Type of the Paper (Research article)

A Split-Face Comparative Study Between the Fractional Carbon Dioxide Laser and Micro-Needling in The Treatment of Facial Photoaging: Clinical and Dermoscopic Evaluation

Doaa A. A. Abd El-Gawad[1]*, Talal A. Abd EL-Raheem[1], Basma H. Mohammed[1], Ahmed M. Sadek[1]

[1]Department of Dermatology, STDs and Andrology, Faculty of Medicine, Fayoum University, Fayoum 63511, Egypt.

*Correspondence: Doaa A. A. Abd El-Gawad, daa13@fayoum.edu.eg, Tel: (002) 01509080911

Received: 20 February, 2024 Reviewed: 21 May, 2024
Accepted: 12 June, 2024 Published online: 30 Sep, 2024

Abstract:

Introduction: Facial photoaging represents a multifaceted biological phenomenon caused by a confluence of internal and external factors. Its characteristic hallmarks include diminished skin elasticity, textural irregularities, telangiectasia, dyschromia, and wrinkles formation. Extrinsic aging or photoaging, is predominantly driven by solar radiation which precipitates a reduction in both the quantity and quality of collagen and elastin fibers within the dermal matrix.

Aim of the study: To evaluate the features of facial photoaging using the dermoscopic photoaging scale.

Subjects and Methods: This study included 52 female subjects aged (25-70) years old. Each subject`s face was examined by the dermoscope to detect different dermoscopic features according to the dermoscopic photoaging scale (DPAS).

Results: The most frequently seen dermoscopic features of DPAS were superficial wrinkles, followed by telangiectasia, lentigo and yellowish discoloration. While the least seen feature was crisscross wrinkles. Also, a notably significant statistical difference was observed between dermoscopic photoaging scale scores and each of sun exposure and usage of sunblock (p <0.001), where cases exposed to the sun for one hour per day showed the least mean DPAS value. Also, cases that used sunblock showed a lower mean value of DPAS. On the other hand, the relationship between Skin type and DPAS score was not statistically significant (p > 0.05).

Conclusions: Dermoscopy is a highly valuable tool in assessing different signs and grades of photoaging. There was an increase in DPAS score with ageing, sun exposure and non-use of sunscreens. Therefore, dermoscopy is a good non-invasive technique which detects different grades of photoaging and helps in the selection of different therapeutic options.

Keywords: Dermoscopy; photoaging; dermoscopic photoaging scale (DPAS).

1. Introduction

The skin is the most complicated and the largest organ in the human body. It has a direct contact with the outside environment [1]. The phenomenon of cutaneous ageing consists of a complex sequence of events. Skin ageing includes both intrinsic (chronological) ageing and extrinsic ageing. Skin phenotype, genetic predisposition, and ethnicity significantly impact the phenomenon of chronological ageing [2].

Photoaging is induced by different extrinsic elements like pollution, smoking, and, most notably, ultraviolet (UV) radiation. Because of the predominance of UV light, the expression photoaging is frequently used to refer to extrinsic ageing [3]. Photoaging manifests predominantly in sun-exposed regions and clinically presents with discernible features such as fine and coarse wrinkles, textural irregularities, dryness, laxity, telangiectasia, diminished tensile resilience, and altered pigmentations. Furthermore, photoaged skin is more susceptible to benign and malignant neoplastic growths. Exposure to UV rays elicits a complicated molecular cascade which harms the skin's connective tissue [4].

Dermoscopy, a non-invasive magnification instrument, employs either polarized or non-polarized illumination to observe different morphological characteristics, such as pigmentation patterns and vascular structures, that cannot be detected by unaided vision [5]. As the utilization of dermoscopy extends across various dermatological conditions, the development of a dermoscopic photoaging scale (DPAS) has emerged to facilitate the evaluation and assessment of skin photoaging [6].

2. Subjects & Methods

2.1.Subjects

Our study included 52 female subjects aged above 25 years old with different grades of facial photoaging, presented to the outpatient clinic of Fayoum University Hospital between June 2021 to June 2022.

Inclusion criteria

All females with ages above 25 years old were included.

Exclusion criteria

People taking medications that affect skin photoaging and Persons who underwent any cosmetic techniques in the last two years were excluded.

2.2.Study design

Our study is an observational study with a cross-sectional study design. The study was conducted after approval of the Dermatology, STDs and Andrology Department of Fayoum University Hospital, Research Ethical Committee (Derma REC).

