The Role of Fractional CO_2 Laser in Treatment of Keloid and Hypertrophic Scar used Alone and in Combination with Intralesional Steroids

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Abstract

Background: The hypertrophic and keloid scars are thick , raised, disfiguring areas of skin with abnormal prolonged inflammatory response of wound healing process and overproduction of collagen. Carbon dioxide (CO_2) laser has been used in the treatment of hypertrophic scar and keloids for more than 20 years.

Aim of Study: To evaluate the effect of (CO_2) laser in treatment of keloid and hypertrophic scar with use of intralesional triamcinolone acetonide (kenacort) 40 mg/ml as adjuvant therapy.

Methodology: The study was done on 22 patients in Imam al-Sadiq teaching hospital in Hilla city with dividing the patients randomly in to two groups ,one group treated with four sessions of intralesional corticosteroids and the second group treated with four sessions of intralesional corticosteroids with carbon dioxide laser.

Keywords: *Hypertrophic scar, Keloid scar , CO_2 laser, Corticosteroid.*

Introduction

The scar is an area of fibrous tissue that replace the normal skin tissue after an injury. Deregulation of the process of wound healing that is complex , regulated response to the injury leads to development of scar. Despite both hypertrophic and keloid scar are common but the keloid scar is more challenging to treatment and may have significant physical and psychological impacts on patients life [1]. The scar biology is less well understood till now and search for the ideal treatment still continues and despite the different types of treatments including radiation, pressure therapy, cryotherapy , intralesional steroid or interferone, topical silicon and many other lines of treatment , no one is 100% curative as the first line treatment [2]. Parameters that used to assess the scar clinically involve scar colour, blood flow, erythema, itching, skin hardness, extension beyond the wound margin and healing spontaneously [3]. Hypertrophic scar is more common than keloid. Its erythematous, itchy, elevated lesion and less nodular than keloid scar and it is not extend beyond the wound margin and may heal alone and its size depends on the size and depth of the original wound [4]. The origin of word keloid from the Greek word Chele which means pincers of crab, the suffix oid means like, so it called keloid because it grows in pincers of crab like lesion [5]. Keloid scars are erythematous, nodular lesions extend beyond the margin of the injured site and not regress spontaneously [6]. The pathogenesis of keloids involve hyperprolifrative state due to abnormal molecular and cellular driving with four folds decrease in cell apoptosis and increase in survival marker AKT [7]. Keloid scar may develop due to trauma ,burn , injury or spontaneously as reported in patients with bethlem myopathy due to mutation in collagen type four [8]. Hypertrophic scar results from injury,burn,surgery and unlike keloid scar, it is more linear in nature and within the wound margins [9]. Keloid is a dermal lesion with excessive collagen and glycosaminoglycan around the wound with increase tissue growth factor B1 and the studies show increase in the incidence of keloid in patients who receive tissue growth factor B1 treatment and decrease incidence in those who receive anti tissue growth factor B1 [10]. Keloid is common in young

black female as polypoidal, glistening ,hairless nodule with different size and by histology it composed of irregularly arranged thick, large collagen fibers, increase elastic tissue in dermis , no involvement of epidermis or papillary dermis and normal number of fibroblast cells while in hypertrophic scar there is fine collagen fibers parallel to epidermis, absent elastic tissue in dermis and flat epidermis [11].

Carbon dioxide laser to be developed and is still one of the useful types that used in resurfacing of skin ,it exerts its effect by production of mid-infrared energy at primary band of (10,600 nm) [12]. It consist of mixture of carbon dioxide, nitrogen and helium. The rule of nitrogen is to increase efficiency by exciting the CO_2, causing more light emission while the helium allows the returning of CO_2 to the ground state and fostering heat transfer [13]. The target of carbon dioxide laser involves the water content of the cell resulting in vaporization of intracellular water and ablation of cell, also it causes denaturation of collagen protein and collagen contraction and decrease to one third of its original length [14].The biochemical changes seen after laser resurfacing include increase in procollagen (1 and 3), increase in several cytokines like interleukin 1 beta, tumor necrosis factor alpha, transforming factor beta [15]. Low complication rate had been seen with use of fractional carbon dioxide laser even after repeating it after (1- 6) minutes but the complication rate increase with 3 concurrent treatments of multiple body locations [16,17]. Laser safety must be taken seriously because of the combination of high output power and an invisible beam with high voltage supplies cause real risk of heart damage from the direct or reflected beam more to anterior structure of eye including cornea, lens, vitrous body but unlikely to reach to retina [18,19].

