Study on the Effect Fractional Ablative Erbium: YAG Laser in Treatment of Melasma

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Abstract

Introduction: Melasma is a kind of acquired chronic hyperpigmentation that primarily have an effect on women on sun-exposed regions of the body, particularly on the face in Fitzpatrick skin types III-V. The investigation background is at the Dermatology Clinic at NILES, Cairo University, Egypt. **The aim:** This investigation aims to evaluate the clinical value and protection of fractional ablative erbium: YAG Laser therapy in handling the melasma. **Patients, materials and methods:** This study included 30 patients with melasma on their face aged 20-50 years. The patients were treated by four sessions of fractional erbium YAG laser at a period of four weeks. **Results:** The percentage of improvement in patients treated by fractional erbium YAG laser was 20 – 80% with a mean 54.33 ± 18.01. **Conclusion:** It was monitored that fractional erbium YAG is successful in treatment of patients with melasma.

Key Words: Erbium YAG Laser, Melasma.

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Introduction

Melasma is a most frequent pigment chaos associated with psychosocial distress. Melasma occurs mainly in women gender (only 10% of the victims are males) with Fitzpatrick skin categories IV to VI. Melasma is typically exemplified by means of brownish macules more often on the face (Pawaskar MD, 2007; Arora P, 2012). The pathogenesis of melasma is not clear enough but the most important etiologic factors are genetic factor and ultraviolet radiation exposure (Puri N, 2013).

It is to be noted that Melasma can be effectively categorized in accordance with the position of the lesions into craniofacial, malar as well as mandibular. Histologically, melasma is three types: epidermal type, dermal type and mixed category. Also the Wood's lamp is effectively employed for the purpose of deciding the category of melasma: epidermal, dermal and mixed (Kang WH, 2002; Rokhsar CK, 2005).

Various lasers are used to effectively take care of melasma, together with Q-switched Nd: YAG, Q-switched alexandrite, pulsed dye laser, as well as different fractional lasers as fractional ablative erbium: YAG laser (2940 nm) (Arora P, 2012).

The laser procedure of pigmented lesions is in accordance with the theory of Selective Photothermolysis as precise wavelength of power is delivered in a phase of time smaller than the thermal relaxation time (TRT) of the intended chromophore (Arora P, 2012).

The ablative lasers target the water. These lasers can indirectly diminish melanin deposits from mutually the epidermis and dermis by vaporization of tissue including amount of irregular epidermal melanocytes and melanin content.

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Also, during healing procedure, the epidermis is effectively restored from the appendiceal components by relocation of novel melanocytes to the epidermis that is incapable of generating melanin (Wanitphakdeedecha R, 2009).

Aim of the Study

In order to assess the clinical effectiveness and safety of fractional ablative erbium: YAG Laser therapy in providing treatment of melasma.

Patients, Materials and Methods

This study included **30** patients with melasma on their face aged 20-50 years. Patients were treated by fractional erbium YAG laser.

We excluded the patients who already been treated inside the precedent 6 months, conceived patients or lactating women.

The investigation protocol was endorsed through the ethical board of National Institute of Laser Enhanced Sciences (NILES), Cairo University. In addition, the study followed the ethical guidelines of the NILES, Cairo University.

Informed approval was acquired from every participants incorporated in the investigation.

It is to be noted that patients were undergone complete records observation together with age, sex, occupation, duration of the lesion, previous treatments received past history and family history of same condition.

Full examination to determine type of melasma was carried out through both Wood's lamp in addition to Dermoscopy, its distribution on the face, and its severity index by MASI score, and its vascular and pigmentary component by dermoscopy.

Treatment was every 4 weeks with fractional ablative erbium: YAG (2940 nm) laser.

Pre-operative measures: application of topical anesthesia for one hour prior to laser Post-operative measures: application of local cooling, antibiotic ointment, and sunscreen. Mild topical steroid was prescribed if erythema and edema persist more than 3 days. Avoidance of rubbing and scratching was advised.

Assessments were effectively performed in accordance with the patient approval, inspections and photographic records at the beginning and the closing stages of the treatment and after the period of follow up.

Histopatological examination: small skin biopsy (by punch 2mm) under complete sterilization from the part of the face before and after the process. The sites of biopsies healed with unnoticeable scars on the face.

Dermoscope was used to evaluate degree of pigmentation and vascular component of melasma.

