



## Original Article

## Pharmacological and Medical Effect of Modified Skin Grafting Method in Patients with Chronic and Severe Neck Burns

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## ABSTRACT

Scar contracture is the major complication of neck burn, which impairs the organs functions. Scar contracture causes limiting the range of neck motion, organ malfunction and some damages to the patient's esthetic and his appearance. Since the studies in this field are not developed well, it is difficult to treat and manage these patients. The principal approach is scar releasing surgery followed by reconstructive surgery. There are many methods of reconstructive surgeries, each patient has his own specific methods, and it depends on surgeons' decision. Split thickness skin graft (STSG), full-thickness skin graft (FTSG), free flaps, local flaps, V-Y plasty, and V-M plasty are the most common methods used for reconstructive surgeries. In this study, modified free-tension skin grafting was used as the reconstructive procedure, which had shorter treatment period and better treatment outcomes in terms of esthetic and range of motion than the traditional methods.

## GRAPHICAL ABSTRACT



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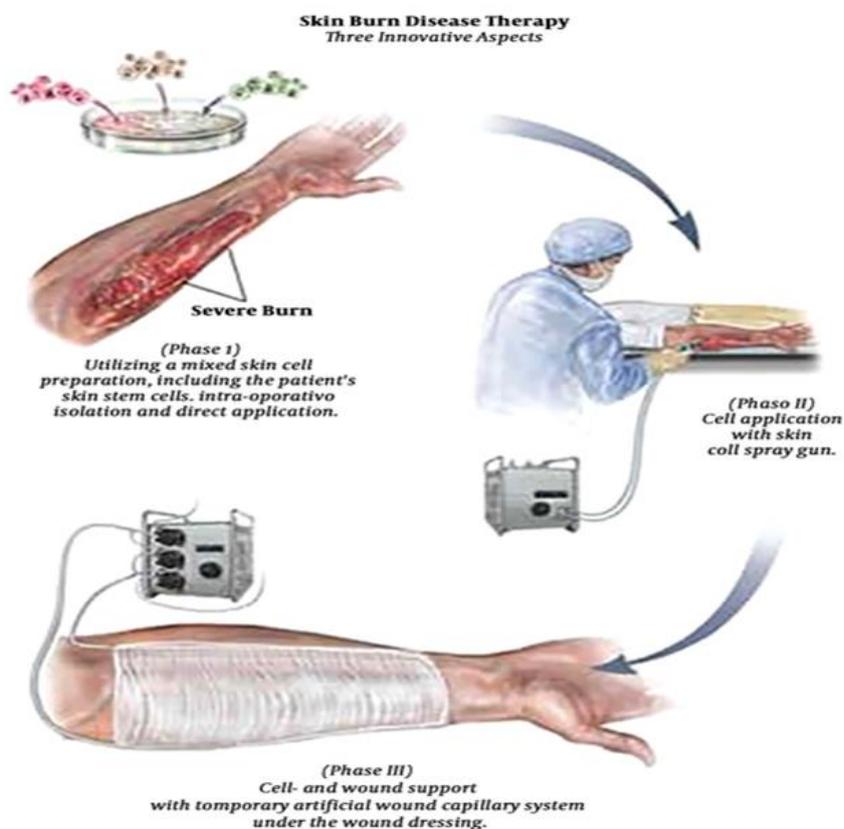
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## Introduction

Burn injury is one of the injuries that can lead to temporary or permanent sequel. In burn injuries, the patient's esthetics and malfunction of organs are important [1-3]. In the case of burn injuries

scar contraction is important as it can be the reason of an organ's malfunction in a patient. Classifying burn injuries helps to describe and understand the injury. Burn injuries are classified according to their depth and size (Figure 1).



**Figure 1:** Repairing Injured Skin: Biologics, Skin Substitutes, and Scaffolds

### Classification According to Size

Depth of burn injury divides into superficial (first degree), superficial partial thickness (second A degree), deep partial thickness (second B degree), full thickness (third degree) and fourth degree. Size of burn injury classified into minor and major. Superficial burn injury affects the upper area of the epidermis layer, which its consequences are pain and erythema. Superficial partial thickness is deeper than first degree. Blister, pain and scar inducing are prominent symptoms of superficial partial thickness so it needs dressing but doesn't need surgery (Figure 2). Deep partial thickness due to destruction of pain receptors is less painful, dry and susceptible to scarring so it needs surgery. Full-thickness burns involve epidermis and dermis (all layers of skin) so it's not painful, susceptible to infection so more attention and surgery are needed. In the fourth degree burn injury deeper tissues are

