REVIEW ARTICLE

EFFICACY OF MICRONEEDLING-ASSISTED GINGIVAL AUGMENTATION: A SYSTEMATIC REVIEW OF SIX-MONTH CLINICAL OUTCOMES

Dr Amrita Kumari[1*], Dr Ashish Yadav[2], Dr Soumya Sanghmitra Arya[3]

[1]Reader, Department of Periodontology, Mahatma Gandhi University of Medical Sciences and Technology (MGUMST), Jaipur, Rajasthan, India.

[2]Professor and Head, Department of Periodontology, Mahatma Gandhi University of Medical Sciences and Technology (MGUMST), Jaipur, Rajasthan, India.

[3]Senior Lecturer, Department of Periodontology, Mahatma Gandhi University of Medical Sciences and Technology (MGUMST), Jaipur, Rajasthan, India.

***Corresponding Author:** Dr. Amrita Kumari, Reader, Department of Periodontology, Mahatma Gandhi University of Medical Sciences and Technology (MGUMST), Jaipur, Rajasthan, India.

Email: amritasweet1414@gmail.com

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ABSTRACT

Background: Microneedling has been investigated as a minimally invasive approach to soft-tissue augmentation, either alone or combined with adjunctive materials or surgical techniques. This systematic review evaluated its clinical benefits in gingival phenotype modification over a minimum follow-up of six months.

Materials and Methods: The protocol was registered in PROSPERO (CRD420251124291). PubMed, Web of Science, the Cochrane Library (Trials) and Google Scholar were searched without language restrictions, with the final search completed in July 2026, supplemented by forward and backward citation searching. Two reviewers independently selected studies, extracted data and assessed risk of bias using the Cochrane RoB 2 tool. Primary outcomes were gingival thickness and keratinized tissue width; secondary outcomes were clinical attachment level and plaque index. Findings were synthesized narratively without meta-analysis.

Results: Four randomized controlled trials comprising 137 participants were included. Combining microneedling with injectable platelet-rich fibrin (i-PRF) produced greater gingival thickness than either component alone in the respective comparisons. Keratinized tissue width findings were inconsistent, with benefits favoring microneedling combined with a coronally advanced flap or with hyaluronic acid. Three trials were judged to be at low overall risk of bias and one as having some concerns. No pooled effect estimate was calculated.

Conclusion: Microneedling-based approaches appear promising for improving soft-tissue thickness over six months, particularly when combined with adjunctive materials. However, small samples and differences in interventions, comparators and tissue types limit firm conclusions about superiority over conventional augmentation. Larger randomized trials with standardized outcomes and longer follow-up are needed.

Keywords: Microneedling, Gingival augmentation, Gingival phenotype, Gingival thickness, Keratinized tissue width, Systematic review.

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INTRODUCTION

The periodontal phenotype is a combination of the gingival phenotype and the thickness of the buccal bone plate, and the gingival phenotype itself is defined by gingival thickness and the width of keratinized tissue.[1] A thin gingival phenotype is characterized by reduced tissue thickness, although the threshold used to define it varies between studies.[1,2] Thin gingiva may be more susceptible to recession in the presence of trauma and inflammation and can influence periodontal, restorative and orthodontic treatment planning.[2] Modifying a thin phenotype is therefore a relevant consideration when planning treatment.

Gingival phenotype has traditionally been modified with surgical procedures, including free gingival grafts, connective tissue grafts and graft substitutes such as acellular dermal matrix.[2] Autogenous grafts require a donor site, whereas acellular dermal matrix avoids harvesting tissue from the patient.[3] These approaches involve recipient-site surgery, and autogenous grafting introduces an additional surgical wound. Interest has therefore grown in less invasive approaches that may reduce the need for graft harvesting.

Microneedling is one such approach. Fine needles create controlled micro-injuries in the tissue, initiating a healing response that may promote collagen formation and tissue thickening.[1,4,5] In periodontics, microneedling has been investigated alone and with injectable platelet-rich fibrin (i-PRF) for increasing gingival thickness.[2] It has also been evaluated after a coronally advanced flap for recession treatment and with hyaluronic acid for peri-implant soft-tissue augmentation.[3,6] These applications include both non-surgical treatment and use as an adjunct to surgery.

