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Evaluation of clinical and histological findings of 73 patients who were diagnosed with skin aging under CO_2 and YAG laser ablation

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Abstract
The use of laser equipment in dermatology was increasing, which the laser to perform skin resurfacing favors the treatment of wrinkles, photo aging, and scars, but it is absolutely necessary to know and understand its bases of operation and its clinical and histological effects. The current study was aimed to evaluate clinical outcomes of skin aging management under CO_2 and YAG laser techniques.
A cross-sectional study aimed to assess patients' clinical and histological data of skin aging undergone lasers (CO_2 and YAG). All medical records were enrolled into 73 patients who were diagnosed in the dermatology clinic department. We had enrolled clinical and diagnostic features of patients with skin aging in both groups. Based on type of laser treatment, This study involved two types of groups where the first group shown 58 cases who underwent to fractional CO_2 laser, while 15 cases who undergone to YAG laser, where it assessed the severity of wrinkles for the skin by wrinkle assessment scale (WAS), it also wrinkle reduction alongside with patient satisfaction in the patients following laser treatment.
Our findings showed that almost all patients with ages 40-49 years had Predominance with 34.2%, where males got 55 cases while females got 18 cases. In improvements of skin aging in patients, we found that 76% patients had skin improvements, 67.6% patients had skin aging reduction (1.7 ± 0.3) after 12-month follow-up, elastin improvement with 80%, and 90% patients were satisfied or more in the CO_2 laser group. In YAG laser group, this study indicated that 66% patients had skin improvements, where 62.6% skin aging reduction (2.2 ± 0.6) after 12 month follow - up, elastin improvement with 75%, and 80% patients were satisfied or more, where almost all 73 patients had complications with 20.55%, prolonged Erythema (>3 weeks), and hyperpigmentation were the most prevalent in the patients, due to that, we conclude which each of fractional CO_2 laser and YAG laser show as a high effectiveness as in skin rejuvenation, but fractional CO_2 laser technology is being superior in reducing wrinkles and stimulating collagen production.

Keywords: C02 laser, yag laser, skin aging, skin histological, wrinkle scale, and satisfaction rate

Introduction

Skin rejuvenation were involved each of renewing the epidermis and stimulating of formation of collagen in the dermis using ablative lasers [1]. The common mechanism of action in this type of laser involves the complete elimination of the epidermis and part of the papillary dermis, residually causing a thermal deposit in the tissue that induces the formation of collagen [2]. It was also found that the main problem after practicing laser skin resurfacing is the long recovery period required by the skin, conditioning that patients cannot continue with their work and/or social activities for several weeks [3]. Adverse effects and complications can become important and difficult to treat, particularly those cases that occur with prolonged erythema, hyperpigmentation, secondary scarring, and/or infection [4].
Laser, after just over 4 years of clinical experience, is presented as one of the lasers of choice for skin rejuvenation [5]. Laser allows us a great versatility depending on the degree of photoaging of the skin, pigment changes, atrophic or acne scars, or other skin alterations. In terms of technological advances, a controlled ablation of the skin layer by layer and associate it with an appropriate heat diffusion creating inflammatory phenomena in the dermis that lead to compact and reorganize collagen and elastin, managing to reduce or eliminate wrinkles and improve the appearance and quality of the skin [6]. According to previous clinical trials, the large number of micro-beams causes a fine ablation of the epidermis at the

same time that the dermis is distended and the collagen fibers are separated [7]. This action is due to a mechanical thrust wave effect caused by the impact of the large number of micro-beams on the skin [8]. The multiple micro-ablations form micro holes on the surface of the skin and generate waves that move inward, pushing and separating the fibers of the dermis without leaving signs of thermal damage [9].

The absence of thermal coagulation lesions in the tissue achieves effective results with minimal adverse effects and, in addition, with a rapid recovery of the treated skin, where it also includes skin rejuvenation using ablative lasers (CO_2 and Er: YAG), which consists of renewing the epidermis and stimulating the formation of collagen in the dermis. The common mechanism of action in this type of laser involves the complete elimination of the epidermis and part of the papillary dermis, residually causing a thermal deposit in the tissue that induces the formation of collagen. As a result, the skin is tightened [10], eliminating fine lines and wrinkles, and is followed by a skin rejuvenation effect. It is well known that the main problem after practicing laser skin resurfacing is the long recovery period required by the skin, conditioning that patients cannot continue with their work and/or social activities for several weeks [11], where pathologies are wrinkles, especially perioral, periorbital, atrophic acne scars, actinic cheilitis, and seborrheic keratosis. A significant increase in elastics in smokers' skin and consider that this is considered part of the so-called clinical features of the smoker's face; wrinkles, thinned skin, and skin discolorations [12, 13].

