test group - 70.69% Control - 67.22%	Test group 50% Control group 33% (P<0.05)

Contd...

Table 2: Contd...

Study ID/ authors	Type of trial study design	Type of GRD	Intervention	Methods of clinical evaluation	MRC (%)	CRC (%)
Shrivastava, 2021 (15 patients)	RCT, parallel experimental study	Miller's Class I or II GRD	Experimental group: 15 patients a CAF and ADM with microsurgery. Control group: 15 patients CAF + ADM using a conventional surgical method	Height of gingival recession, PD, CAL, gingival thickness, and WKT were documented at baseline and 3 and 6 months	Test group at 3 months - 100±0. Control group - 91.67±18, at 6 months: Test group - 89.17±18.4 Control group - 81.67±20, not statistically significant	
Karmarkar, 2022 (10 patients)	Monocentre RCT	Miller's Class I or II GRD	MMTT + CTG was assigned to the test group, MCAF + CTG was the control group	Sulcular bleeding index, RD, PD, CAL WKT, and gingival biotype were recorded at baseline and 1, 3, and 6 months postsurgery	Experimental group mRC - 92.01% Control group - 80% (P=0.703)	Experimental group and 80% Control group - 60% (P=0.545)
Savitri *et al.*, 2022 (32 patients)	RCT	Miller's Class I or II GRD	Test group (MCAF) + (CTG) using microsurgical approach (microscalpel, microscissors, microscope) Control group (MCAF) + (CTG) using conventional macrosurgical approach	FMPS,[11] FMBS,[12] PPD, CAL, assessment of RPGM, RD, RW, WAG, WKM, and percentage of root coverage based on RD	In test group - 86%; control group - 78%. No significant difference (P=0.207)	In test group - 68% Control group - 43%
Tavelli, 2022 (30 patients)	Triple-blind randomized placebo controlled trial	At least 2 sites with MAGR, RT1	Test group - CAF + CCM + rhPDFG Control group - CAF + CCM	Parameters include RW, WKT, MRC, CRC, PD, ultrasonographic measurement of gingival thickness, digital scanning	Test group - 88.25% Control group -77.7%	Test group - 20.45 Control - 59.57
Carcuac, 2023 (30 patients)	RCT	≤2 mandibular incisors with buccal RT1 GR	Test group-modified FGG control group-conventional FGG	RD, KTH, and VAS score for pain assessment	Test group - 91.8% Control group - 60.7%	P<0.001
Zeytinci, 2023 (17 patients)	Single center, parallel armed, RCT	Miller Class I and II GRD at least 3.0 mm deep, localized defects	Test group-CPF + SCTG by using e a microsurgical equipment (microsurgical scalpel, micro scissors, magnification with 2.5X loupes). Macrosurgery approach used CPF + SCTG with conventional instruments	Plaque index, gingival index, RD, PD, CAL WKT, aesthetic score were recorded at baseline and 1, 3, and 6 months postsurgery	Microsurgery group - 92%, macro surgery group - 71% in T (P>0.05)	

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Table 2: Contd...

