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Comparative Evaluation of Microneedling with and without Concentrated Platelet-Rich Fibrin for Gingival Phenotype Modification in Individuals with Thin Gingival Phenotype: A Prospective Split-Mouth Study

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Abstract

Background: Thin gingival phenotype is associated with increased susceptibility to gingival recession, soft-tissue instability, and compromised esthetic outcomes. The present study evaluated the effectiveness of microneedling (MN) with and without concentrated platelet-rich fibrin (C-PRF) for gingival phenotype modification. ***Methods:*** This prospective split-mouth comparative clinical study included 42 sites, with 21 sites each in the group A and group B. Ground A sites received MN with adjunctive C-PRF, whereas Group B sites received MN alone. Gingival thickness (GT) and keratinized tissue width (KTW) were assessed at baseline, 3 months, and 6 months. Postoperative pain was assessed using a visual analogue scale (VAS). Patient-level mean values were used for statistical analysis. ***Results:*** Both groups showed significant improvement in GT and KTW from baseline to follow-up. Group A demonstrated significantly greater GT than Group B at 3 and 6 months ($P < 0.05$). Intergroup differences in KTW were not statistically significant. Pain scores decreased progressively in both groups without significant intergroup differences. ***Conclusion:*** Adjunctive use of C-PRF with microneedling resulted in superior improvement in gingival thickness and may represent an effective minimally invasive option for gingival phenotype enhancement.

Keywords: Concentrated platelet-rich fibrin; gingival phenotype; gingival thickness; microneedling; periodontal plastic surgery.

INTRODUCTION

The concept of periodontal phenotype has received considerable attention in contemporary periodontal therapy because soft-tissue characteristics strongly influence disease progression, treatment planning, and long-term clinical stability. Gingival phenotype generally refers to the thickness of the gingival tissues and associated morphologic features of the periodontium. Individuals with a thin gingival phenotype typically present with delicate tissues, narrow zones of keratinized gingiva, and increased transparency of periodontal instruments through the gingival margin. In contrast, thick phenotype is associated with denser fibrotic tissues and greater resistance to external trauma and inflammatory breakdown. [1–4]

Clinical importance of gingival phenotype extends to multiple disciplines within dentistry. In periodontology, thin tissues are more susceptible to marginal recession and attachment loss. In restorative dentistry, thin tissues may respond unfavorably around subgingival margins. During orthodontic tooth movement, thin phenotype is associated with higher risk of recession, particularly in labially positioned teeth. In implant dentistry, soft-tissue thickness influences esthetic integration and peri-implant tissue stability. Therefore, modification of thin gingival phenotype has become an increasingly relevant therapeutic objective. [5,6]

Conventional methods to increase gingival thickness or keratinized tissue width include free gingival grafts, subepithelial connective tissue grafts,

