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# To Develop An Algorithm And Tactics For The Treatment Of Post-Burn Scars, Depending On The Nature Of The Tissue

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**Abstract:** With an emphasis on accelerating healing, integrating grafts, and reducing complications, recent developments in acute burn wound therapy are revolutionizing the treatment of burn injuries. However, there are many obstacles to existing therapeutic therapies, such as the difficulties of precisely determining tissue viability and wound depth, which can result in less-than-ideal treatment planning. Burn contractures often result in persistent wounds, limitations in movement, and unsightly outcomes. To reduce donor site morbidity and maximize results, careful planning and tissue selection are crucial. According to the principles of burn reconstructive surgery, donor tissues with appropriate texture, color, and pliability must be used to replace the flaws following release. These requirements are met by autologous skin grafting or flap procedures, which resurface the scar defects after release and replace scar tissues. Despite the advantages, burn patients' use of flaps is frequently restricted for a variety of reasons. A huge defect may cause significant donor site morbidity, requiring flap surgery, including free flap surgery, if the surgeon plans to release entirely and reconstruct in a single stage. There are numerous approaches and processes for resurfacing the flaws, and these are examined. This article presents reconstructive techniques and algorithms for the release of burn contractures. Both joint movements and cosmetic abnormalities should significantly improve with the help of these therapy strategies. Thus, a combined and differentiated approach to the treatment of post-burn scars has shown significantly better clinical and functional results compared with traditional therapy. Complex treatment, taking into account the type of scar, depth and localization, can not only improve the appearance of the scar, but also significantly shorten the rehabilitation period, minimizing the risk of complications and recurrence.

**Keywords:** Burn contracture, algorithm, morbidity at the donor site, perforator flap, surgery, treatment approaches, cutting-edge treatments, skin replacements.

**Introduction:** Burns are the fourth most common cause of accidental injury worldwide, after falls, road accidents, and drownings. As a result, millions of people require medical attention each year. Burn-induced coagulopathy, immunological and inflammatory reactions, metabolic abnormalities, and other complicated processes are all brought on by burn injuries. With the help of a multidisciplinary team, therapeutic approaches for patients with severe burns combine critical care treatment with focused wound care. The complexity of burn injuries makes it difficult to manage both systemic and wound-specific consequences, despite tremendous progress in burn care. Trauma is still frequently caused by burn injuries, particularly in low- and middle-income nations. Deep

partial-thickness and full-thickness burns can be incapacitating if they are not treated with early excision and grafting because, in the absence of proper positioning and splinting, these deep injuries frequently result in burn scar contractures [1-5]. Burn scar contractures are extremely painful, itchy, and deforming. Because of this, people who have burn scar contractures that make it difficult for them to perform daily tasks are frequently stigmatized and have trouble getting an education and finding employment. Many treatments are available to lessen contractures, such as intra-lesional corticosteroid injection, antihistamines, hydrotherapy, dynamic or static splinting, laser therapy, compression therapy, and surgical excision and reconstruction. However, it is still unclear which treatment is best for a given contracture, when to start it, and how long or frequently to continue it. Contractures typically result from inadequate burn care. Despite the intense efforts to manage scars, split-thickness skin grafting to the burn wounds may also result in contracture. Additionally, the contracture may be caused by the differing growth patterns of the surrounding tissues and the burn scar in addition to skin loss.Surgery is the most effective way to address contracture release. Donor tissues with the same texture, color, and pliability should be used to replace the defect [6-11]. Improving results and reducing the chance of wound conversion—the gradual deepening of initially superficial burns—requires effective care of burn injuries. Inadequate blood flow, delayed treatment, and inflammatory tissue damage are some of the elements that influence this conversion process. Early and appropriate therapies that stabilize the wound environment, reduce infection, and encourage healing are key components of strategies to slow this process. Optimizing wound debridement, employing topical medications to lower bacterial burden, and utilizing cutting-edge technology like skin substitutes and biologics to promote tissue regeneration are examples of therapeutic techniques. A thorough and customized treatment strategy that successfully incorporates these techniques is necessary to address the complex nature of burn injuries. Burn patients are more susceptible to infections, particularly those brought on by germs that are resistant to drugs. Longer hospital stays, slower wound healing, higher treatment expenses, and higher death rates are frequently the results of these infections. Since sepsis and multiorgan failure are the most common causes of mortality after severe burns, managing and preventing infections is essential to burn treatment. Some of the most common bacteria are widely, multidrug, or even pan-drug resistant. Six bacteria—Enterococcus faecalis, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa and Enterobacter spp.—have been identified by the Infectious Disease Society of America as "ESKAPE pathogens" because of their increasing resistance to antibiotics, even those thought of as last-line defenses [12-16].