Patients were continuously monitored for six months following the completion of the treatment to observe recurrences in addition to any side effects (subsequent to one month, following three months and after six months).

Safety assessment to detect any complications occurred for the patients as burning pain erythema, edema, itching, infection, any allergic manifestations, post inflammatory hypo or hyperpigmentation etc.…

Statistical analysis for the data was done.

Results

This investigation was performed on 30 patients with melasma on their face, aged between 20 years and 50 years with a mean 37.365± 2.955. Patients were undergone four sessions of 2940 nm Erbium YAG fractional laser with mean age 37.13 ± 5.60.

The type of melasma was divided by woods light in to 3 categories (epidermal, dermal, and mixed). It is observed that 16 patients with epidermal melasma, 10 patients with dermal melasma, moreover 4 patients with mixed melasma.

The skin types of the patients ranged from II – IV. There were 12 patients with skin type II, 14 patients with skin type III and 4 patients with skin type IV.

Severity index of melasma according to MSI score in patients treated by laser, there were 4 patients with mild melasma, 18 patients with restrained melasma and 8 patients with rigorous melasma.

The percentage of improvement by laser therapy was 60 – 80 % in epidermal melasma, 20 - 50 % in dermal melasma, and 30 – 50 % in mixed type. There was significant improvement in epidermal type by laser treatment (P- value = 0.001*).

Table 1. The percentage of improvement in different types of melasma

Improvement %	Epidermal	Dermal	Mixed
Range	60 – 80%	20 – 50%	30 – 50%
Mean ± SD	68.13 ± 7.53	38.0 ± 13.04	40.0 ± 14.14
F. test	15.349		
p. value	0.001*		

The percentage of improvement in patients treated by fractional erbium YAG laser was 20 – 80 % with a mean 54.33 ± 18.01 **Table (1).** Clinical and histopathological images of few patients are exposed in **Figs. 1 and 2**.

