Review Article

Medical Aesthetics – Current Trends and a Review of Its Applications

Abstract

Medical aesthetics is the use of a procedure or product for a therapeutic indication which is conventionally used for aesthetics. Several medical conditions are now being treated with products, procedures or equipment that are conventionally used for aesthetic indications. This has widened the scope of treatment modalities available for dermatologists to treat various indications that fall outside the purview of aesthetic dermatology. The authors present aesthetic treatment modalities and procedures which can be used for medical aesthetics, their present-day status and usefulness in field of therapeutics with a review of published literature from "Medline" (via "PubMed"), "Cochrane," the Virtual Health Library, and Google Scholar.

Keywords: *Aesthetic applications, medical aesthetics, therapeutic aesthetics*

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Introduction

The authors define medical aesthetics/ therapeutic aesthetics as the use of a procedure or product for a therapeutic indication, which is conventionally used for aesthetics.

With the experience gained from aesthetic practice, dermatologists are uniquely qualified to implement these procedures and products for therapeutic indications.[1]

This need stems from the therapeutic gap that persists after achieving treatment finality for the primary indication, e.g., persistent erythema post rosacea or steroid atrophy treated with vascular lasers, lipodystrophy post protease inhibitors, or atrophy in en coupe de sabre, to name a few. The quality-of-life improvement after these procedures is unquestionable and here lies its importance. The authors present aesthetic treatment modalities and procedures that can be used for medical aesthetics, their present-day status, and usefulness in the field of therapeutics with a review of published literature from "Medline" (via "PubMed"), "Cochrane," the Virtual Health Library, and Google Scholar.

Indications

Every aesthetic procedure and product has the potential for therapeutic application. A number of these have a therapeutic application as an off-label indication, whereas in some cases only anecdotal reports exist, needing further research to justify their use. The following products, procedures, and equipment have literature support for their use in medical aesthetics.

Injectables

Fillers: Dermal fillers based on their rheological properties can be used for lifting and volumizing in cases of volume loss as in atrophy arising out of lipodystrophy induced by protease inhibitors, Parry–Romberg syndrome, en coupe de sabre, linear morphea, or post-traumatic facial asymmetry [Figure 1].

Autologous fat,[2] hyaluronic acid fillers,[3] calcium hydroxylapatite,[4] and polyacrylamide[5] or a combination of fillers[6] have been used to correct residual atrophy in burnt-out disease [Figure 2]. These fillers address volumetric correction and some such as autologous fat and poly-L-lactic acid have bio-stimulatory properties. The required volume of the fillers varies with the nature of the defect. With fat, a mild over correction is desirable, whereas with hyaluronic acid, under correction is usually done to allow volumetric expansion by water absorption later. The advantages of hyaluronic acid filler are the ability to correct or dissolve excess volume of the filler and reduce the chances of complications.[7]

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Ear lobe ptosis and ear hole piercing correction when surgery is contraindicated or is not desired is another indication that can be treated with dermal fillers. Hyaluronic acid fillers are preferred for this indication [Figure 3].[8]

Complications in therapeutic indications, as compared to aesthetic uses, are amplified as the volumes used are usually higher. Nevertheless, standard precautions and safe injection practices need to be followed and over-correction is avoided.[9]

Botulinum toxin: Since its introduction to clinical and later aesthetic medicine, botulinum toxin is one of the most often used aesthetic procedures worldwide.[10]

Its non-aesthetic use in dermatology is ever-expanding[11] although the U.S. Food and Drug Administration clearance in aesthetics is only for dynamic wrinkles of the glabellar complex and crow's feet.

It inhibits acetylcholine release at the presynaptic vessel along with the release of substance *P* and Calcitonin Gene-Related Peptide (CGRP). The dilutions are standard for aesthetic indications, using 2.5 mL of saline in a 100 IU vial.[12] Some indications such as palmar and axillary hyperhidrosis, however, use higher dilutions [Figure 4].[13] Reduced sweating and improvement in maceration reduced the disease severity in Hailey–Hailey disease[14] and linear IgA disease.[15] Novel uses have been described in psoriasis, atopic dermatitis, Raynaud's phenomenon, flushing, acne, rosacea, epidermolysis bullosa, scar prevention and their treatment, pruritus, post-herpetic neuralgia, and other neuropathic pain disorders.[14,16-19]