When treating full-thickness and deep partial-thickness burns with anticipated healing times longer than three weeks, early excision and autologous skin grafting are regarded as the gold standard. These procedures can also be applied to functional areas where severe scarring is a major issue. Deep burns and other wounds that don't heal in three weeks have prolonged inflammation and delayed re-epithelialization, which interfere with the body's natural healing process. This results in an altered extracellular matrix, decreased angiogenesis, and excessive collagen formation, all of which raise the risk of scarring. Because it lowers the danger of infection, encourages wound healing, and decreases scarring, this strategy is especially beneficial. Debridement is essential because it removes burn eschar, which is a significant cause of inflammation and a conducive environment for bacterial growth. The aftermath is frequently harsh for those who have survived burn damage. A WHO report on child injury prevention states that 8% of survivors have long-term physical impairments. The most common long-term consequences are contractures, keloids, hypertrophic scars, and occasionally the need for amputation. Burn survivors experience severe emotional effects in addition to physical impairments. In addition to the burn's characteristics, the psychological impacts also depend—and this is more crucial—on elements including personal coping strategies, mental health, and family support. Patients from low-income families may find it difficult to return to school or community life in high-income nations [17-20]. These requirements are met by skin flaps, including free flaps, which provide better functional results by replacing scar tissues and repairing the ensuing defect after release. In fact, using nearby skin flaps to minimize disparities in skin features is the gold standard for reconstructing burn scars. The size of the affected area, the region of involvement, and the availability of non-scarred tissue for use as skin flaps all influence how difficult it is to strike a balance between scar resurfacing and reducing donor site morbidity. For the relaxation of burn scar contractures, there are numerous surgical options. The most efficient surgical technique is still unknown, though, according to a new systematic review. Surgeons are therefore dealing with clinical issues. In addition to providing information about flap surgery that may have an impact on burn patients in the future, this study will describe the usage of skin grafts, flaps, and devices now employed in burn scar contracture

[21,22].

**The main purpose** of the presented manuscript is a brief analysis based on the results of reputable scientific research on the importance in medical practice of developing an algorithm and tactics for treating scars after burns, depending on the nature of the tissues, as well as side effects and disadvantages associated with their use.