Methods

A cross-sectional study was designed for 73 patients who underwent examinations and treatment interventions only for those exhibiting clear clinical signs of aging, primarily wrinkles, at the Dermatology Clinics in Baghdad, Iraq, during the follow-up period between October 2024 and October 2025, after providing written informed consent. All participating patients underwent laser treatment for wrinkles during the follow-up period. The inclusion and exclusion criteria for this study included: 1) patients aged 30-66 years, 2) only patients with clinical signs of wrinkles, and 3) only participants with skin types II, III, and IV, while other criteria were excluded in our study in term of: 1) pregnant women, 2) those with active skin infections, and 3) those who had undergone previous surgical procedures, where all data findings of participating patients were evaluated and analyzed using the SPSS 24.0 scale.

Moreover, medical interventions were performed to present skin aging and severity in each patient using either CO_2 or YAG laser technology, which demographic parameters were recorded for participating patients, including pre-procedure data such as age (30-66 years), gender (male and female), and skin type, as well as the skin type requiring rejuvenation who classified according to the Fitzpatrick scale, which categorized the degree of skin aging caused by various factors, where our classification determined the extent of skin damage and the necessary treatment, classifying patients as having skin type II, III, or IV.

Based on skin type, all patients underwent two types of laser procedures for skin rejuvenation, as well as patients were divided into two groups based on the type of laser procedure, where the first group, comprising 58 patients, underwent CO_2 laser treatment, which required both excision and thermal reshaping, while the second group, consisting of 15 patients, underwent YAG laser treatment, which involved superficial excision with less thermal damage. Both CO_2 and YAG laser procedures were performed with energy ranging from 80 to 150 millijoules and intensity ranging from 20% to 40%, with 1 to 3 passes, where both procedures were conducted throughout local anesthesia using lidocaine/prilocaine cream.

In addition, dermatologists and medical experts received a wrinkle evaluation questionnaire for assessing the severity for wrinkles and their effects on the skin, where the success of the therapy in preventing skin aging was another goal of this questionnaire. Further, due to that, it received both before and after therapy during the course of a 12-month follow-up.

Regarding post-treatment outcomes, we identified the side effects experienced by participating patients and assessed their clinical and therapeutic improvements to determine treatment efficacy and future course of treatment, that achieved by monitoring the occurrence of histological changes, side effects, and patient satisfaction rates during the 12-month follow-up period.

Results

We performed a cross-sectional study of 73 patients who participated in the management of skin aging under both techniques CO_2 and YAG lasers. Our findings showed that almost all patients (ages 40 - 60) in the class had the most common category in our study, which including 65%, where 24.7% of patients were in males, while 75.3% of patients were in females. Based on the Fitzpatrick scale, we diagnosed a type of facial skin which showed II type was 20.5%, III type was 43.8%, IV type was 35.6%.

Table 1: Baseline and pre-treatment characteristics of patients who participated in this study.

Parameters	Frequency, {n = 73}	Percentage, %
Age (years)		
30-39	12	16.4%
40-49	25	34.2%
50-59	22	30.1%
≥60	14	19.2%
Sex		
Female	55	75.3%
Male	18	24.7%
Fitzpatrick Skin Type		
II	15	20.5%
III	32	43.8%
IV	26	35.6%

Also, all of 73 participants were evaluated to the severity of skin aging by wrinkle assessment scale, where mild got 27 cases, moderate got 39 cases, and severe got 7 cases. Furthermore, it determined the types of laser treatments in the patients, which the fractional CO_2 group was 59 cases and the YAG group was 14 cases.

