Perspective

Rehabilitation of Patients with Facial Burn Injury: Principles and Practice Experiences

Yating Wei and Cecilia WP Li-Tsang*
Department of Rehabilitation Sciences, Hong Kong Polytechnic University, China

Abstract
Rehabilitation of patients with facial burn injuries is important to help an individual regain normal function and cope with daily living tasks, especially after extensive and deep facial burns. The rehabilitation intervention should be started as early as possible, and with customized therapeutic plan according to the wound conditions. One of the most common complications of facial burns is hypertrophic scar (HS), which will affect the normal appearance of the patients and results in psychological morbidity. Pressure therapy and silicone gel has been widely applied for the prevention and treatment of hypertrophic scars with promising clinical effects. However, due to the contours over the face, pressure therapy may not be effective to control the HS and simply using silicone gel sheets may not work on very severe scars. The application of novel concepts of 3D-printed transparent facemask with silicone linings could help resolving the contour problems. Apart from scar management using pressure therapy and silicone gel, positioning, splinting, facial exercise, massages as well as ADL training are also important intervention aiming at improving the physical and functional well being of the burn survivors. Psychological support to survivors and caregivers/family, social support and community integration are essential to promote the psychosocial function throughout the stages of rehabilitation. The ultimate goal of rehabilitation for patients with facial burn injuries is the re-establishment of self-esteem and eventually returning back to the society.

ABBREVIATIONS
• HS: Hypertrophic Scar; ADL: Activities of Daily Living; 3D: Three-Dimensional

INTRODUCTION
Facial burn injury brings great psychological burdens to the burn survivors because of both functional and aesthetic impairment it brings about. The development of hypertrophic scars (HS) and contractures, as well as hyper or hypo-pigmentation of scar could result insignificant change to the facial appearance of the patients [1]. Orofacial contractures may affect the patient’s ability to perform activities of daily living including oral intake, dental hygiene as well as speech articulation [2]. As human face is routinely exposed and represents the identity of each individual, some patients may not recognize themselves after the injuries and often unable to accept their facial disfigurement. Also, facial scars are difficult to conceal with clothing which further affect the self-image of the survivors significantly. Many may show withdrawal behavior from the society even long after their initial injury [3].

Luckily, facial burns usually heal faster than other parts of the body because of profound blood circulation of the face. Unless the degree of burn injury reaches deep 2nd degree, the wound will be healed within 2 weeks and it is very unlikely to cause scarring problems. The prognoses of superficial facial burns are good, given enough time, the pigmentation would return to normal eventually. Unfortunately, deep facial burns did happen sometimes, especially in cases with extensive burns. Patients suffering from deep facial burns have very low chances to restore the original facial appearance in spite of the advanced wound management methods and reconstructive procedures [4]. The consequences of extensive and deep facial burns are usually unfavorable with poor outcomes.

Until now, there’s yet little knowledge on the actual mechanism of scar formation after deep burn injury. However, with all the treatment provided to facial burns targeting at fast wound healing, timely and effective rehabilitation therapy, we could significantly improve the outcome of those burn injuries. A comprehensive rehabilitation program is always useful for achieving positive functional outcome and acceptable cosmetic results in burn care practice [5,6]. For facial burns, there are some special procedures besides common practice guidelines that the clinicians should pay attention to. Therefore, we introduce the
principle and share our latest clinical experiences in this paper aiming at emphasizing a more comprehensive concept of facial burn rehabilitation.

**PRINCIPLES AND PRACTICE EXPERIENCES**

Facial burn rehabilitation is of great importance in the whole process of facial burn management leading to better outcomes of facial burns after decades of clinical experiences. With the development of rehabilitative theory and techniques, facial burn rehabilitation nowadays should include updated contents and advanced methods, and a comprehensive rehabilitation plan is necessary to enhance the quality of facial burn management.

**TIMING OF FACIAL BURN REHABILITATION**

Early intervention strategy is one of the most important principles for a successful rehabilitation program [7]. Rehabilitation should begin soon after the burn injury and as early as possible, at the same time with different emphasis through the different wound healing stages. Generally, a comprehensive facial rehabilitation program includes the following aspects.

**POSITIONING THE HEAD AND NECK**

Proper positioning of the head is the first rehabilitation procedure for the facial burns at early stage, which should be applied immediately after the burn injury. Lifting the head above the heart level helps to reduce the edema from the wound injury, which also help to reduce the duration of inflammatory agent infiltration. Since long-lasting inflammation is a risk factor for hypertrophic scars developed in later stages. Subsequently, the neck should be in the middle line without rotation or bending to either side. A neutral to slightly extended neck position achieved by removing pillows under the head during the whole wound healing process prevents the deformity of the chin and neck to either side or mandible-chest adhesion due to wound contracture and hypertrophic scarring [8]. Splinting the neck can be used for supporting the mandible and neck if necessary or when positioning alone is difficult to achieve proper positions. If the patient has undergone skin graft surgery, a mandible and neck splint is particularly useful in preventing the contracture of skin grafts.