**Fundamentals of Treating Burn Wounds**. Temperature, time of exposure, and the specific heat of the traumatic agent are some of the variables that affect the degree of tissue damage in the pathophysiological response of burns at the skin level. Three concentric zones of damage are described by Dr. Douglas Jackson's 1953 burn injury model, which is still widely accepted today. The most severely impacted area is the zone of coagulation, where all cells are non-viable and the extracellular matrix proteins have been denatured by direct contact with the chemical that causes burns. Since the injured cells cannot be repaired, the emphasis in this area is on debridement and infection management. This is surrounded by the zone of stasis, which has initially viable tissue but experiences hypoperfusion as a result of vasoconstriction. Although healing in this zone is feasible, if hypoperfusion continues as a result of insufficient fluid resuscitation, edema, or infection, it may develop to necrosis within 24 to 48 hours [3,7,8,11]. This trend can be exacerbated by factors like diabetes, smoking, old age, and other chronic illnesses. The goal of treatment is to stop the stasis zone from degrading into coagulative necrosis since the coagulation zone is irreversible. As long as hypoperfusion or infection are prevented, the outermost zone, referred to as the zone of hyperemia, can completely heal in 7–10 days. It is made up of live cells and related vasodilation brought on by inflammation. The level of burns is categorized according to the layers of skin. Burns that solely injure the epidermis are referred to as first-degree burns (superficial). Unlike those caused by sunburn, these are red, unpleasant, and heal on their own in three to four days without leaving any scars. There are two types of second-degree burns: deep partial-thickness and superficial partial-thickness. Superficial partial-thickness (IIA degree) burns are painful, red, and blister-like, affecting both the papillary dermis and the epidermis [13,14,17]. They heal with little scarring in around 14 days. Burns that pierce further into the reticular dermis are known as deep partial-thickness burns (IIB degree). Surgical intervention is frequently chosen to avoid scarring and contractures since they are pale, spotted, and cause discomfort rather than pain. They may take up to three weeks to heal, but not by re-epithelization but rather through wound contracture. All layers of skin, including the hypodermis, are impacted by third-degree or full-thickness burns. Due to nerve injury, there is no pain and the skin looks white or burnt. Without skin grafting, healing is not feasible. Last but not least, fourth-degree burns, which are occasionally reported in the literature, affect muscle and bone in addition to the skin. They frequently need amputation, reconstruction, or severe debridement [20,21,22].

## METHODS

Application of a comprehensive differentiated approach to the treatment of post-burn scars of the face and neck, based on clinical, instrumental and morphological data. A comparative analysis of the dynamics of clinical parameters, the results of instrumental and histological assessment in the main and control groups of patients was carried out. As a result of the analysis of clinical material (n = 108), the predominant types of post-burn scars in patients treated at the clinic were determined. By the nature of the scars, hypertrophic (42-53.8%) prevailed, less often keloid (22-28.2%), contractural (13-16.7%) and atrophic (1-1.3%) forms. The upper third of the face and the anterior surface of the neck were more often affected, due to the vulnerability of these areas to thermal injuries and the high probability of permanent deformities.

## RESULTS

In the course of a clinical study, the effectiveness of various therapeutic approaches was evaluated in patients with post-burn scars on the face and neck (see Table 1).

**Table 1. Comparative effectiveness of various methods of treatment of post-burn scars of the face and neck**

| Indicators | The main group n=78 | The control group n=30 | p-value |
|---|---|---|---|
| Decline VSS (Δ) | 5,96±0,23 | 2,2±0,3 | < 0,001 |
| Reduction of scar thickness (УЗИ) | 2,21±0,08 | 0,94±0,13 | < 0,001 |
| Decrease in CF (fluorescence) | 4,2±0,1 | 1,4±0,077 | < 0,001 |

| | | | |
|---|---|---|---|
| Aesthetic improvement (based on the photo) | 91% | 53% | < 0,001 |
| Improvement of function (with contractures) | 93% | 47% | < 0,001 |

Therefore, compared to traditional therapy, a combined and diversified approach to the treatment of post-burn scars has demonstrated noticeably improved clinical and functional results. In addition to improving the scar's appearance, complex treatment that considers the scar's kind, depth, and localization can drastically reduce the recovery time and lower the chance of problems and recurrence.

Based on clinical, morphological and instrumental data (ultrasound, fluorescence coefficient, VSS scale), as well as the results of evaluating the effectiveness of various methods, we have developed an algorithm for choosing a differentiated treatment strategy for post-burn scars (see table 2).

**Table 2. Algorithm of a differentiated approach to the treatment of post-burn scars of the face and neck.**

| ***An algorithm for treating post-burn facial and neck scars that is distinct.*** | |
|---|---|
| ***Clinical assessment of the scar*** | Type: hypertrophic/or keloid<br>localization: face/neck<br>Symptoms: itching, pain,<br>height on ultrasound:above 5 mm/below 5 mm |
| ***Fluorescence assessment and USD – blood flow*** | high fluorescence, active scar<br>Blood flow is increased (enhanced)<br>If necessary, histology |
| ***Choosing a method of identification*** | laser therapy for active and hypertrophic scars<br>hormone therapy for keloid or itchy scars<br>combination therapy for persistent or fast-growing scars<br>surgery for severe contractures and deformities |
| ***Performance criteria*** | a decrease in SCD of more than 2 points, a decrease in ultrasound height and the disappearance of symptoms |
| ***Rehabilitation in control*** | Ultrasound every month for 6 months: physical therapy |

