

ORIGINAL ARTICLE

Delphi consensus on melasma management by international experts and pigmentary disorders society

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Abstract

Background: Melasma, an acquired hyperpigmentation disorder, affects individuals of all ethnicities. Its multifactorial aetiology, high recurrence rates and psychosocial impact complicate management and necessitate comprehensive, evidence-based recommendations.

Objectives: The objective was to develop an international consensus on the diagnosis and management of melasma by synthesizing expert opinions and the latest scientific evidence.

Methods:

INTRODUCTION

Melasma is an acquired disorder of hyperpigmentation that affects individuals across all ethnicities, although its prevalence is particularly pronounced in darker skin types and photoexposed populations.¹ While the condition can occur

METHODS

This study was conducted to develop international consensus-based recommendations for managing melasma, focusing on recent advancements in the field. A modified Delphi approach was employed. [Figure 1](#) shows an overview of the workflow. While this study was not prospectively registered, it adhered to a transparent process in alignment with established consensus development practices.

The Core Group and selection of members for voting

The core group comprised two senior members from the PDS with extensive experience in dermatology and melasma research. Their responsibilities included designing, moderating and overseeing the consensus process. A diverse panel of 20 members from PDS, along with 18 international dermatology experts (38 total) from various clinical and geographic backgrounds, was invited to participate in the process ([Table S1](#)). These experts were selected based on their contributions to melasma research, clinical experience, and publications on this topic of interest. The core group did not participate in the voting to avoid potential bias.

Literature search

A search of the PubMed database was conducted to identify relevant studies published between 2014 and 2024.

included structured queries related to melasma management, diagnosis, and treatment ([Table S2](#)). Studies were screened based on methodological rigor, publication type (RCTs), systematic reviews, and the level of evidence. The literature search was performed by two independent reviewers.

Review and consensus building

The core group and the panel of experts reviewed the identified studies and discussed the findings. Consensus was built through iterative discussions and voting.

