Comparative study between fractional carbon dioxide laser versus combined fractional CO2 laser/platelet rich plasma in treating facial rhytides with assessment by the Antera 3D camera

A THESIS FOR PARTIAL FULFILMENT OF MASTER DEGREE IN DERMATOLOGY, VENEREOLOGY & ANDROLOGY

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Haitham Samy El Sayed

DEDICATION

I'm very grateful to the most important people in my life; my father and my mother, whom – literally– I wouldn't have been able to finish this thesis without their unconditional love, care, support and reassurance. I'm proud to dedicate this thesis to them. May Allah bless and protect them always.

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List of Abbreviations

1. CO2	Carbon dioxide
2. Col-7	Collagen type VII
3. DEJ	Dermo-epidermal junction
4. DNA	Deoxyribonucleic acid
5. EGF	Epidermal growth factor
6. GAGs	Glycosaminoglycans
7. GAIS	Global aesthetic improvement scale
8. GFs	Growth factors
9. IGF	Insulin-like growth factor
10.IL-1	Interleukin 1
11.MACs	Microablative columns
12.MTZs	Microthermal treatment zones
13.PDGF	Platelet-derived growth factor
14.PF4	Platelet factor 4
15.PRP	Platelet rich plasma
16.ROS	Reactive oxygen species
17.SAM	Skin Age Management
18.SD	Standard deviation
19.SSPS	Statistical Package for Social Science
20.TEWL	Transepidermal water loss
21.TGF	Transforming growth factor
22.UV	Ultraviolet
23.VEGF	Vascular endothelial growth factor
24.HIFU	High-intensity focused ultrasound
25.FGF	Fibroblast growth factor
26.FT	Fractional technology

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Abstract

Antera camera visual scores-which indicated overall wrinkle size, length and depth- were obtained before the first treatment session, after the last laser session and at the end of the study. They revealed high significance in each side of the face generally. Though there was no significant difference between the two sides since thy both gave the same exact optimum result.

In conclusion, both treatment options whether fractional CO2 laser and PRP or fractional CO2 laser only were both equally effective and improved the wrinkles significantly. No difference was shown on the PRP side when compared to the control side. Additionally, overall patient's before and after evaluation and satisfaction with the cosmetic improvements of their facial imperfections showed a great statistical significance. More comparative studies with this treatment protocol for managing photoaging and wrinkles are needed in the future.

Keywords: Standard deviation - Global aesthetic improvement scale

Introduction

Aging of skin is a complex process that can be assessed clinically using several biophysical parameters such as wrinkles, pigmentation, uneven skin color, reduced elasticity, and dehydration. Skin wrinkles, uneven skin tone, and laxity caused by chronological aging are commonly considered major changes/features observed in skin that has undergone aging, and these are attributable to the loss of collagen and elastin from aging skin ***(Cho et al., 2019).*** It mainly results from chronological aging caused by factors in the internal environment such as heredity and photoaging induced by factors in the external environment such as ultraviolet (UV) radiation ***(Puizina-Ivic, 2008)***. A systematic classification of patient photoaging types has been developed: type I, "no wrinkles"; type II, "wrinkles in motion"; type III, "wrinkles at rest"; and type IV, "only wrinkles" ***(Glogau, 1996).***

Generally in order to treat wrinkles, it is necessary to resurface up to the papillary dermis and sometimes up to reticular dermis so that old collagen is replaced by new collagen, resulting in tightening of skin ***(Alster and Kauvar, 1996).*** For many years, dermabrasion, chemical peeling or surgical face lifting have been used for the treatment of facial wrinkles ***(Jain et al., 2008).***

Fractional carbon dioxide (CO2) laser has been considered as the gold standard for skin rejuvenation ***(Saedi et al., 2012).*** It works through creating multiple microthermal damage areas (called microthermal treatment zones, MTZ) with controllable width, depth, and density ***(Longo et al., 2013).*** Creation of MTZ leads to fibroblasts migration, collagen regeneration and rearrangement, and connective tissue synthesis ***(Pinheiro et al, 2015)***, thereby reducing or eliminating mild to moderate wrinkles, improving skin texture and color, shrinking pores, relieving skin flabbiness and achieving the immediate and long-term effect of firming skin ***(Hui et al., 2017).***

Platelet-rich plasma (PRP) has been considered as an emerging technology in aiding regeneration of both soft and hard tissues ***(Macaluso, 2011; Nofal et al., 2014).*** Platelets are known to contain high concentrations of different growth factors (GFs) and are extremely important in regenerative process; activation of the platelet by endothelial injury initiates the wound-healing process ***(Eppley et al., 2006).*** It may be hypothesized that PRP may induce the synthesis of collagen and other matrix components by stimulating the activation of fibroblasts, thus, rejuvenating the skin. However, experimental studies confirming the effects of PRP on aged fibroblasts are very limited ***(Kim et al., 2011).*** Whilst the literature may be consistent with a modest benefit for specific

indications, there is not sufficient evidence supporting the efficacy of PRP to justify a role in routine dermatological practice at the present time ***(Lynch and Bashir, 2016).***