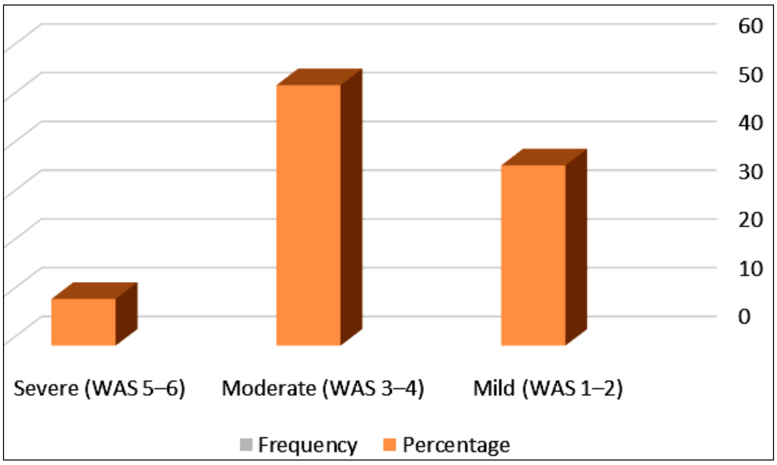

Fig 1: Classification of the prevalence of severity of skin aging at baseline in the patients by wrinkle assessment scale.

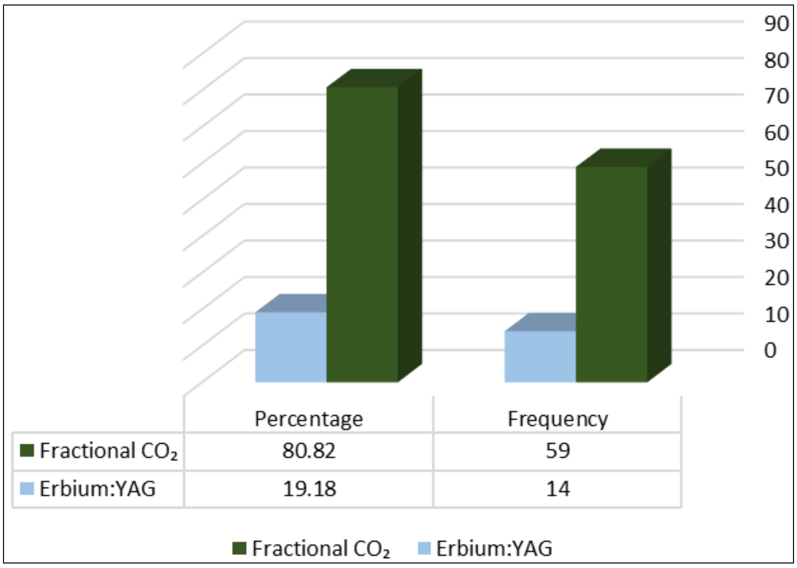

Fig 2: Distribution types of laser treatments on patients.

This study identified side effects associated with patients in post-laser procedure, where it reached 24.66%, where the erythema had 12.33%, and edema had 5.48%. However, this assessed clinical improvements of patients, where it boosted the achievement of excellent patient improvements in 40% of the group that underwent treatment with carbon dioxide laser, while 36% of the group of patients treated with the YAG laser achieved similar results.

Table 2: Determining the side effects related to patients in post-laser procedure.

Side Effect	Freq. {n = 73}	Percentage, %
Erythema	9	12.33%
Edema	4	5.48%
Pain (VAS 3-5)	3	4.11%
Minor Bleeding	2	2.74%
Total	18	24.66%

Table 3: A questionnaire of improvement status for patients who participated in this study.

Improvement Levels	At baseline	After CO_2 Laser {58}	After YAG Laser {15}
Excellent (>75%)	-	40%	36%
Good (50-75%)	-	36%	33%
Moderate (25-49%)	-	14%	25%
Minimal (<25%)	-	7%	25%
No - improved, 0%	100%	3%	6%

Table 4: Enroll clinical outcomes of post-laser procedure in the patients.

Parameters	Pre - treatments	CO_2 Group		YAG Group	
Wrinkle reduction, WAS Scale		**Reduction, %**		**Reduction, %**	
1st month	3.5 ± 0.9	2.8 ± 0.7	22.4%	2.9 ± 0.8	28.3%
5rd month	3.4 ± 0.7	1.8 ± 0.6	47.3%	2.4 ± 0.7	48.7%
12th month	3.5 ± 0.9	1.7 ± 0.3	67.6%	2.2 ± 0.6	62.6%
Histological changes		**Changes, %**		**Changes, %**	
High epidermal thickness	20%	85%	65%	80%	60%
High collagen density	40%	90%	50%	85%	45%
Elastin improvement	10%	80%	70%	75%	65%