Several randomized controlled trials have evaluated microneedling-based approaches, with differences in the accompanying material, comparator and tissue treated.[1-3,6] Previous systematic reviews have examined i-PRF and microneedling, including six-month outcomes, but findings for gingival thickness and keratinized tissue width have not been equally consistent.[7] Careful interpretation is therefore needed to distinguish the benefit of microneedling from that of the accompanying material or procedure. Six-month follow-up provides a defined interval for assessing tissue changes, although it does not establish their long-term durability.[8-10]

Therefore, this systematic review was performed to evaluate whether microneedling, alone or combined with adjunctive materials or techniques, improves the gingival phenotype, as reflected by gingival thickness and keratinized tissue width, over a follow-up of at least six months.

MATERIALS AND METHODS

Protocol and Registration

The protocol for this systematic review was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration number CRD420251124291. The review was reported with reference to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement, and the study selection process was documented in a flow diagram (Figure 1).[11]

Focused Question

Is microneedling, used alone or combined with other materials or techniques, effective in improving gingival thickness and keratinized tissue width in the management of thin gingival phenotype, as assessed by randomized controlled trials with at least six months of follow-up?

Eligibility Criteria

Inclusion criteria

- Randomized controlled trials with a parallel-group or split-mouth design.
- Studies in patients requiring gingival augmentation for the management of a thin gingival phenotype or gingival recession.
- Studies in patients without systemic conditions affecting healing.
- Studies evaluating microneedling-assisted gingival augmentation, either alone or combined with another material or technique.
- Studies comparing the intervention with a conventional augmentation technique without microneedling, such as platelet-rich fibrin or acellular dermal matrix.
- Studies reporting gingival thickness or keratinized tissue width.
- Studies with a minimum follow-up of six months.

Exclusion criteria

- Non-randomized studies, cohort studies, case-control studies, case series and case reports.
- Narrative reviews, systematic reviews, letters, editorials and expert opinions.
- Animal studies and laboratory investigations.
- Studies without a microneedling intervention.
- Studies involving systemic conditions affecting healing.
- Studies with follow-up shorter than six months.

Outcomes

The primary outcomes were gingival thickness and keratinized tissue width. Clinical attachment level and plaque index were the secondary outcomes. Outcome measurements at baseline and six months were recorded.

Search Strategy

Electronic databases

A literature search was conducted in four electronic sources: PubMed, Web of Science, the Cochrane Library (Trials) and Google Scholar. No language restrictions were applied, and the final search was completed in July 2026. The search focused on studies evaluating microneedling-assisted gingival augmentation in individuals with a thin gingival phenotype, and considered peer-reviewed publications, clinical trial reports and grey literature. Forward citation searching and manual screening of the reference lists of the included studies and of relevant reviews were also performed to identify additional trials not retrieved through the electronic searches. All retrieved

records were assessed against the predefined eligibility criteria.

Search terms

The search terms covered two main concepts: microneedling and gingival augmentation or phenotype modification. Terms relating to the intervention included "microneedling," "micro-needling," "micro needling," "dermapen" and "dermaroller." Terms relating to the clinical condition and treatment included "gingival augmentation," "gingival phenotype," "gingival biotype," "gingival thickness," "thin gingival phenotype," "keratinized tissue," "keratinised tissue" and "gingival recession." Synonymous terms were combined using "OR," and the intervention and clinical concepts were combined using "AND." The electronic search used the following string:

> (microneedl*[tiab] OR "micro-needling"[tiab] OR "micro needling"[tiab] OR dermapen*[tiab] OR dermaroll*[tiab] OR "derma pen"[tiab] OR "derma roller"[tiab]) AND (gingiv*[tiab] OR periodontal[tiab] OR "keratinized tissue"[tiab] OR "keratinised tissue"[tiab] OR "peri-implant mucosa"[tiab] OR "peri-implant soft tissue"[tiab])

Study Selection Process

Two reviewers, Amrita Kumari (AK) and Ashish Yadav (AY), independently selected studies in two stages. Duplicate records were removed before screening. In the first stage, AK and AY assessed the titles and abstracts of the retrieved records for relevance to the review question and eligibility criteria.

In the second stage, the reviewers independently evaluated the full texts of potentially eligible reports. Reports excluded at this stage were recorded with their reasons for exclusion. Disagreements were resolved through discussion between AK and AY. If consensus could not be reached, Soumya Sanghmitra Arya (SSA) acted as the third reviewer and made the final decision. The study selection process is documented in the PRISMA flow diagram (Figure 1).

