

# Cosmetic Procedures for Treating Lichen Planus Pigmentosus: A Review

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## ABSTRACT

Lichen planus pigmentosus (LPP) is a rare pigmentary disorder primarily affecting patients with skin of color. Currently, comprehensive evaluations for procedural interventions for LPP are limited in the literature. In this review, we assess current procedural options for LPP treatment, focusing on their efficacy, safety, and practical considerations. A comprehensive literature search using PubMed and Embase identified English studies published through December 2024 that examined cosmetic procedures for the treatment of LPP. Keywords included “lichen planus pigmentosus,” “laser,” “chemical peel,” “glycolic acid,” “salicylic acid,” “TCA,” “jessner,” “VI,” “cosmetic procedure,” “procedure,” and related terms. Articles without original data, sufficient results, or human participants were excluded. Data on study design, participant characteristics, procedural details, and clinical outcomes were extracted and reported in this descriptive review. A total of 16 studies were reviewed, which highlighted procedural approaches to managing LPP, including chemical peels (eg, phenol and glycolic acid), laser therapy (eg, Q-switched Nd:YAG, CO2 fractional, Picosecond Nd:YAG, erbium-doped fiber), and platelet-rich plasma therapy. Evidence was limited by small sample sizes, lack of randomized controlled trials, and reliance on case reports and series. Most studies included fewer than 20 participants, limiting the generalizability of findings. In conclusion, procedural interventions can serve as an alternative treatment option for LPP, especially for those unresponsive to standard treatments. Further research with larger cohorts and comparative trials are needed to further elucidate current findings.

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## INTRODUCTION

Lichen planus pigmentosus (LPP) is a rare variant of lichen planus (LP) characterized by persistent dark brown, black, or slate gray coalescing macules primarily affecting sun-exposed areas, including the face, neck, and upper extremities.<sup>1,2</sup> This condition was first recognized and reported in India.<sup>3</sup> However, since its discovery, it has been reported in various other ethnicities with diverse skin types, including patients of Southeast Asian, Hispanic, and African descent.<sup>4</sup> The exact etiology of LPP remains unclear; however, it has been associated with ultraviolet radiation, hepatitis C infection, environmental pollution, and the topical application of mustard oil, henna, and hair dyes, particularly in India.<sup>5</sup>

LPP patients often experience significant psychosocial distress due to the cosmetic impact of the condition, further compounded by its refractory response to most treatment modalities.<sup>6</sup> Existing studies on treatment for LPP primarily focus on non-procedural therapies such as topical corticosteroids, calcineurin

inhibitors, and systemic treatments. While these treatment strategies may potentially be effective in stabilizing the disease and preventing further progression, the residual pigmentation caused by pigment incontinence in the dermis is often resistant to conventional treatments.<sup>7,8</sup>

Cosmetic procedures are increasingly being used for pigmentary disorders, offering a promising alternative for LPP management.<sup>9-11</sup> Techniques such as laser therapy, chemical peels, and platelet-rich plasma have been used for the reduction of excess pigmentation in LPP patients.<sup>4,8</sup> However, existing literature on their application in LPP remains limited. This review aims to evaluate current procedural options for LPP treatment, focusing on their efficacy, safety, and practical considerations. By providing a comprehensive analysis of these treatment modalities, this paper seeks to guide dermatologists in optimizing care for patients with LPP and highlight areas for future research.

## MATERIALS AND METHODS

A comprehensive literature search using PubMed and Embase identified studies examining cosmetic procedures for the treatment of LPP. Keywords used were: "lichen planus pigmentosus," "laser," "chemical peel," "glycolic acid," "salicylic acid," "TCA," "jessner," "VI," "cosmetic procedure," "procedure." English articles published until December 2024 were screened. Studies that had patients diagnosed with LPP, evaluated the use of cosmetic procedures, and reported clinical outcomes, efficacy, or adverse effects of treatments were included. Articles without human participants or lacking sufficient procedure outcomes were excluded. Reviews, editorials, and commentaries without original data were also excluded. Sixteen studies in total were included in this review. Data were systematically extracted from the included studies, focusing on the following parameters: study design, participant characteristics, procedural details of the intervention, clinical outcomes, and reported adverse effects. A qualitative analysis was performed, and results are presented descriptively. Key features of each study are reported in Table 1.