Study ID/ authors	Methods of aesthetic evaluation	Esthetic result	Final KT increase (mm)	Follow up (months)	Limitation	Conclusion
Andrade *et al.*, 2010 (30 patients)	Not evaluated	Not evaluated	TKT Baseline - 2.23±0.69 At 6 months - 2.92±0.92 (P<0.008) Control group Baseline - 2.02±1.17 At 6 months - 2.11±1.22 (P<0.84)	At baseline and 6 months after surgery	Not reported	Both the groups had a statistically significant reduction in GR height. After 6 months, there was no statistically significant difference between them, however, microsurgical technique demonstrated a statistically significant increase in WKT and TKT
Bittencourt *et al.*, 2012 (24 patients)	A questionnaire at 6 months, the questionnaire recorded the results of the procedures relative to aesthetics, root sensitivity before and after the surgery	Test group - 100% aesthetic satisfaction. Control group - 79.1% were satisfied	Test group - 1.37±1.18 Control group - 1.51±1.01	At baseline and at 6 and 12 months postsurgery, and quantified with a calliper of 0.01 mm resolution	Shorter follow-up period. Difficulty in the randomization method since it was impossible to mask patients to the use of the microscope	Use of the surgical microscope was associated with additional clinical benefits in the treatment of gingival recessions
Pandey and Mehta, 2013 (10 patients)	RD, PD, WKT	Not reported	Difference between test group and control group at 3 months - 0.3, P>0.05 - not significant Difference between test group and control group at 6months - 0.45 months P<0.05 - significant	At baseline to 3 and 6 months	The small sample size Shorter follow-up period	No statistical significance in clinical parameters like CAL, PD Less postoperative discomfort and pain at the microsurgical site, but not statistically significant
Rajendran *et al.*, India 2018 (14 patients)	A questionnaire comprising of aesthetic concerns about recession and the preferred method of treatment. A VAS were used. aesthetics was evaluated at 3- and 6-month follow-up visits	Statistically significant (P<0.001) between the MICAF and the MCAF arms, superior results for the MICAF arm Increased VAS aesthetic score (98.5±3.77) in MICAF procedure, vice versa in MCAF procedure	Test group - 3.9±0.4 Control group - 3.86±0.69 No statistically significant results between the MICAF and the MCAF in WKT	Baseline to - 6 months	Small sample size of 7 patients Only Miller Class I recession defects was included	No statistically significant differences were observed between MICAF and MCAF sites in the change WKT, CRC, MRC after 6 months. However, statistically significant (P<0.001) with respect to patient reported outcomes of aesthetics and morbidity and more favourable results with MICAF as compared to MCAF sides
Patel *et al.*, 2018 (10 patients)	Not recorded	Not reported	Test group - 1.6±0.48 Control group - 1.3±0.65	At baseline to 3 and 6 months	Not reported	Both groups showed statistically significant difference in all parameters, however at 6 months, no statistically significant differences were found between the two groups for all the parameters, that is, RD, RW, PD, CAL, TKG, and WKG (P>0.05) microscope permitted less traumatic and minimally invasive procedure, both groups showed convincing improvement in clinical parameters

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Table 2: Contd...

Study ID/ authors	Methods of aesthetic evaluation	Esthetic result	Final KT increase (mm)	Follow up (months)	Limitation	Conclusion
Ucak, 2018 (50 patients)	RES (Cairo)	Test LMCAF - 9.24±0.93 Control - 8.40±1.35	Test group: Baseline - 0.64±0.57, after 6 months - 5±1.16 Control group: Baseline - 0.72±0.54, after 6 months - 4.6±1.16	At baseline and 6 months	Not reported	At 6 months, in the test group, superior aesthetics, MRC, better patient satisfaction were observed compared to the control group
Mansouri *et al.*, 2019 (24 patients)			The mean KTW was 2.4±0.7 mm at the test and 2.7±0.8 mm at the control sites (P>0.05). No statistical difference in test and control group	Parameters measured at baseline and at 3- and 6 months	Not reported	VISTA, as a minimally invasive approach, was able to treat GRD and reduce their height and width, yielding results similar to those obtained by the use of CAF as the gold standard procedure for root coverage. At 3 and 6 months, no statistically significant differences were found between VISTA and CAF for root coverage and CAL
Shrivastava, 2021 (15 patients)	At 10 days and 1 and 6 months postoperation, patient satisfaction was recorded on a scale of 1–10 based on the criteria of intra-operative experience at 10th day (pain during surgery and discomfort experience related to the duration of procedure and handling by the operator)	Patient satisfaction score showing a higher score for microsurgical (test group)	A significant gain in WAG has been observed at both the test and control groups There was significant change in the ultrasonographic thickness of gingiva in both groups (P<0.003)	At baseline, 3 and 6 months	Not reported	Microsurgical procedure for root coverage was found to be superior to the conventional macrosurgical approach under magnification Healing was faster with microsurgical sites. Ultrasonographic evaluation showed improved gingival thickness and patient satisfaction scores
Karmarkar, 2022 (10 patients)	At baseline and 1, 3, and 6 months postsurgery, patients were provided with a questionnaire for subjective evaluation of their dentinal hypersensitivity. VAS Scale for quantitative evaluation. Root coverage aesthetic score for aesthetic evaluation		At 6 months, the mean KTW was 4.532±0.505 mm (test group) and 3.8±0.447 mm (control group) (P=0.041)	Clinical parameters were evaluated at 1, 3, and 6 months	A longer follow-up period was required	MMTT+CTG helps in faster healing, better aesthetics, lesser morbidity as compared to MCAF+CTG

