

“Comparative evaluation of microneedling alone and microneedling along with 2% curcumin gel application in the Management of gingival hyperpigmentation: a split mouth prospective case series.”

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Abstract

Background: Gingival hyperpigmentation is an aesthetic concern, and minimally invasive techniques such as microneedling may provide an alternative to conventional depigmentation procedures. Curcumin may act as a potential adjunct because of its antioxidant and anti-inflammatory properties. **Aim:** To compare the clinical effect of microneedling alone with microneedling combined with 2% curcumin gel for gingival depigmentation. **Methods:** A split-mouth prospective case series was conducted in 5 participants, involving 10 treatment sites. Five sites received microneedling alone and five received microneedling with 2% curcumin gel. Gingival pigmentation was assessed using the Dummett-Gupta Oral Pigmentation Index (DOPI) at baseline, 1, 4 and 12 weeks. **Results:** DOPI scores decreased from 3.0 at baseline to 1.9 at 12 weeks with microneedling alone and to 1.5 with microneedling combined with 2% curcumin gel. Both approaches showed reduction in pigmentation, with a greater reduction observed in the curcumin group. **Conclusion:** Microneedling demonstrated a clinically evident reduction in gingival hyperpigmentation, while adjunctive 2% curcumin gel showed an additional reduction in DOPI scores. Larger studies with longer follow-up are required to confirm these preliminary findings.

Introduction

Gingival appearance is an important component of smile aesthetics, with gingival colour and contour contributing to overall dental and facial harmony. Physiological gingival pigmentation is primarily caused by melanin produced by melanocytes in the basal layer of the gingival epithelium. Although generally benign, excessive or conspicuous pigmentation, particularly in the anterior region, may be perceived as an aesthetic concern. The intensity and distribution of gingival pigmentation may vary with individual and ethnic characteristics and may also be influenced by factors such as smoking, medications, hormonal influences and systemic conditions.^{1,2}

Gingival depigmentation is a periodontal plastic procedure performed to reduce excessive gingival melanin pigmentation. Various techniques, including scalpel scraping, gingivectomy, bur abrasion, electrosurgery, cryotherapy and laser ablation, have been described.³⁻⁵ Conventional scalpel depigmentation is simple and widely accessible but involves removal of the pigmented epithelium and healing by secondary intention, and may be associated with postoperative pain, bleeding and discomfort. Repigmentation following treatment also remains a potential concern.^{6,7} These considerations have encouraged interest in minimally invasive approaches for the management of gingival pigmentation.

Microneedling produces controlled microperforations in superficial tissues and initiates a wound-healing response. The technique has been extensively investigated in dermatology and regenerative applications because controlled micro-injury can stimulate tissue remodelling and collagen formation.^{8,9} The temporary microchannels created during microneedling may also increase tissue permeability and facilitate penetration of topically applied agents.¹⁰ Its application in gingival depigmentation has recently been investigated. Mostafa and Alotaibi reported successful gingival depigmentation using microneedling followed by topical ascorbic acid, demonstrating the feasibility of this minimally invasive approach.¹¹ Subsequently, a prospective case series reported significant reductions in DOPI and Hedin Melanin Index scores following microneedling with topical ascorbic acid.¹² A randomized controlled clinical study comparing scalpel depigmentation with microneedling and ascorbic acid also reported significant improvement in pigmentation and favourable early wound-healing outcomes with the microneedling approach.¹³

Curcumin, a polyphenolic compound derived from *Curcuma longa*, possesses anti-inflammatory, antioxidant and antimicrobial properties and has been investigated for its potential role in periodontal therapy and tissue healing.^{14,15} The biological effects of curcumin provide a rationale for investigating it as a potential adjunct in minimally invasive periodontal procedures. However, although clinical evidence is emerging for microneedling combined with topical ascorbic acid, evidence specifically evaluating topical curcumin in combination with gingival microneedling remains limited.¹¹⁻¹⁵