Data Extraction

AK and AY independently extracted data from the included trials using a structured extraction form. The completed forms were compared, and discrepancies were resolved by discussion. Unresolved disagreements were referred to SSA. The following information was recorded (Table 1):

- **Study details:** First author, publication details, country and clinical setting, where reported.
- **Study design:** Parallel-group or split-mouth design, number of treatment arms and duration of follow-up.
- **Participant characteristics:** Number of participants, age, sex, gingival phenotype and recession characteristics, where applicable.
- **Treatment sites:** Number of teeth or sites, anatomical location, and whether treatment involved natural gingiva or peri-implant mucosa.
- **Intervention and comparator:** Microneedling device, adjunctive material or surgical technique, treatment schedule and comparator.
- **Clinical outcomes:** Baseline and six-month gingival thickness, keratinized tissue width, clinical attachment level and plaque index, together with reported changes and statistical comparisons.

Continuous outcomes were recorded in the form reported by the original studies, including means and standard deviations or medians and ranges. Medians were not automatically converted into means. For split-mouth trials, participant numbers were distinguished from tooth or site counts, and the within-patient structure was retained in the description of results. Where an article contained conflicting values, the discrepancy was documented rather than resolved by selecting a value without justification.

Risk of Bias Assessment

AK and AY independently assessed the included randomized trials using the revised Cochrane risk-of-bias tool for randomized trials (RoB 2).[12] Disagreements were resolved through discussion; when agreement could not be reached, SSA was consulted.

Five domains were assessed: bias arising from the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome and selection of the reported result. Domain-level and overall judgements were classified as low risk of bias, some concerns or high risk of bias. The study-level assessments and the distribution of domain-level judgements are presented as a traffic-light plot and a summary plot (Figures 2 and 3).

Data Synthesis

The included trials differed in several ways that made pooling inappropriate. They used different study designs (split-mouth and parallel-group), combined microneedling with different materials or procedures (injectable platelet-rich fibrin, hyaluronic acid and a coronally advanced flap) and used different comparators. They also treated different tissues (natural gingiva, recession defects and peri-implant mucosa) and measured outcomes with different methods. This clinical and methodological heterogeneity, together with the small number of eligible trials, meant that combining the data statistically could give misleading results. A meta-analysis was therefore not performed.

Instead, a narrative synthesis was undertaken. The studies were grouped by the material or technique combined with microneedling. Within each group, the changes in gingival thickness and keratinized tissue width from baseline to six months were compared between study groups, followed by clinical attachment level and plaque index. The main characteristics and outcome data of each study were tabulated. The direction and size of the changes and the risk of bias of each trial were considered when interpreting the findings.

RESULTS

Study Selection

The database search identified 166 records, comprising 34 from PubMed, 57 from Web of Science, 27 from Cochrane

and 48 from Google Scholar. After removal of 62 duplicate records, 104 records underwent title and abstract screening. Of these, 92 were excluded: 58 review articles, eight case reports or case series, 22 records unrelated to the review question and four animal studies. Twelve reports were sought for retrieval, and all 12 were assessed in full text. Eight reports were excluded because of an ineligible comparator (n = 6) or follow-up shorter than six months (n = 2). Four randomized controlled trials were included in the review. The study selection process is presented in the PRISMA flow diagram (Figure 1).

