Efficacy of Fractional Carbon Dioxide Laser in Early Treatment of Post-Surgical Scar

Fatma Mounir Aly; M.B., B.Ch

Supervised by:
Prof. Dr. Attia Abdallah Attia, Professor of Dermatology, Venereology and Andrology, Faculty of Medicine-AL-Azhar University
Dr.Shady Mahmoud Attia, Lecturer of Dermatology, Venereology and Andrology, Faculty of Medicine-Al-Azhar University, Faculty of Medicine AlAzhar University

Abstract: Background: Surgical scars represent an entirely highly challenging frustrating clinical problem. Various modalities and protocols were suggested. Fractional CO_2 laser has proved marked improvement in scars. **Aim of work:** In this study we will assess the safety and efficacy of treating surgical scars using an ablative carbon dioxide fractional laser during the early postoperative period. **Patients and methods:** We performed a prospective, split-scar on the postoperative scars of 20 egyptian patients. Patients began treatment 3 weeks after surgery and were treated in 3-5 sessions of CO2 fractional laser therapy on half of the scar at 2-week intervals with clinical assessment using the Vancouver Scar Scale(VSS)and the patients were asked to rate their overall satisfaction using a quartile grading scale. **Results:** The mean of total score of VSS showed significant improvement in comparing before (***5.15± 2.75***) and 3 months post-treatment (2.30±***2.40***) ($P \leq 0.001$). Among the individual parameters in the VSS, the most significant improvements were found in vascularity, height and pliability. Patient's subjective satisfaction scores showed a significant greater degree of satisfaction(40%) after laser treatment. **Conclusion:** Fractional ablative CO2 laser is an effective and safe treatment modality for surgical scars in the early postoperative period.
[Fatma Mounir Aly; M.B., B.Ch. **Efficacy of Fractional Carbon Dioxide Laser in Early Treatment of Post-Surgical Scar.** *Researcher* 2017;9(2):53-56]. ISSN 1553-9865 (print); ISSN 2163-8950 (online). http://www.sciencepub.net/researcher. 5. doi:10.7537/marsrsj090217.05.

Keywords: Efficacy; Fraction; Carbon Dioxide; Laser; Treatment; Post-Surgical Scar

Introduction:

Wound healing is an intricate process where the skin (or another organ-tissue) repairs itself after injury[1] involving multiple factors[2].In normal skin, the epidermis (outermost layer) and dermis (inner or deeper layer) exist in a steady-state equilibrium, forming a protective barrier against the external environment. Once the protective barrier is broken, the normal (physiologic) process of wound healing is immediately set in motion. The classic model of wound healing is divided into three or four sequential, yet overlapping[3], phases: (1) hemostasis (not considered a phase by some authors), (2) inflammation, (3) proliferation and (4) remodeling [4]. Upon injury to the skin, a set of complex biochemical events takes place in a closely orchestrated cascade to repair the damage[3].

Timing is important to wound healing. Critically, the timing of wound reepithelialization can decide the outcome of the healing[5]. If the epithelization of tissue over a denuded area is slow, a scar will form over many weeks, or months[6].

Proper scar classification is important because differences in clinical scar characteristics determine the treatment protocol[7].

Scar color, texture, and morphology, as well as previously applied treatments, will affect the laser parameters and number of treatments required for optimal improvement.[8,9]

The fractional CO_2 laser causes tissue tightening and collagen remodelling initially and later during 3-6 months after treatment. Efficacy was proved in wrinkles, acne scars, solar elastoses and other features of photodamage.[10] Studies on scars revealed that the earlier treatment the better effect.

Therefore, we aimed in this study toevaluate the efficacy and safety of early treatment of post-surgical scar by fractional ablative carbon dioxide.

Patients and methods

Patients:

This study included 20 patients that were proved clinically to have recent postoperative scars, twelve males and eight females. Their ages ranged from 14 – 55 years old, Fitzpatrick skin types II–IV, scar duration/ weeks ranged from 2 – 8 weeks and Vancouver score before treatment ranged from 0 – 14 with Mean± SD 5.15±2.75. Participants with the following criteria were excluded from the study: active infections, history of keloid, recent isotretinoin intake, smoking and pregnancy. Informed consents were obtained from all patients before treatment which the institutional Review Board of Faculty of Medicine, Al-Azhar University, Cairo, Egypt, had reviewed and approved.

