International Platform of Registered Systematic Review and Meta-analysis Protocols

INPLASY

Laser-Induced Hypopigmentation Following Melasma Treatment in Fitzpatrick Skin Phototypes III–VI: A Scoping Review

INPLASY2026110102
doi: 10.37766/inplasy2026.11.0102
Received: 25 November 2026
Published: 25 November 2026

Tawanwongsri, W; Eden, C.

Corresponding author:
Weeratian Tawanwongsri

weeratian.ta@gmail.com

Author Affiliation:
Walailak University.

ADMINISTRATIVE INFORMATION

Support - No support.

Review stage at the time of initial registration - Preliminary searches.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY2026110102

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 25 November 2026 and was last updated on 25 November 2026.

INTRODUCTION

Review question / Objective This scoping review aims to map the available clinical evidence regarding laser-induced hypopigmentation following melasma treatment in patients with Fitzpatrick skin phototypes III–VI. The specific objectives are to summarize the reported frequency of laser-induced hypopigmentation across different laser modalities; identify associated patient-related characteristics, laser parameters, and treatment protocols; describe preventive strategies, management approaches, and subsequent repigmentation outcomes; and identify gaps in the available evidence to guide future research.

Based on the Population, Concept, and Context (PCC) framework, the population comprises patients with melasma and Fitzpatrick skin phototypes III–VI. The concept of interest is laser-induced hypopigmentation, including its frequency, associated factors, prevention, management, and recovery outcomes. The context encompasses any clinical setting or geographical region in which laser-based treatment is administered for melasma, either as monotherapy or in combination with other treatments.

Background Melasma is a common, chronic, acquired hyperpigmentation disorder that predominantly affects sun-exposed areas of the skin and is particularly prevalent among individuals with darker skin phototypes. Its recurrent nature, resistance to conventional treatments, and negative impact on quality of life present considerable challenges in clinical practice. Various laser modalities, including low-fluence Q-switched Nd:YAG, picosecond, and fractional lasers, have been employed to improve melasma, either as monotherapy or in combination with other treatments.

Despite their potential therapeutic benefits, laser-based treatments may result in pigmentary complications, including hypopigmentation. Laser-induced hypopigmentation may present as mottled hypopigmentation, punctate leukoderma, or

Tawanwongsri et al. INPLASY protocol 2026110102. doi:10.37766/inplasy2026.11.0102 Downloaded from https://inplasy.com/inplasy-2026-11-0102/

confetti-like depigmentation. This complication is particularly concerning in patients with darker skin phototypes because of its clinical conspicuousness, potential persistence, and limited treatment options. Patient-related characteristics, laser parameters, cumulative energy exposure, treatment frequency, and treatment intervals may contribute to its occurrence.

Although previous reviews have evaluated the efficacy and safety of laser-based treatments for melasma, hypopigmentation has generally been addressed as a secondary adverse outcome. Earlier literature specifically addressing this complication has predominantly focused on conventional laser toning. Evidence regarding its frequency, associated factors, preventive strategies, management, and recovery outcomes across different laser modalities remains fragmented.

Therefore, this scoping review aims to systematically map the available clinical evidence on laser-induced hypopigmentation following melasma treatment in patients with Fitzpatrick skin phototypes III–VI. The findings may inform clinical decision-making, support the development of safer laser treatment protocols, and identify knowledge gaps to guide future research.

Rationale Laser-induced hypopigmentation is a clinically important complication of laser-based treatment for melasma, particularly in patients with darker skin phototypes. Although previous reviews have primarily focused on treatment efficacy and overall safety, a comprehensive synthesis specifically addressing hypopigmentation across different laser modalities remains lacking.

The available evidence is heterogeneous in terms of patient characteristics, laser technologies, treatment parameters, outcome definitions, and follow-up periods. This heterogeneity limits direct comparisons of reported frequencies and the identification of factors associated with hypopigmentation. Furthermore, evidence regarding preventive strategies, management approaches, and repigmentation outcomes remains fragmented.

A scoping review is therefore appropriate to systematically map the extent, nature, and characteristics of the available clinical evidence without requiring methodological or statistical homogeneity. Restricting the population to patients with Fitzpatrick skin phototypes III–VI enhances the clinical relevance of the review to individuals in whom pigmentary complications are of particular concern. The findings may inform patient counseling, optimization of laser treatment protocols, prevention and management of hypopigmentation, and priorities for future research.

METHODS

Searching for the evidence A systematic literature search will be conducted in three electronic databases: PubMed (National Library of Medicine), Scopus (Elsevier), and Web of Science Core Collection (Clarivate), from database inception to November 27, 2026. The search strategy will combine three main concepts: melasma, laser-based treatment, and hypopigmentation or treatment-related adverse events. Relevant keywords, synonyms, and controlled vocabulary, where applicable, will be combined using Boolean operators (AND and OR). The search strategy will be adapted to the syntax and indexing system of each database.