2.3.Methods

History taking

Personal history, Family history, Sunblock use and Previous photoaging treatments.

Dermatological examination

It was used to detect Fitzpatrick skin phenotype [7].

Dermoscopic evaluation

Each subject's face was divided into the following four regions: the forehead; the right malar area; the left malar area and the chin. The dermoscope Dermlite DL3 (3Gen, Inc., California, USA) was used to examine each area based on the DPAS criteria [6] (**Table 1**). All patients were examined and photographed in the same place with fixed illumination for better evaluation.

The DPAS score was calculated for each face region, and then the total DPAS score was calculated through summation of the DPAS of all regions.

Table 1: DPAS criteria [6].

DPAS evaluation criteria	Clinical description	Dermoscopic description
Yellowish discoloration (solar elastosis) and yellow papules	Abnormal, yellow, non-functional elastotic substance which is accumulated in the dermal upper part, skin coarsening	More evident yellowish pigmented macules and yellowish dots were detected by the dermoscope than by the non-aided eye examination
White lines of scarring (atrophied skin)	Irregular wound repair of easily torn, delicate skin	Whitish, clear, uneven extensions
Ephelides/lentigo	Well-defined, brownish macules and patches	Fair-brown, entangled, pigmented network
Hypopigmented -	Permanent pigmentation which is	Uneven pigmentation manifests as

hyperpigmented macules	present in a mottling pattern	hypopigmented macules interspersed among hyperpigmented patches.
Telangiectasias	Dilated vessels with atrophy of the walls	Erythematous linear structures displaying various arrangements
Actinic keratosis	skin neoplasm due to keratinocyte proliferation with cellular atypia	Perifollicular, erythematous pseudo-network, apparent follicles openings with white halo around, pigmented ostia, brownish-grayish dots and globules
Senile comedones	Periorbital, localized, non-inflamed, open and closed comedones	Pilosebaceous openings which contain brownish-blackish keratinized material in the center, near the eye
Deep wrinkles	Wrinkles not improved by stretching	More evident deep lines were observed by the dermoscope than by the non-aided eye evaluation.
Superficial wrinkles	Fine wrinkles which improve with skin stretching	More pronounced superficial wrinkles were detected by dermoscope than by the non-aided eye examination.
Criss-cross wrinkles	Deep, crossing lines	More prominent crisscross wrinkles were detected by dermoscope than by the non-aided eye.

2.4.Statistical Methods

All data were analyzed using Statistical Package for Social Science (SPSS) 26.0. Quantitative data were presented using both the mean and median, while qualitative data were represented through absolute and relative frequencies. Independent samples Student's t-test was employed to assess the comparison between two groups of normally distributed variables. A Pearson correlation test was used to correlate variables with DPAS. All tests were two-sided.

3. Results

The studied group included 52 female subjects with different grades of photoaging. The studied group age ranged from 25 to 70 years and the mean age was 35.29 ± 8.28. The most frequently seen dermoscopic feature was the superficial wrinkles which were found in (98.1%) of cases, followed by telangiectasia (90.4%), lentigo (90.4%) and yellowish discoloration (61.5%). Half of the patients showed hypo and hyperpigmentations and white lines. Deep wrinkles were seen in (28.8%) of cases while crisscross wrinkles were seen in only (3.8%) of them. About (26.9%) of cases presented with yellowish papules. Also, senile comedones were found in only (23.1%) of cases **(Table 2, Figure 1).**

Table 2: Dermoscopic assessment of different dermoscopic features of DPAS within the studied group (n=52).

Variables		No.	%
Yellowish discoloration	**No**	20	38.5
	Yes	32	61.5
Yellowish papules	**No**	38	73.1
	Yes	14	26.9
Lentigo	**No**	5	9.6
	Yes	47	90.4
Hypo and hyper-pigmentations	**No**	26	50.0
	Yes	26	50.0
White line	**No**	26	50
	Yes	26	50
Telangiectasia	**No**	5	9.6
	Yes	47	90.4
Senile comedones	**No**	40	76.9
	Yes	12	23.1
Superficial wrinkles	**No**	1	1.9

	Yes	51	98.1
Criss-cross wrinkles	**No**	50	96.2
	Yes	2	3.8
Deep wrinkles	**No**	37	71.2
	Yes	15	28.8