**FACIAL EXERCISE**

Facial exercise is also an important part in a comprehensive rehabilitation program [7]. Except for the periods waiting for skin graft taking, facial exercise through the active movements of facial muscles should be encouraged all through the healing process of facial burns. Facial exercise mainly includes oral movement (movements involving mandibular joints and perioral muscles), and the movement of eye lids. The oral movements help to prevent the development of microstomia due to wound and scar contracture, atrophy of chewing muscles due to fasting, tube feeding or insufficient food intake. It has been shown that exercise based treatment was effective in assisting restoration of full oral function and normal horizontal mouth opening range for most patients [9]. Eye lids movements can improve the mobility of eyelids and prevent ectropion of upper and lower eye lids due to scar contractures.

**SPLINTING**

After burn injury, due to the wound and scar contractures, it is important to prevent narrowing of mouth opening, nostrils and auricles. Therefore, conformers are needed for these facial areas. Splints supporting the nostrils are necessary for patients with burns involving the nose region, in order to prevent the contracture of the nostrils and affect breathing. Splints supporting the ear can prevent the shrinkage of the auricle. Because of the sphincter-like nature of the orbicular is oris and the absence of supporting skeletal structures underneath, oral commissure contractures are common for patients with perioral burns [10,11]. Oral splints including horizontal, vertical, and circumferential lip stretch is needed as an effective contracture management against microstomia [12]. There are passive stents and dynamic stents according to the way it apply force. Also there are intraoral and extra oral devices according to their location [13]. Oral splints are used during resting hours, together with engagement of oral exercise, to maintain the functional size of mouth opening (Figure 1).

**SCAR MANAGEMENT**

Wound healing time is essential in determine the formation of hypertrophic scars after burn injury. It is well-known that the risks for hypertrophic scar increase with time, and is regarded high if the wound cannot heal within 21 days [14]. It is important to identify the wounds that were deep enough to inducing hypertrophic scarring and cannot heal spontaneously within a safe timeframe of less scarring. Those highly risky burns should be covered with skin grafts as soon as possible [4]. However, sometimes, it is difficult to anticipate the healing speed of facial burns, especially partial thickness burns with mixed depth, in many cases spontaneous healing is the most favorable choice for both physician and the patients. Also, for extensive and severe burn cases, the source of grafting skin is sometimes insufficient. Therefore, in these cases, as soon as the wound heals, rehabilitation procedure for preventing hypertrophic scar should be applied whether there is perceivable scar or not, as facial appearance plays important role in one's social life and patients usually have a high demands on the outcomes while any changes in facial appearance may become stressful. The most widely used rehabilitation treatment targeting at the prevention and treatment of hypertrophic scars is pressure therapy and silicone gel [15].

**Pressure therapy**

Traditional pressure therapy for facial scar management

---

Figure 1: The oral expander for preventing microstomia (left) and the ear splint for preventing shrinkage of the auricle (right).
is through elastic pressure garments [16]. However, it bears a number of limits. Firstly, the look of the garment is not acceptable for many patients, which give them sinister looks and separate them from the world outside [17]. Secondly, the elastic fabric cannot provide pressure on concave surface, which is not convenient for facial burns involving the complicated facial surface [18]. Thirdly, the holes made on the eyes, nose, ears and mouth of the fabric would decrease the pressure significantly around these areas, making the treatment ineffective (Figure 2). The pressure provided by pressure garment alone is low [17]. In fact, pressure dosage is an important factor deciding the effectiveness of pressure therapy [19]. In some cases, inserts can be used with pressure garment to increase local pressure, but the fabrication and use of the inserts are not convenient and the scar condition cannot be easily monitored [18].

Transparent facemask, firstly described in 1979 [20], is becoming more preferable by the therapists and the patients. However, the fabrication of transparent facemask is not convenient in the past and the accuracy might be affected through multiple impression and mold taking process. Recently reported 3D scanning and 3D printing techniques has brought revolutionary changes to the fabrication of transparent facemask, which is more efficient and convenient, as well as retaining higher accuracy without multi-step molding process [21]. The advantages of 3D printed facemask compared with elastic facial pressure garment made from Lycra net is that it is able to provide more evenly distributed pressure on face, while the pressure garment cannot achieve the function. But the design of the facemask is essential for the pressure distribution of the transparent facemask and should be individualized. It has been realized that for transparent facemask design, it is necessary to avoid over-pressurize the bony areas and applying more pressure on areas with more soft tissue that generally has less pressure. 

Silicone gel intervention

Silicone gel is recommended to apply for the prevention and treatment of hypertrophic scars after both burn injury and surgery [22]. For deep burn injury, the sweat and sebaceous glands are usually destroyed, and the function of the newly healed epidermis is usually abnormal, therefore there is higher trans-epidermal water loss on the scarring areas. The resulted skin of hypertrophic scar is usually dry and scaling, which partially contributes to the pruritus symptoms of the patients and easily develop new wounds. Silicone gel is suggested to work through occlusion and hydration effect, which can reduce the water loss from the scar through the mal-functional scarring epithelium, therefore improve the common dryness symptom of the hypertrophic scar and subsequently decrease inflammatory reaction and cell proliferation [23]. Another possible effect that silicone gel worked on the hypertrophic scar may through reducing the tension of the stretching scarring tissues, as tension is also an important cause of hypertrophic scarring [24].