Regenerative medicine products: Regenerative medicine is an emerging new interdisciplinary field and its products are being used for acne scars, androgenetic alopecia, and facial rejuvenation amongst others in aesthetic dermatology.[20] Soluble molecules/growth factors utilized in platelet-rich plasma, platelet-rich fibrin, and autologous fat for their accelerated tissue healing apart and improvements in skin surface features are now being used for non-healing wounds [Figure 5], post burns, and post-traumatic scars.[21-23] Their use in morphea and scleroderma for their regenerative potential has also been described.[24,25]

Lipolytic injections: Phosphatidylcholine (PDC) and deoxycholate (DC) injections are used for injection lipolysis as an FDA-cleared indication of small pockets of fat, less than 500 mL in volume. PDC and DC form liposomes and micelles, from the larger fat globules, which are easily cleared from the body.[26] It is this mechanism of action that is extrapolated to treat lipomas. PDC also acts as an emulsifier and stimulator of lipase enzyme. Their use has been extrapolated off-label to treat superficial subcutaneous lipomas and also to shrink them before surgery.[27,28] It causes fat necrosis. Shrinkage in the size from 37% to complete resolution has been reported. However, recurrence after treatment has been reported.[29] No standard protocol is devised, and the volume of injection depends on the size of the lipoma.[30,31] In the authors' experience, smaller lipomas (smaller than 5 cm in diameter) respond well, whereas larger lipomas have at best a moderate reduction in size [Figure 6].

Figure 1: Volume restoration in a case of post-traumatic facial asymmetry with hyaluronic acid filler

Figure 2: Linear morphea over forehead managed with hyaluronic acid fillers and platelet-rich plasma

Figure 3: Ear lobe piercing corrected with hyaluronic acid filler

Dermal threads

Absorbable dermal threads of polydioxanone, poly-L-lactic acid, polyglycolic acid, polycaprolactone, and poly L-lactide-co-ϵ-caprolactone induce collagen remodeling and have been used for rejuvenation, volumization, lifting, and augmentation of skin.[32,33] Neo-angiogenesis, fibroblast stimulation with collagen remodeling, results in subsequent skin tightening, which

Figure 4: Starch-iodine test in a case of axillary hyperhidrosis: pretreatment (left) and posttreatment (right) with botulinum toxin (20 mg/mL) after 1 week, revealing improvement with a few areas (persistent positive starch-iodine test) needing additional treatment.

Figure 5: Non-healing ulcer treated with platelet-rich plasma fortnightly sessions for 3 months and saline dressings

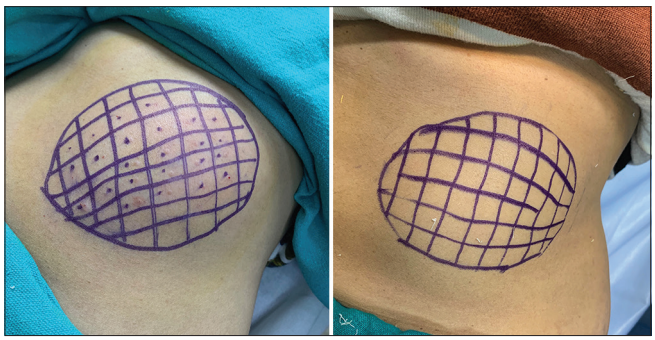

Figure 6: Large lipoma over the abdominal wall showing a moderate response to four sessions of monthly intralesional deoxycholic acid (10 mg/mL) injections

continuously improve over a period of time.[34] They have been used in facial paralysis by targeting the affected side to improve it by volumization and countering the tissue descent and correcting tissue laxity, thus preventing drop of oral commissure.[35-37] Use of barbs to grasp tissue has been used to specifically target the ptotic/sagging skin.[32,35,38] Acne scars improvement is induced by inducing tissue remodeling.[39,40] Hair mass index was observed to improve in androgenic alopecia with monofilament thread injections as monotherapy or in combination with minoxidil.[41,42]

Lasers and light sources

Hair removal and follicular disorders: Hair removal using Ruby, Alexandrite, Diode, Neodymium: Yttrium Aluminum Garnet (Nd: YAG) lasers and Intense Pulse Light (IPL) sources can also be used for their therapeutic applications to treat post graft hypertrichosis,[43] faun tail nevi, and the rarer anterior cervical hypertrichosis [Figure 7].[44] Chronic inflammatory disorders of the follicle such as pilonidal sinus,[45,46] folliculitis decalvans, dissecting cellulitis, hidradenitis suppurativa, pseudofolliculitis barbae[47,48] and keratosis pilaris are now increasingly being treated with laser-assisted hair reduction to obviate the need for prolonged medications and surgery and to improve the quality of life.