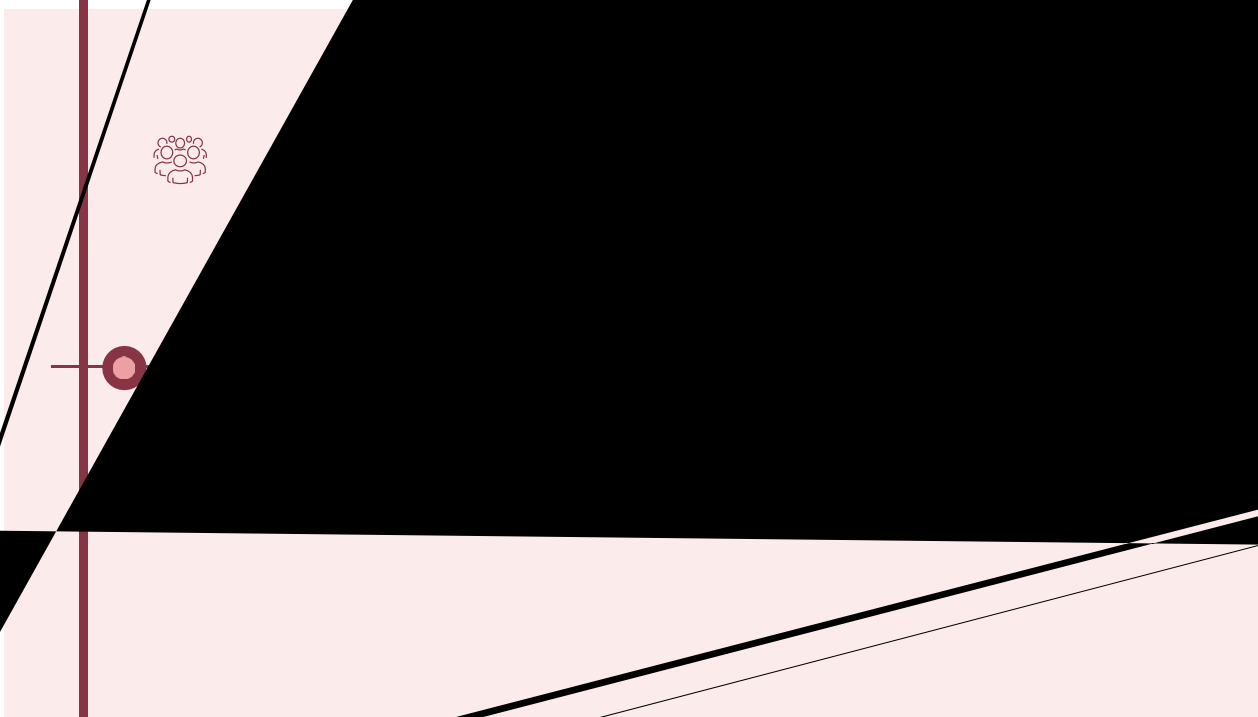


FIGURE 1 Overview of the workflow for the consensus-building process.

and low agreement (<55%). Statements were retained, revised or removed based on feedback. Consensus statements that did not receive high or moderate agreement and had a substantial number of 'neither agree nor disagree' responses were identified as areas where evidence remains inconclusive, highlighting the need for further research. The study materials and survey instruments were designed to be clear and focused. Separate piloting prior to dissemination was not conducted.

Consensus development process

The consensus development process followed a modified Delphi methodology involving voting and discussions. The first round involved voting on the initial set of consensus statements. A virtual meeting was then convened to discuss

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TABLE 1 Finalized consensus statements.

Sl. no.	Finalized consensus statement	Level of evidence	Finalized in round	Final level of consensus
Diagnostic and monitoring tools				
1	Wood's lamp remains a favoured method for determining the extent and severity of melasma	5	3	High
2	Dermoscopic examination is an accepted non-invasive tool that can facilitate the differential diagnosis of melasma from similar conditions	2b, 5	2	High
3	Treatment monitoring with reflectance confocal microscopy enables the objectification of pigment variations after treatment and the identification of prognostic factors for different treatment modalities	2a	2	Moderate
4	Occasionally, melasma may appear like another hyperpigmentary condition. In such cases, a skin biopsy with histopathological examination is needed to confirm the diagnosis	5	1	High
Photoprotection				
5	The characteristics of an ideal sunscreen should include broad-spectrum coverage with protection against UVA, UVB and visible light, an optimal sun protection factor and cosmetic acceptability	4, 5	3	High
6	The addition of active ingredients such as antioxidants, depigmenting and moisturizing agents to sunscreen can increase its efficacy in managing melasma and enhance the skin's tolerability to topical treatments	5	2	Moderate
Topical agents				
7	Triple combination therapy (hydroquinone, tretinoin and fluocinolone acetonide) is the gold standard for the management of melasma and may be used as a first-line option	1b, 1a	2	High
8	Unsupervised use of triple combination therapy is not recommended, and proper precaution should be used	5, 5	2	High
9	The duration of intensive daily treatment with triple combination cream (TCC) can be up to 12 weeks. However, treatment variations may be patient-dependent	2b	2	High
10	The twice-weekly regimen of triple combination cream is effective for melasma and can be followed by tapering to other topical agents after the initial period of treatment	1b	1	High
11	Azelaic acid can serve as an effective treatment option for melasma patients with concerns about the adverse effects of hydroquinone	1a	1	High
12	Antioxidants such as topical vitamin C can be beneficial in managing melasma	1a	1	High
13	Combinations with ingredients such as kojic acid, arbutin, vitamin E and other botanical ingredients may be used as additional options	2b	3	High
Oral agents				
14	Oral tranexamic acid is effective in the management of melasma	2b, 5	3	High
15	Oral antioxidants, in combination with other appropriate treatment modalities, can serve as an option for the management of melasma	1b, 2b, 4	3	High
Chemical peels				
16	Glycolic acid is the most studied peel and shows superior outcomes compared to others. Other options include salicylic acid peels, retinoic acid peels, trichloroacetic acid (TCA) peels (low concentration) and Jessner's peels	2a	2	High
17	Glycolic acid and salicylic-mandelic acid peels have comparable efficacy and are well tolerated	1b	2	Moderate
18	Some of the refractory melasma can be treated by using a combination of a depigmenting agent (4% hydroquinone/TCC) and a peeling agent	4, 1b, 1b	1	High
19	Combination peels may be used as an additional option for the treatment and maintenance of melasma	2b	2	High
Energy-based devices and procedural treatments				
20	A low-fluence Q-switched Nd:YAG laser can be a suitable option for refractory cases of melasma	2a, 5	2	High
21	Vascular abnormalities have been implicated in melasma. There is promising evidence supporting the use of tranexamic acid and laser/light therapies to target the vascular component of melasma	2a	2	High