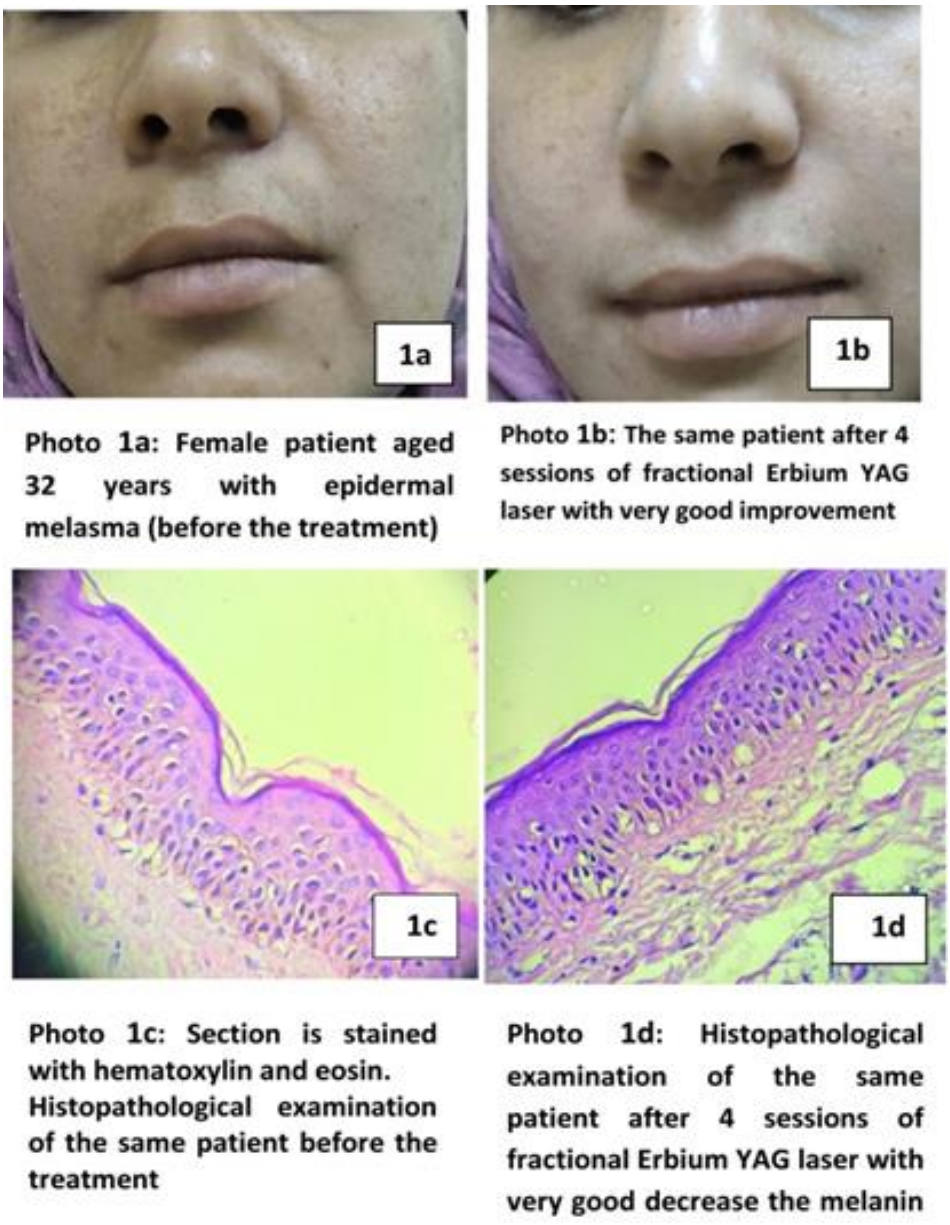

Fig. 1. Patient with epidermal melasma before and after the laser treatment

Photo 2a: Female patient aged 35 years with mixed melasma (before the treatment)

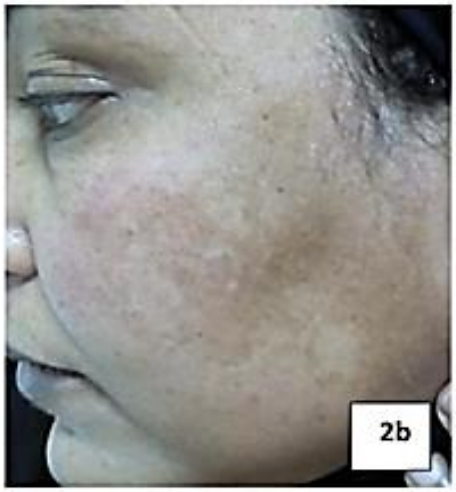

Photo 2b: The same patient after 4 sessions of fractional Erbium YAG laser with good improvement

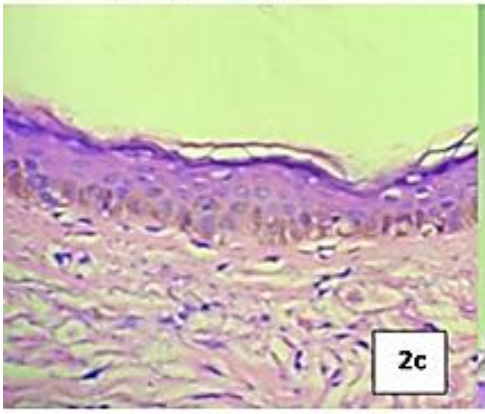

Photo 2c: Section is stained with hematoxylin and eosin. Histopathological examination of the same patient before the treatment

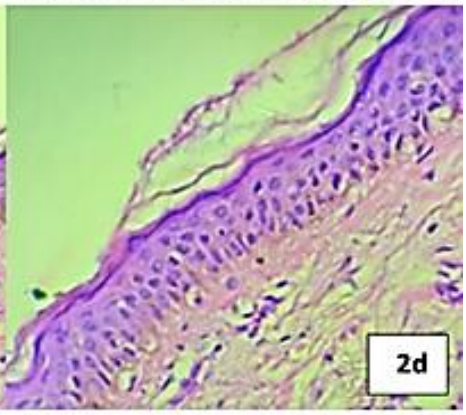

Photo 2d: Histopathological examination of the same patient after 4 sessions of fractional Erbium YAG laser with good decrease the melanin content

Fig. 2. Patient with mixed melasma before and after the laser treatment

The percentage of improvement in patients treated by laser with skin type II was 50-80%, 20 - 70% in patients having skin type III and 30% in patients having skin type IV with significant improvement in skin type III (p. value =0.012*).

The improvement was 50% in patients having mild melasma, 20-80% in patients having modest melasma and 30-75% in patients having severe melasma with non-significant value (p. value =0.693).