## RESULTS

### Chemical Peels

Chemical peeling, or chemical exfoliation, involves applying a chemical substance to the skin to induce controlled damage to the epidermis and sometimes the dermis. This promotes skin regeneration and remodeling, improving texture and appearance.<sup>12</sup> Chemical peels are classified by penetration depth: superficial (eg, glycolic acid (GA) 30–50%, salicylic acid (SA) 30%, Jessner solution (JS), resorcinol 25%–50%, lactic acid 10%–30%, mandelic acid 50%, pyruvic acid 50%, and trichloroacetic acid (TCA) 10%–35%, medium (glycolic acid >70%, glycolic acid 70% + TCA 35%, TCA 30–50% + JS and salicylic acid >30%), and deep (eg, TCA >50% + JS and phenol 88%).<sup>13</sup>

Few studies in the literature examine the role of chemical peels in LPP. A retrospective analysis done by Sonthalia et al analyzed the effect of six sessions of modified phenol peel on the reduction of LPP in Indian patients. The investigators used a modified, croton oil-free phenol preparation to diminish the risks associated with conventional phenol peels, which due to the presence of croton oil, demonstrate deep and unpredictable penetration that places individuals with darker skin types at high risk of postinflammatory hyperpigmentation. The authors describe this modified peel as medium-depth to deep.<sup>2</sup> In this study, 17 patients with Fitzpatrick skin types (FST) IV and V and biopsy confirmed LPP on the face, neck, and various other regions (chest, back, arms, etc) were included. The croton oil-free peel contained phenol 8%, trichloroacetic acid 15%, glycolic acid 2%, ascorbic acid, retinoic acid, and a mixture of other  $\alpha$ - and  $\beta$ -hydroxy acids at 1% each. The investigators evaluated the efficacy of the peel using a non-validated pigment reduction scale. At the end of treatment, 29.4% of patients had excellent

improvement (>75% reduction in pigment from baseline), in which pigmentation completely cleared from most involved areas with significant lightening in less involved regions.<sup>2</sup> In addition, 76.5% of patients had moderate (26–50% reduction), good (51–75% reduction), or excellent improvement of their pigmentation.<sup>2</sup> Adverse effects noted during the procedure included temporary burning and nasopharyngeal irritation due to phenolic odor. All patients experienced expected reactions, namely erythema, scaling, and crusting on the postpeel days 3 or 4.<sup>2</sup> Two patients had prolonged peel reactions and temporary postinflammatory hyperpigmentation (PIH) that resolved in 15 days with topical hydroquinone 2%.<sup>2</sup>

Due to the mid-to-deep dermal pigmentation in late stages of LPP, it is expected that only a medium to deep peel would be effective. However, attempts have been made to treat LPP with more superficial chemical peels. Wolff et al. reported a case involving an 18-year-old Hispanic male with LPP who was treated with Jessner's solution and glycolic acid chemical peels, in conjunction with topical retinoids.<sup>4</sup> After 16 weeks of treatment with glycolic acid increased from 35% to 70% over the course of six sessions, and significant improvement was observed in the facial lesions.<sup>4</sup> Only mild improvement, however, was noted on the forearms, where Jessner's solution was used exclusively. No adverse events were reported.<sup>4</sup> A prospective study of 40 patients with various facial melanoses in India compared the therapeutic effect of microdermabrasion (MDA) followed by 35% glycolic acid peel to treatment with 35% glycolic acid alone.<sup>14</sup> Each treatment group consisted of 20 patients. Among the participants, one patient with LPP, whose FST was not specified, demonstrated a 50% improvement with the MDA and glycolic acid peel combination. More patients receiving the combination treatment (n=9) experienced a 50–100% improvement of symptoms compared to those only treated with 35% glycolic acid (n=4). The most observed side effects in this study were intense burning and erythema, followed by pigmentation, which was usually transient.<sup>14</sup> Ultimately, combination therapy with MDA proved more effective than 35% glycolic acid alone.

While chemical peels have demonstrated potential in the treatment of LPP, more robust, long-term studies are needed to establish their efficacy and safety comprehensively. Standardization of protocols is particularly important to ensure the procedure's safety and effectiveness across diverse Fitzpatrick skin types. Additionally, future research should focus on identifying optimal peel concentrations, depth of penetration, application techniques, and adjunctive therapies to maximize therapeutic benefits while minimizing adverse events.

### Lasers

Lasers are sources of high-intensity monochromatic coherent light indicated for multiple dermatologic conditions. Their effectiveness in treating pigmented lesions is based on

TABLE 1.