in melasma include inappropriate activation of melanocytes, aggregation of melanin and melanosomes in both the dermis and epidermis, increased mast cell count and solar elastosis, altered basement membrane integrity and increased vascularization.² Understanding these pathophysiological mechanisms is critical for selecting appropriate treatment modalities.

radiation are significant contributors to its pathogenesis.¹³ However, poor adherence to photoprotection, more so among high-risk groups, remains a challenge.^{13,14}

Cosmetic elegance and tone compatibility have been indicated as important considerations for sunscreen -9.1 (en -2-6.7(t)-2

Diagnosis and monitoring (Statements 1–4 in Table 1)

The diagnosis of melasma can be challenging due to its clinical resemblance to other hyperpigmentation disorders. The panel agreed that Wood's lamp remains a favoured method for determining the extent and severity of melasma, but the constraints in accurately determining melanin depth may limit its use.⁸ Although the utility of dermoscopy in the determination of depth has been contested, the expert panel felt that it is an accepted and non-invasive tool that can facilitate the differential diagnosis.^{9,10} Though some authors suggest considering the intradermal component of melasma during diagnosis and treatment planning,¹¹ the panel discussion highlighted that therapeutic choice depends not so much on the depth as on the severity of melasma. The limited availability of reflectance confocal microscopy outside of research establishments was pointed out. However, its utility, when available, was acknowledged. A skin biopsy may be needed to confirm melasma in cases with close differential diagnosis. Histopathological findings typically show epidermal hyperpigmentation with hypertrophied melanocytes, increased melanin and mature melanosomes. The dermis can exhibit melanin-laden macrophages along with mononuclear infiltrates, increased vascularity, mast cells and elastosis.¹²

Treatment

Photoprotection (Statements 5, 6 in Table 1)

Photoprotection remains the cornerstone of melasma management, as high-energy visible light and ultraviolet

(TCCs). It is often combined with other agents to enhance efficacy but requires close supervision due to rare yet significant risks like exogenous ochronosis. Hydroquinone can be applied evenly over the affected areas and used concurrently with sunscreen to protect from damaging UV light, which increases pigmentation. If there are no results after 3 months, hydroquinone should be discontinued. It is prudent to stop hydroquinone-containing creams for a few months before restarting to decrease the risk of side effects. It can also be used during weekends only or three times a week for more extended maintenance therapy with minimal complications. TCC, incorporating hydroquinone (4%), tretinoin (0.05%) and fluocinolone acetonide (0.01%), is regarded as the gold standard for melasma treatment and remains a first-line therapy. Although 4% is the standard, the use of TCC with a lower concentration of hydroquinone (2%) has also been reported. TCC formulations using different corticosteroids have shown efficacy. However, it has been indicated that fluorinated steroids (e.g., fluocinolone acetonide) are more effective and safer than non-fluorinated steroids.²⁷ TCC containing fluocinolone acetonide 0.01% has been shown to be as effective as mometasone furoate 0.1% with fewer side effects.²⁸ Treatment typically lasts up to 12 weeks, followed by a maintenance regimen, though the duration may vary. A twice-weekly regimen after intensive treatment and tapering to other topicals was suggested.²⁹ The expert panel emphasized that the TCC should only be used under clinical supervision, and proper precautions should be taken. Although TCC is recommended as first-line treatment, the expert panel agreed on azelaic acid as an option for those with concerns about adverse effects. Azelaic acid exhibits anti-inflammatory properties, making it a promising alternative to treatments that primarily target melanin production without addressing inflammation.³⁰ Azelaic acid-containing creams at concentrations of 15%–20%, twice daily for 6 months, have been recommended.³¹ There was high consensus on the use of topical antioxidants, such as vitamin C, for melasma management. The benefits of topical vitamin C in the management of melasma and photoaging have been reported.³² Such a dual role is noteworthy in light of evidence on pathophysiology suggesting melasma as a photoaging disorder.³³ For reasonable results, it has been suggested that a vitamin C concentration higher than 8% is required. Concentrations above 21 (s)-6.0 (a)-13%2.72otn 6.7 (c)-9.6 (en)15 (e)-9.8 (a)-16.8 (s)-8.4 (o)74 ()]TJ0.032 Tc20 -1