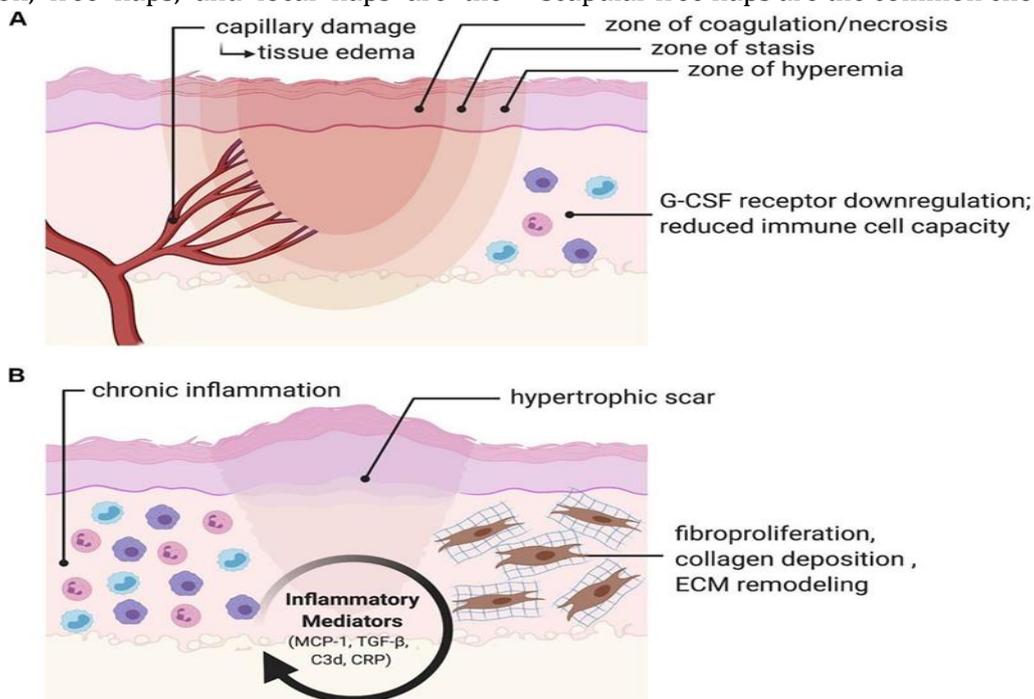
destroyed so lead to tissue loss or amputation [4].

"Minor" burn injuries, defined as the burns that involve less than 10% of total body surface (TBS) and usually are superficial. "Major" burns injury refer to the burns that more than 10% of TBS in adult or more than 20% in children [5].

The ideal time for facial full thickness burns grafting is when the swelling gets alleviated, so it usually performs no earlier than day 5 post-burn. For deep dermal facial burns is third- week post-burn. This delay decreases risk of hypertrophic scar formation. Deep burns to the eyelids should be excised and grafted early in order to prevent cicatricial ectropion and corneal exposure. Each region thus requires special and accurate techniques [6]. Deep partial thickness or full-thickness burns prone to induce scar contracture if they don't receive primary excision and skin

grafting but scarring may also occur after excision and skin grafting. The best strategy for scar contracture treatment is releasing the contractures then repair the induced defect by skin graft or flap [7]. After the primary management of burn, most scars contracture need reconstructive surgery. Although there are many reconstruction methods, there is no specific approach to each scar contracture so it depends on patients' condition and surgeons' decision. Split thickness skin grafts (STSG), full thickness grafts (FTG), V-Y plasties, V-M plasties, dermal substitution, free flaps, and local flaps are the

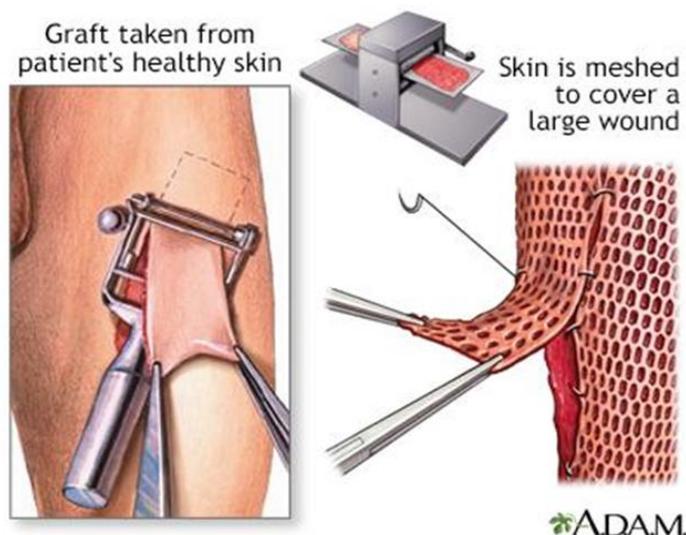
common methods that are used [8-11]. contracture release surgery is the main approach to repair contractures, that include releasing and excising of the scar, then repairing the defect with reconstructive techniques [12]. For the small and linear contractures, local transposition flaps such as the Z-plasty are indicated. Wider contractures need a different approach followed (Figure 3) by the excise defect through contracture release surgery, for example split-skin graft, full-thickness skin grafts and skin flaps [13-15]. For injuries that involve both upper chest and neck, scapular free flaps are the common choice.