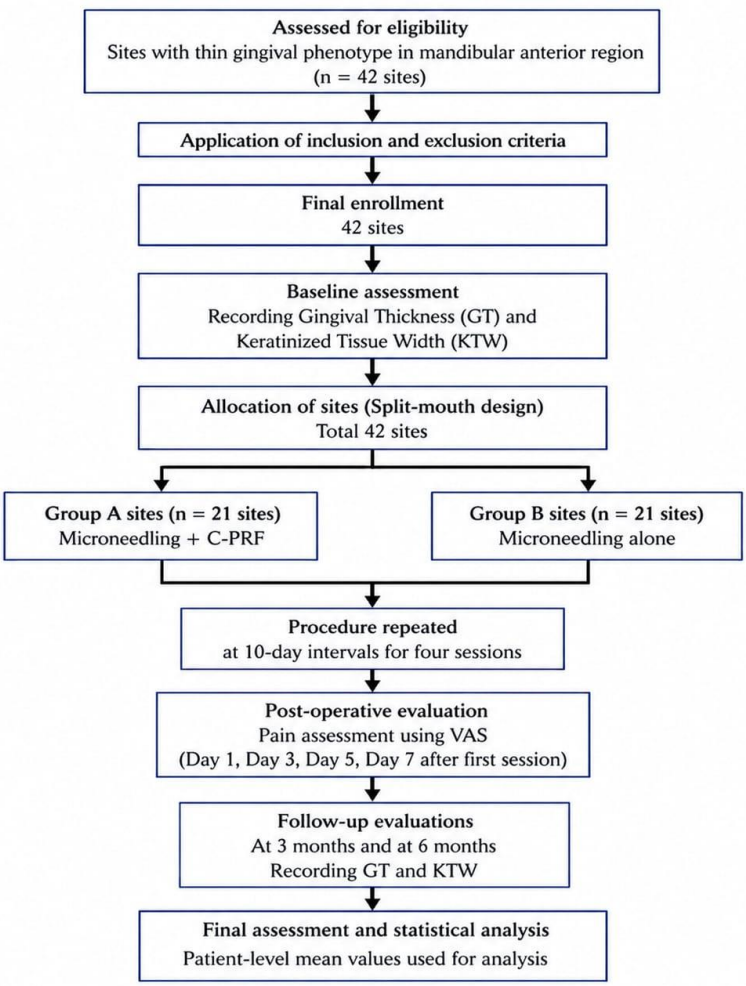
acellular dermal matrices, and various soft-tissue substitute. Although these procedures are predictable and well documented, they involve surgical intervention, donor-site morbidity, increased chairside time, higher cost, and postoperative discomfort. Patient acceptance of such procedures may be limited, especially when only modest phenotype enhancement is required rather than extensive mucogingival correction. [5,6]

In recent years, minimally invasive approaches aimed at stimulating endogenous tissue regeneration have gained interest. Microneedling is one such technique that creates multiple controlled micro-perforations in soft tissue. Originally popularized in dermatology, microneedling promotes collagen induction through a wound-healing cascade characterized by platelet activation, release of growth factors, fibroblast proliferation, angiogenesis, and extracellular matrix remodeling. Similar biologic principles may be applicable to gingival tissues, potentially resulting in increased thickness and improved tissue quality. [7–9]

Autologous platelet concentrates have also emerged as useful adjuncts in regenerative periodontal procedures. Platelet-rich fibrin (PRF) contains platelets, leukocytes, fibrin matrix, and growth factors that may accelerate wound healing and enhance tissue maturation. Concentrated platelet-rich fibrin (C-PRF) is obtained from the platelet-rich buffy coat layer after centrifugation and is reported to contain higher cellular and growth factor concentration than conventional liquid platelet derivatives. [10–12] Delivery of C-PRF into tissues subjected to microneedling may improve cellular migration, angiogenesis, collagen deposition, and tissue thickening.

Although preliminary reports have demonstrated favorable outcomes with injectable platelet concentrates and microneedling, evidence regarding adjunctive use of C-PRF for gingival phenotype modification remains limited. Furthermore, data specific to mandibular anterior thin phenotype are scarce. Therefore, the present study aimed to compare the clinical effectiveness of microneedling with and without adjunctive concentrated platelet-rich fibrin in individuals with thin gingival phenotype.

MATERIALS AND METHODS



Calculation of sample size:

Sample quantity estimation was done using G*Power software version 3.1.9.7. Effect size of 0.7 was calculated for the primary objective of comparing gingival thickness between the two groups at follow-up intervals. Type I (α) and Type II (1-β) were fixed at 0.05 and 0.80, respectively. The total sample size obtained was 42 sites, which were equally distributed as 21 sites in each group under the split-mouth study design.

A prospective, split-mouth comparative clinical study was conducted in compliance with the STROBE guidelines from September 2025 to January 2026 in the outpatient section of the Department of Periodontics, Bapuji Dental College and Hospital, Davangere, Karnataka, India.

This trial received approval from the Institutional Ethics Committee prior to the initiation of the present study and was conducted in accordance with the principles stated in the Helsinki Declaration (1975, revised 2013).

A total of 42 sites with thin gingival phenotype in the mandibular anterior region were included in the present study. Systemically healthy individuals aged 25–45 years fulfilling the inclusion criteria were recruited after obtaining written informed consent.