Diode, long-pulse Nd: YAG laser and IPL are better suited for darker terminal hair in the skin of color and regions with heavily melanized skin. Nevertheless, unlike aesthetic laser, hair removal pain associated is higher in treating these indications. Topical anesthesia is useful, and authors recommend using it as a routine.

For pilonidal sinus, it is a necessary addon to surgery and has proven effective in preventing recurrences. Six or more sessions 4–6 weeks apart are needed for long-lasting results. The first session may be administered up to a week before surgery and followed up thereafter with additional sessions. More than 80% reduction in recurrences has been reported.[45,46]

Hidradenitis suppurativa needs higher doses with double or triple stacking to treat the inflamed hair follicles and scarring, which may have already been present. In a meta-analysis on the use of non-ablative lasers, long-pulse Nd: YAG, IPL, and Alexandrite proved useful. Higher fluences and management of Hurley stage I/II for up to 10 sessions administered 4–6 weeks apart produced the best results.[49,50] Unlike the safer, conventional use of IPL in the super pulse mode (750–1200 nm) here, a 400–1200 nm filter is used.

Vascular disorders: Lasers such as Pulse Dye Laser targeting oxyhemoglobin with absorption peaks at 542 nm and 577 nm are used for the management of vascular malformations either by themselves or by administering photodynamic therapy.[51] Increasingly, other lasers and light sources such as eodymium-doped, yttrium–aluminum–garnet (Nd-YAG) laser, 532 nm Potassium-Titanyl-Phosphate (KTP), 595 nm PDL, dual-wavelength long-pulsed 775 nm alexandrite/ neodymium: yttrium-aluminum (Nd: YAG) 1064 nm, and IPL are being used for spider nevi, telangiectasia, and

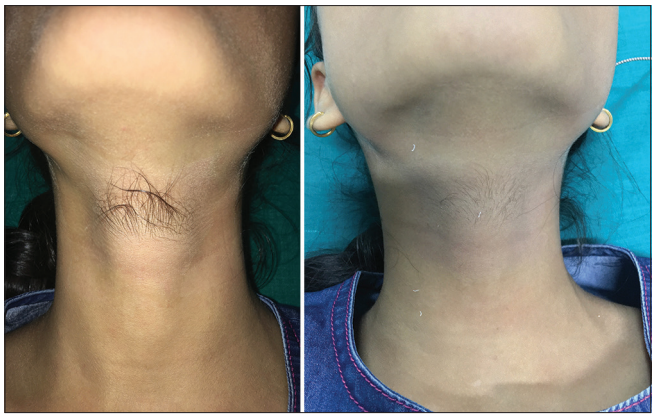

Figure 7: Anterior cervical hypertrichosis pretreatment (left) and post-treatment (right) after five monthly intense pulse light sessions (755–1200 nm)

cherry angiomas. Among these PDL, Nd: YAG, and IPL are usually preferred. Telangiectasias with a diameter less than a 30 gauge needle is amenable to laser therapy.[52] Larger spot sizes of Nd: YAG owing to its longer wavelength help treat deeper reticular vessels. Superficial spider nevi and fine telangiectasias respond to IPL with a 500–1200 nm filter. However, erythema, blistering purpura, and erosions at high fluences restrict widespread IPL use [Figure 8].

Inflammatory acne and its vascular component respond to PDL 595 nm and 1319 nm, IPL 400–1200 nm, by upregulating TGFB2, an anti-inflammatory cytokine.[53,54] PDL 595 nm has no depilatory effects and can hence be used safely in males too.