The planned search strategy for Scopus is as follows: TITLE-ABS-KEY ((melasma OR chloasma) AND (laser* OR "laser toning" OR "Q-switched" OR "Q switched" OR "Nd:YAG" OR "Nd-YAG" OR picosecond* OR nanosecond* OR photothermolysis) AND (hypopigment* OR depigment* OR leukoderma OR leucoderma OR hypomelanosis OR achromia OR "pigment loss" OR "melanin loss" OR safety OR complication* OR "adverse event*" OR "adverse effect*" OR "side effect*" OR tolerability)) AND (LIMIT-TO (LANGUAGE, "English"))

Only English-language publications will be considered because of limited translation resources. No restrictions on publication year, geographical region, laser modality, or study design will be applied during the database searches. Fitzpatrick skin phototypes and eligible study designs will be assessed during screening. Backward and forward citation searching, grey literature searching, and manual journal searching will not be performed. These restrictions will be acknowledged as potential limitations of the review. All retrieved records will be exported, and duplicates will be removed before screening. The final search dates, complete database-specific search strategies, and numbers of retrieved records will be documented to ensure transparency and reproducibility.

Eligibility criteria Population: Studies involving patients with a clinical diagnosis of melasma and Fitzpatrick skin phototypes III–VI who undergo

Tawanwongsri et al. INPLASY protocol 2026110102. doi:10.37766/inplasy2026.11.0102 Downloaded from https://inplasy.com/inplasy-2026-11-0102/

laser-based treatment will be eligible, regardless of age, sex, ethnicity, melasma subtype, disease severity, or disease duration. Studies involving mixed skin phototypes will be included if all participants have Fitzpatrick skin phototypes III–VI or if relevant outcome data for participants within this range can be extracted separately. Studies in which skin phototypes are not reported will be excluded.

Concept: The review will focus on laser-induced hypopigmentation following melasma treatment, defined as an unintended reduction or loss of cutaneous pigmentation, including mottled hypopigmentation, punctate leukoderma, confetti-like hypopigmentation, and depigmentation. Eligible studies must report at least one relevant outcome, including the frequency of hypopigmentation, associated patient-related factors, laser parameters, preventive strategies, management approaches, or repigmentation outcomes. Studies explicitly reporting either the occurrence or absence of hypopigmentation will be eligible. Studies that do not explicitly report hypopigmentation will not be assumed to have zero events. Intended lightening of melasma lesions as a therapeutic outcome will not be considered hypopigmentation.

Context: Studies conducted in any clinical setting or geographical region will be eligible. All laser modalities used for melasma treatment will be considered, regardless of wavelength, fluence, pulse duration, spot size, treatment frequency, number of sessions, or follow-up duration. Laser-based treatments administered as monotherapy or in combination with other therapeutic modalities will be eligible. Studies exclusively investigating nonlaser treatment modalities, including intense pulsed light, will be excluded.

Study designs: Randomized controlled trials, nonrandomized clinical trials, prospective and retrospective cohort studies, case-control studies, and before-and-after intervention studies will be eligible. Case reports, case series, review articles, editorials, expert opinions, animal studies, in vitro studies, and conference abstracts without full-text publications will be excluded.

Publication characteristics: Only full-text articles published in English from database inception to November 27, 2026, will be eligible.

Source of evidence screening and selection All records retrieved from the electronic databases will be exported and deduplicated before screening. Prior to formal screening, the two reviewers will independently screen a subset of records to ensure consistent interpretation and application of the eligibility criteria.

The selection process will consist of two stages. First, both reviewers will independently screen the titles and abstracts of all retrieved records against the predefined eligibility criteria. Records considered potentially eligible or for which eligibility remains uncertain will proceed to full-text assessment. Second, both reviewers will independently assess the full-text articles to determine final eligibility. Any disagreements arising during either stage will be resolved through discussion and consensus between the two reviewers, with reference to the predefined eligibility criteria. Reasons for exclusion at the full-text assessment stage will be documented.

The entire study selection process, including the numbers of identified records, duplicates removed, screened records, excluded records, full-text articles assessed, and studies ultimately included, will be presented in a PRISMA flow diagram in accordance with the PRISMA-ScR reporting guideline.

Data management All records retrieved from the electronic databases will be exported into reference management software, where duplicate records will be identified and removed before screening. Screening decisions, full-text eligibility assessments, and reasons for exclusion will be systematically documented.

Data from the included studies will be recorded using a standardized data charting form developed in Microsoft Excel. The form will be piloted before formal data charting and refined as necessary to ensure consistency and completeness. Both reviewers will independently verify the recorded data, and any discrepancies will be resolved through discussion and consensus.

All search records, screening decisions, extracted data, and relevant study documents will be stored securely in electronic format and will be accessible to both reviewers throughout the review process. The final dataset will be retained to support transparency and reproducibility.

Language restriction English.

Country(ies) involved Thailand.

Keywords 0 of 20 max words.Melasma; Hypopigmentation; Laser therapy; Laser toning;

Tawanwongsri et al. INPLASY protocol 2026110102. doi:10.37766/inplasy2026.11.0102 Downloaded from https://inplasy.com/inplasy-2026-11-0102/

Punctate leukoderma; Fitzpatrick skin phototypes; Adverse events; Scoping review.

Contributions of each author

Author 1 - Weeratian Tawanwongsri.
Email: weeratian.ta@gmail.com
Author 2 - Chime Eden.

Tawanwongsri et al. INPLASY protocol 2026110102. doi:10.37766/inplasy2026.11.0102 Downloaded from https://inplasy.com/inplasy-2026-11-0102/