By dermoscopy, melasma has pigmented component and vascular component. The percentage of decrease of vascular component was 20-60% with significant decrease in vascular component in patients treated by fractional Erbium YAG laser (P. value= 0.001*) **Table (2).**

Table 2. The percentage of decrease of vascular component by dermoscopy

Dcrease of vascular component % by dermoscopy	Erbium YAG Laser
Range	20 – 60
Mean ± SD	45.23 ± 12.46
P. value	0.001*

In this study, all patients were continuously monitored after 3 months and after 6 months. No recurrence occurred after 3 months but the recurrence occurred in some cases after 6 months.

There was recurrence in 6 patients of 30 patients treated by laser (20 %).

All patients (100%) suffered from burning pain during and immediately after session with variable degree. All patients (100%) suffered from

erythema after laser sessions but this erythema was improved by the topical steroid. No post inflammatory hypo or hyperpigmentation was occurred.

Discussion

Melasma is a common pigment disorder and always needs for dermatological care. Melasma causes psychosocial as well as emotional distress, and reduces the superiority of life of the concerned patients (Handel AC, 2014).

This study was carried out on 30 patients (29 female and only one male) with melasma on their face with skin types II-IV, with mean age 37.365±2.955. That was in agreement with **Miot in 2009** and **Handel in 2014** who said that melasma is a kind of acquired chronic hypermelanosis which primarily have an effect on women at some stage in productive age and additional pigmented phenotypes. Melasma is differentiated through unbalanced brown macules symmetrically dispersed on sun-exposed regions of the body, especially on the face (Handel AC, 2014; Miot HA, 2009).

Sun exposure (devoid of burning) is the most imperative triggering aspect for melasma. The exploitation of elevated-protection-factor sunscreen considerably reduces the strength of the disease in 50% (Handel AC,2014; Miot HA,2009; Lakhdar H, 2007).

Here, the patients were undergone through 2940 nm Erbium YAG fractional laser**. Manaloto in 1999** reported that the Erbium YAG laser resurfacing effectively improves melasma (Manaloto RMP, 1999).

There are other topical modalities of treatment of melasma as topical hydroquinone. Hydroquinone is the kind of top level healing of melasma. Hydroquinone influences not only the development, melanization, and deprivation of melanosomes, however it also have an effect on the membranous configurations of melanocytes and ultimately causes necrosis of complete melanocytes (Bandyopadhyay D,2009).

In addition, there are other categories of lasers employed in process of melasma as Q-switched Nd: YAG. This is the most extensively exploited laser for the healing process of melasma. The 1064 nm Q- switched Nd: YAG is well engrossed through melanin and as a result of a longer wavelength roots negligible injury to epidermis and is not engrossed by haemoglobin. The deeper skin infiltration is also supportive in the process of aiming dermal melanin. Small dosage QS Nd: YAG laser stimulates sublethal injury to melanosomes causing disintegration and crack of melanin granules into the cytoplasm (Arora P,2012; Lee MWC, 2003).

The type of melasma was divided by woods light in to 3 types (epidermal, dermal, and mixed). That was in agreement with **Tamler in 2009** who mentioned that by Wood's lamp examination: epidermal melasma - there is a color emphasis since the light is engrossed through the surplus of melanin in the basal or suprabasal areas, dermal melasma– no color emphasis is obvious and mixed melasma– augmented staining is observed only in a small number of sites as the deposit of melanin happens in both dermis and epidermis (Tamler C, 2009).

Tamler also said that by dermoscopy, epidermal category the brownish and standard pigmented network; dermal category, the discoloration bluish gray, where the network drops its reliability; and mixed category, the presentation of regions in agreement with both (Park GH, 2015).

On the other hand, **Lee in 2017** mentioned that melasma engages augmented melanin construction and melanocytosis. It will possibly be epidermal, dermal, or mixed (Tamler C, 2009).

Also **Hammerschmidt in 2012** reported that although Wood's lamp is a extensively employed technique in the process of classification of melasma, on the other hand it has a extremely low rate of proper diagnosis and dermoscopy can be used to classify melasma into: epidermal, dermal, and Mixed (Sheth VM, 2011).

Melasma was classified according to the severity index of melasma in to mild, moderate and sever. As **Hammerschmidt in 2012** reported that the MASI is a constructive measure in the clinical categorization of melasma (Sheth VM,2011).