Therefore, the present study was undertaken to clinically evaluate and compare the effect of microneedling alone and microneedling combined with **2% curcumin gel** in the management of gingival hyperpigmentation. Clinical pigmentation was assessed using the **Dummet-Gupta Oral Pigmentation Index (DOPI)** at baseline and during follow-up to determine whether adjunctive curcumin provides additional clinical benefit over microneedling alone.¹⁶

Materials and Methods

Clinical assessment

Clinical assessment of gingival pigmentation was performed using the **Dummet Oral Pigmentation Index (DOPI)**. The DOPI was recorded at baseline before treatment and subsequently at 1 week, 4 weeks and 12 weeks after the intervention.

The DOPI was scored according to the degree of visible gingival pigmentation as follows:

score 0 indicated pink gingiva or absence of pigmentation;

score 1 indicated mild/light brown pigmentation;

score 2 indicated medium brown pigmentation; and

score 3 indicated deep brown or blue-black pigmentation.

Treatment protocol

Following clinical evaluation, the selected gingival areas were divided according to the split-mouth treatment allocation into a control site and a test site.



Figure 1 : A Dermapen device and 2 % Curcumin gel were the material used in microneedling technique

Microneedling alone

The control site received microneedling alone. Following administration of local anesthesia using 2% local anesthetic with adrenaline (1:200,000), microneedling was performed using a microneedling pen (Dermapen) equipped with a single-use microneedle cartridge. The needle penetration depth was selected according to the gingival thickness. Dermapen has an adjustable penetration range of 0.2–3 mm. Microneedling was performed for approximately four to five passes until mild erythema and pinpoint microbleeding were clinically evident. The treated area was subsequently irrigated with saline. No

periodontal dressing was placed over the treated site.

Microneedling with 2% curcumin gel

The test site underwent the same microneedling procedure using a microneedling pen and a single-use microneedle cartridge. Following microneedling and saline irrigation, **2% curcumin gel** was applied topically to the treated gingival surface. The gel was allowed to remain in contact with the treated area for 10 minutes. No periodontal dressing was placed following the procedure. Postoperative instructions were provided to the participants.



Figure 2 : Microneedling technique



Figure 3 : Microneedling of Maxillary

anterior region

Figure 4 : Microneedling along with 2% curcumin gel on one side

Follow-up

Participants were recalled for clinical evaluation at 1 week , 4 weeks and 12 weeks following treatment. Gingival pigmentation was assessed at each follow-up visit using the DOPI. The DOPI scores obtained at follow-up were compared with the corresponding baseline scores to assess the clinical change in gingival pigmentation following microneedling alone and microneedling combined with 2% curcumin gel

**Figure 5 :
Preoperative
and
Postoperative
pictures**

**RESULTS**

A total of 5 participants with gingival hyperpigmentation fulfilling the predefined eligibility criteria were included in the study. A split-mouth design was followed, resulting in a total of 10 treatment sites, with 5 sites allocated to the microneedling-alone group (control group) and 5 sites to the microneedling with 2% curcumin gel

group (test group). The study population comprised individuals between 18 and 30 years of age who presented with melanin-based gingival pigmentation and fulfilled the inclusion and exclusion criteria.

Gingival pigmentation was evaluated using the Dummet Oral Pigmentation Index

(DOPI) at baseline, 1 week, and 4 weeks, 12 weeks following treatment. The DOPI was recorded on a four-point ordinal scale, ranging from score 0, indicating pink gingiva or absence of pigmentation, to score 3, indicating deep brown to blue-black pigmentation.

DOPI findings

At baseline, the DOPI scores of the selected sites were recorded before commencement of the depigmentation procedures. The baseline DOPI scores were **3.0** in the microneedling-alone group and **3.0** in the microneedling with 2% curcumin gel group.

At 1-week follow-up, a reduction in gingival pigmentation was observed in both treatment groups. The mean/median DOPI score was **2.4** in the microneedling-alone group and **2.1** in the microneedling with 2% curcumin gel group. The change from baseline was comparable ranging from 0.6 to 0.9. At 4-week follow-up, further changes in gingival pigmentation were observed. The DOPI score was **1.8** in the

microneedling-alone group and **1.3** in the microneedling with 2% curcumin gel group.