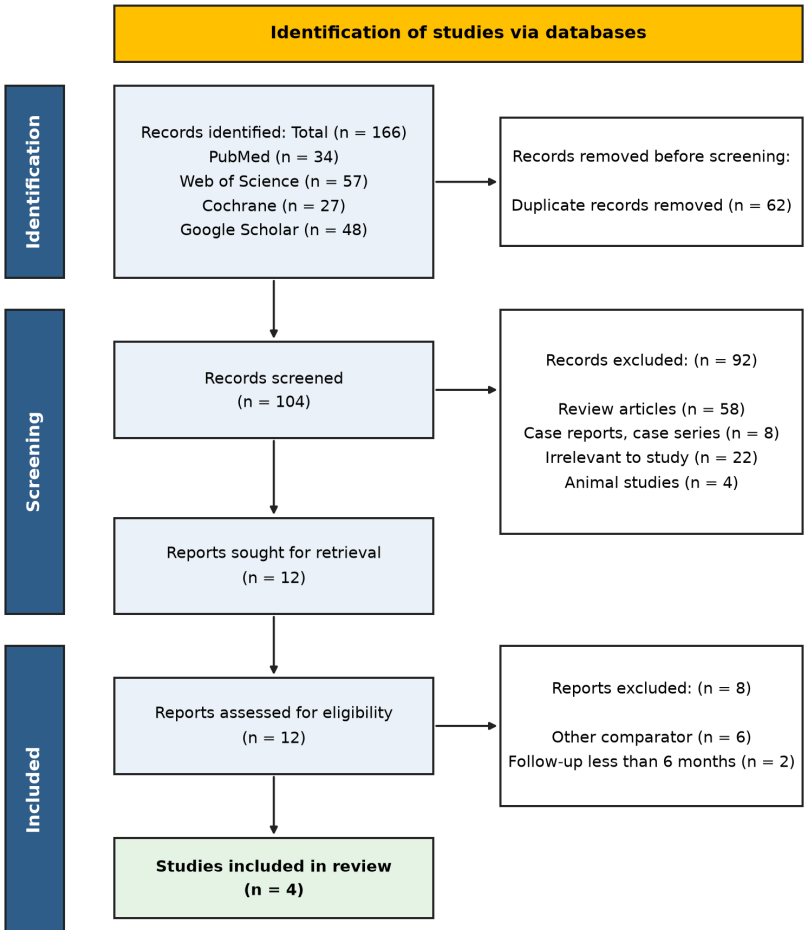


Figure 1: PRISMA 2020 flow diagram of the study selection process

Characteristics of the Included Studies

The four trials were conducted in Turkey, India and Egypt and included 137 participants in total; individual sample sizes ranged from 15 to 65 participants.[1-3,6] Ozsagir et al.[1] and Chetana et al.[2] used split-mouth designs, whereas Bawankar et al.[6] and Zaaya et al.[3] used parallel-group designs.

Ozsagir et al.[1] compared microneedling plus i-PRF with i-PRF alone in 33 patients, while Chetana et al.[2] compared microneedling plus i-PRF with microneedling alone in 15 patients. Bawankar et al.[6] compared microneedling alone (n = 30) with microneedling followed by hyaluronic acid injection (n = 35) for peri-implant soft-tissue augmentation. Zaaya et al.[3] compared a coronally advanced flap (CAF) followed by microneedling with CAF plus acellular dermal matrix (ADM), with 12 patients per group, for single RT1 recession defects. All four trials reported six-month outcomes, and their characteristics are summarized in Table 1.

Table 1: Characteristics of the included studies

Study and country	Study design	Sample and population	Microneedling intervention	Comparator	Assessment periods	Review-relevant outcomes
Ozsagir et al. (2020), Turkey[1]	Randomized split-mouth trial	33 patients; 198 mandibular anterior teeth. Systemically healthy patients with thin gingival phenotype (GT < 0.8 mm).	MN + i-PRF; four treatment sessions at 10-day intervals.	i-PRF alone	Baseline and monthly assessments through six months after the final injection.	GT, KTW, CAL and PI
Chetana et al. (2024), India[2]	Randomized split-mouth trial	15 patients; 120 sites (60 per treatment arm). Systemically healthy patients with thin gingival phenotype (GT < 1.5 mm).	MN + i-PRF; four treatment sessions at 10-day intervals.	MN alone	Baseline and one, three and six months.	GT, KTW and PI; CAL not reported

Study and country	Study design	Sample and population	Microneedling intervention	Comparator	Assessment periods	Review-relevant outcomes
Bawankar et al. (2024), India[6]	Randomized parallel-group trial	65 patients: MN alone, n = 30; MN + HA, n = 35. Systemically healthy patients undergoing augmentation of thin peri-implant soft tissues.	MN followed by injectable HA around implants.	MN alone	Baseline and three and six months.	MT, KTW, CAL and PI; peri-implant measurements
Zaaya et al. (2024), Egypt[3]	Randomized parallel-group trial	24 patients (12 per arm). Systemically healthy patients with thin gingival phenotype and a single RT1 recession in the esthetic zone.	CAF followed by MN, starting one month after surgery; four MN sessions at 10-day intervals.	CAF + ADM	Baseline and three and six months.	GT, KTW, CAL and PI

ADM: acellular dermal matrix; CAF: coronally advanced flap; CAL: clinical attachment level/loss, as reported; GT: gingival thickness; HA: hyaluronic acid; i-PRF: injectable platelet-rich fibrin; KTW: keratinized tissue width; MN: microneedling; MT: mucosal thickness; PI: plaque index.