Hypertrophic scars respond better than keloids to PDL and long-pulse Nd: YAG. Mechanisms of action postulated are capillary destruction resulting in hypoxemia, a decrease in cytokine or growth factor levels with a resultant reduction in local collagen production.[55] Combination treatments with intralesional triamcinolone and 5-fluorouracil improve the results.[56] Superficial vessels can be targeted by Nd: YAG and deeper with PDL. Repeated sessions are needed until there is no erythema/induration. Contact mode Nd: YAG has a better response owing to its deeper penetration as compared to non-contact mode Nd: YAG.[55]

Erythematotelangiectatic rosacea responds well to PDL, Nd: YAG, and IPL [Figure 9]. A combination with retinoids or follow-up with topical brimonidine 1% improves results.[57,58] Papulopustular lesions showed a good response to treatment by IPL. Epidermal cooling helps to reduce the side effects of treating superficial vessels with higher fluences and including a margin of 1–2 mm of normal skin helps improve results. IPL is also useful for other conditions causing superficial erythema, e.g., Poikiloderma of Civatte and post steroid abuse red skin.[57-62]

Tissue ablative/non-ablative resurfacing and scar revision: Skin resurfacing and scar revision are common aesthetic procedures used for facial rejuvenation and acne scar

Figure 8: Port wine stain in a 9-year-old boy: bruising and superficial erosions 5 days after a session of intense pulse light (550–1200 nm)

treatment. Initial treatment of scars with ablative lasers was described in the early 1980s when ablative continuous wave CO_2 lasers were used.[63] With the introduction of fractional photothermolysis, the side effect profile improved and downtime reduced considerably. Ablative fractional resurfacing (AFR) lasers include the fractionated CO_2 (10,600 nm), Erbium: Yttrium Aluminum Garnet (Er: YAG 2990 nm) and Yttrium Scandium Gallium Garnet (YSGG 2790 nm) lasers that have a high affinity for water.

Burn scar pliability, texture, and sclerosis improve with PDL (585–595 nm) if the scar is less than 1.2 mm and if instituted after 3 to 6 months of burn injury.[64]

The use of fractional CO_2 alone or in combination with platelet-rich plasma, micro fragmented adipose tissue, or stromal vascular fraction administered as monthly sessions improve post-traumatic scars.[63-67] Burns and post-traumatic scars need higher fluences of up to 70 mJ/cm^2 as compared to acne scars.[68-70] Ablative CO_2 laser is also used to debulk phymatous rosacea.[71]

An ideal approach would be to treat erythema and texture with PDL or IPL or wait for it to settle as mentioned above and then use the ablative lasers for deeper scar management.

Non-ablative management of scar using 1,550 nm non-ablative fractional Erbium laser, which has a penetration depth of 2 mm had shown a good response as reported by Waibel *et al*.[72] They reported an excellent response in up to 60% of cases. Other non-ablative lasers described for acne scar management such as 1540 nm Erbium glass laser, long-pulsed neodymium-doped yttrium aluminum garnet laser 1320 nm or 1064 nm need to be explored for post-burn and traumatic scars.[73] Although

Figure 9: Rosacea in a 64-year-old male patient: Pretreatment (left) and posttreatment (right) after six sessions of intense pulse light (550–1200 nm)

they are safer in Fitzpatrick skin types IV–VI with a lower downtime, they are limited by their depth of penetration.

Combination with regenerative products may enhance results [Figure 10].[74]

Ablative lasers are used for therapeutic removal of benign and early malignant skin growths such as actinic keratosis, angiofibroma, Bowen's patches, comedones, colloid milium, milia, superficial basal cell carcinoma, xanthelasma palpebrarum, dermatosis papulosa nigra, epidermal nevi amongst other skin conditions [Table 1].[75,76]

Their use in the management of onychomycosis from the clearance of the affected nail to the treatment of the infected nail is being increasingly described. Fractional CO_2 lasers function to destroy the fungal elements with heat and promote transdermal drug delivery on topical antifungals. Long-pulse and Q-switched Nd: YAG target the chromophores such as xanthomegnin found in the fungal cell wall. The authors have reported that their therapeutic response is as good as oral agents. We found that using Nd: YAG is much more painful than a fractional CO_2 laser. Repeated passes administered in sessions every 4–6 weeks for 3–6 sessions are effective [Figure 11].[77-81] Non-onychomycotic onychogryphosis also responds to fractional CO_2 laser ablation.