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Table 2: Contd...

Study ID/ authors	Methods of aesthetic evaluation	Esthetic result	Final KT increase (mm)	Follow up (months)	Limitation	Conclusion
Savitri *et al.*, 2022 (32 patients)	Not recorded, however WHI and VAS pain scores in test and control groups at 1 week indicated that there was significant improvement in early wound healing and lower VAS pain scores in the test group compared to the controls ($P \leq 0.05$)	Not recorded	No statistical increase in WKT in both the groups	At baseline and at 6 months	Smaller sample size (16 patients in each group) with a shorter follow-up period of only 6 months	At 6 months, no significant differences in MRC, CRC, WKT using macro or microsurgical method however, better wound healing, less postoperative pain, and discomfort were observed in the microsurgical group
Tavelli, 2022 (30 patients)	RES	Test group - 6.98 Control group - 8.17	Test group - 0.25 Control group - 0.32	At baseline, 1 month, 3 months, 6 months	Cost of biomaterial like PDGF	Enhanced results in mRC, CRC , gingival thickness
Carcuac, 2023 (30 patients)	Not reported	Not reported	Height of KT was improved by 4.2 in test group, control group - 2.2 mm	At baseline, 3, 6 and 12 months	No assessment of esthetic outcomes was done	The modified FGG gave superior results compared to traditional FGG in terms of root coverage, gain of keratinized tissue height, and patient satisfaction
Zeytinci, 2023 (17 patients)	Aesthetic score RES[19] using the parameters of LGM; level of the gingival margin MJA, MTC, STT, GTC	High satisfaction scores were found at the follow-up evaluation in both the groups. However, there was no significant difference within or between the groups	No statistical increase in WKT in both the groups	At baseline, 1 month, 3 months, 6 months	1. Smaller sample size 2. Thickness of KT not evaluated 3. Standardization of protocol for digital photograph 4. VAS Scale for pain measurement was recorded after giving analgesics, however, no control group without analgesics was made	Macrosurgical versus macrosurgical procedures both gave good clinical results, however, to increase KGW, microsurgery has greater benefits than a conventional surgical approach

RCT=Randomized clinical trials, GRD=GR defect, MAGR=Multiple adjacent GR, RT1=Recession type 1, GR=Gingival recession, CAF=Coronally advanced flap, EMD=Enamel matrix derivative, CTG=Connective tissue graft, MICAF=Minimally invasive CAF, PRF=Platelet-rich fibrin, MCAF=Modified CAF, LMCAF=Laterally moved CAF, VISTA=Vestibular incision sub-periosteal tunneling technique, ADM=Acellular dermal matrix, MMTT=Modified microsurgical tunnel technique, rhPDFG=Recombinant PDGF, CCM=Cross-linked collagen membrane, FGG=Free gingival graft, WKT=Width of keratinized gingiva, TKT=Thickness of keratinized gingiva, CAL=Clinical attachment level, RW=Recession width, VAS=Visual Analog Scale, RD=Recession depth, MRC=Mean root coverage, CRC=Complete root coverage, PD=Probing depth, FMPS=Full mouth plaque scores, FMBS=Full-mouth bleeding scores, PPD=Probing pocket depth, RPGM=Relative gingival position at the surgical site, WAG=Width of attached gingiva, WKM=Width of keratinized mucosa, WHI=Wound-healing index, RES=Root coverage esthetic score, MJA=Mucogingival junction alignment, MTC=Marginal tissue contour, STT=Soft tissue texture, GTC=Gingival tissue color, PDGF=Platelet-derived growth factor, TKG=Thickness of keratinized gingiva, WKG=Width of keratinized gingiva, KGW=Keratinized tissue width , CEJ=Cemento-Enamel junction, SCTG=Sub-epithelial connective tissue graft, LMCAF=Laterally moved coronally advanced flap, KT=Keratinized tissue, KTH=Keratinized tissue height, LGM=Level of gingival margin, WAG=Width of attached gingiva