Chemical peels (Statements 16–19 in Table 1)

Chemical peels increase epidermal exfoliation and also target the dermal component of melasma by inducing phagocytosis of melanin granules. The expert panel agreed that, among other peels, glycolic acid is the most studied and shows superior outcomes.⁵² This recommendation augments the previous Latin American consensus, which suggests a lack of clear evidence of superiority, but is in line with the Chinese consensus that supports the effectiveness of alpha hydroxy acid peels.^{31,40} Serial glycolic acid peels enhance the efficacy of the topical regimen with a more rapid initial response and overall lightening of the skin.

In trials, glycolic acid has most commonly been used at 30%–50% concentrations, with higher strengths (up to 70%) also reported.^{53–56} Higher concentrations may be suited for spot peels only under expert supervision. The utility of other options, such as salicylic acid (20%–30%),⁵⁴ retinoic acid (1%–10%),^{57,58} trichloroacetic acid (low concentration of 10%–35%)⁵⁹ and Jessner's peels, was also acknowledged. Combining depigmenting agents such as 4% hydroquinone or TCC with chemical peels can enhance treatment outcomes for refractory melasma. Chemical peels promote controlled exfoliation, facilitating deeper penetration of topical agents and improving skin texture.^{60,61} However, it has been recommended that medium-depth peels should be avoided.³¹ The panel was also in favour of combination peels as an additional option for the treatment and maintenance of melasma. The agreement was moderate regarding whether glycolic acid and salicylic–mandelic acid peels have comparable efficacy. Some evidence reports that glycolic acid and salicylic–mandelic acid (20% salicylic/10% mandelic acid) peels are equally effective and provide better outcomes than phytic acid combination peels.⁶² However, the scarcity of studies with head-to-head comparisons of different peels was pointed out.

Laser or energy-based devices and procedural treatments (Statements 20–24 in Table 1)

Laser treatment of melasma is at best a third-line therapy. Q-switched Nd:YAG laser (1064 nm) in toning mode is preferred for its selective melanin targeting with minimal complications.^{63,64} Laser or energy-based devices, including Q-switched Nd:YAG lasers, picosecond lasers, intense pulsed light (IPL), pulsed dye laser (PDL) and radiofrequency, show efficacy but carry risks of relapse and adverse effects.⁶ Though effective, the panel expressed that laser therapies require careful patient selection and are best reserved for refractory cases.^{63–66} The expert consensus emphasized laser therapy as an adjunct rather than monotherapy, supported by meta-analysis data.⁶⁵ The potential of lasers to improve the delivery of topical agents to the target site has been reported.^{65,67} There was high consensus that TA can be combined with laser/light therapies to treat the vascular component of melasma.⁶⁸

Microneedling improves transcutaneous drug delivery and can be considered a step-up option before invasive

procedures.⁶⁹ The discussion highlighted that microneedling promotes collagen production and remodelling of the dermal matrix and can serve as an additional procedural option. Evidence from an RCT suggests that both microneedling and TA improve the performance of TCC, with microneedling providing sustained remission.⁷⁰ Studies have shown that microneedling with 5% TA is effective.⁴⁵ The findings from a systematic review and meta-analysis also suggest that among various routes of TA delivery, intradermal injection and microneedling can be effective alternatives for melasma treatment.⁷¹ However, the expert panel expressed the need for more studies confirming improvements in transcutaneous drug delivery, and the statement reached a moderate consensus. Several studies and RCTs suggest that 4

include glutathione in this consensus, but clinicians should be prepared to counsel patients on its uncertain effectiveness and IV-related safety concerns.