In this study, the percentage of improvement was 60 – 80 % with significant in epidermal melasma treated by laser (P- value = 0.001*). It was in agreement with **Wanitphakdeedech in 2009** who mentioned that the fractional lasers that target the water, can indirectly decrease melanin deposits from both the epidermis and dermis because of vaporization of tissue leading to decrease the amount of abnormal epidermal melanocytes and melanin substance and also to decrease the quantity of melanin dumped into dermal melanophages. Also, during healing procedure, the epidermis is redeveloped from the appendiceal units by relocation of new melanocytes to the

epidermis that is not capable to generate melanin (Wanitphakdeedecha R, 2009).

In this study, the percentage of improvement in patients treated by fractional erbium YAG laser was 20 – 80 % with a mean 54.33 ± 18.01 and the percentage of improvement in patients treated by chemical peeling was 30 – 85 % with a mean 53.33 ± 18.09. So, there was no noteworthy differentiation in the percentage of improvement in both clusters (P- value = 0.881). This is expected as the mechanisms of both procedures are very effective.

By dermoscopy, melasma has pigmented component and vascular component. The percentage of decreasing in vascular component in group (I) was 20-60% and in group (II) was 10-30% with significant vascular decrease in patients treated by laser (P. value= 0.001*)**. Tamler in 2009** mentioned that dermoscopy of melasma demonstrates incredibly distinctive transformations. It is probable to observe the vascular constituent, which is there in a huge quantity of patients (Tamler C, 2009).

Vascular and pigmented components can be observed by dermoscopy. But the dermoscopy is more useful in measuring the vascular component and Wood's lamp is more useful in measuring the pigmented component. It was in agreement with **Hammerschmidt in 2012** who reported that in a relative investigation with Wood's lamp, dermoscopy was regarded as more suitable for classifying melasma since it assessed vascular constituents independently. Dermoscopy was not regarded as a better classification scheme to evaluate pigmentary components (Hammerschmidt M, 2012).

The decrease of vascular component by the laser might be due to thermal effect of laser on blood vessels causing thermal necrosis. It was in agreement with **Katz in 2010** who reported that fractional photothermolysis creates manifold microscopic zones of thermal harm and leaves the greater part of the skin intact as a pool for healing. These manifold columns of thermal harm are called micro thermal treatment zones (MTZ) and initiate extrusion of melanin and damaged melanocytes (Katz TM, 2010).

Also **Park in 2015** mentioned that the fractional type fabricates denatured columns of epidermis and dermis, and effectively interrupts the dermal-epidermal junction (Park GH, 2015).

During the follow up of patients, there was recurrence in 6 patients of 30 patients (20 %). **Sardesai in 2013** and **Sheth in 2011** said that due to unclear pathogenesis of melasma, treatments of melasma aim to decrease exposure to sun radiation. This reduces the biosynthesis, transfer and relocate of melanin. As a result, long-term therapies are essential, and reappearance rates are elevated (Sheth VM, 2011; Sardesai VR, 2013).

All patients (100%) suffered from burning pain during and immediately after session with variable degree. All patients (100%) suffered from erythema after laser sessions but this erythema was improved by the topical steroid. No post inflammatory hypo or hyperpigmentation was occurred. **Sharad in 2013** reported that the slight consequences observed are: erythema, stinging sense, feeling of pulling of facial skin, gentle burning, and fleeting post inflammatory hyperpigmentation. (Sharad J, 2013).

Also **Arora in 2012** mentioned that the laser procedure of melasma is still divisive. This is for the reason that lasers have not been capable of constructing absolute clearance of melasma and reappearance rates are higher. Laser procedures also root impediments like hypopigmentation and post-inflammatory hyperpigmentation (Arora P, 2012).

Conclusion

Here, Melasma occurred mainly in females (skin type II-IV). There was significant percentage of improvement in patients treated by laser. By dermoscopy, the laser treatment caused significant decreasing in the vascular component. There was recurrence after 6 months.

Conflict of Interest

The authors declare that they have no conflict of interest.

Funding

There are not any financial ties to include.

Ethical Approval

"All procedures performed in studies involving human participants were in accordance with the ethical standards of National Institute of Laser Enhanced Sciences (NILES), Cairo University. In addition, the study followed the ethical guidelines of the National Institute of Laser Enhanced Sciences (NILES), Cairo University."

Informed Consent

Informed consent was obtained from all individual participants included in the study.

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