Thin gingival phenotype was identified clinically by transgingival probing with gingival thickness of <1 mm at the selected sites. Sites with active periodontal disease, tobacco habit, pregnancy or lactation, ongoing orthodontic treatment, previous mucogingival surgery in the study area, systemic illness affecting wound healing, or use of medications known to influence gingival tissues were excluded.

Baseline clinical parameters including Gingival Thickness (GT) and Keratinized Tissue Width (KTW) were recorded prior to treatment. (Figure 1a, 1b, 1c) The selected sites were then allocated under split-mouth design as:

- Group A (n = 21 sites): Microneedling with adjunctive concentrated platelet-rich fibrin (C-PRF)
- Group B (n = 21 sites): Microneedling alone

Microneedling was performed using repeated controlled punctures over the keratinized gingival tissue until uniform pinpoint bleeding was achieved. (Figure 2a) In Group A, freshly prepared C-PRF was injected immediately after microneedling. (Figure 2b) The procedures were repeated at 10-day intervals for four sessions.

Postoperative pain was assessed using Visual Analogue Scale (VAS) after the first treatment session on Days 1, 3, 5, and 7. Follow-up clinical parameters were recorded at 3 months and 6 months after completion of therapy. Statistical analysis was performed using Jamovi software, and significance was set at P <0.05.

Clinical Parameters

The following parameters were recorded at baseline, 3 months, and 6 months:

1. Gingival Thickness (GT) Measured at the mid-buccal aspect using transgingival probing with an endodontic spreader/file and digital vernier caliper.
2. Keratinized Tissue Width (KTW) Measured from free gingival margin to mucogingival junction at the mid-buccal point using a periodontal probe.
3. Postoperative Pain Assessed after the first intervention using visual analogue scale (VAS) at designated intervals.

All measurements were performed by a single calibrated examiner using standardized methods.

Treatment Protocol

After topical/local anesthesia, microneedling was performed using repeated controlled punctures with sterile lancet tips over the keratinized gingival tissue until uniform pinpoint bleeding was observed. (Figure 2a) In Group A, freshly prepared C-PRF was injected into the treated tissues immediately after microneedling using an insulin syringe. (Figure 2b) In Group B, only microneedling was performed. The procedures were repeated at 10-day intervals for four sessions to allow repeated biologic stimulation while maintaining adequate healing.

Preparation of C-PRF

Approximately 10 mL venous blood was collected in sterile tubes without anticoagulant and centrifuged according to standardized protocol.12 The platelet-rich buffy coat fraction above the red blood cell layer was aspirated and used immediately as C-PRF.

Statistical Analysis

Because multiple teeth were included within each participant, three sites per group were averaged to obtain patient-level mean values. Data were analyzed using Jamovi software. Intra-group comparisons were performed using paired t-tests, intergroup comparisons using independent t-tests, and VAS comparisons using Mann–Whitney U test. Statistical significance was set at P <0.05.

RESULTS

Both groups demonstrated statistically significant improvements in gingival thickness (GT) and keratinised tissue width (KTW) from baseline to 3 months and 6 months (all $p < 0.05$; Table 1). GT increased significantly more in Group A (microneedling with C-PRF) than in Group B (microneedling alone) at 3 months (1.23 ± 0.19 mm vs. 1.03 ± 0.09 mm; $p = 0.024$) and at 6 months (1.21 ± 0.19 mm vs. 1.01 ± 0.08 mm; p

= 0.026), indicating a superior effect of C-PRF augmentation on gingival thickening. (Figure 3 and 4) By contrast, KTW gains were statistically comparable between both groups at all follow-up time points (all $p >$ 0.05), suggesting that microneedling alone was equally effective in increasing keratinised tissue width. (Figure 5)

Postoperative pain was mild and self-limiting in both groups. Median VAS scores declined from Day 1 to Day 5, with complete pain resolution (VAS = 0) in all participants by Day 7. (Figure 5) No significant intergroup difference was identified at any postoperative time point (Mann–Whitney *U* test; all $p > 0.05$), confirming that the addition of C-PRF to microneedling does not increase postoperative discomfort.