Adjunct therapies and skincare (Statement 26 in Table 1)

Cosmeceuticals enriched with bio-actives, plant extracts, and hydrating agents can improve tolerability and compliance.^{22,83} Skin care products often contain ingredients that help repair the skin barrier, which is crucial as impairment of the skin barrier can exacerbate melasma. When combined with treatments such as chemical peels or lasers, they can enhance efficacy and patient satisfaction. Moisturizers help restore the compromised skin barrier in melasma. While transdermal epidermal water loss in melasma lesions is similar to the surrounding skin, the barrier recovery rate in lesional skin is significantly slower, leading to reduced moisturizing capabilities and forming a vicious cycle.



management of melasma, drawing on the latest evidence and expert opinions. By integrating these guidelines, dermatologists can optimize outcomes and improve patients' quality of life. A simplified algorithm summarizing the outcomes from the panel discussion is presented in [Figure 3](#). Future research is needed to validate therapies and reduce recurrence.

AUTHOR CONTRIBUTIONS

All authors made substantial contributions to the conception or design of the work and participated in the critical review and editing of the manuscript for important intellectual content. Additionally, data curation and formal analysis were conducted by Dr. Rashmi Sarkar and Dr. Seemal R. Desai. All authors approved the final version of the manuscript to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are properly investigated and resolved.

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DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

ETHICAL APPROVAL

No ethical approval was required because this Delphi-based study involved only expert opinions via questionnaire rounds. No patient data, human biological samples or clinical interventions were involved.

ETHICS STATEMENT

All participants were informed about the study's purpose and provided consent prior to initiating the Delphi process. All panellists received an email invitation and completed the questionnaire only after providing informed consent via a consent statement embedded at the beginning of the survey. In surveying professional experts, no personal or sensitive data were collected.