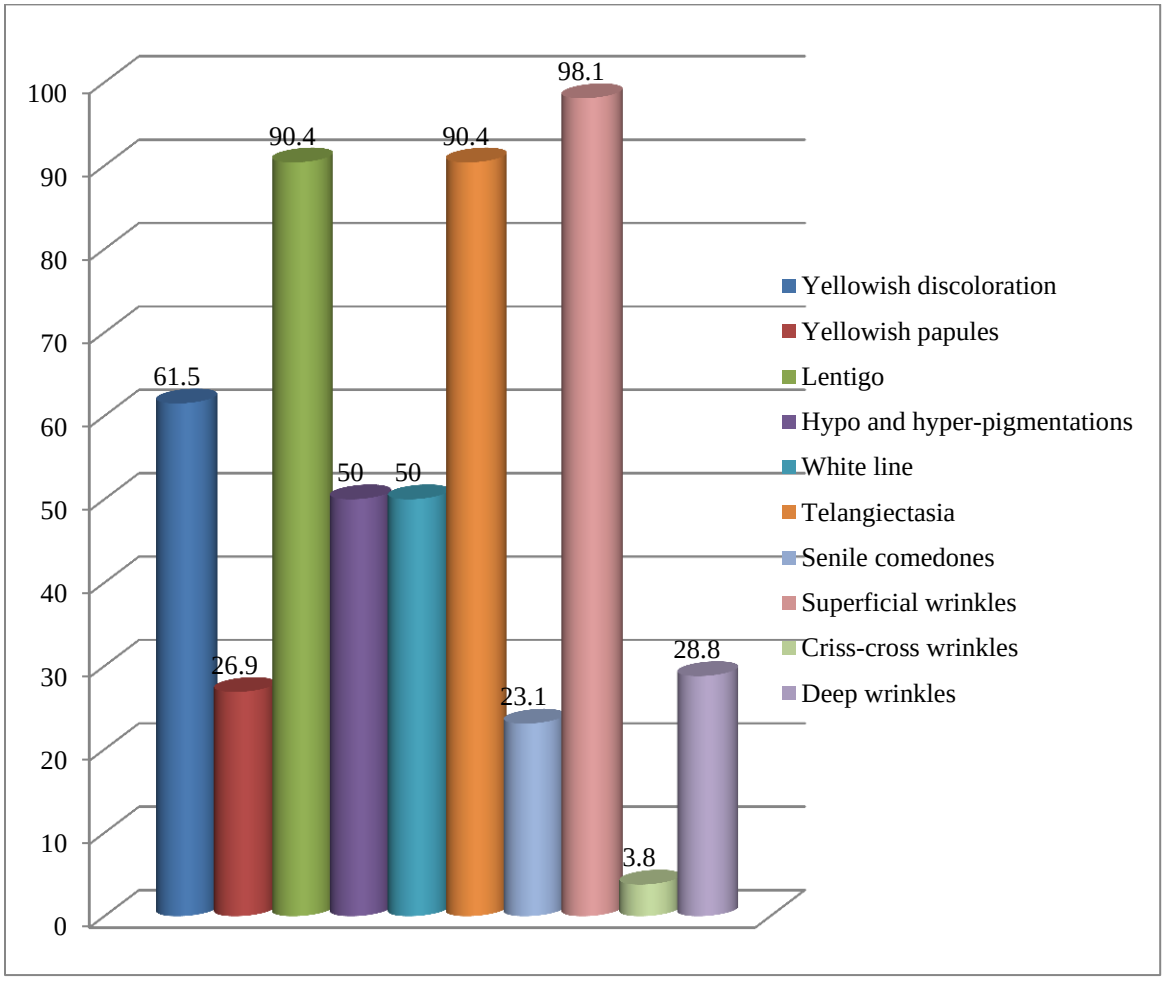

Figure 1: Chart graph illustrating the prevalence of DPAS features.

The mean dermoscopic photoaging score (DPAS) was 9.85±2.75 SD ranging from 2 to 16. A statistically significant disparity was observed between DPAS scores and sun exposure (p <0.001), where people who were exposed mildly to sunlight revealed the least mean DPAS value. Also, a statistically significant disparity was found between DPAS scores and usage of sunblock, where cases that used sunblock

showed a lower mean value of DPAS. Conversely, no statistical significance was found between DPAS scores and Fitzpatrick skin phenotypes (p >0.05) **(Table 3, Figure 2).** There is a positive significant correlation was found between DPAS and age, where cases with older age have a higher DPAS **(Table 4).**

Table 3: Comparing DPAS scores and Fitzpatrick skin type, sun exposure and usage of sunblock among the studied group.