## Summary of Studies Examining Dermatologic Procedures for the Treatment of Lichen Planus Pigmentosus

Citation	Study Design	Treatment Procedure	Condition	Body Parts Affected	Number of Patients	Patient Race and/or FST
Sonthalia S et al. <i>J Cosmet Dermatol.</i> 2019;18(5):1479-1486.	Retrospective Analysis	Chemical peel (phenol)	LPP	face, neck, upper chest, back, forearm	17	FST IV and V
Bhari N et al. <i>Dermatol Ther.</i> 2020;33(2):e13208.	Pilot Study	Laser Therapy (QSNYL)	LPP	head, neck, upper extremities, chest, abdomen, lower extremities, back	9	*Study conducted in India
Shah Dr SD et al. <i>J Cosmet Laser Ther.</i> 2019;21(2):108-115.	Open-label non-randomized prospective pilot study	Laser Therapy (QSNYL)	LPP	face	13	FST IV and V
Mhatre M et al. <i>Iran J Dermatol.</i> 2021;24(1)	Retrospective observational study	Laser Therapy (QSNYL)	LPP, PIH, melasma, photomelanosis, nevus of Ota, periorbital melanosis, nevus spilus, Riehl melanosis, Cafe-au-lait macules, freckles, compound nevus, Hori's nevus	face	100 * (2 of which had LPP)	Indian
Mamatha et al. 2015. Available from: <a href="https://www.semanticscholar.org/paper/Comparative-Study-on-Combination-of-with-35-Acid-35-Mamatha-Hanumanthayya/09b0d043a7f97f6a861d3a8d0bf218e27cad5efd">https://www.semanticscholar.org/paper/Comparative-Study-on-Combination-of-with-35-Acid-35-Mamatha-Hanumanthayya/09b0d043a7f97f6a861d3a8d0bf218e27cad5efd</a> [accessed on 1 February 2025]	Comparative Study	Chemical peel	LPP, melasma, PIH, acne, photo-melanoses	face	40 * (1 of which had LPP)	Indian
Garg S et al. [preprints.org/manuscript/202310.0539]. Accessed December 11, 2024.	Retrospective observational study	Laser Therapy (Pixel Q-switched, ablative pixel erbium YAG)	LPP, melasma, ashy dermatosis, dermal nevi, tattoos	face	122 * (11 of which had LPP)	Indian
Wolff M et al. <i>J Clin Aesthetic Dermatol.</i> 2016;9(11):44-50	Case Report	Chemical peel (glycolic acid, Jessner's)	LPP	face, neck, forearms	1	Hispanic
Belzer A et al. <i>JAAD Case Rep.</i> 2023;34:45-47.	Case Report	Laser therapy (Picosecond Nd-YAG)	LPP	face	1	Black
Kim JE et al. <i>J Dermatol.</i> 2012;39(2):189-191.	Case Report	Laser therapy (Nd-YAG)	LPP	forehead	1	Korean
Han XD et al. <i>Dermatol Ther.</i> 2014;27(5):264-267.	Case Report	Laser therapy (Nd-YAG)	LPP	face	1	Chinese
Jung CJ et al. <i>Ann Dermatol.</i> 2023;35(Suppl 1):S38-S42.	Case Series	Laser therapy (CO2 fractional, non-ablative fractional)	LPP	chin	2	FST III and IV, Korean
Murray TN et al. <i>Dermatol Surg.</i> 2023;49(11):1046-1048.	Case Report	Laser therapy (erbium-doped fiber)	LPP	face, neck	1	FST V
Wu CY et al. <i>Australas J Dermatol.</i> 2019;60(4):e336-e337.	Case Report	Laser therapy (Picosecond Nd-YAG)	LPP	face	1	N/A
Bandali T et al. <i>JAAD Case Rep.</i> 2024;53:136-138	Case Report	Laser Therapy (QSNYL)	LPP	face, neck	1	FST IV, South Asian
Radmanesh R et al. <i>Iran J Dermatol.</i> 2020;23(3):125-128.	Case Report	Laser Therapy (CO2 laser resurfacing)	LPP	face	1	FST III

selective photothermolysis: when a specific wavelength of light is selectively absorbed by a target chromophore, that energy can destroy its target while minimizing damage to surrounding tissue.<sup>15</sup> In patients with LPP, pigment and pigment-laden macrophages are predominantly observed in the papillary dermis. Q-switched Nd:YAG lasers (QSNYL) deliver high-intensity irradiation, which is preferentially absorbed by melanin particles measuring 10–100 nm in size within the skin.<sup>15</sup> This absorption generates a sharp temperature gradient between the melanosomes and surrounding structures, resulting in thermal expansion and selective destruction of melanosome-containing cells.<sup>15,16</sup> Picosecond lasers, which operate on the scale of picoseconds, deliver even faster pulses compared to Q-switched lasers, which operate on a nanosecond scale.<sup>15</sup> This ultrashort pulse duration further minimizes heat diffusion to surrounding tissue, potentially enhancing the precision and efficacy of pigment destruction. Subsequently, the disrupted pigment is cleared by macrophages, potentially leading to clinical improvement in LPP.<sup>16</sup>