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14. Agarwal SB, Godse K, Patil S, Nadkarni N. Knowledge and attitude of general population toward effects of sun exposure and use of sunscreens. *Indian J Dermatol*. 2018;63(4):285–91.
15. Song H, Beckles A, Salián P, Porter ML. Sunscreen recommendations for patients with skin of color in the popular press and in the dermatology clinic. *Int J Womens Dermatol*. 2021;7(2):165–70.
16. Zhou C, Lee C, Salas J, Luke J. Guide to tinted sunscreens in skin of color. *Int J Dermatol*. 2024;63(3):272–6.
17. Schneider SL, Lim HW. A review of inorganic UV filters zinc oxide and titanium dioxide. *Photodermatol Photoimmunol Photomed*. 2019;35(6):442–6.
18. Seit  S, Deshayes P, Dr no B, Misery L, Reygagne P, Saiag P, et al. Interest of corrective makeup in the management of melasma. *J Cosmet Dermatol*. 2012;5:123–8.
19. Brown A, Passeron T, Granger C, Gilaberte Y, Trullas C, Piquero-Casals J, et al. An evidence-driven classification of non-filtering ingredients for topical photoprotection. *Br J Dermatol*. 2025;192(6):1132–4.
20. Lim HW, Kohli I, Ruvolo E, Kolbe L, Hamzavi IH. Impact of visible light on skin health: the role of antioxidants and free radical quenchers in skin protection. *J Am Acad Dermatol*. 2022;86(3S):S27–S37.
21. Passeron T, Lim HW, Goh CL, Kang HY, Ly F, Morita A, et al. Photoprotection according to skin phototype and dermatoses: practical recommendations from an expert panel. *J Eur Acad Dermatol Venereol*. 2021;35(7):1460–9.
22. Lee DJ, Lee J, Ha J, Park KC, Ortonne JP, Kang HY. Defective barrier function in melasma skin. *J Eur Acad Dermatol Venereol*. 2012;26(12):1533–7.
23. Wang Y, Zhao J, Jiang L, Mu Y. The application of skin care product in melasma treatment. *Clin Cosmet Investig Dermatol*. 2021;14:1165–71.
24. Bronzina E, Clement A, Marie B, Fook Chong KT, Faure P, Passeron T. Efficacy and tolerability on melasma of a topical cosmetic product acting on melanocytes, fibroblasts and endothelial cells: a randomized comparative trial against 4% hydroquinone. *J Eur Acad Dermatol Venereol*. 2020;34(4):897–903.
25. Schwartz C, Jan A, Zito PM. Hydroquinone. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK539693/> (last accessed 29 January 2025).
26. Bhattar PA, Zawar VP, Godse KV, Patil SP, Nadkarni NJ, Gautam MM. Exogenous ochronosis. *Indian J Dermatol*. 2015;60(6):537–43.
27. Shankar K, Godse K, Aurangabadkar S, Lahiri K, Mysore V, Ganjoo A, et al. Evidence-based treatment for melasma: expert opinion and a review. *Dermatol Ther (Heidelb)*. 2014;4(2):165–86.
28. Vadukul DP, Rathwa M, Varu DP, Apurva P, Sunidhi RG, Nipul VV, et al. Comparison of effectiveness and ADR profile of topical triple combination preparation containing fluocinolone acetonide 0.01% versus mometasone furoate 0.1% in treatment of melasma – a split face study. *Eur J Cardiovasc Med*. 2024;14(5):115–9.
29. Grimes PE, Bhawan J, Guevara IL, Col n LE, Johnson LA, Gottschalk RW, et al. Continuous therapy followed by a maintenance therapy regimen with a triple combination cream for melasma. *J Am Acad Dermatol*. 2010;62(6):962–7.
30. Albzeia W, AlRashidi R, Alkandari D, Sadan M, Alkandari A, Alkanderi JJ, et al. Azelaic acid versus hydroquinone for managing patients with melasma: systematic review and meta-analysis of randomized controlled trials. *Cureus*. 2023;15(7):e41796.
31. Gao TW, Gu H, He L, Lei TC, Li M, Li TN, et al. Consensus on the diagnosis and treatment of melasma in China (2021 version)#. *Int J Dermatol Venereol*. 2021;4(3):133–9.
32. Correia G, Magina S. Efficacy of topical vitamin C in melasma and phototoaging: a systematic review. *J Cosmet Dermatol*. 2023;22(7):1938–45.
33. Passeron T, Picardo M. Melasma, a photoaging disorder. *Pigment Cell Melanoma Res*. 2018;31(4):461–5.
34. Al-Niaimi F, Chiang NYZ. Topical vitamin C and the skin: mechanisms of action and clinical applications. *J Clin Aesthet Dermatol*. 2017;10(7):14–7.
35. Desai S, Chan L, Handog E, Djojoseputro L, Lim J, Ling R, et al. Optimizing melasma management with topical tranexamic acid: an expert consensus. *J Drugs Dermatol*. 2023;22(4):386–92.
36. Zhang L, Tan WQ, Fang QQ, Zhao WY, Zhao QM, Gao J, et al. Tranexamic acid for adults with melasma: a systematic review and meta-analysis. *Biomed Res Int*. 2018;2018:1683414.
37. Ferra OM, Marlyn GK, Herry EJP, Alexandro IC, Lidya T, Joan AT, et al. Comparative efficacy of topical 10% versus 5% tranexamic acid in treatment of women with melasma: a double-blind randomized controlled trial. *Universa Med*. 2024;43(2):213–9.
38. Konisky H, Balazic E, Jaller JA, Khanna U, Kobets K. Tranexamic acid in melasma: a focused review on drug administration routes. *J Cosmet Dermatol*. 2023;22:1197–206.
39. Saka S, Rao GRR, Komaram RB, Kotha S, Tatavarthi R, Chitturi LP. Efficacy of 10% 699 topical tranexamic acid in melasma – A randomized controlled trial. *J Cosmet Dermatol*. 2023;22:1197–206.

