ORIGINAL RESEARCH

Clinical Efficacy of Early Plastic Surgery Treatment for Patients with Deep Hand Burns

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ABSTRACT

Objective • This study aims to assess the effectiveness of early plastic surgery for deep hand burns by examining variables like VAS scores, wound healing time, and excellent hand function recovery rates.

Methods • A total of 130 patients with deep hand burns admitted to our hospital between January 2020 and October 2021 were enrolled in this study. They were randomly assigned to either a control group (n = 65, deferred reconstructive surgery) or an observation group (n = 65, early reconstructive surgery) using a random number table. We compared the VAS scores, wound healing time, rates of excellent hand function recovery, complications, and overall treatment efficacy between the two groups.

Results • The preoperative VAS scores were comparable between the observation and control groups ($P > .05$). Postoperative VAS scores in the observation group were significantly lower than those in the control group at 1, 3, and 7 days following surgery ($P < .05$). Additionally, the observation group exhibited shorter wound healing times and higher rates of excellent hand function recovery ($P < .05$). The incidence of complications such as numbness, infection, and necrosis of implants was lower in the observation group compared to the control group ($P < .05$). The overall treatment efficacy was also significantly better in the observation group than in the control group ($P < .05$).

Conclusions • These findings underscore the high clinical value of early surgical intervention, supporting its broader application in the treatment of deep hand burns and potentially improving patient outcomes. (*Altern Ther Health Med.* 2024;30(1):326-331).

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INTRODUCTION

Burns are generally referred to as injuries caused by heat, while tissue damage caused by chemicals, electrical currents, radiation, lasers, etc., have similar manifestations to burns and are often included in treating burns.[1,2] Burns can be classified as first-degree, superficial second-degree, deep second degree and third degree. Deep burns of the hand are often classified as deep second and third-degree, which have damaged the deep dermis and even the deep muscles and bones, resulting in blistering, dulled pain, scab scorching, or carbonization, which seriously impairs the function and aesthetic appearance of the hand.[3,4] In clinical practice, patients with burns are often given reconstructive surgery to help restore a more normal skin appearance. Several studies have shown that early implementation of reconstructive surgery facilitates healing of the burn site and positively impacts reducing scar growth and improving aesthetic and functional appearance.[5,6] Therefore, in this study, we propose to compare the efficacy of delayed plastic surgery and early plastic surgery in 130 patients with deep hand burns admitted from January 2020 to October 2021, to analyze the practical application of early plastic surgery, and to investigate the effect of this surgical treatment on VAS score, wound healing time and excellent hand function recovery rate.

Burns, typically resulting from heat exposure, can also arise from chemicals, electrical currents, radiation, and lasers, all of which present similarly and are often treated under the umbrella of burn care.[1,2] Burns are categorized into first-degree, superficial second-degree, deep second-degree, and third degree. Deep hand burns, usually classified as deep second-degree, and third-degree, damage the deep dermis and can even affect muscles and bones.[3,4] These burns lead to blistering, reduced pain sensation, scab formation, or carbonization, severely compromising the hand's function and aesthetics. In clinical settings, reconstructive surgery is frequently employed to restore the skin's appearance for burn patients.[5] Prior research indicates that early reconstructive

surgery accelerates burn wound healing and effectively reduces scar formation, enhancing both aesthetic and functional outcomes.[5,6] This study compares delayed versus early plastic surgery outcomes in 130 patients with deep hand burns admitted between January 2020 and October 2021. We seek to evaluate the practical benefits of early plastic surgery and its impact on the Visual Analog Scale (VAS) score, wound healing duration, and the rate of excellent hand function recovery. Our objective is to evaluate the practical benefits of early plastic surgery and its influence on key variables, including the Visual Analog Scale (VAS) score, wound healing duration, and the rate of achieving excellent hand function recovery.