Several studies and case reports have demonstrated improvement of LPP with pigmented lasers. A pilot study by Bhari et al. included 9 Indian patients with LPP who were treated with QSNYL.<sup>17</sup> Primary sites of involvement were the head and neck. Additional sites of involvement were the upper extremities, chest, abdomen, back, and lower extremities. A total of 6 sessions were completed at 2-week intervals for each patient. The laser parameters were: 1,064 nm wavelength, 6 mm spot size, fluence 3 J/cm<sup>2</sup>, and 10 Hz repetition rate. After the 6th session, a mean of 25.7% clinical improvement was noted by physician assessment. The Fitzpatrick skin types of the patients were not indicated.<sup>17</sup> In another study by Shah et al, investigators used the standard protocol of QSNYL with a 5 mm spot size, fluence 3–4.6 J/cm<sup>2</sup>, and 5 Hz repetition rate on 13 patients with LPP for 5 to 6 sessions.<sup>8</sup> Patients were of FSTs IV and V. The treatment response, measured by the clearance of pigment, was graded as follows: Grade I (<25% improvement, minimal), Grade II (26–50%, moderate), Grade III (51–75%, marked), Grade IV (>75%, good), and Grade V (>90%, almost clear).<sup>8</sup> All patients showed a satisfactory response to treatment, defined as Grade III or higher. 38.4% of patients achieved Grade V improvement, 38.4% exhibited a Grade IV response, and 23% showed a Grade III response.<sup>8</sup>

In addition to the QSNYL, there are cases of LPP treated with fractional CO<sub>2</sub> lasers and picosecond lasers. A case series involving two Korean women with Fitzpatrick skin types III and IV described the use of fractional laser treatments for managing LPP of the chin.<sup>18</sup> One patient underwent 10 sessions of CO<sub>2</sub> fractional laser treatment at 6-week intervals, while the other received 7 sessions of a 1,927 nm non-ablative fractional laser at 8-week intervals.<sup>18</sup> Both patients demonstrated marked improvement, with minor residual atrophy and clinically reduced pigmentation following their respective treatments.<sup>18</sup> In another

report, a Black woman with LPP, whose Fitzpatrick skin type was not specified, was treated with a picosecond Nd:YAG laser on her full face with 1,064 nm wavelength for 10 total treatments, with approximately 1-month between treatments.<sup>19</sup> After 10 sessions, there was moderate improvement of the patients dark brown to gray macules, identified via clinical images, but pigmentation persisted.<sup>19</sup> The patient underwent 4 additional treatments at 785 nm which led to significant improvement of pigmentation.<sup>19</sup>

Reported adverse effects of laser therapy for LPP included swelling, depigmentation, scarring and PIH. Excluding these, no other major side effects were noted.

Laser therapy has shown promise as a potential alternative treatment modality for LPP. However, future studies are warranted to further develop strategies to allow for efficacious and safe use of lasers across different skin types. Additionally, future research should focus on optimizing laser parameters to minimize adverse effects and enhance therapeutic outcomes.

#### Platelet-Rich Plasma

Platelet-rich plasma (PRP) is an autologous blood-derived product characterized by a high concentration of platelets suspended in plasma. It is rich in bioactive molecules, including growth factors, immune system mediators, and enzymes, which collectively contribute to tissue repair and regeneration processes.<sup>20</sup> The proposed mechanism by which PRP targets pigmentation involves its ability to modulate melanogenesis and reduce melanin accumulation in pigmented lesions.<sup>20</sup> Studies have shown that PRP increases transforming growth factor-beta (TGF-β), which decreases melanogenesis and associated signaling proteins, as observed in melasma patients.<sup>21</sup> Evidence from clinical trials demonstrates significant reductions in melanin levels following intradermal PRP administration, with measurable decreases in modified Melasma Area and Severity Index (mMASI) scores and melanin content in treated areas compared to controls.<sup>21</sup> These findings suggest that PRP's effects on melanogenesis and melanin clearance may offer a promising therapeutic option for pigmentary disorders, including LPP.

