CASE REPORT

Treatment of Epidermal Melasma Using a Combination of Dual Yellow Laser, Oral and Topical Tranexamic Acid, and Alpha Arbutin

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Abstract: Melasma is a common hyperpigmentation disorder that poses a significant challenge in terms of effective treatment. Conventional therapies often yield limited success, necessitating the exploration of alternative modalities. This case report demonstrates the efficacy of a dual yellow laser (511 nm and 578 nm) in combination with oral tranexamic acid and topical anti-pigment cream in the treatment of melasma. A 38-year-old Chinese woman with a 2-year history of melasma had previously sought multiple laser treatments at beauty centres but achieved unsatisfactory results. She opted for the Norseld dual yellow laser due to its minimal downtime and comfort. Due to financial constraints, she underwent four sessions of dual yellow laser (settings as per manufacturer protocol), two months of oral tranexamic acid, and depigmentation cream (5% tranexamic acid/alpha arbutin 2%). The mMASI score was reduced from 3.6/24 to 0.6/24 after four sessions of treatment. No side effects were reported following the yellow laser treatment. It can be concluded that the combination of dual yellow laser, oral tranexamic acid, and depigmentation cream holds promise as an effective and safe treatment modality for melasma. Further research and larger clinical studies are warranted to validate these findings.

Keywords: Alpha arbutin, Dual yellow laser, Melasma, Oral tranexamic acid

Introduction

Melasma is a skin condition characterized by the development of brown or grey-brown patches, typically on the face. These patches result from the overproduction of melanin, the pigment responsible for the colour of skin, hair, and eyes [1]. The areas of increased pigmentation are well-defined, often with scalloped edges. Although melasma affects individuals of all races, it is much more common in women and is more prevalent among those with darker skin tones. The lesions tend to darken with sun exposure. Several factors can trigger melasma, including

sunlight, pregnancy, oestrogens, oral contraceptives, scented cosmetics, thyroid dysfunction, and photosensitizing drugs [1].

The treatment of melasma is often challenging, and achieving complete patient satisfaction can be difficult [1]. While some patients find hydroquinone-based bleaching agents helpful, others do not [1]. Among the various treatment options for melasma, laser therapy is commonly used, but its effectiveness varies depending on the wavelength and energy applied. According to the theory of Selective Photothermolysis (SP), specific wavelengths can selectively target melanosome chromophores [2]. The optimal wavelengths for treating melasma should match the absorption coefficient for melanin pigments, which range from 400 nm to 1200 nm. As a result, lasers such as the Argon laser (488 nm), Nd laser (1064 nm), and Dual Yellow laser (511 nm and 578 nm) are frequently chosen for this purpose.

The Dual Yellow Laser, also known as the copper bromide (CuBr) laser, is a technology used in aesthetic medicine for various skin-related treatments. It is named "Dual Yellow" due to its emission of two specific wavelengths: 511 nm, which is strongly absorbed by melanin, and 578 nm, which is strongly absorbed by hemoglobin [3]. This laser has been proven effective in treating vascular lesions [4-6] demonstrated that using the Dual Yellow laser to treat melasma resulted in improvements in the Melasma Area and Severity Index (MASI), pigmentation intensity, and redness after four sessions.

In addition, several therapeutic agents have been employed to treat melasma, particularly those that inhibit melanin production by reducing melanogenesis and melanocyte proliferation. Topical agents such as azelaic acid, kojic acid, and tranexamic acid have demonstrated significant efficacy in reducing melasma and should be considered before proceeding with chemical peels or laser therapy. Kligman's formula, which combines hydroquinone, tretinoin, and dexamethasone in a cream base, is among the most effective treatments [7].

Moreover, a recent randomized control-led trial has shown that topical isoniazid offers a significant depigmenting effect with acceptable efficacy and tolerability [8]. However, further research is needed to assess its safety and long-term side effects. Oral treatments with systemic distribution, including tranexamic acid and plant-based supplements such as Polypodium leucotomos extract, carotenoids, and melatonin, have also been acknowledged for their role in treating melasma [8].

Combination therapy appears to deliver promising results for melasma treatment. For instance, the combined use of topical treatments and chemical peels may enhance and accelerate treatment outcomes, even in cases of resistant melasma [9]. Therefore, this case report explores the use of combination therapy, specifically the Dual Yellow Laser alongside oral and topical treatments, as a potential approach for managing epidermal melasma.

Case Presentation

A 38-year-old Chinese woman with no known medical illnesses presented with a history of skin hyperpigmentation over her bilateral cheeks for less than two years. She first noticed the pigmentation after attending several days of outdoor school activities for her child. Initially, she thought it was just sunburn and did not pay much attention to it. However, the faint hyperpigmentation gradually became more noticeable over the months, and she realized it worsened with prolonged sun exposure, such as during her recent vacation in Langkawi earlier this year. She denied having a similar skin condition in the past but mentioned that her sister also had comparable pigmentation issues.