Treatment protocol:

Patients began treatment 3 weeks after surgery and were followed for 3 months after the final treatment session. Four sessions of CO2 FS using a 10,600-nmCO2 laser were performed on half of the scars at 2-week intervals. The scars were divided into two halves along the closure axis. For vertical scars, the lower half was treated, and for transverse scars, the left side of the scar, from the evaluator's perspective, was treated. The treatment area was cleansed with70% alcohol, and a topical anesthetic (EMLA cream) was applied around the scar under occlusion for 1 hour before laser treatment. The treatment settings were a pulse power of 10-15 Watt according skin type, dwell time of 500 µs, stack 2 and 700 µm spacing.

After treatment, the treated areas were cooled with ice packs for 5 to 10 minutesto relieve pain.. The application of a sunscreen continued. Topical antibiotic cream was applied twice per day for 3 days following the session. Patients were instructed to use a full spectrum sunscreen regularly.

Assessment:

Photographs were obtained using identical camera settings, lighting, and patient positioning at baseline and 3 months after the final treatment. Two blinded dermatologists made objective clinical assessments separately using the Vancouver Scar Scale (VSS), which includes.

pigmentation (0 = normal, 1= hyp-opigmented, 2 = mixed pigmentation, 3 = hyper-pigmented), pliability (0= normal, 1= supple,2= yielding, 3= firm, 4 = ropes, 5= contracture), height (0= flat,1= 1– 2 mm, 2 = 2– 5 mm, 3=3– 5 mm), and vascularity (0 = normal, 1 = pink, 2= red,3 = purple).

Objective evaluations were made separately for each half of the scar in non chronologic order. Three months after the last treatment, patients were asked to rate their overall satisfactionusing a quartile grading scale (very satisfied, satis-fied, slightly satisfied, unsatisfied) for each half of thescar. Patients were also questioned about side effects.

Statistical Analysis:

We calculate sample size according to Raosoft and All statistical calculations were done using SPSS (statistica package for the social science version 20.00) statistical program. at 0.05, 0.01 and 0.001 level of probability. Qualitative data were presented as number and percentages and compared using Chi-square test Quantitative data with non parametric distribution were done using Analysis of variance Kruskal Wallis test and Mann-Whitney test (Z test). The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered non significant (NS) at the level of > 0.05, significant at the level of < 0.05, 0.01 and highly significant at the level of < 0.001. Pearson linear correlation coefficient (r) was estimated to show the relationship between quantitative parameters.

Results

The present study was designed to evaluate safety and efficacy of early fractional CO2 laser treatment of post-surgical scar using VSS assessment. This study included twenty patients that were proved clinically to have recent postoperative scars, twelve males (60%) and eight females (40%). Their ages ranged from 14 – 55 years old with Mean± SD 28.95±12.01 years, Fitzpatrick skin types II(15%) III(25%) IV(60%), scar duration/ weeks ranged from 2 – 8 weeks with Mean± SD.

3.45±1.31 and Vancouver score before treatment ranged from 0 – 14 with Mean± SD 5.15±2.75. The anatomic distribution of scars was 5 on the face; 3 on the arm; 1 on the neck; 3 on forearm and 1 on chest, 1 on scalp, 1 on ear, 1 on hand and 4 on abdomen.

At the end of the study, there was a significant improvement in VSS total score of fractional CO2 laser treatment of early post-operative scar in comparing the scores before ***(5.15± 2.75***) and 3 months post-treatment (2.30±***2.40***) ($P \leq 0.001$). Among the individual parameters in the VSS, the most significant improvements were found in vascularity, height and pliability.

Patient's subjective satisfaction scores showed a significant greater degree of satisfaction after laser treatment whereas eight patients were very satisfied (40 %), five were satisfied (25 %), seven were slightly satisfied (35 %), following three sessions of fractional CO2 laser. No side effects of the laser treatment were noted.