PATIENTS AND METHODS

Patient Selection

From January 2020 to October 2021, 130 patients with deep hand burns who met the diagnostic criteria for deep second-degree and third-degree burns were enrolled in this study. Inclusion criteria were as follows: (i) age range of 22-62 years; (ii) presence of characteristic symptoms such as blistering, diminished pain sensation, and skin charring; (iii) complete baseline patient information; (iv) informed consent voluntarily signed by patients and their family members. Exclusion criteria included: (i) coexisting severe infectious or contagious diseases; (ii) concurrent burns at other anatomical sites; (iii) underlying comorbidities such as uncontrolled diabetes mellitus or hypertension; (iv) cognitive, linguistic, or cooperative impairments. Patients were randomly allocated into either a control group (n = 65, deferred plastic surgery) or an observation group (n = 65, early plastic surgery) using a random number table. Etiologies of burns in the control group comprised 29 cases of scald burns, 22 flame burns, 9 electrical burns, and 5 contact burns, while the observation group included 31 scald burns, 24 flame burns, 8 electrical burns, and 2 contact burns. No significant differences were observed between the two groups in baseline characteristics such as age, burn area, gender distribution, and etiology of burns ($P > .05$). The study received approval from the Medical Ethics Committee of the No. 971 Hospital of the People's Liberation Army Navy, and informed consent was obtained from each participant prior to study initiation.

Treatment Measures

The treatment measures for the observation group were as follows. Early plastic surgery for the patient. Preoperative examination and preoperative preparation were performed. 0.5 mg of atropine (Hubei Xinghua Pharmaceutical Co., Ltd., State Drug Quotient H42020590, specification 1ml: 0.5 mg × 10 pcs) and 0.1 g of phenobarbital (Chongqing Yuyou Pharmaceutical Co., Ltd., State Drug Quotient H50021537, specification 2 ml:0.2 g) were injected intramuscularly 30 min before the operation, the affected limb was elevated, and the patient was brought into anesthesia. After the patient has been put under anesthesia, the skin slice is cut from the donor area. If only skin tissue is injured, the flap should be 12 cm × 5 cm-20 cm × 7 cm, if bone or muscle is injured, the flap should be 4 cm × 3 cm-20 cm × 7 cm, and the flap should be repaired. After the flap is effectively sutured to the wounded area, the area is covered with saline gauze and bandaged with pressure. After the operation, the patient was advised to elevate the affected limb, and according to his surgical treatment and specific condition, he was given comprehensive treatment, regular dressing changes to the wounded area, and guided to start rehabilitation training. The operation was carried out within 3 d of the patient's admission to the hospital. Patients in the control group were treated as follows: The patients were deferred for reconstructive surgery treatment. The plastic surgery treatment in this group was identical to that in the observation group, except for the timing of the surgery, which was performed 3 d after admission.

Observation indicators

The VAS scores and wound healing times of the two groups were compared: The Visual Analog Scale (VAS) is a tool employed in measuring subjective experiences, with one of its primary applications being the assessment of pain intensity. It comprises a straight line, typically 10 centimeters or longer, with one end labeled "No Pain" and the other marked as "Worst Pain Imaginable" or a similar extreme descriptor. Users are instructed to place a mark on this line to indicate the intensity of their pain, with the distance from the "No Pain" end serving as a quantitative measure of pain intensity. The VAS is widely used in healthcare and research to assess not only pain but also various subjective sensations and emotions, owing to its simplicity and effectiveness in gathering self-reported data. The patients were assessed for pain using a visual analog scale (VAS) at four time periods: preoperatively, 1d postoperatively, 3d postoperatively, and 7d postoperatively, with a total score of 0-10, with a positive correlation between the score and the severity of the pain; the time required for the patients to heal was counted.

The excellent rate of hand function recovery was compared between the two groups: the patients were counted up to 1 month postoperatively for excellent hand function recovery. Excellent: no deformity of hand joints, normal recovery of skin tissues, and no hand function impairment; Good: mild deformity of hand joints, good recovery of skin tissues, and basically normal hand function; Fair: deformity of hand joints, fair recovery of skin tissues and slight hand function impairment; Poor: deformity of hand joints, poor recovery of skin tissues and significant hand function impairment. Overall excellent rate = (total number of cases - poor)/total number of cases × 100%. Let's assume there are 100 surgical cases, and 20 of them are categorized as "Poor." The calculation for the overall excellent rate is as follows: Overall excellent rate = (100 - 20) / 100 × 100%=80%

Complications were compared between the two groups: the number of patients with postoperative symptoms such as numbness, infection and necrosis of the implant was counted.

