



## Improvement of Scar Contractures with Ablative Fractional CO<sub>2</sub> Laser Treatments: A Case Report

He Fang, Kaiyang LV, Fang Zhang, Pengfei Luo and Zhaofan Xia\*

Department of Burn Surgery, Second Military Medical University Affiliated Changhai Hospital, China

### Abstract

Scar contractures from burn injuries often performed after the burn wounds healed, especially when the burn wounds involving the joints. Although many therapeutic modalities have been used to the administration of scar contractures, a great number of burn patients suffered from dysfunction of major joints involved by burn injury. Ablative fractional CO<sub>2</sub> laser (AFCL) treatment has become a more popular therapeutic procedure for burn scars in the past decades. This report presents a case of left knee joint scar contracture treatment with AFCL after 79% total body surface area (TBSA) burn.

A 20-year-old male patient underwent 79% TBSA flame burn. The burn wounds were healed about 1-month post injury and classical anti-scar treatments including pressure garments, onion extract cream and silicone gel and sheeting were applied as soon as the entire wounds were healed. However, the major joints (both elbow joints and left knee joint) developed to contracture about 6 months later and the activities of daily living, such as dressing, ambulation, bathing and eating, were affected by the contractures of joints. AFCL treatment was then applied and the function of involved joints improved significantly and the pruritus was also alleviated.

In summary, AFCL treatments can improve burn scar contracture dramatically. Further researches are needed to define optimal parameters of AFCL and the mechanisms.

**Keywords:** Burn injuries; Laser treatments; Scar

### Introduction

Scar contractures from burn injuries often performed after the burn wounds healed, especially when the burn wounds involving the joints. Contractures are defined as failure to complete full range of motion of a joint [1]. Although many therapeutic modalities have been used to the administration of scar contractures, a great number of burn patients suffered from dysfunction of major joints involved by burn injury. The treatment modalities contain silicone gel sheeting, surgical excision, pressure treatments, tissue expanders, and interferon injections [2]. In the past decades, ablative fractional CO<sub>2</sub> laser (AFCL) treatment has become a more popular therapeutic procedure for burn scars [3]. However, the treatment outcome with AFCL for burn scar contractures, especially for severely burned victims, is little known. Here, we report a case of left knee joint scar contracture treatment with AFCL after 79% total body surface area (TBSA) burn.

### Case Presentation

A 20-year-old male patient underwent 79% TBSA flame burn when he worked. Burned areas distributed among the whole body surface excluding legs (10% TBSA), buttock (4% TBSA), trunk (2%), head (1% TBSA) and feet (5% TBSA). After successful fluid resuscitation, the patient underwent mesh auto grafting procedures to the lower extremities and upper extremities. The burn wounds were healed about 1-month post injury. Classical anti-scar treatments including pressure garments, onion extract cream and silicone gel and sheeting were applied as soon as the entire wounds were healed. About 6 months after the initial auto grafting, the patient suffered from scar contracture, involving the major joints (both elbow joints and left knee joint). The left knee joint flexion range of motion reduced gradually. The activities of daily living, such as dressing, ambulation, bathing and eating, were affected by the contractures of joints.

Eight months after mesh auto grafting surgery, ablative skin resurfacing using an AFCL (UltraPulse Encore, Lumenis, Yokneam, Israel) was administrated to treat the scar contracture. Local anesthesia was performed on by using lidocaine gel on the contracture sites around the left knee joint. The surgeon operated the laser system assisted by two assistants. One assistant was

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#### \*Correspondence:

Zhaofan Xia, Department of Burn Surgery, Second Military Medical University Affiliated Changhai Hospital, Shanghai 200433, China, Tel: +86-21-3116182; Fax: +86-21-65589829; E-mail: xiazaofan\_smmu@163.com

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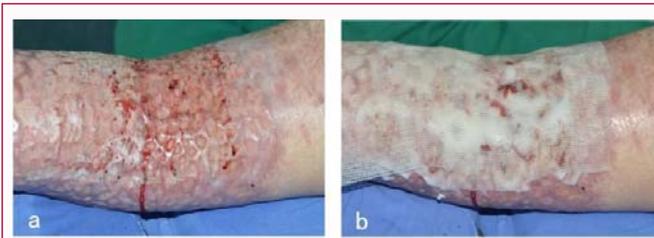
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**Figure 1:** AFCL operation was carried out under local anesthesia.  
(a): The bleeding volume was less than 10 ml.  
(b): The wound was covered by hydrophobic dressing after operation.