An experimental pilot study conducted by Pituvong et al evaluated the effectiveness of platelet-rich plasma (PRP) for treating hyperpigmentation in patients with LPP.<sup>22</sup> Five patients aged 18 to 60 years, with histologically confirmed LPP and facial lesions lasting six months or longer, were included.<sup>22</sup> The cohort consisted of four female and one male patient, all of whom completed the treatment protocol. Their average age was 47.6 years (range 35–56 years). Among these participants, three (60%) had Fitzpatrick skin type (FST) IV, and two (40%) had FST V, with a duration of illness ranging from one to six years.<sup>22</sup> The patients received three PRP intradermal injections, two weeks apart, and follow-ups at two weeks, one month, and two months post-treatment.

Significant improvement in pigmentation was observed, with the mean melanin index decreasing from  $450.33 \pm 69.91$  at baseline to  $392.60 \pm 73.88$  after eight weeks ( $P < 0.05$ ).<sup>22</sup> A consistent reduction in the melanin index was noted after each treatment, with an overall improvement of 14.93% after two weeks.<sup>22</sup> Physician assessments indicated moderate improvement after three treatments, and patient satisfaction increased progressively, with "very satisfied" ratings following the second treatment. Side effects, including mild edema and bruising, resolved spontaneously with no reports of infection.

This study's efficacy demonstrates promising results though findings are limited by a small sample size and lack of placebo controls. Large-scale studies are recommended to validate these outcomes and explore the therapy's potential across Fitzpatrick skin tones. Topical PRP with or without microneedling has not been studied.

## DISCUSSION

This review highlights the role of cosmetic procedures—chemical peels, lasers, and PRP in the management of LPP. Each modality has demonstrated varying degrees of efficacy, safety, and cost-effectiveness. Chemical peels involving medium to deep penetration including modified phenol peels, showed significant improvement in pigmentation with relatively mild adverse effects like temporary burning and PIH.<sup>14</sup> Lasers, such as the QSNYL and fractional ablative lasers, offered promising outcomes, although the results varied based on FST. Clinicians should consider administering a spot treatment first when treating higher Fitzpatrick patients to minimize risk of adverse events. PRP demonstrated potential as a safe and effective alternative but was supported by limited data.

Cost-effectiveness varied significantly depending on the procedure and resources available. PRP, while slightly more expensive due to the need for blood collection and processing, may still offer a cost-effective alternative when compared to laser therapies, particularly in clinics that already have access to the necessary equipment for PRP. In contrast, lasers like QSNYL, which require highly specialized and costly equipment, often involve higher upfront costs, maintenance, and operator expertise, which may limit their availability and affordability in low-resource environments. Total cost-effectiveness of each treatment depends on the number of sessions required for optimal results and the long-term benefits observed, as repeated treatments can increase the overall cost of some therapies.

Evidence on procedural interventions for LPP is limited by small sample sizes, lack of randomized controlled trials and reliance on case reports and series. Most studies included fewer than 20 participants, limiting the generalizability of findings. There is also a lack of direct comparative studies between procedures, making it difficult to establish treatment preferences. To address

these limitations, larger, well-designed randomized controlled trials are needed to validate the efficacy and safety of cosmetic procedures for LPP. Comparative studies evaluating different modalities across various FSTs would provide clearer guidance for clinicians. Additionally, exploring combination therapies such as microneedling with PRP could optimize treatment outcomes by targeting multiple mechanisms of hyperpigmentation.

Lastly, expanding access to these procedures for conditions like LPP in resource-limited settings is crucial for addressing disparities and improving outcomes for underserved populations. In many low-income areas, limited access to advanced dermatological care can exacerbate the burden of conditions like LPP, especially among individuals with skin of color. Cosmetic procedures offer an alternative treatment modality for LPP, particularly for patients unresponsive to conventional therapies. While existing evidence demonstrates their potential, further research is essential to refine protocols, enhance efficacy, and ensure safety across diverse patient populations. By addressing these gaps, dermatologists can tailor treatments to individual needs and advance care for this challenging pigmentary disorder.

## DISCLOSURES

Dr Adotama is an advisory board member/consultant with Galderma, Bristol-Myers, Regeneron, Proctor and Gamble and Janssen. The other authors have no relationships to disclose.

**Data availability statement:** The data that support the findings of this study are available from the corresponding author upon reasonable request.

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