METHODOLOGY PHOTOS

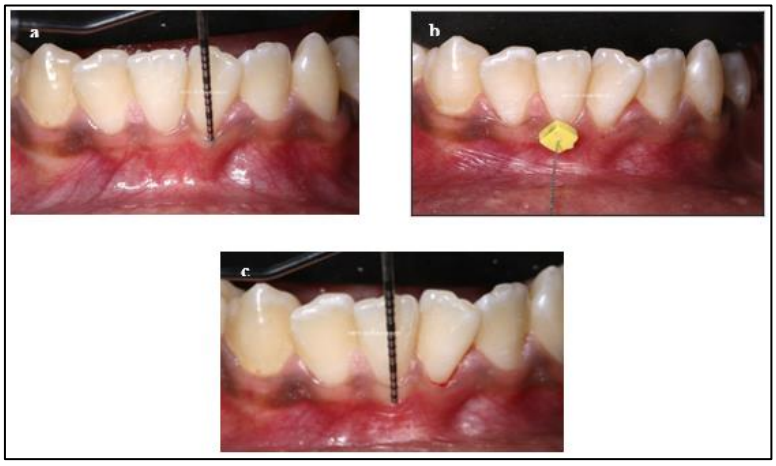


Figure 1: a) Pre-operative trans gingival probing, b) Measurement of Gingival Thickness using no.15 endodontic file c) Measuring of Keratinised Tissue Width

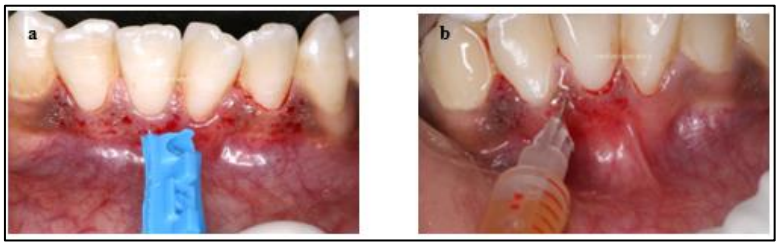


Figure 2: a) Microneedling with Lancet b) C-PRF is injected into Group A site

RESULTS PHOTOS

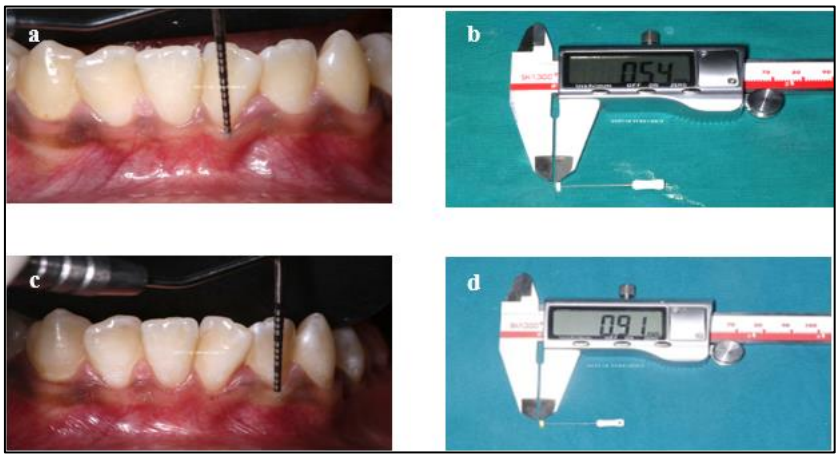


Figure 3: a) Transgingival probing at baseline in Group B b) Gingival thickness measured at baseline in Group B c) Transgingival probing at 3 months follow up in Group B d) Gingival thickness measured at 3 months follow up in Group B