The developed algorithm for choosing therapeutic tactics, based on a comprehensive assessment of the condition of the scar (type, thickness, activity), provides a clear and practical action plan for clinicians and can be recommended for widespread implementation in the practice of reconstructive and laser medicine. The most significant improvements (a decrease in the VSS scale to 3-4 points, a decrease in the thickness of scar tissue to 1.6–2.2 mm, and a decrease in the fluorescence coefficient to 2.0) were achieved when using a fractional $Co_2$ laser in combination with Nd:YAG exposure and photodestruction.

In patients who received combined laser therapy, the duration of treatment averaged 2-3 months, while in the control group it was up to 6 months. This was accompanied by a shorter rehabilitation period and a higher level of satisfaction with the results. Long-term results (after 6 months) confirmed a stable clinical effect in 92% of patients in the main group and a minimal level of complications and relapses.

**DISCUSSION**

With an emphasis on accelerating healing, integrating grafts, and reducing complications, recent developments in acute burn wound therapy are revolutionizing the treatment of burn injuries. However, there are many obstacles to existing therapeutic therapies, such as the difficulties of precisely determining tissue viability and wound depth, which can result in less-than-ideal treatment planning. Delays in wound closure, low graft survival, insufficient tissue regeneration, and insufficient vascularization are common problems with traditional closure techniques.

Additionally, controlling infection and reducing scarring continue to be challenges that affect both functional recovery and aesthetic results. Post-burn scarring is a common issue, and the effectiveness of current non-surgical treatments varies. The best non-surgical treatment for burn scars is not well established. This study does a thorough assessment and comparative ranking of non-surgical treatments for post-burn scars using a multi-index network meta-analysis. Finding the best treatment approaches is the goal in order to provide a solid, evidence-based basis for clinical decision-making. With the use of cutting-edge technologies and innovative therapeutic approaches, burn wound care is undergoing a significant change [5-11]. By encouraging quicker and more efficient wound healing, reducing the risk of infection, and reducing scar formation, cutting-edge methods are improving patient outcomes. Even while these inventions have a lot of potential, there are still a number of obstacles to overcome before they may be used in clinical settings. These include the necessity of uniform procedures, exorbitant expenses, and the need for specific tools and instruction. The broad use of these techniques is further complicated by the variation in patient situations, wound kinds, and treatment response. To further improve these techniques, maximize their efficacy, and increase their accessibility for a wider spectrum of patients, more research and clinical trials are essential. Future burn care may see significant advancements in both the functional recovery and aesthetic look of healed burn wounds as these technologies develop, thereby improving patients' quality of life. Advanced imaging methods that allow for more exact evaluation of wound size, depth, and tissue viability are important areas of innovation that facilitate more precise treatment planning. New closure techniques are also being developed to improve graft longevity, speed up wound closure, and deal with issues such tissue regeneration, vascularization, and infection control [13-18]. By minimizing scarring and enhancing the quality of life for burn victims, these tactics seek to maximize both functional recovery and cosmetic results. Even though these new methods show promise, more study and clinical validation are needed to improve their efficacy and increase their accessibility. When taken as a whole, these developments provide the possibility of more individualized, effective, and efficient therapies, marking a substantial change in acute burn care. The most successful non-surgical treatments for lowering the Vancouver Scar Scale score, scar thickness, and Visual Analogue Scale score for post-burn scars are massage therapy, CO2 laser therapy, and extracorporeal shock wave therapy + routine treatment, according to this network meta-analysis. The results, however, show results at a particular stage of scar growth. Additionally, because we only considered a small number of research, our conclusions should be interpreted cautiously. To confirm these results in the future, carefully planned randomized controlled trials with a sizable sample size are required [19-22].