Hyperpigmentation and laser: Tattoo removal has been synonymous with pigment lasers apart from their application in skin and color rejuvenation. Q-switched ruby laser (694 nm), alexandrite (755 nm), 1064 nm, and 532 nm Nd: YAG lasers are the main lasers used. Actinic lentigo, lento simplex, ephelides, siderosis, and hemosiderosis need shorter wavelength lasers with adequate epidermal cooling, and acquired dermal melanocytosis responds better to longer 1064 nm wavelengths. Fixed-drug eruptions [Figure 12], drug-induced argyrosis, and chrysiasis, ochronosis, and lichen planus pigmentosus respond well to 1064 nm Qs Nd: YAG and low-fluence 1064 nm Nd: YAG picosecond laser.[82] Skin toning treatment with 1064 nm Qs Nd: YAG 1.8–4.6 J/cm^2 in up to 10 passes and multiple sessions alone or combination with tacrolimus have shown good response.[82-84] Bhari *et al*.[85] reported reduced tyrosinase activity with the use of 1064 nm Q-switched Nd-YAG laser, with no significant change in erythema or pigmentation index. Larger spot sizes of 8–10 mm with low fluences have been proposed to be safer and effective with the least side effects in darker skin types.[26]

Figure 10: Post-traumatic scar on the face in a 30-year-old male patient: pretreatment (left) and post-treatment (right) after six monthly sessions of fractional CO_2 laser (10,600 nm) with platelet-rich plasma

The use of ablative fractional CO_2 and Erbium YAG before the use of pigment laser helps enhance their response when targeting thicker lesions.[86]

Low-level laser therapy

The use of red and infrared spectrum wavelengths used as cold lasers at non-thermal irradiance to prevent thermal damage and at the same time cause biological activity has been reported for some time. Their mechanism of action is not fully understood. The wavelengths penetrate deep enough to cause cellular changes. Cytochrome C oxidase acts as a mitochondrial chromophore along with photo acceptors in the plasma membrane, resulting in increased enzymatic activity, ATP production, and mitochondrial activity, thereby enhancing intracellular signaling and resulting in cellular proliferation and tissue repair.

As a therapeutic modality, it has been used in pigmentary conditions, papulosquamous disorders, burns and wounds, and alopecia.[87,88]

Microneedling

Microneedling was initially described in 1995 when Orentreich and Orentreich demonstrated dermal needling for scar treatment. Traditionally used as a collagen induction therapy for facial scars and skin rejuvenation, it now finds itself being useful for post-traumatic, post-varicella, hypertrophic and burn scars, alopecia, drug delivery, and hyperhidrosis, amongst other indications. The delivery device may be a manual dermaroller, dermastamp, or an automated device, with or without combinations with other technologies, such as radiofrequency.[89]

Burn scars have been shown to respond up to 80% with normalization of the dermis within a year of treatment. Camirand and Doucet initially used a tattoo gun with needles in the absence of pigment to treat scars.[90] Like ablative lasers, microneedling radiofrequency using

Table 1: Applications of medical aesthetics

Treatment modality		Indication
Lasers and light sources	Low-level laser light therapy	Vitiligo
		Acne
		Wound healing
		Burns
		Psoriasis
		Alopecia areata
		Alopecia
		Recurrent herpes
		Photoprotection
		Hypertrophic scars and keloids
		Aphthous ulcers
	CO_2 Laser	Scars atrophic and hypertrophic
		Verruca vulgaris
		Seborrheic keratosis
		Xanthelasma palpebrarum
		Acrochordons
		Nevi
		Angiokeratomas
		Contractures
		Calcinosis cutis
		Alopecia
		Laser-assisted drug delivery
		Onychomycosis
	Nd: YAG	Nevi
		Onychomycosis
		Spider nevi, telangiectasia, cherry angiomas
		Keloids and hypertrophic scars
		Lichen planus pigmentosus
		Fixed drug eruption
	Intense pulse light	Acne
		Rosacea
		Vascular malformations
		Therapeutic hair removal
Regenerative medicine	Micro fat	Scars
		Morphea, scleroderma, lipodystrophy in HIV
		Biofillers in atrophic scars
	Autologous micrografting	Androgenetic alopecia
		Vitiligo
	PRP/PRF	Scars
		Androgenetic alopecia
		Alopecia areata
		Non-healing ulcers
		Biofillers
		Lichen sclerosus
		Vitiligo
Microdermabrasion		Acne
		Acne scars
		Post-inflammatory hyperpigmentation
		Transepidermal drug delivery
		Primary cutneous amyloidosis

Contd...

Table 1: Contd...