**Figure 2:** The scar contracture improvement of left knee joint.  
(a): The knee flexion was limited to 92 degrees before AFCL treatment.  
(b): The patient could flex the knee to 69 degrees by himself 1 month after AFCL treatment.  
(c): The patient could flex the knee to 62 degrees by an outside force 1 month after AFCL treatment.  
(d): The active movement of his knee was improved to 47 degrees 6 months after the AFCL treatment.

responsible for the smoke suction, and the other one was in charge of keeping the patient's body in a extensio position for operating. The operation was carried on by using SCAAR FX mode, with the parameter was as followed: 150 mJ energy, 300 Hertz, 5% density. The operation lasted for 30 min and the bleeding volume was less than 10 milliliters (Figure 1a). The operated knee joint could be kept in a extensio position when the operating was over and the operating site was covered by hydrophobic dressing (Figure 1b), which was changed the next day and was removed on Day 4 after operation. There was no skin ulcer at the operating site. First-generation cephalosporin antibiotics were given intravenously in the first 3 days after the operation and the body temperature was kept in normal range during the whole hospitalization.

The scar contracture improvement of left knee joint was followed up and goniometer was used to measure the left knee range of motion. The scar of left knee joint was assessed by Vancouver Scar Scale (VSS) in pigmentation, thickness, vascularity and pliability. One month after the AFCL treatment, the flexion function of left knee joint was improved significantly. Before the operation, the knee flexion was limited to 92 degrees and the VSS was 12. One month after the AFCL treatment, the patient could flex the knee to 69 degrees by himself and flex to 62 degrees by an outside force. The VSS was 9. The active movement of his knee was improved to 47 degrees 6 months after the AFCL treatment and the VSS was decreased to 6, which was

comparable to the normal adult (Figure 2). What's more, the scarring pruritus also improved.

## Discussion

During the past decades, the survival rates of severe burn patients have increased significantly [4]. As a result, more attentions have been shifted to the functional recovery, especially burn scars after the burn wounds healed. Scar contractures at the site of deep burn wounds lead patients to suffering from physical and psychological problems, which in turn may result in a decreased quality of life. The prevention and treatment of scar contracture contains silicone gel, pressure, exercise, radiotherapy, steroids and surgical correction. In the present paper, we report a case of improvement of scar contractures with ablative fractional CO<sub>2</sub> laser treatments after the patient suffered from severe burn injury.

Laser treatment has been used to improve our ability to treat patients with scars. The mechanism of laser treatment involves collagen and neocollagenesis remodeling [5], which is responsible for the improvement of car contractures. AFCL treatment on skin can create micro-thermal treatment zones in the epidermis and upper dermis, the undamaged tissue left between these columns is responsible for collagen formation and re-epithelialization [6,7]. The AFCL was rarely reported in the administration of burn scars. The patient in this case suffered scar contracture and underwent AFCL treatment after burn injury and the outcome was satisfying.

The development of contractures was mainly associated with burn size, burn depth and hospitalization. In the present case, the burn depth of operation site was III degree and the burn wounds covered the whole knee joint. The knee flexion function was limited obviously and the VSS was high when the scar contracture developed after wound healing. After treatment of AFCL, the function of knee joint improved significantly and the pruritus was also alleviated.

According to our experience, hypothermia sometime occurs when the AFCL was carried out. Many factors are associated with it, including general anesthesia, body surface exposure without covers, long operating time and low environment temperature. Perioperative hypothermia is associated with clinical complications including increased bleeding, wound-healing delay, and even cardiovascular events [8]. In this case; we applied multiple strategies to avoid the perioperative hypothermia. The AFCL operation was only carried out at the site around left knee. As a result, the operating time and body surface exposure were reduced obviously. What's more, as the operating area was limited, local anesthesia could be well tolerated and was taken instead of general anesthesia, which was very important for maintaining normal temperature during the operation. For the patients with large area scar contracture, multistep operation can be effective in preventing hypothermia. Two or even more laser system applied in one AFCL operation for patients with large area of scar contracture at the same time is another alternative method to decrease incidence rates of hypothermia.

In summary, AFCL treatment can improve burn scar contracture dramatically. Further researches are needed to define optimal parameters of AFCL and the mechanisms.

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