In terms of Table 4 findings diagnostics in post-laser conducting, our findings highlighted at wrinkle reduction got 3.5 ± 0.9 at baseline, while 1.7 ± 0.3 with a reduction rate of 67.6% in the CO_2 group, while 2.2 ± 0.6 with 62.6% in the YAG group. Also, we also enrolled the histological changes of the patient in pre-treatment and post-treatment. Due to that, the current results of histological changes shown high epidermal thickness with 20%, high collagen density with 40%, and elastin improvement with 10%. In post-laser approaches, it indicated that improved with 85%, 90% high collagen density, and elastin improvement of 80% in the CO_2 laser patients group, while improved with 80%, 85% high collagen density, and elastin improvement of 75%% in the YAG laser patients group.

Furthermore, we defined post-treatment complications, where it found ensured that out of 73 patients, only 15 cases had complications, where the most common were prolonged erythema got 7 cases, and hyperpigmentation got 5 cases.

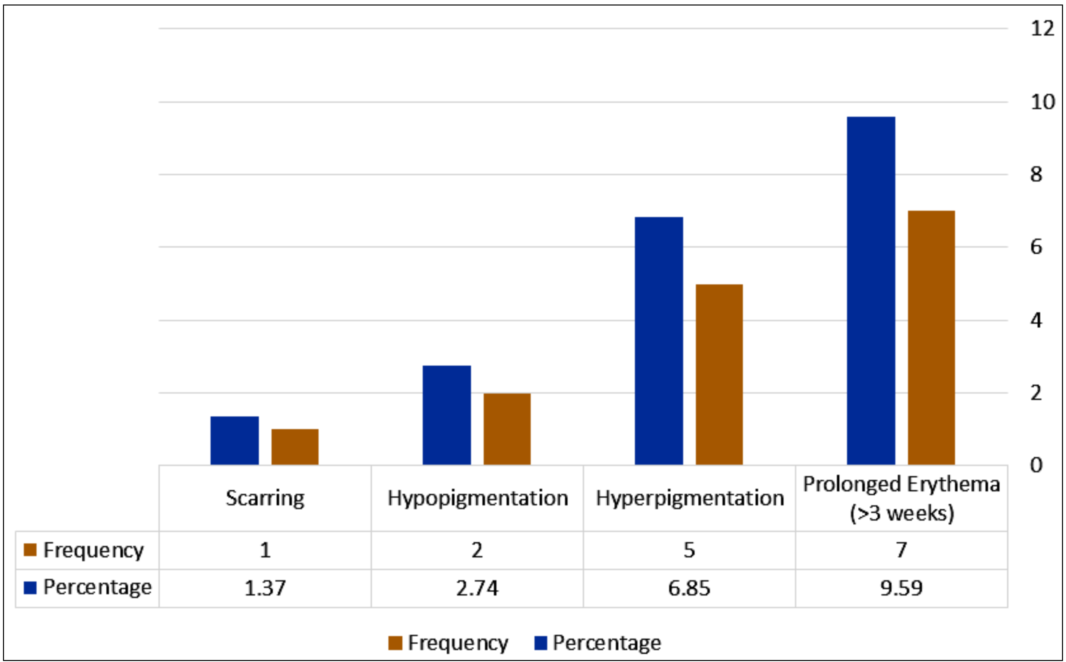

Fig 3: Establishing complications associated with patients in post-laser interventions.

Our study were evaluated satisfaction rates in patients who undergone in both lasers wherever (CO_2 or YAG lasers, where the satisfaction rate (very satisfied or satisfied) were 95% in the CO_2 laser group and 80% in the YAG laser group. In addition, it analyzed further skin hydration and elasticity, where TEWL (g/m²/h) was 18.5 ± 3.3 in pre - treatment, 12.4 ± 2.2 in post - treatment, where it reinforced to improvements with 35.6%, while elasticity was 0.63 ± 0.1 in pre - treatment, while 0.79 ± 0.2 in post - treatment, as result in improvements with 26.7%.

Table 5: Patients' satisfaction rates after laser treatment interventions.

Satisfaction levels	CO_2 Laser group		YAG Laser group	
	Frequency, {58}	**Percentage, %**	**Frequency, {15}**	**Percentage, %**
Very Satisfied	40	68.97%	8	53.33%
Satisfied	15	25.86%	4	26.67%
Neutral/Dissatisfied	3	5.17%	3	20%

Table 6: Clinical findings of skin hydration and elasticity.