**Figure 2:** Current and Emerging Topical Scar Mitigation Therapies

Anterior neck injuries that extend to infrahyoid muscles induce significant deformity so deltopectoral flap or the extended deltopectoral flap are the best choice [16-18]. Scar is a part of fibrous tissue that replaces normal skin after injury. Wounds are caused by the biological process of wound healing in the skin as well as other organs and tissues of the body. Therefore, scarring is a natural part of the healing process. In order to prevent scar contracture, understanding the scar formation physiology and scar formation stimulants are considerable (Figure 3). Chronic inflammatory state which leads to abnormal wound repair, e.g., to

hypertrophic or keloid scars. Keloids contain thick collagen fibers, whereas hypertrophic scars contain thin fibers which are organized into nodules [19]. The main change in scar formation is impaired collagen maturation. Apoptosis is another factor that may affect the scar formation so that mechanical irritation in the early proliferative phase might result in hypertrophic scars by inhibiting apoptosis [20]. In addition, mechanical stress can increase scar formation through stimulating mechanosensitive nociceptors in skin that change the vessel modifications and fibroblast activation.



**Figure 3:** Skin graft Information

Neck injuries are present in two types; anterior neck contracture and lateral neck contracture. Lateral cervical contractures were divided into two types based on their anatomy: edge and medial. Medial contracture induced by burns located in the lateral surface of the neck. Edge contracture is induced by contracture and might be in the posterior surface of the neck. Since the neighboring surfaces are mostly healthy, this region is considered as a donor site for the local-flap technique which is the first reconstructive option [19].

There are two types of skin graft. Full-thickness skin graft (FTSGs) include complete epidermis and dermis which are used for small avascular cells that are less than 1 cm or large area with adequate blood supply. Common donor sites for FTSG are supraclavicular, preauricular, postauricular, antecubital (inner elbow) areas, scalp, groin and areola. partial-thickness skin grafts (PTSG) or split-thickness skin graft (STSG), include the entire epidermis and only partial dermis, leaves behind sufficient reticular (deep) dermis in the wound bed to enable the skin to regenerate itself. Most common donor sites for PTSG include; thigh, buttock, back, upper arm, forearm and abdominal wall. STSG can survive in weak blood supply rather than FTSG so it's useful in large wounds. Composite grafts made of skin and another type of tissue, usually cartilage so used when a donor site has lost underlying muscle or bone. FTSGs are more resistant against trauma and have better aesthetic results because less contracture induced, but susceptible to graft

failure than STSGs [3]. The thickness of graft changes the metabolic need of the graft so the thicker grafts have more metabolic rate and are more susceptible to failure. Split-thickness skin grafts classify according to their thickness into thin STSGs (0.15 to 0.3 mm), intermediate STSGs (0.3 to 0.45 mm), and thick STSGs (0.45 to 0.6 mm). well-vascularized wound bed for graft ingrowth is necessary, so a viable base of tissue with some vascularity is needed therefore it can be performed after moving muscle or soft tissue flap to the wound base or after secondary healing due to allow growth of granulation tissue.