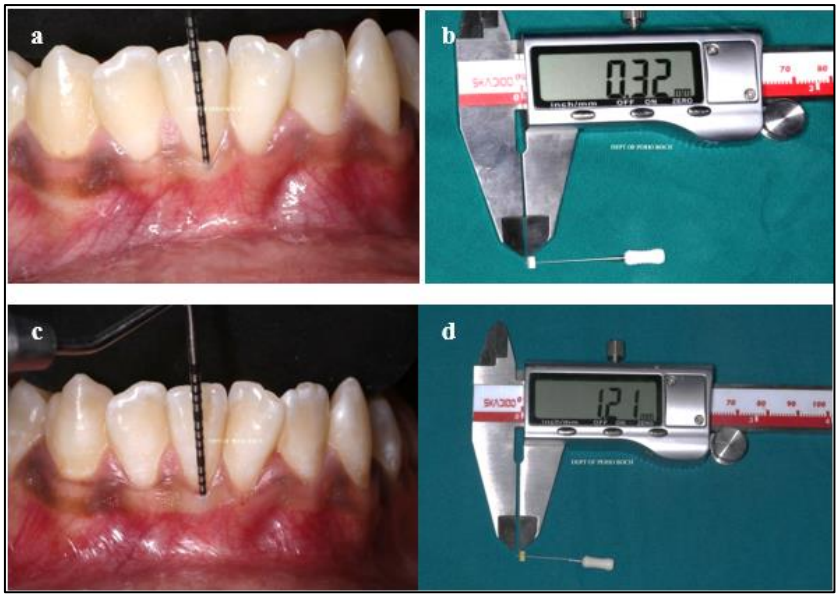


Figure 4: a) Transgingival probing at baseline in Group A b) Gingival thickness measured at baseline in Group A c) Transgingival probing at 3 months follow up in Group A d) Gingival thickness measured at 3 months follow up in Group A

Table 1. Clinical outcomes – gingival thickness and keratinised tissue width at baseline, 3 months, and 6 months.

Variable	Time Point	Group A (MN + C-PRF) Mean ± SD	Group A (MN + C-PRF) Within-group *p* value	Group B (MN only) Mean ± SD	Group B (MN only) Within-group *p* value	Between-groups *p* value
Gingival Thickness (mm)	Baseline	0.42 ± 0.10	—	0.59 ± 0.11	—	0.010
	3 Months	1.23 ± 0.19	<0.001†	1.03 ± 0.09	<0.001†	0.024*
	6 Months	1.21 ± 0.19	<0.001†	1.01 ± 0.08	<0.001†	0.026*
Keratinised Tissue Width (mm)	Baseline	2.62 ± 0.42	—	2.74 ± 0.68	—	0.700
	3 Months	3.38 ± 0.44	0.002†	3.47 ± 0.30	0.011†	0.682
	6 Months	3.36 ± 0.46	0.004†	3.45 ± 0.34	0.010†	0.680

MN, microneedling; C-PRF, concentrated platelet-rich fibrin; SD, standard deviation. $n = 7$ per group (patient-level means, 3 measurement sites per patient). Within-group comparison: paired t-test vs baseline. Between-group comparison: independent samples t-test. † Statistically significant vs baseline within group ($p < 0.05$). * Statistically significant between groups ($p < 0.05$). — Not applicable (baseline has no within-group comparison).

Figure 5.