which incorporated root surface bio-modification with 24% ethylenediaminetetraacetic acid. Tavelli *et al*.[23] used a CAF with a cross-linked collagen membrane and recombinant platelet-derived growth factor (Rh PDGF). A study by Mansouri *et al*.[19] included the VISTA technique with the CTG, whereas Karmakar *et al*. used the modified microsurgical tunneling technique with the CTG.[21] In a study by Shrivastava *et al*.,[20] a CAF with Alloderm as a biomaterial was used. The characteristics of the studies are summarized in Table 2. The use of surgical operating microscopes (SOP) during the surgical procedures was incorporated in some studies,[8,16,22,26] however, a study by Ucak *et al*.[18] used Galilean loupes with a ×2.5.

Treatment outcomes

Data regarding clinical measurements (WKT, MRC, CRC, etc.) were extracted from selected studies and are described in Table 2. However, three RCTs did not report MRC and CRC,[11,16,22] although gain in KT in millimeters was documented. In addition, VAS score too was documented in some studies,[18,19,22,23] while the RES was documented in four studies.[19,22,24,26] There was an overall improvement in parameters such as MRC, CRC, WKT, clinical attachment level (CAL), and probing pocket depth at least 6 months postsurgery in both the test and control groups; however, statistical difference in between both the groups in these parameters were seen in only three studies.[8,18,21] A split-mouth RCT by Pandey and Mehta used the free rotated papilla autograft combined with the CAF by conventional (macrosurgery) technique and surgery under magnification (microsurgical) technique. They concluded that surgery incorporating the microsurgical procedure had better clinical outcome in terms of postoperative pain and discomfort.[11] A study by Rajendran *et al*. concluded that there was statistically significant ($P < 0.001$) difference with respect to patient-reported outcomes of esthetic and morbidity and more favorable in the microsurgical group.[17] Tavelli *et al*. reported a statistically significant difference in volumetric and esthetic outcomes after 6 months when a xenogeneic collagen matrix was used with a rhPDGF for root coverage.[23] Similar results were found in studies by Ucak *et al*.[18] and Zeytinci *et al*.[25] in terms of the RES (Cairo) score.[27] A statistically significant increase in the thickness of keratinized gingiva after root coverage was also documented in the microsurgical group in a few studies.[20,23,26]

Results

All the studies in this SR showed that there was significant gain in WKT, CAL, CRC, and MRC values when a microsurgical approach was used. However, statistical difference between the microsurgical and macrosurgical procedures was seen only in few studies.[18,20,23] This compels us to infer that although conventional and microsurgical procedures are equally successful as root coverage procedures, microsurgical procedures are minimally invasive and produce superior esthetic and comfort parameters for the patient. They are therefore highly recommended in periodontal surgical procedures.

Discussion

The primary objective of this SR was to summarize the RCTs to evaluate the clinical effectiveness of MIS periodontal therapy in treating GRD. There is a lack of consensus and evidence of any superior technique or protocol regarding the most favorable technique for root coverage. This may be attributed to the absence of a standard surgical protocol and the availability of a wide spectrum of biomaterials used as adjuncts to the gingival augmentation procedures.