### Material and Methods

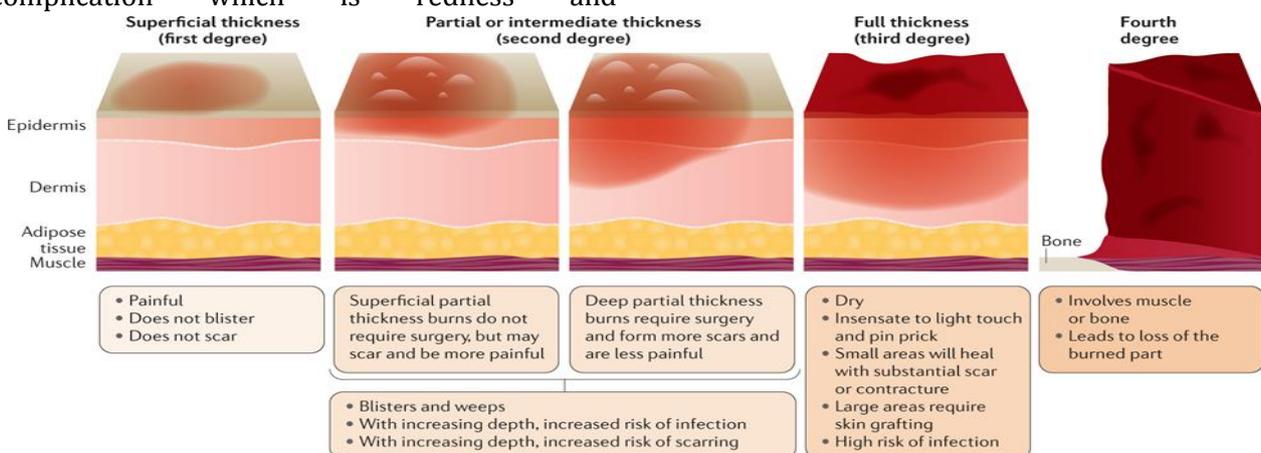
Shahid Motahari burn injury center in Tehran is a major burn injury center in the Middle-east which annually performs 5000 burn surgeries that 3500 cases admit with acute burn injury and 1500 cases admit with elective surgery, also the procedures that perform in this center include up to date skin grafting and skin flapping. In this study 21 cases have been selected from this center. Patients selected based on chronic and severe neck scar contracture with dysfunctional neck movement which need reconstruction surgery. Selected patients were approached through our modified skin grafting procedure. In this procedure, at First remove the dead skin and scar in order to make a bare area considered as a recipient site. It is notable that the Z-plasty method was not used in this procedure. Next, undermine the healthy tissue close to the mandible, which keep the thickness of the tissue

so it will not become necrotic. Consequently, create two upper and lower free flaps as they are mobile and even the hand will go under these like abdominoplasty procedures. Then apply the graft (autograft) that was brought from the thigh surface as donor site in the bare recipient site. The graft shouldn't apply in tension mode in contrast to another site that needs to apply tight-graft. Eventually suture the graft to the recipient site with appropriate suturing method. Also its considerable that the size of graft is calculated when the tissue has been released from tension.

## Results and Discussion

There are many methods for reconstruction surgery of scar tissue. Efficacy and outcome of these procedures are considerable, and selecting an appropriate method is challenging for surgeons. Scar tissues induce contracture of skin which causes organ dysfunction so considerable complications are limited range of motion and aesthetic. There are few studies on approach and treatment of neck scar contracture. Karami et.al follows up 6 pediatrics with severe burn contracture on neck and face area who underwent secondary reconstruction of burn scars with a free tissue a few months ago. They selected a fasciocutaneous anterolateral thigh flap for all patients. The flaps were considered as the size of defect then applied with end-to-end anastomosis. They reported one post-operative complication which is redness and

staphylococcus epidermidis positive culture but no major complications were noted. The Flaps' survival was 100%. In The 12 months later follow up improve limitation of motion with no need to further revision surgeries reported. Karami et al., 2020 in the other study Losken et.al used omental free flap followed by split thickness skin graft coverage on 7 patients to reconstruction of neck deformity. Post-operative ileus, wound infection, total and partial flap loss, hematoma and seroma were reported as complications so secondary additional revision performed on all patients. Also, in the systematic review of tissue expansion reconstruction method on 35 worldwide English languages articles which published by Martha et.al, hematoma, seroma, delayed wound healing, bone moulding, neuropraxia, infection, dislocation, leakage and deflation, exposure, wound dehiscence, skin necrosis, extrusion were reported as complication of the tissue expansion procedure. Another method which is used in neck burns scar contractures is using myocutaneous flaps which Latissimus dorsi myocutaneous flap is kind of like these flaps. The notable complications of the Latissimus dorsi myocutaneous include post-operative seroma/hematoma and secondary complications due to kinking and twisting of pedicles of the flap (Figure 4).



**Figure 4:** Burn injury

## Conclusions

Considerable aspects of the result of each reconstruction method are complications, advantages and outcome, so these three factors

indicate the necessity of secondary reconstruction revision surgery. In this research study, we performed free-tension grafting which is a modified procedure of skin grafting. There was one patient with scar contracture recurrency

and the 20 patients did not have any scar contracture recurrence or example complications in previous methods. It was found that secondary reconstruction surgery revision was not needed during the follow up period. Since this study was performed on 21 patients, we recommend performing further study on more patients.

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### Authors' contributions

All authors contributed toward data analysis, drafting and revising the paper and agreed to be responsible for all the aspects of this work.

### Conflict of Interest

We have no conflicts of interest to disclose.

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