Discussion:

Cosmetic outcomes are becoming an increasingly important component of patient satisfaction after successful surgery. Severe scarring such as hypertrophic scar or keloids used to be the only concern, but as closure materials and techniques have advanced, minor scars are also subjected to treatment.[11]

Proper scar classification is important because differences in clinical scar characteristics determine the treatment protocol.[7]

Scar color, texture, and morphology, as well as previously applied treatments, will affect the laser parameters and number of treatments required for optimal improvement.[8] Various modalities have been used to improve the appearance of postsurgical scars or even to prevent them. Among them, laser treatment is the most preferred method because of its convenience. Pulsed-dye, ablative, and nonablative fractional lasers are the favored choices. Several

studies have demonstrated their efficacy and compatibility. More recently, attention has focused on scar prevention rather than revision or reduction.[11]

Our study designed as split-scar, evaluator-blinded study used both objective and subjective grading to assess the effects of treating post operative scars with the AFL 3 weeks after surgery. In the current study 20 patients began treatment 3 weeks after surgery and were followed for 3 months after the final treatment session. Four sessions of CO2 FS using a 10,600-nmCO2 laser were performed on half of the scars at 2-week intervals. Additionally, the absence of significant adverse events suggests that AFL treatment of early postoperative scars is safe.

There have been many studies on the use of fractional lasers to treat surgical scars, but most have focused on mature scars months to years after surgery. Although normal wound healing and scar remodelling continue to occur until 2 – 3 years after surgery, many patients desire treatment of scars as soon as possible, especially when the scars are located on visible sites. Therefore, focus has recently been directed toward laser treatment for scar prevention..

Previous authors have shown that early treatment of post-surgical scars with PDL [13] and NAFL [14]improve scar appearance, few prospective studies have analyzed the effects of an AFL when used early in the postoperative setting on surgical scars[11,15,12].

Kim et al. evaluated the effectiveness of 3 monthly sessions of non-ablative 1,550 nm fractional Er: glass laser versus ablative 2,940 nm fractional Er: YAG laser on a split-scar study of post-surgical thyroidectomy scar beginning 3 weeks postoperatively in seven subjects. The portion treated with ablative 2,940 nm fractional Er: YAG laser scored significantly better than the side treated with non-ablative 1,550 nm fractional Er: glass laser by the blinded physicians and patients[15].

Jung et al. treated 23 thyroidectomy scars 2–3 weeks after treatment with a single session of fractional carbon dioxide laser[11]. A statistically significant improvement in scars was observed 3 months after the laser session, however, no control group was used in this study.

Similar findings were achieved by Lee and colleagues who performed a prospective, split-scar, evaluator blinded study on 16 scars, using an AFL 2 times over 4 weeks beginning 3 weeks postoperatively. At 3 months post-laser treatment, significantly greater improve-ments were noted on the treated halves of the scars in terms of scar thickness and texture ($p < .001$). There was no significant difference in VSSscore improvements after 3 months according to the pigmentation and vascularity. Three months after treatment completion, patients were also significantly more satisfied with the treated half of their scar[12].

Another similar findings were found by[20]) who performed a prospective randomized, comparative split-scar study on 20 scars of Mohs surgery for non melanoma skin cancer of the face. On the day of suture removal, all subjects had one-half of their scar randomly selected and treated with a 10,600 nm CO2 fractional laser. Three months after laser treatment, a significant decrease in VSS and 3 of the 4 of its individual parameters were detected in both control and treated halves of the scar. The only parameter not significantly affected with time was the pigmentation subscale. No side effects of the laser treatment were noted.

Three months after treatment completion, patients were also significantly more satisfied with the treated half of their scar according to a 3-point grading scale. For the treated side of the scar, 8 of the 20 patients (40%) were very satisfied, 5 were satisfied(25%), 7 was slightly satisfied(35%) with the results. No side effects of the laser treatment were noted.

Our study was designed to build on the work of previous authors.. It is possible that additional treatment sessions or more aggressive laser settings could have a greater impact on scar appearance. The absence of any adverse events supports the safety of early postoperative treatment of scars with the AFL for future studies. The results of this study demonstrate that ablativeCO2 FS is effective for treating surgical scars in the early postoperative period.

Whereas no objective differences in scar appearance were detected, patients subjectively favored the appearance of the treated half of the scar. Patients' subjective assessment of the appearance of the scar may be clinically important. Scarring can cause substantial emotional distress, especially in the immediate postoperative period[17,18]. Subjective improvement of scar appearance may ease psychological distress postoperatively. [17,19]

Conclusion

Fractional ablative CO2 laser is an effective and safe treatment modality for postoperative scars in the early postoperative period. Overall improvement was statistically significant in the Vancouver Scar Scale.