The treatment results of the two groups were compared: the surgical treatment results achieved by the two groups

were counted up to 1 month after surgery. Significant: symptoms such as blistering and yellowing of the skin have basically disappeared, the post-operative scar tissue has softened and flattened, the skin implant area is well integrated with the surrounding normal skin, the hand function has recovered well, and the aesthetic appearance of the lesion area has improved significantly; Effective: symptoms such as blistering and yellowing of the skin have improved significantly, the post-operative scar tissue has improved, but the skin in the skin implant area is still significantly different from the surrounding normal skin, and the hand function has recovered well or Invalid: no significant improvement in symptoms such as blistering and yellowing of the skin, obvious postoperative scar tissue, poor articulation between the skin of the implant area and the surrounding normal skin, and poor functional recovery of the hand. Total effective rate = (total number of cases - invalid)/total number of cases × 100%. Let's assume there are 100 surgical cases, and 20 of them are categorized as "invalid." The calculation for the total effective rate is as follows: total effective rate = (100 - 20) / 100 × 100%=80%

Statistical Methods

Data were processed using Statistical Package for the Social Sciences (SPSS) 20.0 statistical software. Enumeration data were expressed as percentages or frequencies and compared using the chi-square test; measurement data were expressed as mean ± standard deviation ($\bar{x} \pm s$), and t test was used for comparison. Differences were statistically significant when $P < .05$.

RESULTS

Comparison of VAS score and wound healing time between the two groups

In this comparative study involving two groups of 65 subjects each, labeled as the Observation group and the Control group, various aspects of postoperative recovery were assessed. Initially, both groups displayed similar pre-operative Visual Analog Scale (VAS) scores, with averages of 6.84 and 6.88 points, respectively, indicating no significant differences. However, as the postoperative timeline unfolded, distinctions emerged. At one day post-operation, the Observation group exhibited slightly lower pain scores (4.84 vs. 5.19 points, $P = .047$), and by day three, this gap became more pronounced (3.98 vs. 4.58 points, $P = .001$), suggesting more effective pain management. Seven days after surgery, the Observation group reported significantly lower pain scores (1.87 vs. 2.68 points, $P = .001$), emphasizing superior pain relief. Additionally, wound healing times were notably shorter in the Observation group (23.29 vs. 34.55 days, $P = .041$), indicating expedited recovery. In summary, the Observation group demonstrated enhanced pain management and accelerated wound healing, likely attributable to the applied intervention. Please refer to Table 2 and Figure 1 for details.

Table 1. Comparison of basic data between the two groups ($\bar{x} \pm s$, n)

Group	Number of subjects	Age (years)		Burn Area (%)		Gender composition	
		Age range	Mean age	Range of disease course	Mean disease duration	Male	Female
Observation group	65	22-62	42.16 ± 4.87	30-95	62.51 ± 5.84	35 (56.00%)	30 (44.00%)
Control group	65	22-60	41.75 ± 4.46	30-93	62.05 ± 5.16	39 (53.00%)	26 (47.00%)
χ^2/t	-	.501		.476		.502	
P value	-	.618		.635			

Table 2. Compares the time to resolution of the condition between the two groups ($\bar{x} \pm s$, d)

Group	Number of subjects	VAS score (points)				Wound healing time (d)
		Pre-op	1 d after operation	3 d after operation	7 d post-op	
Observation group	65	6.84 ± 1.25	4.84 ± 0.97	3.98 ± 0.91	1.87 ± 0.29	23.29 ± 6.84
Control group	65	6.88 ± 1.36	5.19 ± 1.02	4.58 ± 0.99	2.68 ± 0.64	34.55 ± 8.02
t	-	0.175	2.005	3.597	9.294	8.612
P value	-	.862	.047	.001	.001	.041