The combined intervention strategy of pressure therapy and silicone gel

The combination of silicone gel with pressure therapy has been showed more effective with providing benefits to the scar maturation outcome [25]. It is also recommended by the ISBI Practice Guidelines Committee that all extensive burn hypertrophic scars should receive pressure therapy with silicone therapy as the first line of treatment [26]. Since the facial contour is complicated with individualized convex and concave surfaces, the combined pressure therapy with silicone gel for facial hypertrophic scars needs more customized intervention strategy. The 3D-printed transparent facemask with silicone linings is a promising solution for the effective application of the combined therapy (Figure 3). It has been used in our patients with favorable clinical results [21]. But the patients need to maintain the treatment for at least half a year, until the maturation of the hypertrophic scars to achieve a stable clinical outcome.

Scar massage

Massage can increase the pliability of the scarring skin, reduce pain, hypersensitivity and pruritus, therefore is also recommended for facial burn rehabilitation, especially for cases that already developed protruding hypertrophic scars and contracting scar bands [15]. Massages are usually applied with emollients [26]. Techniques of massage mainly include Zig-Zag mobility, pinch and roll, traction, stretch, friction and circular mobility with different combinations [27-28].

ADL TRAINING

ADL training should be started as early as possible to help building up patients’ self-advocacy and independence, even at the very early stage when wound still not heals up yet. For most patients with facial burns, grooming (clean face, brush teeth, comb hair) by themselves is the first step for returning back to their life. This also helps to improve the acceptance of the changing facial appearance. Some aids and customized tools would be needed to facilitate early independence in these ADL tasks. Once the patient’s physical conditions become more stable, bed mobility training, dressing practice, toileting and bathing would be encouraged. These are the basic steps for the patients to get prepared for adapting to their normal life after surviving from the facial burn injury.
Central

Bringing Excellence in Open Access

Psychological support

The most important role for a person in a society is to regain the social life after the injury and hospitalization. The human face represents the identity of the person, as it gives the first impression of a person who then will serve as a way to discriminate one from another in a society. Patients with facial burns tend to show withdrawal behavior after injury because they are afraid to be judged by people on their facial disfigurement after burns. In some severe cases, patients may develop depression and lose hope for their future life [3]. Therefore, psychological intervention should be implemented as one of the key components of rehabilitation for those survivors with facial burns. Psychological support should be provided as soon as the patient is admitted. Emotional care from nurses, doctors, family members and social workers are important to prevent and ameliorate psychological disorders [29]. Psychological professionals should be involved in the multidisciplinary team too for screening and treatment of psychological disorders [3]. In addition, burn survivors might benefit from psychosocial support group with other peers suffering similar problems. Self-help organization would also serve as facilitators helping these survivors to regain confidence and maintain sufficient social contacts.

Family/caregiver education

Family/caregiver education is necessary for these survivors both at the early rehabilitation stage and at the final stage when they return home. Early education of care and rehabilitation process will help family/caregivers to understand the medical and rehabilitation management at the same time; also education can improve the compliance of the therapy and they could then assist in ongoing practice of nursing and rehabilitation procedures throughout the period of rehabilitation, therefore it can positively affect the patients’ rehabilitation outcomes. Education provided to both family members and people around the patient with the knowledge of burn rehabilitation can improve their skills in dealing with the patient and understanding their needs.

Prior to the discharge back home, family/caregivers should be psychologically prepared to accept the burn survivors’ physical and psychological adjustment back home and later back to work. Psychological support to family members are also important, particularly, spousal relationships which might be affected.

Social reintegration

Although there are a number of surgical or non-surgical reconstructive procedures to improve the facial scars, it is still difficult to remove the burn scars completely and restore the unwounded facial appearance for most patients with deep facial burns. The acceptance of their permanently changed facial appearance and return back to their normal life is the ultimate goal of the rehabilitation program, which may last for years, but should be carried on with the effort of health professionals, family and society, as well as the patients themselves.

Discussion

As the face is a special body region with complicated contour, mixed biological and social function, also since the evaluation of treatment outcome is limited by the lack of standard method, it is difficult to form uniform and universal strategies regarding the rehabilitation of facial burn injury. The principles and experiences presented in this article can serve as a reference for the implementation of a comprehensive rehabilitation program. Although therapists may provide diverse treatments to their specific patients with available resources and individual experience, it is worthwhile to emphasize that a successful rehabilitation plan should be made according to each patient’s individual condition and needs. Effective implementation of these rehabilitation strategies is eventually dependent on the compliance of the patient.

Conclusion

Although facial burns can bring devastating impact on the patient’s life, a comprehensive rehabilitation program and the early application through a rehabilitation team is important to improve the outcome of the patients and promote quality of life.

References