References:

1. *Nguyen, D.T., Orgill D.P., Murphy G.F. (2009).* Chapter 4: The Pathophysiologic Basis for Wound Healing and Cutaneous Regeneration. Biomaterials For Treating Skin Loss. Woodhead Publishing (UK/Europe) & CRC Press (US),

Cambridge/Boca Raton, p. 25-57. (ISBN 978-1-4200-9989-8/ISBN 978-1-84569-363-3).
2. *Rieger, S.; Zhao, H.; Martin, P.; Abe, K.; Lisse, T.S. (2014).* "The role of nuclear hormone receptors in cutaneous wound repair". Cell biochemistry and function 33 (1): 1–13. doi:10.1002/cbf.3086. PMID 25529612.
3. *Stadelmann, WK; Digenis, AG; Tobin, GR (1998).* "Physiology and healing dynamics of chronic cutaneous wounds". American journal of surgery 176 (2A Suppl): 26S–38S. doi:10.1016/S0002-9610(98)00183-4. PMID 9777970.
4. *Quinn, J.V. (1998).* Tissue Adhesives in Wound Care. Hamilton, Ont. B.C. Decker, Inc. Electronic book.
5. *Cubison TC, Pape SA, Parkhouse N (December 2006).* "Evidence for the link between healing time and the development of hypertrophic scars (HTS) in paediatric burns due to scald injury". Burns 32 (8): 992–9. doi:10.1016/j.burns.2006.02.007. PMID 16901651.
6. *John Kraft and Charles Lynde, MD, FRCPC.* "Giving Burns the First, Second and Third Degree - Classification of burns". skincareguide.ca. Retrieved 31 January 2012. Formation of a thick eschar, slow healing (>1month), Obvious scarring.
7. *Alster TS, Tanzi EL. Hypertropic scars and keloids:* Etiology and management. Am j Clin Dermatol4(4):235-43 (2003).
8. *Lupton JR, Alster TS.* Laser scar revision. Dermatol Clin 20(1):55-65 (2002 Jan).
9. *Groover Il, Alster TS. Laser revision of scars and striae. Dermatol* Ther 13:50-9 (2000).
10. *Katz, B. (2010*): Efficacy of a new fractional CO2 laser in treatment of photodamage and acne scarring. Dermatologic therapy, vol.23:403-406.
11. *Jung JY, Jeong JJ, Roh HJ, Cho SH, Chung KY, Lee WJ, Nam K-H, Chung WY, Lee JH.* Early postoperative treatment of thyroidectomy scars using a fractional carbon dioxide laser. Dermatol Surg 2011; 37:217–223.
12. *Lee SH, Zheng Z, Roh MR.* Early postoperative treatment of surgical scars using a fractional carbon dioxide laser: a split-scar, evaluator-blinded study. Dermatol Surg 2013; 39:1190–1196.
13. *Nouri K, Jimenez GP, Harrison-Balestra C, Elgart GW.* 585-nm pulsed dye laser in the treatment of surgical scars starting on the suture removal day. Dermatol Surg 2003; 29:65–73.
14. *Tierney E, Mahmoud BH, Srivastava D, Ozog D, Kouba DJ.* Treatment of surgical scars with nonablative fractional laser versus pulsed dye laser: A randomized controlled trial. *Dermatol Surg* 2009; 35:1172–1180.
15. *Kim HS, Lee JH, Park YM, Lee JY.* Comparison of the effectiveness of nonablative fractional laser versus ablative fractional laser in thyroidectomy scar prevention: A pilot study. J Cosmet Laser Ther 2012; 14:89–93.
16. *Midwood KS, Williams LV, Schwarzbauer JE.* Tissue repair and the dynamics of the extracellular matrix. Int J Biochem Cell Biol 2004; 36:1031–1037.
17. *Brown BC, McKenna SP, Siddhi K, McGrouther DA, Bayat A.* The hidden cost of skin scars: Quality of life after skin scarring. J Plast Reconstr Aesthet Surg 2008; 61:1049–1058.
18. *Young VL, Hutchison J.* Insights into patient and clinician concerns about scar appearance: Semiquantitative structured surveys. Plast Reconstr Surg 2009; 124:256–265.
19. *Partridge J, Rumsey N.* Skin scarring: New insights may make adjustment easier. BMJ 2003; 326:765.
20. *Sobanko JF, Vachiramon V, Rattanaumpawan P, Miller CJ.* Early postoperative single treatment ablative fractional lasing of Mohs micrographic surgery facial scars: A splitscar, evaluator-blinded study. Lasers Surg Med 2015;47:1–5.

2/25/2017