Figure 1. Comparison of VAS score between the two groups

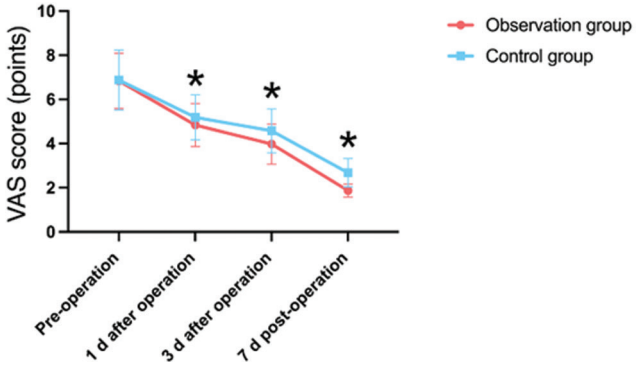
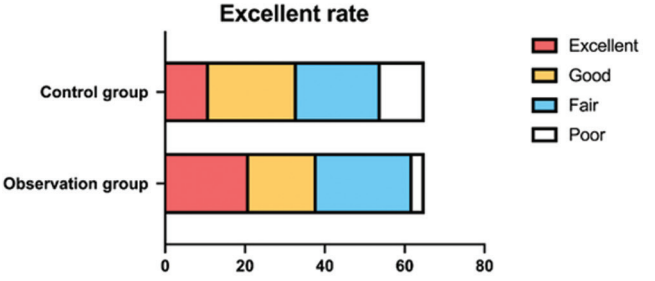


Table 3. Comparison of excellent and good rate of hand function recovery between the two groups [n, (%)]

Group	Number of subjects	Excellent	Good	Fair	Poor	Overall good rate
Observation group	65	21 (32.31%)	17 (26.15%)	24 (36.92%)	3 (4.52%)	62 (95.38%)
Control group	65	11 (16.92%)	22 (33.85%)	21 (32.31%)	11 (16.92%)	54 (83.08%)
χ^2	-	4.145	0.916	0.306	5.123	5.123
P value	-	0.042	.339	.580	.024	.024

Figure 2. Comparison of excellent and good rate of hand function recovery between the two groups



Hand function recovery in the two groups

Table 3 and Figure 2 summarizes the comparison of excellent and good rates of hand function recovery between the Observation group and the Control group, each consisting of 65 subjects. In the Observation group, 32.31% achieved an "Excellent" hand function recovery status, while 26.15% fell into the "Good" category. A higher percentage, 36.92%, was

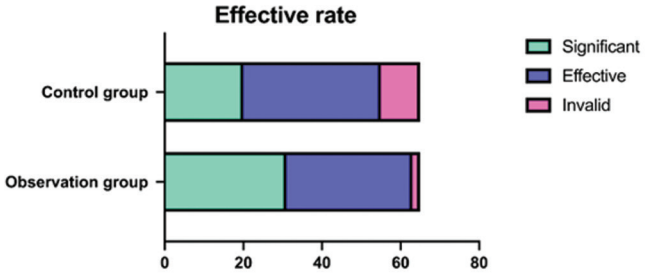
Table 4. Comparison of complications between the two groups [n, (%)]

Group	Number of subjects	Numbness	Infection	Skin graft necrosis	Total Occurrence
Observation group	65	1 (1.54%)	0	1 (1.54%)	2 (3.08%)
Control group	65	3 (4.62%)	2 (3.08%)	4 (6.15%)	9 (13.85%)
χ^2	-	0.258	0.508	0.832	4.866
P value	-	.612	.476	.362	.027

Table 5. Comparison of treatment effect between the two groups [n, (%)]

Group	Number of subjects	Significant	Effective	Invalid	Overall response rate
Observation group	65	31 (47.69%)	32 (49.23%)	2 (3.08%)	63 (96.92%)
Control group	65	20 (30.77%)	35 (53.85%)	10 (15.38%)	55 (84.62%)
χ^2	-	3.904	0.277	5.876	5.876
P value	-	.048	.599	.015	

Figure 3. Comparison of treatment effect between the two groups



categorized as "Fair," and only 4.52% were labeled as "Poor." The overall good recovery rate in the Observation group was notably high at 95.38%.In contrast, the Control group exhibited a lower percentage of "Excellent" recoveries, with 16.92%, while 33.85% achieved a "Good" recovery status. A similar proportion, 32.31%, was categorized as "Fair," and 16.92% fell into the "Poor" category. The overall good recovery rate in the Control group was 83.08%.Statistical analysis revealed significant differences between the groups, with a chi-square (χ^2) value of 5.123 and a corresponding *P* value of .024. These findings suggest that the Observation group had a significantly higher overall good recovery rate compared to the Control group, indicating the potential efficacy of the intervention in improving hand function recovery.