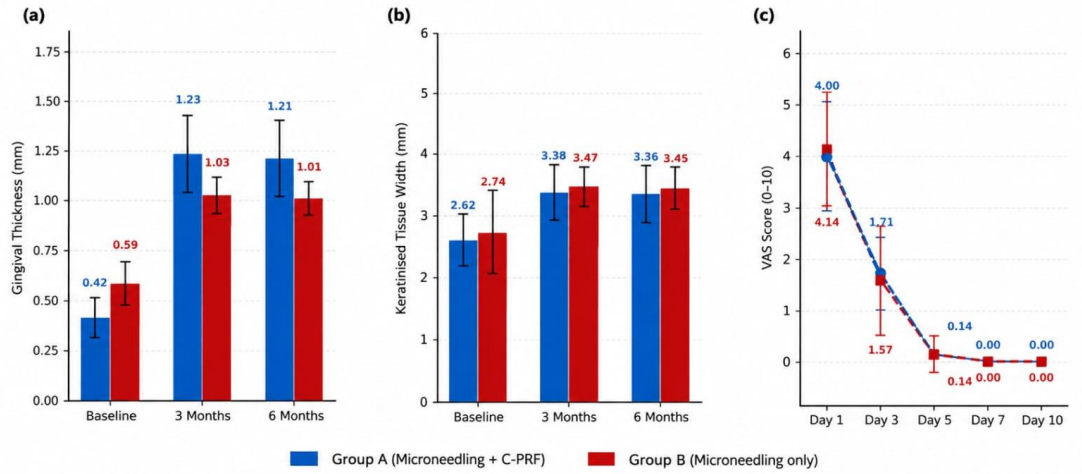


Figure 1. Clinical outcomes of micro-needling with concentrated platelet-rich fibrin (C-PRF) versus micro-needling alone. Error bars represent standard deviation (SD). **(a)** Mean gingival thickness (mm) at baseline, 3 months, and 6 months. **(b)** Mean keratinised tissue width (mm) at the same time points **(c)** Mean postoperative Visual Analogue Scale (VAS) pain scores (0–10) on Days 1, 3, 5, 7, and 10 following each treatment session.

DISCUSSION

The present findings may be interpreted from the perspective of periodontal wound-healing dynamics. Gingival tissues possess a favorable vascular supply and relatively rapid healing capacity compared with many other oral tissues. Controlled micro-injury produced by microneedling may therefore initiate an efficient regenerative cascade characterized by early hemostasis, recruitment of inflammatory cells, fibroblast activation, and subsequent connective tissue maturation. The repeated treatment sessions employed in the present study may have sustained this stimulatory effect, thereby contributing to cumulative gains in gingival thickness over time. [12–14]

An important clinical observation during subsequent treatment visits was the increasing firmness and resistance of gingival tissues during needle penetration, particularly in Group A. This may reflect progressive collagen fiber organization and increased connective tissue density resulting from repeated collagen induction and biologic stimulation. In addition, the clinically appreciable glossy appearance of tissues may indicate improved epithelial maturation and vascular perfusion. Although these observations were qualitative, they are consistent with the favorable quantitative improvements recorded in gingival thickness.

The role of C-PRF in the present study deserves particular emphasis. Compared with conventional platelet concentrates, C-PRF is harvested from the platelet-rich buffy coat layer and contains higher concentrations of platelets and leukocytes. This enriched biologic composition may provide a sustained local source of platelet-derived growth factor, transforming growth factor-β, vascular endothelial growth factor, and other signaling molecules involved in angiogenesis and extracellular matrix synthesis. These mediators are known to enhance fibroblast migration, collagen deposition, and wound maturation, thereby offering a biologically plausible explanation for the superior gains in gingival thickness observed in Group A. [10–12]

Another potential advantage of combining microneedling with C-PRF is improved tissue delivery of regenerative mediators. The microchannels created by needling may function as pathways that facilitate deeper diffusion and broader distribution of C-PRF within the gingival connective tissues. This could increase contact between bioactive factors and resident fibroblasts, endothelial cells, and extracellular matrix components, thereby enhancing therapeutic efficiency. Such a synergistic mechanism may explain why adjunctive biologic therapy produced greater tissue thickening than microneedling alone. [15,16]

The increase in keratinized tissue width observed in both groups, despite the absence of significant intergroup differences, remains clinically relevant. Even modest increases in KTW may improve plaque control comfort, reduce marginal inflammation in susceptible areas, and enhance patient tolerance during oral hygiene procedures. [22] It is possible that repetitive controlled stimulation of the gingival tissues promoted epithelial-connective tissue adaptation independent of platelet concentrate use. Furthermore, the baseline KTW in the present study was already within a functional range, which may have reduced the likelihood of detecting marked additional benefit from C-PRF.

The findings of the present study are in accordance with previous reports evaluating platelet concentrates for gingival phenotype enhancement. Ozsagir et al. demonstrated greater improvement in gingival thickness when microneedling was combined with injectable PRF. Similarly, Sidharthan et al. reported significantly superior gingival thickness gain with microneedling and injectable PRF compared with microneedling alone. Soundarajan and Malaippan also observed favorable improvement in soft-tissue thickness and contour with adjunctive injectable PRF therapy. In addition, studies by Miron et al. and Ghanaati et al. highlighted the regenerative potential of liquid platelet concentrates through sustained release of growth factors, enhanced angiogenesis, and collagen maturation, which may explain the superior gingival thickness observed in Group A. [17–21]