56. Kadu PP, Laul RA. 80% lactic acid peel versus 50% glycolic acid peel for melasma: a randomised clinical trial. *Indian J Dermatol*. 2025;70(3):152–6.
57. de Andrade ACDV, Coqueiro RDS, Python MM, Leite MF. Peeling with retinoic acid in microemulsion for treatment of melasma: a double-blind randomized controlled clinical study. *J Cosmet Dermatol*. 2024;23(2):479–85.
58. Khunger N, Sarkar R, Jain RK. Tretinoin peels versus glycolic acid peels in the treatment of melasma in dark-skinned patients. *Dermatol Surg*. 2004;30(5):756–60.
59. Sarkar R, Bansal S, Garg VK. Chemical peels for melasma in dark-skinned patients. *J Cutan Aesthet Surg*. 2012;5(4):247–53.
60. Mashiko T, Oka A, Osawa E, Koshima I. A deceptively simple solution for refractory melasma: glycolic acid peels and hydroquinone at home. *Plast Reconstr Surg Glob Open*. 2017;5(5):e1335.
61. Sarkar R, Kaur C, Bhalla M, Kanwar AJ. The combination of glycolic acid peels with a topical regimen in the treatment of melasma in dark-skinned patients: a comparative study. *Dermatol Surg*. 2002;28(9):828–32.
62. Sarkar R, Garg V, Bansal S, Sethi S, Gupta C. Comparative evaluation of efficacy and tolerability of glycolic acid, salicylic mandelic acid, and phytic acid combination peels in melasma. *Dermatol Surg*. 2016;42(3):384–91.
63. Cassiano DP, Espósito ACC, da Silva CN, Lima PB, Dias JAF, Hassun K, et al. Update on melasma—part II: treatment. *Dermatol Ther (Heidelb)*. 2022;12(9):1989–2012.
64. Shah SD, Aurangabadkar SJ. Laser toning in melasma. *J Cutan Aesthet Surg*. 2019;12(2):76–84.
65. Ma W, Gao Q, Liu J, Zhong X, Xu T, Wu Q, et al. Efficacy and safety of laser-related therapy for melasma: a systematic review and network meta-analysis. *J Cosmet Dermatol*. 2023;22(11):2910–24.
66. Sarkar R, Aurangabadkar S, Salim T, Das A, Shah S, Majid I, et al. Lasers in melasma: a review with consensus recommendations by Indian pigmentary expert group. *Indian J Dermatol*. 2017;62(6):585–90.
67. Park SJ, Park JW, Seo SJ, Park KY. Evaluating the tolerance and efficacy of laser-assisted delivery of tranexamic acid, niacinamide, and kojic acid for melasma: a single center, prospective, split-face trial. *Dermatol Ther*. 2022;35(3):e15287.
68. Masub N, Nguyen JK, Austin E, Jagdeo J. The vascular component of melasma: a systematic review of laboratory, diagnostic, and therapeutic evidence. *Dermatol Surg*. 2020;46(12):1642–50.
69. Bailey AJM, Li HO-Y, Tan MG, Cheng W, Dover JS. Microneedling as an adjuvant to topical therapies for melasma: a systematic review and meta-analysis. *J Am Acad Dermatol*. 2022;86(4):797–810.
70. Cassiano D, Esposito ACC, Hassun K, Bagatin E, Lima MMDA, Lima EVA, et al. Efficacy and safety of microneedling and oral tranexamic acid in the treatment of facial melasma in women: an open, evaluator-blinded, randomized clinical trial. *J Am Acad Dermatol*. 2020;83(4):1176–8.
71. Chen LY, Kang YN, Hoang KD, Chen KH, Chen C. Intradermal injection of tranexamic acid for the treatment of adult melasma: a systematic review and meta-analysis of randomized controlled trials. *Facial Plast Surg Aesthet Med*. 2025;27(4):305–12.
72. Lueangarun S, Sirithanabadeekul P, Wongwicharn P, Namboonlue C, Pacharakornpong S, Juntongjin P, et al. Intradermal tranexamic acid injection for the treatment of melasma: a pilot study with 48-week follow-up. *J Clin Aesthet Dermatol*. 2020;13(8):36–9.
73. Alshammari NM, Almustaafa ZZ, AlBaqshi HN, Abu Jawhar Z. Efficacy and safety of platelet-rich plasma in melasma: a systematic review. *Cureus*. 2024;16(7):e63746.
74. Bikash C, Sarkar R, Relhan V, Singh S. Role of platelet-rich plasma therapy as an adjuvant in treatment of melasma. *Dermatol Surg*. 2022;48(4):429–34.