Characteristic		DPAS (N=52)	Test	*P* value	Post hoc
Fitzpatrick Skin type	**Type 3**	9.73±2.89	-0.343 (t)	0.733	---------
	Type 4	10±2.6			
Sun exposure	**Mild**	8.64±2.79	10.735 (f)	<0.001*	*P1* =0.008*
	Moderate	10.61±1.72			*P2* <0.001*
	Severe	13.17±1.17			*P3* =0.025*
Usage of sunblock	**Yes**	7.53±2.32	-6.002 (t)	<0.001*	-------
	No	11.18±1.99			

t: Independent sample t-test; f: ANOVA test. * significant.

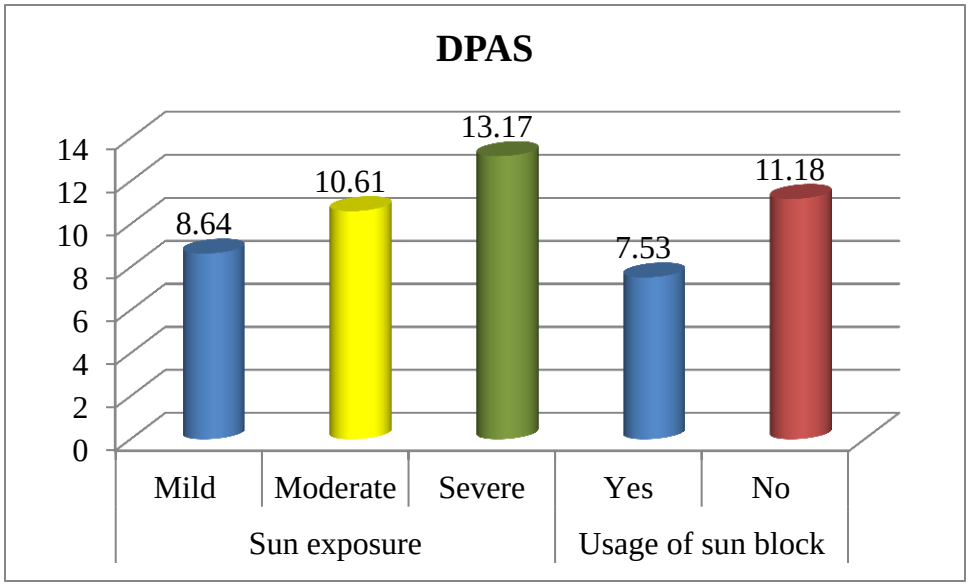

Figure 2: The relation between DPAS scores and each of sun exposure and usage of sunblock.

Table 4: Correlation between DPAS and each of age and Fitzpatrick skin type.

Variables		DPAS
Age	**r**	**0.578****
	p	**0.000**
Fitzpatrick **skin type**	**r**	**0.048**
	p	**0.733**

P= Sig. (2-tailed), r= Pearson Correlation.

4. Discussion

Cutaneous ageing may result from extrinsic factors such as ultraviolet radiation, tobacco use, and exposure to hazardous substances. Among these, ultraviolet radiation is the most significant contributor to extrinsic cutaneous ageing, leading to a phenomenon known as photoaging [8]. In contrast to intrinsic ageing, photoaged skin exhibits distinct features, including laxity, pronounced dryness, and exfoliation [9].

Photoaging is characterized by textural irregularities, dryness, mottled pigmentation, and the formation of wrinkles, all of which result from prolonged exposure to ultraviolet radiation. Moreover, photoaging may predispose individuals to various cutaneous inflammatory, immunological, and neoplastic conditions [10].

Dermoscopy, a non-invasive imaging technique, uses polarized or non-polarized light to visualize morphological features of the epidermis and dermis, as well as to detect vascular structures and pigmentation patterns that are not visible to the naked eye [11].

Our study adopted an observational approach within a cross-sectional design and included 52 female subjects. We evaluated the dermoscopic features of facial photoaging using the DPAS [6].

The results of our study showed that the most prominent dermoscopic feature of facial photoaging was superficial wrinkles, followed by telangiectasia, lentigo, and yellowish discoloration. The least observed dermoscopic criterion was crisscross wrinkles. Notably, actinic keratosis was not diagnosed in any of our cases, likely due to

the rarity of these lesions in our skin photo type.