Risk of Bias

Based on the RoB 2 assessments, three trials (75%), namely those of Ozsagir et al.,[1] Bawankar et al.[6] and Zaaya et al.,[3] were judged to have a low overall risk of bias. The trial by Chetana et al.[2] (25%) was judged to have some concerns, arising from selection of the reported result. All four trials were rated at low risk in the remaining domains: the randomization process, deviations from intended interventions, missing outcome data and measurement of the outcome. The study-level and domain-level assessments are shown in Figures 2 and 3.

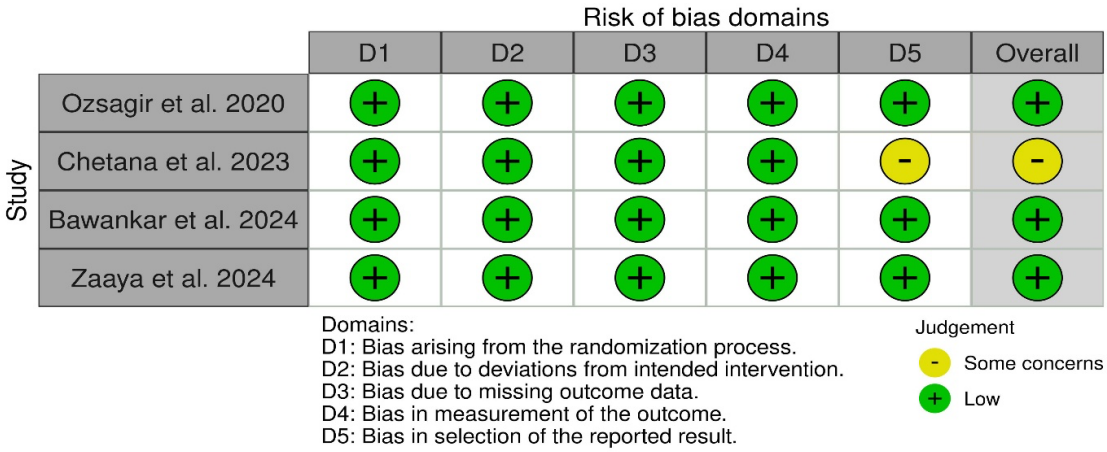


Figure 2: Risk-of-bias traffic-light plot of the included trials (RoB 2)

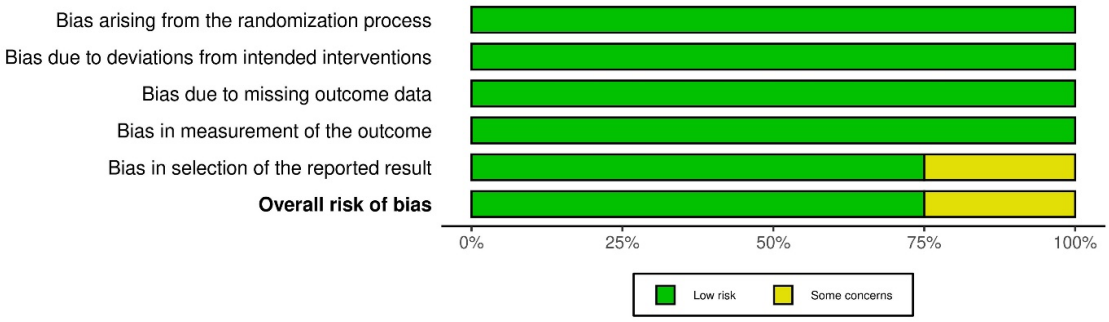


Figure 3: Risk-of-bias summary plot showing the proportion of judgements in each RoB 2 domain

Gingival and Peri-implant Mucosal Thickness

In the trial by Ozsagir et al.,[1] mean gingival thickness increased from 0.40 ± 0.14 mm to 0.66 ± 0.12 mm with microneedling plus i-PRF and from 0.43 ± 0.14 mm to 0.62 ± 0.11 mm with i-PRF alone; both increases were significant ($p < 0.001$). The between-group difference in gingival thickness was significant only at six months, favoring the combined intervention ($p = 0.007$).