75. Bertold C, Fontas E, Singh T, Gastaut N, Ruitort S, Wehrle Pugliese S, et al. Efficacy and safety of a novel triple combination cream compared to Kligman's trio for melasma: a 24-week double-blind prospective randomized controlled trial. *J Eur Acad Dermatol Venereol*. 2023;37(12):2601–7.
76. Lima PB, Dias JAF, Cassiano D, Esposito ACC, Bagatin E, Miot LDB, et al. A comparative study of topical 5% cysteamine versus 4% hydroquinone in the treatment of facial melasma in women. *Int J Dermatol*. 2020;59(12):1531–6.
77. Grimes PE, Bhawan J, Howell MD, Desai S, Coryell E, Nashawati R, et al. A novel proof-of-concept study assessing the lightening effects and safety of malassezin for treatment of facial hyperpigmentation. *J Am Acad Dermatol*. 2022;87(2):456–8.
78. AboAlsoud ES, Eldahshan RM, AbouKhodair Mohammed H, Mohammed H, Elsaie ML. Safety and efficacy of topical metformin 30% cream versus triple combination cream (Kligman's formula) in treating melasma: a randomized controlled study. *J Cosmet Dermatol*. 2022;21(6):2508–15.
79. de Dormael R, Sextius P, Bourokba N, Mainguene E, Tachon R, Gaurav K, et al. 2-Mercaptopyridine glycine prevents UV-induced skin darkening and delayed tanning in healthy subjects: a randomized controlled clinical study. *J Cosmet Dermatol*. 2024;23(5):1745–52.
80. Sarkar R, Sahu A, Mendiratta V, Langar S. Thiamidol in melasma in patients of skin of color: a preliminary report of efficacy and safety. *Indian Dermatol Online J*. 2025;16:276–9.
81. Sarkar R, Sahu A, Mendiratta V. Efficacy and safety of cysteamine in melasma in patients of skin of colour: a brief report. *Indian Dermatol Online J*. 2025;16:276–9.
82. Sarkar R, Yadav V, Yadav T, Janaani P, Mandal I. Glutathione as a skin-lightening agent and in melasma: a systematic review. *Int J Dermatol*. 2025;64(6):992–1004.
83. Mendoza CG, Singzon IA, Handog EB. A randomized, double-blind, placebo-controlled clinical trial on the efficacy and safety of 3% *Rumex occidentalis* cream versus 4% hydroquinone cream in the treatment of melasma among Filipinos. *Int J Dermatol*. 2014;53(11):1412–6.
84. Desai SR, Alexis AF, Elbuluk N, Grimes PE, Weiss J, Hamzavi IH, et al. Best practices in the treatment of melasma with a focus on patients with skin of color. *J Am Acad Dermatol*. 2024;90(2):269–79.
85. Pennitz A, Kinberger M, Avila Valle G, Passeron T, Nast A, Werner RN. Self-applied topical interventions for melasma: a systematic review and meta-analysis of data from randomized, investigator-blinded clinical trials. *Br J Dermatol*. 2022;187(3):309–17.
86. Morag M, Nawrot J, Siatkowski I, Adamski Z, Fedorowicz T, Dawid-Pac R, et al. A double-blind, placebo-controlled randomized trial of *Serratulae quinquefoliae* folium, a new source of β -arbutin, in selected skin hyperpigmentations. *J Cosmet Dermatol*. 2015;14:185–90.
87. Amer M, Metwalli M. Topical liquiritin improves melasma. *Int J Dermatol*. 2000;39:299–301.
88. Majeed M, Pineda R, Chan G, Gabriel T. A randomized, double-blind, placebo-controlled, comparative study the safety and efficacy of 0.25% tetrahydrocurcumin (turmeric) cream as depigment agent against 4% hydroquinone cream. *HPC Today*. 2010;3:44–6.
89. Tengamnuay P, Pengrungruangwong K, Pheansri I, Likhitwitayawuid K. *Artocarpus lakoocha* heartwood extract as a novel cosmetic ingredient: evaluation of the in vitro anti-tyrosinase and in vivo skin whitening activities. *Int J Cosmet Sci*. 2006;28(4):269–76.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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