

Fractional CO₂ laser Combined with TCA for the Treatment of Keloid Scars

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1. Introduction

Scarring is a complex phenomenon, Following an injury to the skin, whether voluntary or post-surgical, the healing process begins. This is a long physiological process designed to restore the integrity of the skin covering [1]. In certain circumstances, ad integrum restitution cannot be achieved, leading to pathological scarring. Risk factors can be local, depending on the topography of the lesion, or general, depending on age or genetic predisposition. We distinguish two types of pathological scars: hypertrophic and keloid [2]. Indeed, it has been confirmed that the latter are the cause of serious psychological problems, as they are not only aesthetically embarrassing, but also lead to an alteration in patients' quality of life and self-esteem [3]. The therapeutic arsenal is broad, and includes corticosteroids in intra-lesional and topical injections, pressotherapy, surgery, radiotherapy, cryotherapy, 5-fluorouracil (5-FU) and lasers [4].

Since 1983 (work by Castro et al.), lasers have amply demonstrated clinically, histologically and immunohistochemically their biomodulatory capacities to modify and normalize the abnormal fibroblastic phenotype, hypertrophic or keloidal, into a "normal" phenotype, or to stimulate fibroblast synthesis [5-30]. Described by German dermatologist Unna in 1882, trichloroacetic acid has been universally used for many years to treat signs of cutaneous photo-aging, hyperpigmentation and certain acne scars. Given its corrosive properties (strong acid), it can also be used for pathological scars, notably keloids. The therapeutic arsenal is wide, laser and trichloroacetic acid have demonstrated their effectiveness.

2. Objective

The aim of our work was firstly to carry out an exhaustive literature review on the treatment of keloid scars by different

lasers, in order to establish a defined protocol to be applied. Secondly, to evaluate the effectiveness of a protocol based on the combination of fractionated CO₂ laser + TCA 30% in the treatment of keloid scars in the Dermatology and Venereology Department of the Ibn Rochd University Hospital in Casablanca.

3. Materials and Methods

Prospective study was conducted between november 2022 and april 2023 in the Department of Dermatology and Venerology at Ibn Rochd University Hospital. Our patients benefited of combined protocol including TCA 30% and Fractional CO₂ laser therapy, using the above parametres : (Fractional CO₂ laser : Fluence of 30 mj/cm², Density 0.6 mm, Penetration time: 2ms). Trichloroacetic acid: 30% applied immediately after laser treatment. All patients were placed under photoprotection with silicone plates. Overall improvement measured by the Vancouver score assessing scar suppleness, size, color and thickness was good (Figure 1, 2, 3.).

4. Results

Comparing the results of the different protocols, it appears that the fractionated CO₂ laser delivers the best results. We proceeded to potentiate efficacy by applying trichloroacetic acid 30% immediately after the laser. Fractional CO₂ laser treatment promotes the penetration of trichloroacetic acid: dermoporation technique: Five patients were included in the protocol, four women and one man. Mean age was : 42 years (extremes: 28 and 56 years), All patients were phototype IV. Based on the Vancouver score, the results showed one patient with a score of 6 versus 13 initially, 2 patients with a score of 9 versus 13, and the last patient with a score of 8 versus 12 with overall satisfaction estimated at 75%.



Figure 1: Keloid scar of the thigh after thermal burn in a 36-year-old patient
 (A): Before protocol
 (B) : After 5 protocol sessions



Figure 2: Post-folliculitis keloid scar in a 41-year-old patient
 (A): Before protocol
 (B) : After 5 protocol sessions



Figure 4: Post-acid burn keloid scar in a 39-year-old patient
(A): Before protocol
(B) : After protocol

5. Discussion

5.1. Effects of Co2 Laser on Pathological Scars

Ablative lasers remodel collagen and elastin by lifting the epidermis and part of the dermis [31]. However, they are accompanied by a visibly long recovery time and postoperative erythema lasting weeks to months [32]. Although the exact mechanism of fractional photothermolysis in the treatment of pathological scars is not yet known, it would appear that columns of thermal energy characterized by focal epidermal necrosis and collagen denaturation may trigger a cascade of events via the production of pro-inflammatory cytokines and growth factors that could eventually lead to normalization of the collagenesis-collagenolysis cycle [33, 34].

6. Trichloroacetic Acid

6.1. Physicochemical Composition

TCA is a trichloroacetic acid derivative in the form of colorless, water-soluble crystals. It is a trichloroacetic acid derivative in which the three hydrogen atoms of the methyl group have been replaced by three chlorine atoms [35]. It is non-toxic to the body (unlike phenol) and non-allergenic. After preparation, the solution is stable for at least six months when stored in an amber glass bottle at room temperature or in a cool place. Its

activity tends to diminish over time, so the solution needs to be renewed at regular intervals, especially as the product is very inexpensive. 30% TCA provides a medium peel, allowing healing in 4 to 7 days [36].

TCA causes precipitation of epidermal proteins, necrosis and more or less deep exfoliation. Because 100% TCA is more caustic than pure phenol, successive applications increase the depth of the peel, enabling the desired depth to be achieved progressively. TCA cannot be neutralized, but can be diluted with water to stop its action.

7. Undesirable Effects

Risk of infection: (- Herpesvirus infection: suspected when patients present with burning or pain during the first 7 days after peeling. Low-dose oral antiviral prophylaxis, starting the day before the peel and continuing for 7 days afterwards.

Erythema: (- Generally resolved in 4 to 7 days.- May persist longer with deeper peels or in patients with a light phototype. Post-inflammatory hyperpigmentation: - More frequent in darker phototypes. - Temporary in most cases.) Hypopigmentation : (- Rare. - Patients with dark phototypes - Deep peels).

8. Contraindications

Pregnancy, Unbalanced diabetes, immunodepression, Mental illness, Facial herpes, Open wounds, Isotretinoin treatment less than 1 year old average)

9. Combined Action of Fractional CO₂ LASER and 30% TCA

The technique consists in creating microscopic channels with the CO₂ laser to create microscopic channels that conduct TCA directly into deep skin tissue.

Trichloroacetic acid (TCA) induces ultrastructural changes in the epidermis and dermis. It improves the morphological appearance of collagen and elastin. It acts by depositing new collagen and normalizing elastic tissue that has been destroyed by the overproduction of collagen I and III, and can therefore be used in keloids.

Our study is similar to the El-Hamid El-Azhary al study, where out of 3 groups of patients, one group received laserCO₂ alone, the second group TCA AND THE 3 rd group received the combination TCA and LaSER CO₂ with a good response in the 3 rd group.

10. Conclusion

Our protocol has demonstrated the effectiveness of combining the fractional ablative CO₂ laser with the immediate application of 30% trichloroacetic acid. On the other hand, we present only preliminary results; further study is therefore desirable to confirm the results.

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