Parameter	Pre-Treatment	Post-Treatment	Improvement
TEWL (g/m²/h)	18.5 ± 3.3	12.4 ± 2.2	35.6%
Elasticity (R^2)	0.63 ± 0.1	0.79 ± 0.2	26.7%

Discussion

The two primary ablative fractional lasers used for skin rejuvenation are fractional CO_2 lasers and fractional Er: YAG lasers. Both of these procedures appear to be effective, even though sometimes they cause pain, have a lengthy recovery duration, or have adverse reactions. The current trend in the treatment of skin aging uses CO_2 or YAG techniques in fractional mode, or those non-ablative, so that patients can continue with their occupations in the short term and do not interrupt their social activities [14, 15]. Both lasers pursue the same goal as ablative; that is, to make a thermal deposit sufficient to induce collagen formation in the dermis, which is considered essential to produce skin tightening and eliminate fine lines and wrinkles, coinciding with a skin rejuvenation process. The improvement of the skin with CO_2 laser treatments is considered superior in terms of the results obtained by the YAG laser. Although both treatment avoids important complications and adverse effects that accompany treatments with CO_2 and YAG lasers [16].

In order to compare the safety and effectiveness in fractional CO_2 versus fractional Er: YAG treatments on facial wrinkles, we conducted a cross-sectional experiment using a split-face design on 40 volunteers over the course of three treatment sessions. Prior studies on fractional CO_2 & fractional Er: YAG laser safety and effectiveness mostly involved a limited number of participants and fewer sessions of therapy [17]. Several of these studies also revealed substantial differences concerning the safety and efficacy of these methods. They showed that both modalities had approximately the same effect, but the discomfort following Er: YAG treatment was a little more noticeable in the initial days of therapy. Later, however, there were greater complaints after the CO_2 laser [18].

It was developed as an alternative to the fractional ablative treatments with YAG erbium laser because it achieved a rapid recovery of the skin [19]. Due to some studies, fractional CO_2 lasers could yield better outcomes, whereas fractional Er: YAG lasers can be more well-tolerated along with need shorter recovery time in people with acne scars [20], where fractional CO_2 laser therapy was deemed better than fractional Er: YAG However, based to a Canadian study findings were tentative and based on a small number of patients. Additionally, it revealed that whereas Er: YAG laser patients recovered faster, CO_2 laser patients saw comparatively superior wrinkle improvement [21]. However, in an experimental context using a cross-sectional study of therapy sites, along with an additive objective assessment in skin biomechanical characteristics, our study revealed significant variations between these resurfacing procedures in terms of improving wrinkles on the skin. Skin wrinkles were substantially decreased by both laser systems, and both techniques' efficacy was about equivalent [22]. The subjects appeared to handle both laser systems well and experienced no major over time negative effects; nevertheless, the pain was slightly worse following the fractional CO_2 laser [23-25].

The difference in depth and width of each fractional ablation microzone is practically twice as much with the CO_2 laser as with the YAG laser [26]. On the other hand, in the histologies of the present work, we observed an effect of separation of the fibers in the dermis, presumably due to the mechanical action of pushing by the resonance waves that enter the skin. The effect of photo thermolysis and removal of a few layers of cells from the epidermis by the Er: YAG laser how quickly the skin recovers and the mild erythema that lasts only for 2 weeks {27, 28}, where attempted to decrease the duration of erythema indicate that this effect can be prolonged up to 6 weeks in CO_2 fractional laser treatment, and up to 3 weeks in the case of Er: YAG [29-31]. They indicate, similar to our results, that both laser systems are effective on improvement of atrophic acne scars with no significant difference, but the participants faced less discomfort and downtime with the fractional Er: YAG laser.

Conclusion

Our findings indicates that women outnumber men in laser treatment interventions, which it is also showing that fractional CO_2 laser which exhibits highly effective results into reducing wrinkles as well as managing aging, accompanied by high precision and a longer recovery period, where reinforces is position as the optimal choice for stimulating collagen production and skin rejuvenation, although the YAG laser also achieves remarkable results in tissue survival after treatment, along with a faster recovery period. This study highlights both types of laser treatments (YAG, fractional CO_2) and indicates that they are the optimal procedures for achieving better results in skin rejuvenation and wrinkle reduction compared to pre-treatment skin, with the advantage of fractional CO_2.

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