She has no significant gynaecological or obstetric history, is married with two children, and has never taken contraceptive pills. Her

menstrual cycle is regular, occurring every 23 to 27 days. She works as an executive and spends most of her time in the office. For recreation, she typically engages in walking or jogging with her family at the park two to three times a week, usually after 5 p.m. on weekends. Her skincare routine consists of a gentle cleanser, moisturizer, and occasional use of sunscreen.

Further history reveals that the patient had attempted to remove the pigmentation at several beauty centres over the past year, but these efforts were unsuccessful. She is unsure of the specific type of laser used during her visits, but she was informed that it was a picosecond laser. She reported being traumatized by the pain experienced during the procedures, which ultimately led her to discontinue the treatment after several sessions. Following this experience, she began to accept that her skin condition might be lifelong and expressed that any treatment that could lighten the pigmentation would be satisfactory.

On examination, she is classified as Fitzpatrick Skin Type III and presents with prominent, almost symmetrically distributed brown-black macular patches on the malar regions of both cheeks, as shown in **Figure 1**. Examination with a Wood's lamp further accentuated the hyperpigmented patches, and the findings from non-polarized dermoscopy supported the diagnosis of epidermal melasma. Polarized dermoscopy also revealed increased vascularity in the form of telangiectasia. Based on the relatively short duration of the pigmentation and the positive clinical findings, she is diagnosed with epidermal melasma.

Management and Outcome

The client's personal preferences, financial constraints, and fear of pain due to previous experiences at the beauty centre have unfortunately limited our treatment options for her epidermal melasma, including the use of pico laser. After obtaining her consent, she agreed to be treated with the Norseld Dual Yellow laser for 4 sessions, in addition to topical and oral medications for 2 months which were tailored according to her limited monetary budget. She started on tranexamic acid tablets (250 mg twice daily), along with a topical cream containing active depigmenting ingredients: Tranexamic acid 5% and alpha arbutin 2% as a day cream. Additionally, she was advised to continue regular application of SPF 50 sunscreen for photoprotection and to prevent further exacerbation. Due to budget constraints, only 4 treatment sessions were initially planned.

Figure 1 Front, right, and left views of the patient's face. The melasma lesions are visible on both sides of the malar region.

For each session of the Dual Yellow laser treatment, photographs of the patient are taken from three angles: front view, 45 degrees to the left, and 45 degrees to the right. These photos are captured before and immediately after each laser session using a standardized camera (iPhone 12 Pro) in a room with consistent lighting conditions. Improvement and differences are evaluated using the modified Melasma Area and Severity Index (mMASI) scoring system by comparing the photos taken at the beginning of the treatment with those taken after 4 sessions of laser treatment (see **Figure 2** to **Figure 4**).

For the treatment of epidermal melasma, a dual yellow laser machine with a pulse duration of 45 microseconds and wavelengths of 511 nm and 578 nm was used. One treatment session consisted of three steps (Table 1). The settings used were according to the manufacturer's protocol for melasma. In the first step, the 578

nm yellow laser was used with a 5 mm spot size, delivering a total of 1600 J (20 J/cm²) to the whole face. The second step involved the Y10G setting (yellow laser with 10% 511 nm green) using the same 5 mm spot size, delivering a total of 800 J (20 J/cm²) to the full face. The third step used the Y10G setting (yellow laser with 10% 511 nm green) with a 1 mm spot size, delivering a total of 300 J (10 J/cm²) specifically to the melasma lesions, as shown in **Table 1**.

After four treatment sessions with the dual yellow laser, along with the concurrent use of topical and oral medication, the client was re-evaluated. The mMASI score before starting the treatment was 3.6/24, and after four sessions, it had improved to 0.6/24 **(Table 2).** The client had reported no discomfort during the sessions and did not experience any side effects such as post-inflammatory hyperpigmentation (PIH), skin dryness, or erythema. A future treatment plan was discussed with the client, considering the likelihood of recurrence and exacerbation of melasma. However, due to financial constraints, the client chose not to continue further treatment sessions at that time. The client was advised to continue regular sunscreen application and to use over-the-counter topical depigmenting creams or serums.

Figure 2A Front views of the patient's face at baseline; **2B** Front views of the patient's face after four treatment sessions.

Figure 3A Right views of the patient's face at baseline; **3B** Right views of the patient's face after four treatment sessions.

Figure 4A Left views of the patient's face at baseline; **4B** Left views of the patient's face after four treatment sessions.

Table 1 Laser settings used for each treatment session with a 2-week interval.

Laser mode (pulse duration: 45 microseconds)	Spot size	Area (cm^2)	Total energy	Fluence (J/cm^2)
1st Step: Yellow laser (578 nm)	5 mm	80	1600 J (Whole face)	20
2nd Step: Yellow laser with 10% Green (511 nm)	5 mm	40	800 J (Whole face)	20
3rd Step: Yellow laser with 10% Green (511 nm)	1 mm	30	300 J (Over melasma lesion)	10

Table 2 The mMASI score at baseline and after four treatment sessions.