The past few decades have witnessed the seamless amalgamation of PPS for the treatment of marginal tissue recession for root coverage. Optimal root coverage is governed by several factors such as minimal tissue trauma, less morbidity, and maximizing the healing potential of the surgical site by minimizing the use of bone grafts and membranes. These periodontal plastic surgical procedures are classified as minimally invasive when they incorporate at least one of the above-mentioned criteria.[27] Among the spectrum of root coverage procedures, the CAF technique is the most documented approach in the scientific literature.[28] There has been a paradigm shift in the choice of root coverage procedures by the incorporation of different modifications of CAF without releasing incisions, the envelope, pin-hole surgery, VISTA technique, the pouch and tunnel techniques, laterally positioned flap, etc. In all the 13 RCTs, there was an evident improvement in the clinical parameters such as MRC, CRC, and gain in KT. In light of the results of our SR, which included 343 patients, it can be stated that both microsurgical and macrosurgical techniques for root coverage are equally effective as root coverage procedures. The outcomes in terms of MRC ranged from 70.69% to 100% in the microsurgical group while it was 70.69% to 87% in the macrosurgical group. However, the difference between the two techniques was not significant. It was also observed that there was an overall higher patient satisfaction with the microsurgical techniques with respect to pain which was assessed by questionnaires[17,21] and VAS score.[18,19] In a few studies, the esthetics postsurgery was assessed by the RES.[19,22,24,26]

Magnification plays a vital role in dictating precision and refined esthetic skills in root coverage procedures. Several studies have confirmed that the use of magnification along with microsurgical instruments and suture materials yield better results as compared to the traditional approaches.[8,16,22,26] A SR by Kang *et al*.[29] comprising of four RCTs concluded that CRC by sub-epithelial CTG was obtained with microsurgical procedures (using an operational microscope and microsurgical instruments). Superior esthetics and greater predictability were found in the outcome of root coverage procedures as compared with the conventional surgical procedures. However, in our SR, although all the RCTs showed that both the microsurgical and macrosurgical groups had a significant improvement in root coverage, there was no statistical difference between the two groups.[11,19,21,23,27] In a RCT by Savithri *et al*.,[22] they concluded that the intergroup analysis of the wound-healing index and VAS scores showed better healing and less postoperative pain in the microsurgical group which used a microscope as compared to the macrosurgical group ($P < 0.05$). In an RCT by Zeytinci *et al*., superior results in gain in KT were found in the microsurgical group incorporating the use of magnification (×2.5 loupes) as compared to the macrosurgical group.[25]

Limitations

There were a few limitations in the SR due to the heterogeneous nature of RCTs which comprised of several variables in the protocols of the surgical procedures. These resulted in the lack of uniformity in the comparison of the studies. Microsurgical periodontal treatments are relatively new and had a short-term follow-up, making it challenging to assess the sustainability of the surgical outcomes. Microsurgical techniques require a high level of expertise, which vary from clinician to clinician. This variability in surgical skills could have impacted the consistency of the results in the studies. Besides this, it is challenging to blind both the patient and the clinician due to the nature of the intervention carried out in the selected studies. This could have introduced biases and influence the subjective outcomes assessed.

Conclusion

Microsurgical procedures have revolutionized the field of periodontology, offering precise and minimally invasive treatment options for patients. By utilizing advanced magnification and microsurgical instruments, periodontal microsurgery has improved treatment outcomes, patient comfort, and overall esthetic results. However, we must exercise caution before espousing the concept of MIPT; an evidence-based approach is required for its incorporation into the optimal management and treatment of patients at a global level. We as clinicians and researchers should strive to design well-controlled and adequately powered studies to overcome some of these challenges and contribute robust evidence to the field of microsurgical periodontal treatment in periodontics.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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