At 12-week follow-up, further changes in gingival pigmentation were observed. The DOPI score was **1.9** in the microneedling-alone group and **1.5** in the microneedling with 2% curcumin gel group, which is slightly raised than 4 weeks because of physiologic melanin pigmentation. The overall reduction in pigmentation from baseline to 12 weeks was **1.1** for the microneedling-alone group and **1.5** for the microneedling with curcumin group.

On intergroup comparison, the difference in DOPI scores between microneedling alone and microneedling combined with 2% curcumin gel at 4 weeks and 12 weeks was 0.5 and 0.4 respectively. Overall, both treatment approaches demonstrated a **reduction** in gingival pigmentation during the 12-week observation period. The addition of 2% curcumin gel demonstrated **greater** reduction in DOPI scores compared with microneedling alone.

Table 1. DOPI scores at baseline, 1 week, 4 weeks and 12 weeks

Time point	Microneedling alone	Microneedling + 2% curcumin gel
Baseline	3.0	3.0
1 week	2.4	2.1
4 weeks	1.8	1.3
12 weeks	1.9	1.5

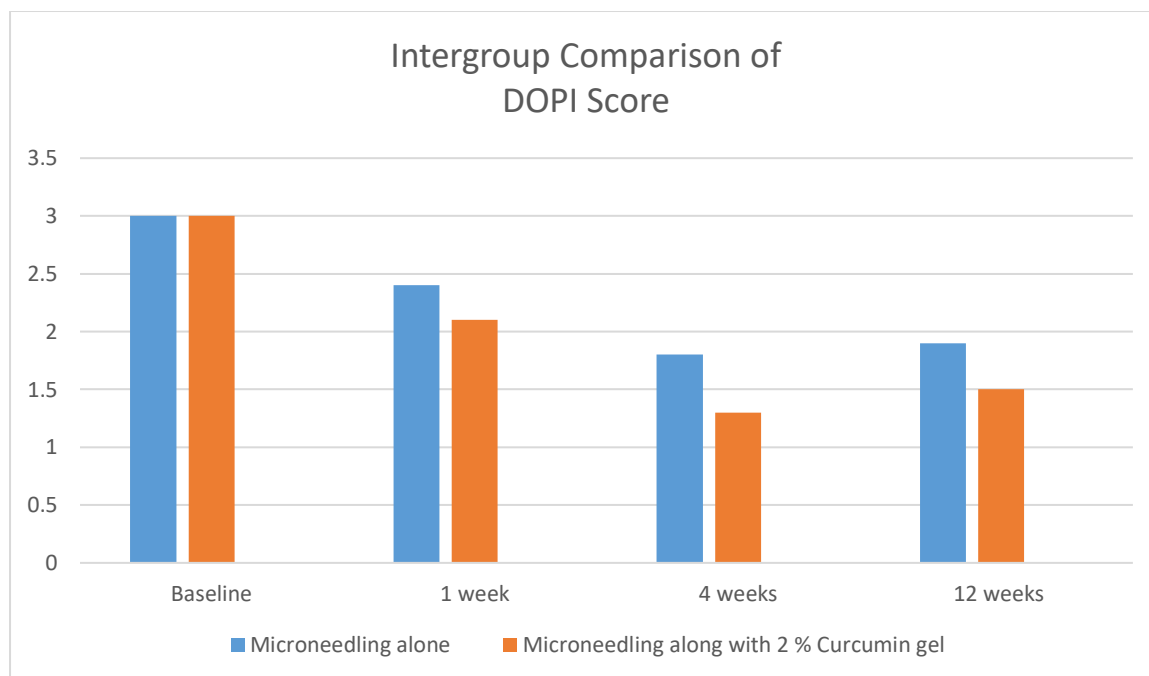


Chart 1: Intergroup comparison of DOPI score between microneedling alone and microneedling along with 2% curcumin gel

Because the present study included only 5 participants and 10 sites, the findings should be interpreted as preliminary clinical observations. Statistical analysis should account for the split-mouth nature of the design and should avoid treating individual sites as independent observations when the participant is the experimental unit.