	Baseline	After four treatment sessions
Total score	3.6	0.6

Discussion

Melasma is a common disorder characterized by hyperpigmentation of the skin, primarily affecting the face [10]. It is often classified into epidermal, dermal, and mixed types based on the level of melanin deposition in the epidermis (epidermal melanosis) and/or the dermis (dermal melanosis) [11]. Although the pathogenesis of melasma remains unclear, it is recognized as a disorder often associated with photoaging [10]. Multiple etiological factors have been identified as leading cause to the release of vascular mediators that stimulate angiogenesis which lead to the subsequent activation of melanocytes [12].

Factors implicated include:

Ultraviolet (UV) light – UV light can penetrate the epidermis and is thought to induce the formation of reactive oxygen species and promote melanin production (melanogenesis) in the skin [13]. Shorter wavelengths of visible light, such as blue and purple light, have been shown to induce long-lasting hyperpigmentation, parti-

cularly in darker skin types [14]. Prolonged sun exposure can lead to increased pigmentation in the skin, which often persists for an extended period [10].

Family history – It is an important risk factor for developing melasma. Some studies have reported that up to approximately 60% of patients with this condition have a positive family history, suggesting a genetic predisposition [10,15].

Hormonal influences – Oestrogen and progesterone may be implicated in the development of melasma, especially given its increased prevalence during pregnancy, in addition to the use of oral contraceptives containing these hormones, menopausal hormone therapy, and intrauterine devices and implants [12,16,17]. The activities of oestrogen and progesterone are mediated by specific receptors expressed in human skin, and these hormonal factors have been implicated in approximately a quarter of affected women [10]. Melasma on the extra-facial aspect of body such as forearm has been associated with the perimenopausal state and the use of topical oestrogen replacement therapy. Oestrogen is considered relatively a more significant mediator than progesterone [10].

Medications – Ingredients found in some perfumed soaps and cosmetic products may cause phototoxic reactions that can trigger melasma [10]. Systemic agents, including anti-epileptic, antimalarial, antipsychotic, and cytotoxic/antineoplastic medications, have also been reported to potentially induce hyperpigmentation [18].

Heat exposure – Extended occupational heat exposure or exposure to cooking fires has been suggested as a possible link to the development of melasma through thermal and UV damage. [11]. Thus, in this case, the main risk factor for the patient is exposure to UV light and sunburns, which aggravated her skin condition by inducing melanocyte activity and increasing hyperpigmentation, Specifically in the bilateral malar regions. Given its frequent involvement of the face, melasma significantly impacts her quality of life.

Satisfying results have been demonstrated with combination therapy for melasma. Therefore, this study aims to evaluate the efficacy of dual yellow laser therapy in combination with oral and topical agents for treating epidermal melasma. In this case report, the combination of dual yellow laser with oral and topical depigmenting creams was found to be effective in treating melasma. The dual yellow laser is known for its effectiveness in addressing various skin conditions, including pigmented lesions, vascular lesions (such as blood vessels), and tattoos. Its different wavelengths target various chromophores in the skin, providing a versatile and comprehensive approach to skin rejuvenation and treatment [19].

Energy-based devices, such as lasers, have been utilized in the treatment of melasma and other pigmentation conditions, especially in cases refractory to topical treatments or chemical peels [20]. The dual yellow laser treats pigmentation by selectively targeting melanin, the pigment responsible for skin colour, through several mechanisms. This laser employs the principles of selective photothermolysis, which involves targeting specific chromophores (color-absorbing molecules) in the skin without damaging surrounding tissues. In the context of pigmentation, melanin is the primary chromophore. The dual yellow laser uses two specific wavelengths: 532 nm (greenish-yellow) and 577 nm (yellow-orange), both of which are well absorbed by melanin, the pigment responsible for the brown color in the skin. When melanin absorbs the laser energy, some of it is converted into heat, causing thermal damage to the pigmented cells. This damage fragments the pigmented cells, which are then eliminated

through the body's natural processes. Additional benefits of the dual yellow laser include its ability to stimulate collagen production through the generation of heat during the procedure. This stimulation can provide structural support to the skin, contributing to skin tightening and rejuvenation. Additionally, the dual yellow laser is a non-invasive procedure, making it relatively safe and minimizing damage to surrounding tissues [15].

Although many topical agents have been introduced, the key strategy for managing melasma remains consistent photoprotection. This involves the application of broad-spectrum sunscreens with a high sun protection factor (SPF) of 50+ or more [13]. Patients with melasma are at high risk of clinical relapses, making prolonged use of photoprotection highly recommended [21].

Conclusion

In summary, successfully treating epidermal melasma often requires a multifaceted approach. This approach may include various treatments such as dual yellow laser therapy, oral medications like tranexamic acid, and topical anti-pigment agents such as tranexamic acid and alpha arbutin. Additionally, applying sunscreen is crucial for protecting the skin from further pigmentation and preventing the recurrence of melasma.

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Potential Conflict of Interest

Authors declare no potential conflict of interest.

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