Methodology

This randomazied control study was done since july of 2018 till july of 2019 with total of 22 patients with keloid and hypertrophic scars resulting from burns, surgery, wound healing and acne with duration for at least one year were included in the study. Pregnancy, breast feeding, systemic retinoid eight months before exposure to treatment, acute infection and history of cancer were excluded from the study. Written information consent was obtained from each patient.

Clinical features hypertrophic and keloid scars regarding colour, site and size wereshown in table (1) & figure (1) .

Table (1): Features of scar.

Type	Size	Colour	Site
Hypertrophic	1 - 30 (cm)	Red	Cheek
		Brown	Neck
		Dark red	Chest
		Dark brown	Back
			Axilla
			Limb
Keloid scar	1 - 5 (cm)	Brown	Cheek
		Dark red	Chest

The goal of study to measure the results of use fractional CO_2 laser followed by intralesional triamcinolone acetonide (kenacort), 40 mg/ml in one group of hypertrophic scar patients and to compare it with another group of patients used intralesional steroid injection alone. The duration of treatment was every month sessions with a total course of 4 months. Each patient subjected to topical anaesthetic gel by topical lidocaine 8% for (0.5-1) hour before starting laser and intralesional steroid injection. Fractional CO_2 laser parameters used for patients in the study regarding wavelength, power and pulse duration.

The energy used by CO_2 laser depending on the site of hypertrophic scar, and depth of ablation (µm) was shown in table (2). Regarding the combination treatment group, five minutes after the completion of CO_2 laser session, intralesional steroid was injected until blanching of scar was happened.

Table (2): Energy used for different sites.

Site of lesion	Energy(mJ)	Depth of ablation(µm)
hand	15	190
Under breast	25	330
Pre sternal area	25 - 30	380
Neck	30	400
Axilla	30 - 60	560
Cheek and Limb	60	720

After the sessions of laser, ice packs were put on the lesions for (5-10) minutes, patients also instructed to use moisturising cream (Arden healing and soothing cream) twice /day to prevent development of erythema and swelling following laser therapy.

Three blinded observers evaluated photographs taken both at baseline and at 4 months following the final session. Photographs were obtained using(I phone high resolution camera). The observers determined which photograph was before and after. They evaluated the improvement in the appearance and degree of hypertrophy.

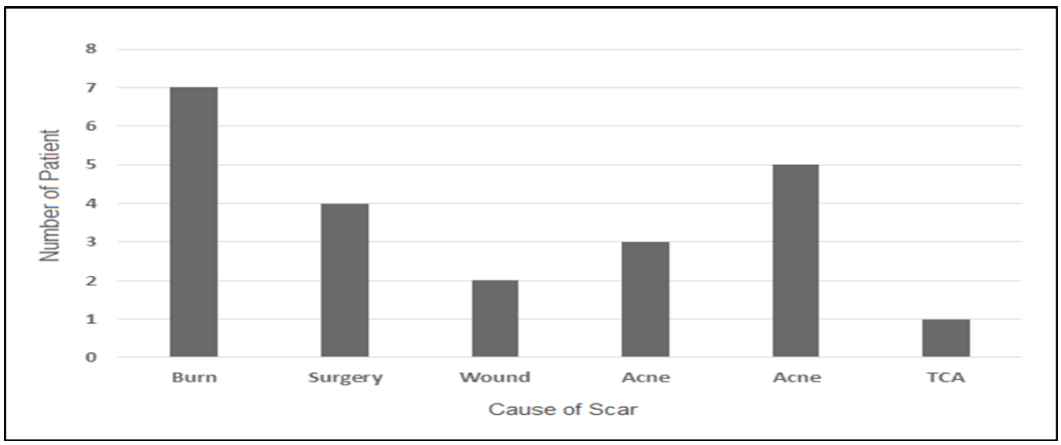

Figure (1): Number of patients according to cause of scar.