DISCUSSION

Gingival hyperpigmentation is primarily associated with increased melanin deposition and may represent a significant aesthetic concern, particularly when it involves the anterior gingiva. Although physiologic gingival pigmentation does not generally require treatment from a functional standpoint, depigmentation procedures may be undertaken when the patient has an aesthetic concern.^{1–3} The present study was designed to clinically evaluate microneedling as a minimally invasive approach for gingival depigmentation and to assess whether the addition of 2% curcumin gel could provide an additional clinical benefit.

The principal finding of the present study was a greater reduction in DOPI index observed with **microneedling with 2% curcumin gel**. Both treatment sites underwent microneedling, while the test sites additionally received topical application of 2% curcumin gel following the procedure. The outcome was assessed using the DOPI at baseline, 1 week, 4 weeks and 12 weeks. This approach allowed the early clinical response following depigmentation to be assessed in a split-mouth manner.

Microneedling is a minimally invasive technique in which multiple fine needles create controlled micro-injuries within the tissue. The procedure induces a wound-healing response and has been extensively investigated for collagen induction and tissue remodelling.^{8,9} The principle of controlled micro-injury provides a biological basis for its application in gingival depigmentation. The creation of transient microchannels may additionally facilitate penetration of topical substances applied immediately following the procedure.¹⁰ In the present study, a microneedling pen was used with

penetration depth adjusted according to gingival thickness. Multiple passes were performed until mild erythema and microbleeding were observed, followed by saline irrigation.

The clinical response observed with microneedling in the present study can be compared with the findings of Mostafa and Alotaibi (2022), who reported successful gingival depigmentation using a microneedling technique combined with topical ascorbic acid.¹¹ Their case report demonstrated improvement in gingival colour following treatment and supported microneedling as a minimally invasive approach for management of gingival pigmentation. Subsequently, Mostafa et al. reported a prospective case series in which microneedling followed by topical ascorbic acid resulted in noticeable improvement in gingival pigmentation, with significant reductions in DOPI scores after treatment.¹² These findings provide clinical support for the use of microneedling as a minimally invasive depigmentation modality.

The findings of the present study may also be compared with the randomized controlled study by P and Subasree, which evaluated scalpel depigmentation versus microneedling with ascorbic acid.¹³ The study reported reductions in pigmentation with both approaches, while the microneedling group demonstrated favourable early wound-healing findings.¹³ Although the topical agent used in that study was ascorbic acid rather than curcumin, the findings support the concept of combining controlled microneedling with a topical biologically active agent. More recently, a randomized clinical trial comparing microneedling with ascorbic acid and scalpel depigmentation demonstrated significant pigmentation reduction with both approaches, while also emphasizing the need for longer follow-up because repigmentation may occur after treatment.¹⁷

An important aspect of the present study was the addition of 2% curcumin gel to the microneedling procedure. Curcumin, the principal bioactive component of turmeric, has been investigated for its anti-inflammatory, antioxidant and antimicrobial properties.^{14,15} Molayem reviewed the available evidence regarding the use of curcumin in modern periodontology and described its potential anti-inflammatory, antimicrobial, antioxidant and tissue-regenerative effects.¹⁴ Similarly, Li et al. reviewed experimental evidence concerning curcumin and its possible mechanisms in periodontal therapy.¹⁵ These biological properties provide a rationale for investigating curcumin as an adjunct to procedures involving controlled tissue injury.

The application of curcumin immediately after microneedling may have particular relevance because the procedure creates controlled microchannels and superficial tissue injury. In the present protocol, following microneedling and saline irrigation, curcumin gel was topically applied to the treated gingiva for 10 minutes. No periodontal dressing was placed over the treated area. The temporary microchannels produced by microneedling may facilitate local delivery of topical substances.¹⁰ However, whether topical curcumin provides an additional depigmenting effect over microneedling alone cannot be established definitively from the present study because of the very small sample size and limited follow-up.