## CONCLUSIONS

When used by skilled surgeons to restore burn contracture defects, full-thickness skin grafts and local flaps yield good results. Patients who are willing to endure a lengthier procedure and hospital stay in exchange for better aesthetic outcomes at both the recipient and donor sites might benefit from free perforator flap transfer with low morbidities. In the future, perforator-based interposition flaps might be a standard in post-burn trunk and extremity surgery. In order to help reconstructive surgeons choose the best reconstructive techniques when burn scar contractures are released, useful algorithms have been developed. These algorithms are an effort to streamline the reconstructive process for burn contractures. Before choosing a course of treatment, the benefits and drawbacks of these various methods should be weighed.

Therefore, compared to traditional therapy, a combined and diversified approach to the treatment of post-burn scars has demonstrated noticeably improved clinical and functional results. In addition to improving the scar's appearance, complex treatment that considers the scar's kind, depth, and localization can drastically reduce the recovery time and lower the chance of problems and recurrence. Thus, a differentiated approach to the treatment of post-burn scars of the face and neck in children, based on clinical, ultrasound and fluorescent assessment, allowed to increase the effectiveness of therapy and individualize the choice of therapeutic tactics.

## REFERENCES


1. Cretu A, Grosu-Bularda A, Bordeanu-Diaconescu E-M, Hodea F-V, Ratoiu V-A, Dumitru C-S, Andrei M-C, Neagu T-P, Lascar I, Hariga C-S. Strategies for Optimizing Acute Burn Wound Therapy: A Comprehensive Review. Medicina. 2025; 61(1):128. https://doi.org/10.3390/medicina61010128
2. Hayashida K, Akita S. Surgical treatment algorithms for post-burn contractures. Burns Trauma. 2017 Mar 14;5:9. doi: 10.1186/s41038-017-0074-z.
3. Bordeanu-Diaconescu, E.M.; Grosu-Bularda, A.; Frunza, A.; Grama, S.; Andrei, M.C.; Neagu, T.P.; Lascar, I.; Hariga, C.S. Diagnostic and Prognostic

Value of Thrombocytopenia in Severe Burn Injuries. Diagnostics 2024, 14, 582.