Chetana et al.[2] reported significantly greater gingival thickness with microneedling plus i-PRF than with microneedling alone at one, three and six months; the six-month values were 0.644 ± 0.089 mm and 0.564 ± 0.076 mm, respectively ($p < 0.001$). In the trial by Zaaya et al.,[3] the median six-month gingival thickness gain was 1.75 mm (range: 1–3 mm) with CAF plus microneedling and 1.50 mm (range: 1–2 mm) with CAF plus ADM, without a significant between-group difference ($p = 0.165$).

In the peri-implant trial, Bawankar et al.[6] reported increased mucosal thickness in both groups, from approximately 0.90 ± 0.16 mm to 1.04 ± 0.12 mm with microneedling alone and from 1.09 ± 0.26 mm to 2.49 ± 0.46 mm with microneedling

plus hyaluronic acid. Six-month thickness was significantly greater in the combined-treatment group ($p < 0.001$), although baseline thickness also differed significantly between groups.

Keratinized Tissue Width

In the trial by Ozsagir et al.,[1] six-month keratinized tissue width was 2.99 ± 1.22 mm with microneedling plus i-PRF and 2.99 ± 1.09 mm with i-PRF alone, with no significant between-group difference ($p = 0.984$). A small within-group increase was reported for the combined intervention, whereas Chetana et al.[2] reported no significant within-group change or between-group difference in keratinized tissue width.

Zaaya et al.[3] reported a median six-month keratinized tissue width gain of 2 mm (range: −1 to 3 mm) with CAF plus microneedling and 1 mm (range: −2 to 4 mm) with CAF plus ADM; the between-group difference in gain was significant ($p = 0.037$). These values are changes from baseline rather than final tissue width measurements.

In the trial by Bawankar et al.,[6] keratinized tissue width in the microneedling-alone group changed from approximately 2.67 ± 0.92 mm at baseline to 2.44 ± 0.84 mm at six months, with no significant change across the assessment periods ($p = 0.536$). In the microneedling-plus-hyaluronic-acid group, width increased from approximately 3.17 ± 1.01 mm to 4.34 ± 1.03 mm, with a significant change over time ($p < 0.001$). Six-month width differed significantly between groups ($p < 0.001$), but a significant baseline difference was also present ($p = 0.041$).

Clinical Attachment Level

Ozsagir et al.[1] reported mean clinical attachment loss of 2.07 ± 0.22 mm at baseline and 2.05 ± 0.21 mm at six months, corresponding to a numerical reduction of 0.02 mm. The reported overall comparison across assessment periods was significant (Friedman test, $p < 0.001$); however, separate treatment-arm CAL values and a between-group CAL comparison were not provided. Accordingly, these data do not establish a CAL advantage for either intervention.

Zaaya et al.[3] reported a median six-month CAL gain of 2.5 mm in both groups, with ranges of 0–6.5 mm for CAF plus microneedling and −1 to 5 mm for CAF plus ADM; there was no significant between-group difference ($p = 0.748$). Bawankar et al.[6] reported lower six-month CAL values with microneedling plus hyaluronic acid than with microneedling alone ($p < 0.001$); however, the six-month CAL values differed between the article's intragroup and intergroup tables, so a single definitive numerical estimate was not extracted. Chetana et al.[2] did not report CAL.

Plaque Index

Ozsagir et al.[1] reported a reduction in mean plaque index from 0.17 ± 0.05 at baseline to 0.12 ± 0.04 at six months, with a significant overall difference across assessment periods ($p < 0.001$). Chetana et al.[2] reported a reduction from 0.93 ± 0.24 to 0.52 ± 0.14, with significantly lower follow-up scores than at baseline. Zaaya et al.[3] reported improvement over time in both groups, with no significant between-group difference in six-month plaque index change ($p = 0.850$). In the trial by Bawankar et al.,[6] six-month plaque index values were approximately 0.83 ± 0.12 with microneedling alone and 0.79 ± 0.07 with microneedling plus hyaluronic acid, without a significant between-group difference ($p = 0.114$).

DISCUSSION

This systematic review examined the clinical effects of microneedling, used alone or with adjunctive materials or surgical techniques, over six months. The included studies suggest potential benefits for gingival or peri-implant tissue thickness, but the findings do not establish that microneedling is consistently superior to conventional augmentation procedures. The trials addressed different comparisons: adding microneedling to i-PRF, adding i-PRF or hyaluronic acid to microneedling, and comparing a coronally advanced flap followed by microneedling with a flap combined with acellular dermal matrix. These distinctions are important because improvement following treatment is not, by itself, evidence of superiority over another intervention.