The DOPI was selected as the clinical outcome measure because it provides an ordinal assessment of gingival pigmentation. The Dummet-Gupta Oral Pigmentation Index has been used in clinical studies to categorize the intensity of gingival pigmentation.¹⁶ The index provides a practical clinical method for documenting changes in pigmentation following depigmentation procedures. In

the present study, DOPI was recorded at baseline and at 1-, 4- and 12-week follow-up visits, allowing the short-term change in pigmentation to be documented.

The findings of the present study should also be considered in relation to previous depigmentation approaches. Conventional methods such as scalpel depigmentation, bur abrasion, electrosurgery, cryotherapy and laser therapy have all been described for the management of gingival melanin pigmentation.³⁻⁷ A systematic review by Lin et al. evaluated several treatment modalities, including bur abrasion, scalpel surgery, cryosurgery, electrosurgery, gingival grafting and laser techniques, and demonstrated that repigmentation rates vary according to the treatment modality and follow-up period.⁶ Therefore, the development of minimally invasive approaches such as microneedling represents a continuing area of interest in aesthetic periodontal therapy.

The findings of the present study may also be interpreted alongside the work of Mostafa and Alotaibi (2022), who reported successful gingival depigmentation using microneedling with topical vitamin C.¹¹ Although vitamin C and curcumin have different biological mechanisms, both have been investigated as adjunctive agents in minimally invasive approaches.¹¹⁻¹⁵ Therefore, the present investigation extends the concept of adjunctive topical therapy by evaluating 2% curcumin in combination with microneedling. Nevertheless, direct comparison between the present findings and previous vitamin C studies should be made cautiously because of differences in study design, sample size, treatment protocol, topical agent and follow-up duration.

The clinical response observed at the 1-week, 4-week and 12-week follow-up visits should, however, be interpreted cautiously. Repigmentation following gingival depigmentation is a recognized clinical

concern and may occur because melanocytes can repopulate previously treated areas.^{6,7} Previous literature has demonstrated variable intervals for repigmentation depending on the depigmentation technique and duration of follow-up.^{6,7} More recent clinical studies have also documented repigmentation during longer follow-up periods after minimally invasive depigmentation procedures.¹⁷ Therefore, the absence of repigmentation during the present 12-week observation period, if observed, cannot be interpreted as evidence of long-term stability.

Clinical significance

The potential clinical significance of the present approach lies in its minimally invasive nature. Microneedling requires relatively limited tissue manipulation compared with conventional surgical depigmentation, while the addition of a topical agent such as curcumin provides a potential biological adjunct. Previous clinical studies have demonstrated that microneedling with topical ascorbic acid can produce clinically evident reductions in gingival pigmentation.¹¹⁻¹³ The present study extends this concept by investigating 2% curcumin as the adjunctive topical agent.

If the observed reduction in DOPI is maintained and demonstrated consistently in larger studies, this approach may represent an additional minimally invasive option for patients seeking management of gingival hyperpigmentation. However, the present findings should be regarded as preliminary because of the small number of participants and short follow-up.

Limitations

The major limitation of the present study is the very small sample size of 5 participants and 10 treatment sites. Consequently, the findings cannot be generalized to the

broader population. In addition, the follow-up period was limited to 12 weeks, which does not permit assessment of long-term stability or recurrence of pigmentation. This limitation is particularly relevant because repigmentation following gingival depigmentation may become evident over longer observation periods.^{6,7}

Furthermore, the present study evaluates only the short-term clinical effect of 2% curcumin as an adjunct to microneedling. The split-mouth design permits comparison within the same participant but does not eliminate the limitations associated with the small sample size. Larger randomized controlled trials with longer follow-up, standardized photographic assessment and additional objective pigmentation measurements would be required to establish the long-term efficacy, stability and reproducibility of this technique.

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