The use of PRP after fractionated CO2 laser resurfacing has potential as a more effective method for enhancing wound healing and improving skin tightening than CO2 laser only in reducing wrinkles. Furthermore, PRP in combination with fractional CO2 ablative laser (carbon dioxide) for deep wrinkles and severe photodamaged skin has also been shown to reduce commonly encountered, transient adverse effects and decrease the downtime ***(Na et al., 2011).***

A novel device for 3D in vivo optical skin imaging called Antera 3D (Miravex, Ireland) is now used for objective evaluation of skin changes. It allows the immediate analysis of the optical skin structure to be used. This camera relies on multi-directional illumination and computer-aided reconstruction of the skin surface, illuminating the surface from different angles and using the differences between these images to reconstruct the surface in three dimensions ***(Cantisani, 2016).***

Aim of the Work

The aim of the study to compare and assess the clinical efficacy of fractional CO2 laser alone versus combined fractional CO2 laser and PRP in treatment of facial rhytides (in terms of size, depth and overall appearance) using the Antera 3D camera, Miravex© .

I-Skin Aging

IA-Definition:

Being the most voluminous organ of the body that is exposed to the outer environment, the skin suffers from both intrinsic and extrinsic aging factors. Skin aging is characterized by features such as wrinkling, loss of elasticity, laxity, and rough-textured appearance. This aging process is accompanied with phenotypic changes in cutaneous cells as well as structural and functional changes in extracellular matrix components such as collagens and elastin. ***(Shoubing and Enkui, 2018).***

Intrinsic aging is an inevitable physiological process that results in thin, dry skin, fine wrinkles, and gradual dermal atrophy, while extrinsic aging is engendered by external environment factors such as air pollution, smoking, poor nutrition, and sun exposure, resulting in coarse wrinkles, loss of elasticity, laxity, and rough-textured appearance ***(Mora et al., 2016, Krutmann et al., 2017).***

Additionally, lifestyle factors like diet, sleeping, smoking, should be analysed carefully, as common age-related conditions as well as associated comorbidities, such as metabolic illnesses common in the elderly, nutritional deficiencies, and the use of drugs such as corticosteroids, and even cancer treatments, should be assessed by dermatologists attending to skin conditions associated with aging ***(Addor,***

2018).

The understanding of the basic physiological processes of aging as well as the spectrum of its effects on the skin will facilitate the efficacy of future treatments ***(Farage et al., 2013).***

Generally as the skin ages, changes are seen in skin thickness and quality of the epidermis and dermis in the form of thinning of the epidermis, flattening of the dermal-epidermal junction and decrease in dermal thickness, vascularity and cellularity **(Figure 1)** ***(Farage et al., 2007).***

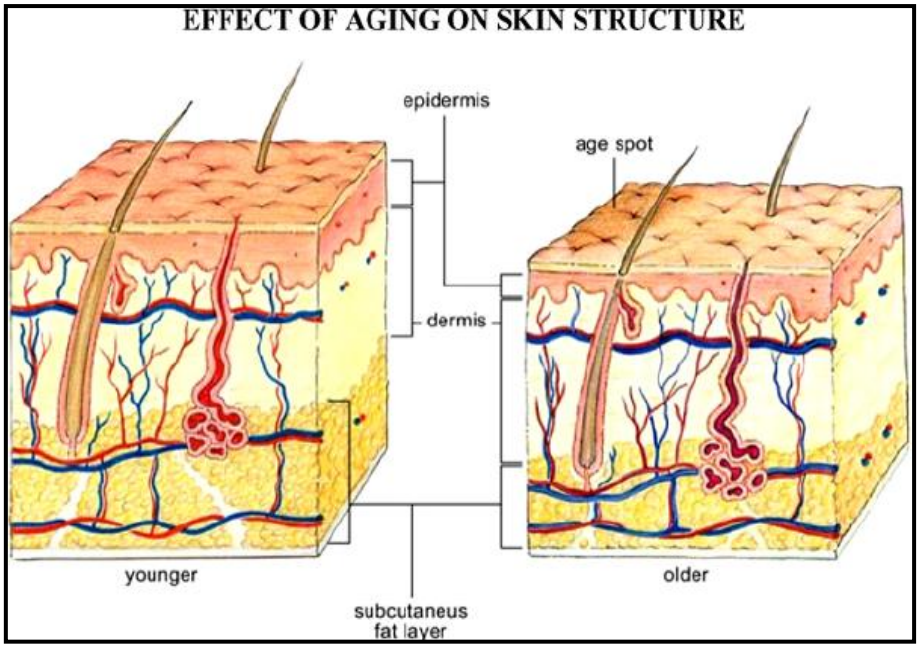

Figure (1): General structural differences between youthful skin and aged skin ***(Farage et al., 2007).***