4. Bordeanu-Diaconescu, E.M.; Grosu-Bularda, A.; Frunza, A.; Grama, S.; Andrei, M.C.; Neagu, T.P.; Hariga, C.S.; Lascar, I. Venous Thromboembolism in Burn Patients: A 5-Year Retrospective Study. Medicina 2024, 60, 258.
5. Badoiu, S.C.; Enescu, D.M.; Tatar, R.; Miricescu, D.; Stanescu-Spinu, I.I.; Greabu, M.; Coricovac, A.M.; Badoiu, S.E.; Jinga, V. Adipokines—A Cohort Prospective Study in Children with Severe Burns. Int. J. Mol. Sci. 2024, 25, 7630.
6. Bordeanu-Diaconescu, E.M.; Grosu-Bularda, A.; Frunza, A.; Grama, S.; Andrei, M.C.; Dumitru, C.S.; Costache, R.A.; Marinescu, B.M.; Lascar, I. Comprehensive review and update on multiple organ dysfunction syndrome in burn patients: Pathophysiology, risk factors, and management strategies. RJMM 2024, 127, 480.
7. Badoiu, S.C.; Enescu, D.M.; Tatar, R.; Stanescu-Spinu, I.I.; Miricescu, D.; Greabu, M.; Ionel, I.P.; Jinga, V. Serum Plasminogen Activator Inhibitor-1, α 1-Acid Glycoprotein, C-Reactive Protein, and Platelet Factor 4 Levels—Promising Molecules That Can Complete the "Puzzle" of the Biochemical Milieu in Severe Burns: Preliminary Results of a Cohort Prospective Study. J. Clin. Med. 2024, 13, 2794.
8. Palackic, A.; Jay, J.W.; Duggan, R.P.; Branski, L.K.; Wolf, S.E.; Ansari, N.; El Ayadi, A. Therapeutic Strategies to Reduce Burn Wound Conversion. Medicina 2022, 58, 922.
9. Hodea, F.V.; Lazarescu, A.L.; Grosu-Bularda, A.; Cretu, A.; Teodoreanu, R.N.; Lascar, I.; Hariga, C.S. Antimicrobial Resistance of Eskape Pathogens in Major Burns Patients—One-Year Retrospective Study. Farmacia 2023, 71, 549–555.
10. Jeschke, M.G.; Van Baar, M.E.; Choudhry, M.A.; Chung, K.K.; Gibran, N.S.; Logsetty, S. Burn injury. Nat. Rev. Dis. Prim. 2020, 6, 11.
11. Butts, C.C.; Holmes, J.H.; Carter, J.E. Surgical Escharotomy and Decompressive Therapies in Burns. J. Burn. Care Res. 2019, 41, 263–269.
12. Putri, A.; Tobing, J.; Hasibuan, L.; Faried, A.; Mose, J. The Evaluation of a Golden Period of Fasciotomy for High Voltage Electrical Burn Injury Patients With Compartment Syndrome. Ann. Burn. Fire Disasters 2023, 36, 57–62.
13. Sun, J.A.; Adil, A.; Biniazan, F.; Haykal, S. Immunogenicity and tolerance induction in vascularized composite allotransplantation. Front. Transplant. 2024, 3, 1350546.
14. Gray, K.M.; Peterson, J.M.; Padilla, P.L.; Smith, J.M.; Zapata-Sirvent, R.L.; Branski, L.K.; Norbury, W.B.; Dziewulski, P. Vascularized Composite Allotransplantation in Burn Reconstruction: Systematic Review and Meta-analysis. J. Burn. Care Res. 2021, 42, 465–472.
15. Yang, J.H.; Johnson, A.C.; Colakoglu, S.; Huang, C.A.; Mathes, D.W. Clinical and preclinical tolerance protocols for vascularized composite allograft transplantation. Arch. Plast. Surg. 2021, 48, 703–713.
16. Grosu-Bularda, A.; Hodea, F.-V.; Zamfirescu, D.; Stoian, A.; Teodoreanu, R.N.; Lascăr, I.; Hariga, C.S. Exploring Costimulatory Blockade-Based Immunologic Strategies in Transplantation: Are They a Promising Immunomodulatory Approach for Organ and Vascularized Composite Allotransplantation? J. Pers. Med. 2024, 14, 322.
17. Abbasi, R.; Shineh, G.; Mobaraki, M.; Doughty, S.; Tayebi, L. Structural parameters of nanoparticles affecting their toxicity for biomedical applications: A review. J. Nanoparticle Res. 2023, 25, 43.
18. Abid, S.; Ziauddin; Hussain, T.; Nazir, A.; Mahmood, U.; Hameed, M.; Ramakrishna, S. Nanoengineered Therapeutic Scaffolds for Burn Wound Management. Curr. Pharm. Biotechnol. 2022, 23, 1417–1435.
19. Pormohammad, A.; Monych, N.K.; Ghosh, S.; Turner, D.L.; Turner, R.J. Nanomaterials in Wound Healing and Infection Control. Antibiotics 2021, 10, 473.
20. Wang, Y.; Hua, Z.; Tang, L.; Song, Q.; Cui, Q.; Sun, S.; Yuan, Y.; Zhang, L. Therapeutic implications of extracorporeal shock waves in burn wound healing. J. Tissue Viability 2024, 33, 96–103.
21. Tsolakidis, S.; Rosenauer, R.; Schmidhammer, R.; Pallua, N.; Rennekampff, H. Wireless microcurrent stimulation improves blood flow in burn wounds. Burns 2022, 48, 1230–1235.
22. Yang X, Li R, Mao X, Gong S, Fan Y, Xu C, et al. (2025) Non-surgical treatments for post-burn scars: A network meta-analysis. PLoS One 20(8): e0330428. https://doi.org/10.1371/journal.pone.0330428