Our findings are consistent with those of El-Sayed et al., who reported that the predominant DPAS observations among females included yellowish papules, hypo-hyperpigmentation, solar lentigo, and superficial wrinkles. Similar to our study, none of their cases had actinic keratosis [12]. Magdy and Sadek also found that solar lentigines were the predominant DPAS feature in their study [13].

Our study revealed a significant correlation between DPAS scores and age. Additionally, a statistically significant difference was observed between DPAS scores and sun exposure, with individuals who had minimal sun exposure showing the lowest mean DPAS values. Furthermore, a statistically significant difference was found between DPAS scores and the use of sunblock, with sunblock users demonstrating lower mean DPAS scores.

5. Conclusion

Dermoscopy is an effective, fast, and non-invasive technique for accurately evaluating facial photoaging and detecting its early signs. Early detection of photoaging can facilitate timely and appropriate treatment, potentially mitigating the progression of skin damage. We recommend conducting further studies on a larger scale and including diverse ethnic groups to assess potential differences in DPAS features across various populations.

Ethical approval and consent to participate: Our study was accepted by the ethical committee of the faculty of medicine of Fayoum University. To get informed consent from subjects, after discussion of the study, the aim of the study and they had the right not to participate (protocol code 78 with approval number M 504 and date of approval October 11, 2020).

Funding: This study is not funded.

Conflicts of Interest: All authors declare they have no conflicts of interest.

References

1. Bang E, Kim DH, Chung HY. Protease-activated receptor 2 induces ROS-mediated inflammation through Akt-mediated NF-κB and FoxO6 modulation during skin photoaging. Redox Biol. 2021;44:102022. doi: 10.1016/j.redox.2021.102022.
2. Sitohang IB, Legiawati L, Suseno LS, Safira FD. Trichloroacetic Acid Peeling for Treating Photoaging: A Systematic Review. Dermatol Res Pract. 2021;2021:3085670. doi: 10.1155/2021/3085670.
3. Šínová R, Pavlík V, Ondrej M, Velebný V, Nešporová K. Hyaluronan: A key player or just a bystander in skin photoaging?. Exp Dermatol. 2022;31(4):442-458. doi: 10.1111/exd.14473.
4. Sjerobabski Masnec I, Poduje S. Photoaging. Coll Antropol. 2008;32 Suppl 2:177-180.
5. Hu SCS, Lin CL, Yu HS. Dermoscopic assessment of xerosis severity, pigmentation pattern and vascular morphology in subjects with physiological aging and photoaging. Eur J Dermatol. 2019;29(3):274–280. doi: 10.1684/ejd.2019.3574.
6. Isik B, Gurel MS, Erdemir AT, Kesmezacar O. Development of skin aging scale by using dermoscopy. Skin Res Technol. 2013;19(2):69–74. doi: 10.1111/j.1600-0846.2012.00609.x.
7. Fitzpatrick TB. The Validity and Practicality of Sun-Reactive Skin Types I Through VI. Arch Dermatol. 1988;124:869–871. doi: 10.1001/archderm.124.6.869.
8. Fisher GJ, Kang S, Varani J, Bata-Csorgo Z, Wan Y, Datta S, Voorhees JJ. Mechanisms of photoaging and chronological skin aging. Arch Dermatol. 2002;138(11):1462-70. doi: 10.1001/archderm.138.11.1462.
9. Fernandez-Flores A, Saeb-Lima M. Histopathology of cutaneous aging. Am J Dermatopathol. 2019;41(7):469-479. doi: 10.1097/DAD.0000000000001344.
10. Worrede A, Douglass SM, Weeraratna AT. The dark side of daylight: photoaging and the tumor microenvironment in melanoma progression. J Clin Invest. 2021;131(6):1-11. doi: 10.1172/JCI140778.
11. Wen J, Li XH, Yang QP, Yu JB. Clinical and dermoscopic features of livedoid vasculopathy. Chin Med J (Engl). 2020;133(17):2137-2142. doi: 10.1097/CM9.0000000000000944.
12. El-Sayed MH, Saleh HM, El Zawahry KMA, Mostafa AE. The dermoscopic features of facial aging among Egyptians: A comparative study between males and females. J Cosmet Dermatol. 2019;18(6):1803–1813. doi: 10.1111/jocd.12919.
13. Magdy R, Sadek A. Dermoscopic findings of photo-ageing in Egyptian patients. EDOJ. 2015;11(1):6.