Treatment modality		Indication
Microneedling	Dermaroller	Hypertrophic scars
	Dermastamp	Burn and posttraumatic scars
	Automated microneedling device	Atrophic acne scars
	Microneedling radiofrequency	Hyperhidrosis
		Hidradenitis suppurativa
		Transdermal drug delivery
Dermal threads		Facial nerve palsy
		Atrophic acne scars
		Alopecia
Dermal fillers		Facial deformities
		Depressed scars
		Lip augmentation for angular cheilitis
		Acquired lipodystrophy
		Parry–Romberg syndrome
		Lupus panniculitis
		AIDS lipodystrophy
		Linear morphea
		Earlobe plumping, earring ptosis
		Ear lobe repair
Botulinum toxin		Palmoplantar and axillary hyperhidrosis
		Auriculotemporal syndrome
		Hailey–Hailey disease
		Chromhidrosis and Bromhidrosis
		Psoriasis
		Hidradenitis suppurativa
		Pompholyx
		Eccrine nevus
		Keloids and hypertrophic scars
		Raynaud's phenomenon
		Facial flushing
		Linear IgA bullous dermatosis, epidermolysis bullosa simplex, Darier disease, pachyonychia congenita
		Notalgia paresthetica
		Postherpetic neuralgia
		Alopecia areata
		Androgenetic alopecia
Chemical peeling		Active acne
		Acne scarring
		Superficial scars
		Seborrheic keratoses
		Actinic keratoses
		Warts
		Milia
		Sebaceous hyperplasia
		Dermatosis papulosa nigra
Electroporation		Transdermal drug delivery
Tattoo		Vitiligo

non-insulated needles targets the entire depth of the scar, surface down. They are used in the destruction of apocrine and eccrine glands in focal hyperhidrosis and hidradenitis suppurativa.[49] Microneedles are increasingly being used to deliver macromolecules such as insulin, growth hormones, immunobiological, proteins, peptides, and vaccines apart from cosmeceuticals in aesthetic practice.[91,92]

Figure 11: Total dystrophic onychomycosis: Pretreatment (left) and post-treatment (right) after six sessions of monthly fractional CO_2 laser (10,600nm, 256 spots/cm², pulse interval of 0.5 mm, pulse duration of 0.1 ms) and a follow-up period of 3 months

The addition of bilayer dissolving needles containing triamcinolone and 5-fluorouracil have been described for the management of hypertrophic scars.[93] Solid needles can be used for access to deeper layers with application of topical agents after microneedling as in the treatment of alopecia areata with triamcinolone acetonide.[94]

Chemical peels

Peeling agents exhibit an ability to produce chemical burns at controlled skin depths, induce improvement, modulate the function of the stratum corneum barrier,[95] and reduce sebum production by their antibacterial, anti-inflammatory, keratolytic, and comedolytic effects. Because of these actions, they have been used in acne vulgaris, xerosis and ichthyosis, and superficial scarring.[95] Chen *et al*.[96] in their systematic review on acne management noted a positive response to chemical peels. Salicylic acid, trichloroacetic acid, mandelic acid, and Jessner's peel have been used with recommendations to avoid deep peels in darker skin types. Salicylic acid and mandelic acid combinations were more effective in mild to moderate acne than glycolic acid. "Field-directed" therapy with chemical peels is useful in multiple actinic keratoses and seborrheic keratoses. A combination of 5-fluorouracil with Jessner's solution or with 70% buffered glycolic acid solution, carried out for 8 weeks, offered higher clearance than just peeling alone.[97] Glycolic and trichloroacetic acid have been used for warts and superficial scars.[98,99] Combination peels have been used for verruca plana.[100]

Conclusion

The extrapolation of aesthetic products and procedures into the therapeutic arena is fast growing. Thorough knowledge of the changes in local anatomy and dermatological condition induced is paramount in providing the best clinical outcomes as then the robust science behind the procedure, product, or equipment can be best utilized.[11] Their use in aesthetics is revolutionizing the treatment of many medical conditions, with several therapeutic indications now being treated with conventional aesthetic products and equipment. Medical aesthetics, hence, has the potential to fill a therapeutic gap that conventional dermatological practices are unable to address.

Figure 12: Lightening of pigmentation in a case of fixed drug eruption after three sessions administered once a month with Q-switched neodymium-doped yttrium aluminum garnet laser 1064 nm

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Conflicts of interest

There are no conflicts of interest.

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