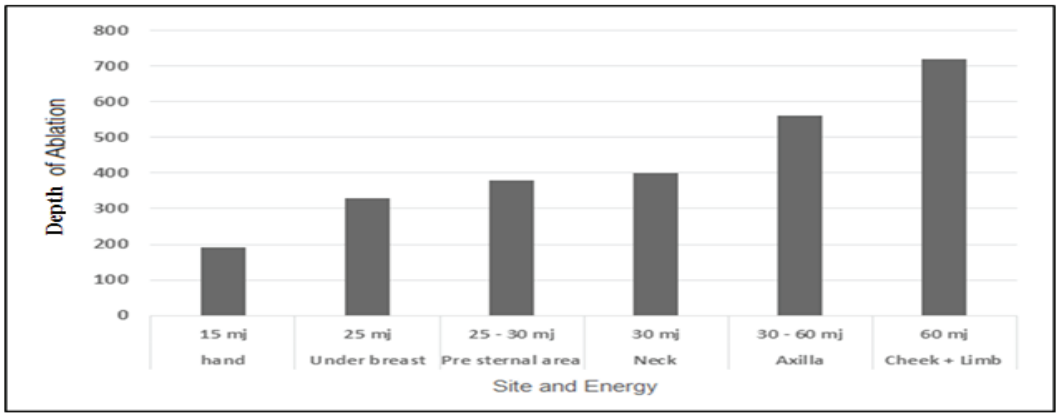

Figure (2): Site of scar and laser energy used for each site.

The degree of improvement was utilised according to the following 4 - point scale:

Improvement for < 25 % was 0

Improvement for 25-50% was 1

Improvement for 50-75% was 2

Improvement for > 75% was 3

In our study, mild response to treatment considered if degree of improvement < 25 % , moderate response to treatment if degree of improvement for 25-75% and a good response if degree of improvement > 75% .

Results

A total 22 patients with hypertrophic scars and keloids were exposed to treatment by fractional CO_2 laser therapy in combination with intralesional steroid and with intralesional steroid alone. There was 13 males and 9 females ,their age ranged from (14 – 37) years , the duration of the scar ranged from 6 months – 20 years .The patient were divided into two equal groups. The first group (11 patients; seven males and four females) received combination therapy with CO_2 laser and intralesional steroid, the second group (11 patients, six males and five females) received intralesional steroid alone. Every patient in each group subjected to four

sessions every month.

The overall average improvement score including hypertrophy, texture and colour improvement for both treatment groups was seen in figure (3). Three blinded investigators were determined at four months post treatment.

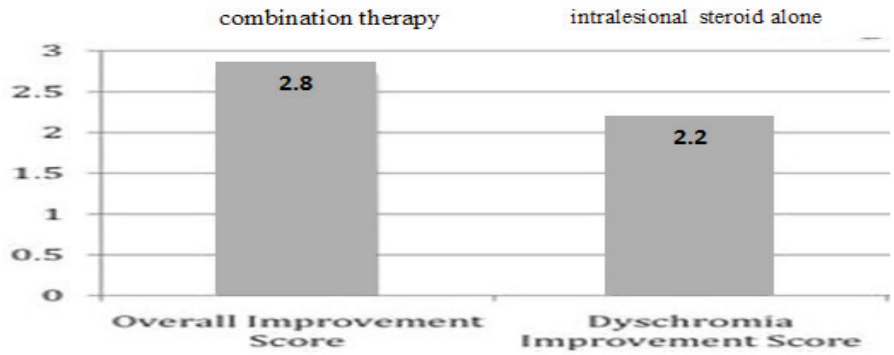

Figure (3): Average general improvement score as determined by investigators.

Average general score assessed by the 4 blinded observes for first group was 2.8corresponding to (2- 3) scale. The highest average improvement score was 3 which seen in **7** of 11 patients figure (4).