From a patient-centered standpoint, the favorable pain profile noted in both groups is noteworthy. Postoperative discomfort was transient, diminished rapidly, and resolved completely within a short period. This compares favorably with conventional grafting procedures, which frequently involve donor-site pain, need for sutures, prolonged healing, and greater postoperative care requirements. Therefore, minimally invasive phenotype modification techniques may be particularly appealing to patients who decline surgical grafting or seek shorter recovery time. [5,6]

The mandibular anterior region was intentionally selected because it commonly demonstrates thin gingival phenotype, shallow vestibular anatomy, reduced labial bone thickness, and higher susceptibility to recession caused by traumatic brushing or malpositioned teeth. Improvement of soft-tissue dimensions in this region may therefore offer preventive benefits in addition to esthetic and functional advantages. The present results suggest that targeted phenotype enhancement in such vulnerable areas may be feasible using nonsurgical regenerative methods. [2,6]

Future investigations should evaluate larger multicenter samples, extended follow-up periods, patient-reported outcome measures, and advanced imaging techniques for more precise soft-tissue assessment. Comparative studies against established mucogingival surgical procedures may also help define the exact clinical indications of microneedling with C-

PRF in routine periodontal practice. The present study supports the concept that biologically enhanced minimally invasive therapy may represent a promising direction in contemporary periodontal phenotype management.

Limitations

Limitations of the present study include modest sample size, short-term follow-up, absence of histologic evaluation, and inability to blind the operator fully. Larger multicenter studies with longer follow-up are necessary to confirm long-term stability.

CONCLUSION

Within the limitations of the present study, both microneedling alone and microneedling combined with concentrated platelet-rich fibrin improved gingival phenotype parameters. However, adjunctive use of C-PRF produced significantly greater gains in gingival thickness compared with microneedling alone. This minimally invasive approach may be considered a practical treatment option for selected patients requiring gingival phenotype enhancement.

AUTHOR CONTRIBUTION

Manjusri P: Writing - original draft(lead), Conceptualization(equal), Methodology(equal), Investigation(lead), acquisition(lead). Data curation(lead), Software(equal), Resources(equal), Funding

Triveni M Gowda: Conceptualization(equal), Visualization(lead), Formal analysis(equal), Supervision(lead), Writing - review & editing(lead), Project administration(equal), Resources(equal), Validation(equal)

Anto Jobson: Writing - original draft(supporting), Conceptualization(supporting), Data curation(supporting), Software(equal), Formal analysis(equal), Validation(equal)

Rucha Shah: Conceptualization(supporting), Writing - review & editing(supporting), Formal analysis(equal), Validation(equal)

Gayathri G V: Conceptualization(supporting), Supervision(supporting), Writing - review & editing(equal)

Key Points

- To the best of our knowledge, this is among the first clinical studies to evaluate the effectiveness of microneedling in combination with concentrated platelet-rich fibrin (C-PRF) for gingival phenotype modification in individuals with thin gingival phenotype.
- Repeated minimally invasive microneedling demonstrated favorable improvement in gingival thickness and keratinized tissue width, while preserving tissue integrity and minimizing postoperative discomfort.
- Adjunctive use of autologous C-PRF enhanced gingival thickness compared with microneedling alone, suggesting a beneficial role of biologic mediators in soft-tissue phenotype enhancement.

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Plain Language Summary

This study evaluated a minimally invasive method to improve thin gum tissues in the lower front tooth region. Forty-two sites with thin gingival tissues were treated using microneedling, a technique that creates tiny controlled punctures to stimulate natural healing. Some sites additionally received a biologic material called concentrated platelet-rich fibrin (C-PRF), prepared from the patient's own blood.

After treatment, both approaches improved gum thickness and the width of protective gum tissue. However, sites treated with microneedling along with C-PRF showed greater improvement in gum thickness than microneedling alone. Patients reported only mild temporary discomfort that reduced quickly after treatment.

These findings suggest that microneedling with C-PRF may offer a safe, effective, and less invasive option for strengthening thin gum tissues and improving periodontal soft-tissue health.

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