The findings for i-PRF indicate a possible benefit from combining biological supplementation with microneedling. Ozsagir et al.[1] found greater gingival thickness at six months with microneedling plus i-PRF than with i-PRF alone, whereas Chetana et al.[2] found greater thickness with the combination than with microneedling alone. However, these comparisons answer different questions: the former assesses the additional effect of microneedling, while the latter assesses the additional effect of i-PRF. They should therefore not be treated as interchangeable evidence of the independent efficacy of microneedling.

The biological rationale for this combination involves a repair response to controlled micro-injury, together with the growth-factor delivery associated with i-PRF.[13-16] This provides a plausible explanation for tissue thickening, but clinical thickness measurements alone cannot demonstrate histological regeneration or establish which biological mechanism produced the observed change.[17,18] The small additional differences in thickness also require clinical interpretation: statistical significance does not necessarily indicate a meaningful reduction in future recession or an improvement in long-term treatment stability.

The findings for keratinized tissue width were less consistent than those for thickness. The i-PRF trials did not demonstrate a significant between-group advantage in keratinized tissue width, despite improvements in thickness. This suggests that thickening the gingiva and increasing its keratinized width should be considered separate treatment objectives. Consequently, a positive thickness outcome should not automatically be interpreted as comprehensive modification of the gingival phenotype.

In recession treatment, Zaaya et al.[3] found no statistically significant difference in gingival thickness gain between a coronally advanced flap followed by microneedling and a flap combined with acellular dermal matrix,[19,20] while keratinized tissue width outcomes favored the microneedling group at six months. These findings support further investigation of microneedling as an adjunct to flap surgery, rather than as a proven replacement for graft-based procedures. Importantly, the absence of a statistically significant difference does not establish equivalence.

Because both groups underwent flap surgery and there was no flap-only group, the contribution of microneedling cannot be fully separated from that of the surgical procedure.

Bawankar et al.[6] reported greater six-month mucosal thickness and keratinized tissue width with hyaluronic acid plus microneedling than with microneedling alone around implants. This comparison supports a possible additional benefit from hyaluronic acid, but it does not isolate the effect of microneedling because both groups received it. Furthermore, peri-implant mucosal outcomes should be interpreted separately from gingival outcomes around natural teeth. The article also contains discrepancies between some intragroup and intergroup clinical attachment values, warranting caution when interpreting that secondary outcome.

The secondary outcomes do not establish a uniform benefit attributable specifically to microneedling. Zaaya et al.[3] reported no significant between-group difference in clinical attachment gain or plaque index change, and Bawankar et al.[6] reported no significant between-group plaque index difference. Changes in plaque scores should not be interpreted as direct evidence of tissue augmentation, particularly when participants also received oral hygiene measures. Similarly, clinical attachment measurements around implants should not be assumed to represent the same biological outcome as attachment measurements around natural teeth.

The thickness findings are broadly consistent with an earlier systematic review that reported an advantage for i-PRF combined with microneedling over i-PRF alone, without a significant keratinized tissue width advantage.[7] However, that review's pooled estimates should not be presented as estimates from the present review, which used narrative synthesis. The current interpretation is limited by small study samples, different comparators, variation in treatment protocols and measurement methods, and the inclusion of both gingival and peri-implant applications. Six-month observations also cannot establish long-term maintenance of the tissue changes or prevention of subsequent recession.

Overall, microneedling-based approaches appear promising for increasing soft-tissue thickness, particularly when combined with adjunctive materials. Nevertheless, the evidence does not justify a general claim that microneedling alone is superior to conventional augmentation or that it reliably increases keratinized tissue width in every clinical setting. Future trials should include controls that isolate the contribution of microneedling, standardize outcome measurement, preserve paired analyses in split-mouth designs, and assess longer-term stability, patient-reported outcomes and adverse events. Gingival and peri-implant applications should be evaluated separately to clarify where these approaches provide a clinically meaningful benefit.

CONCLUSION

The included trials suggest that microneedling-based approaches may improve gingival or peri-implant soft-tissue thickness over six months, particularly when combined with adjunctive materials. However, improvements in keratinized tissue width were inconsistent, and the findings do not establish that microneedling alone is superior to conventional augmentation procedures. These findings should be interpreted cautiously because the trials were small and differed in their interventions, comparators and clinical applications. Larger randomized controlled trials with standardized outcome assessment and longer follow-up are needed to establish the clinical relevance and durability of the observed benefits.

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