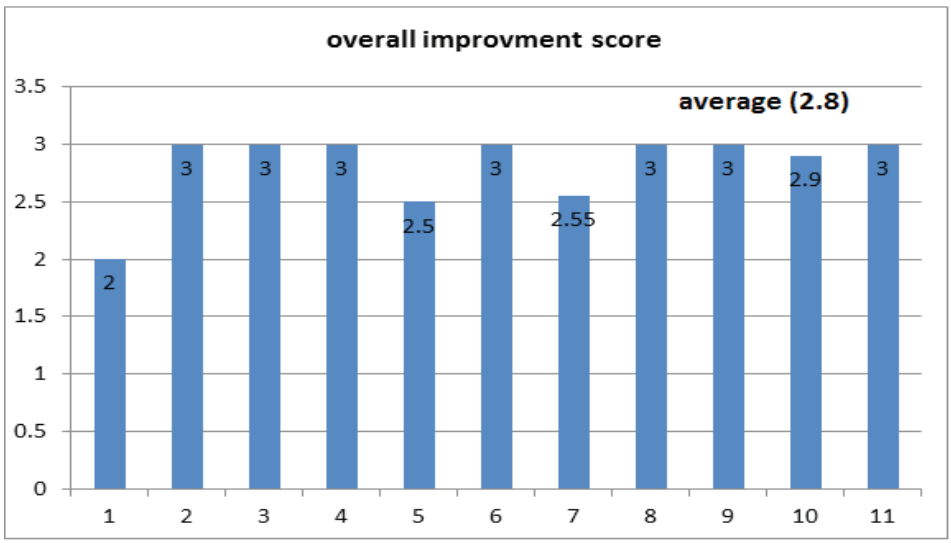

Figure (4): The score of improvement as resolute by three investigators at four months post treatment.

The overall average improvement score for the second group (intralesional steroid alone).

The highest average overall improve score was 2.5 which was seen in 2 of 11 patients.

Treatment was tolerable by patients and no adverse effects were reported except mild pain and transient erythema in some patients immediately after treatment.

Discussion

Keloid and hypertrophic scar are improper body responses to trauma resulting in itchy , painful nodular lesion that may cause serious functional and cosmetic disability [20]. Different lines of treatments have been used for both keloid and hypertrophic scars, among them are: surgical excision with or without grafting, pressure therapy, interferon, topical and local corticosteroid ,local injection of bleomycin, laser therapy, silicone gel sheeting, onion extract gel and other therapies directed at collagen synthesis [21,22]. corticosteroid was used for the treatment of pathological scars since the mid – 1960 , still have major rule in the regression of hypertrophic scars and keloids. Although there are multiple lines of

treatment of scar but still some of patient not response well to any one of these lines completely and no one of them was 100% curative , make the search for new treatment continue [23].

Steroid injections have been shown to cause regression in scar by its anti-inflammatory effect, increase tissue hypoxia and decrease fibroblast this lead to decrease synthesis of collagen and glycosaminoglycan [24]. The most common steroid that used in treatment of scar is triamcinolone acetonide (10-40 mg /ml) alone or with lidocaine to decrease pain, once or twice monthly sessions are required for treatment [25].

Despite the few randomized, prospective studies, the intralesional steroid represent the first line therapy for keloid scar and second line therapy for hypertrophic with response rate 50-100% and recurrence rate 9-50% [26].

Manuskuatti and Fitzpatrick showed that the use of intralesional steroid with contratubex together are more effective than steroid alone in treating hypertrophic and keloid scar with lower side effects [27].

Recent advance in laser application provide another option in treating scar with fractional ablative laser that produce zone of ablation with different depth followed by wound healing process leading to collagen remodelling also remove the fibrotic tissue. This application also used postoperative to enhance delivery of the drug and other substance.

The result of our study indicated that the combination same - session treatment with both fractional carbon dioxide laser and intralesional steroid in treatment of hypertrophic and keloid scar was more effective and efficient than intralesional steroid alone. Various aspects of scar parameters like texture and hypertrophy were improved with this treatment.

Conclusion

The combination of same-session treatment with fractional carbon dioxide laser and intralesional steroid produce an efficient and more effective therapy in treatment of hypertrophic and keloid scars.

Financial Disclosure: There is no financial disclosure.

Conflict of Interest: None to declare.

Ethical Clearance: ll experimental protocols were approved under the University of Babylon – Hammurabi Medical College and all experiments were carried out in accordance with approved guidelines.

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