Complications in the two groups

Table 4 presents a comparison of complications observed in both the Observation group and the Control group, each comprising 65 subjects. In the Observation group, 1.54% of patients reported numbness, with no reported cases of infection. Additionally, one patient (1.54%) experienced skin graft necrosis, resulting in a total complication occurrence of 3.08% in this group. Conversely, the Control group exhibited a slightly higher incidence of complications, with 4.62% of patients experiencing numbness, 3.08% encountering infections, and 6.15% dealing with skin graft necrosis. The total occurrence of complications in the Control group was significantly higher at 13.85%. Statistical analysis, represented by a chi-square (χ^2) value of 4.866 and corresponding *P* values ranging from 0.027 to 0.612, indicates a significant difference in complication rates between the two groups. Specifically, the Observation group demonstrated a notably lower overall occurrence of complications compared to the Control group, suggesting that the intervention may be associated with a reduced risk of postoperative complications.

Treatment effects in the two groups

Table 5 and Figure 3 presents a comparison of treatment effects between the Observation group and the Control group, both consisting of 65 subjects. In the Observation group, 47.69% of patients experienced a "Significant" treatment effect, while 49.23% had an "Effective" response, resulting in a robust overall response rate of 96.92%. In contrast, the Control group exhibited a lower response rate, with 30.77% experiencing a "Significant" treatment effect and 53.85% achieving an "Effective" response. Notably, 15.38% of patients in the Control group were classified as "Invalid," resulting in an overall response rate of 84.62%. Statistical analysis, indicated by a chi-square (χ^2) value of 5.876 and corresponding *P* values ranging from .015 to .599, underscores significant disparities in treatment effects. These findings suggest that the Intervention group's treatment approach yielded a significantly higher overall response rate compared to the Control group, indicating the potential effectiveness of the intervention in achieving positive treatment outcomes.

DISCUSSION

Importance of Hand Function and High Risk of Hand Burns

As the main labor organ of the human body, the daily use frequency of this part is high, and the hand is in the exposed position. Once adverse events occur, such as fire, hot oil pan fall, etc., the human subconsciously protective actions are mostly blocked by the hand, the chance of hand injury is higher, and the risk of deep hand burns is generally high.[8] Epidemiology shows that among the burn conditions, hand burns account for about 44% and can affect the whole hand. Compared with the skin at other sites, the skin of the human hand is thin, soft, and flaccid, especially the skin on the dorsum of the hand, with less overall subcutaneous fat and less tight connection with the deep tissues.[9] Therefore, once burns occur in the hand, they easily damage to deep tissues, injure infrastructure, joint capsule, and other parts, and severely damage the appearance of the skin surface of the hand and hand function, resulting in symptoms such as hand deformity and inability to straighten finger flexion in patients, which will cause serious damage to the physical and mental health of patients.[10,11] In clinical practice, for patients with deep hand burns, plastic surgery, including crust and skin grafting, is also required in addition to conventional medical treatment to promote the recovery of the patient's hand appearance and hand function.[12,13]

Benefits of Early Reconstructive Surgery

Early reconstructive surgery within 3 days of a burn injury has shown benefits in reducing pain, promoting

recovery, and improving hand function. This study found that the observation group, which underwent early plastic surgery, had significantly lower Postoperative Visual Analog Scale (VAS) scores at 1, 3, and 7 days compared to the control group. This suggests that early plastic surgery effectively reduces pain and facilitates the healing of burn wounds.

The success of early plastic surgery can be attributed to several factors. Firstly, within 3 days of the burn, the deep tissues of the hand have not yet initiated self-repair processes, allowing physicians to effectively manipulate hand tissues and structures during plastic surgery. This supports restoring a more normal tissue structure and positioning, facilitating functional recovery. Secondly, early intervention prevents the formation of conspicuous scar tissue as the affected limb's skin has not yet undergone significant scarring. Timely plastic surgery effectively integrates skin grafts with the surrounding normal skin tissue, reducing scar formation and aiding in wound healing. Lastly, effective wound healing significantly improves the inflammatory response and alleviates pain resulting from inflammation. Early plastic surgery further promotes wound healing, shortens healing time, and reduces postoperative pain.[14]

Reduced Complications and Improved Surgical Outcomes

Regarding hand function recovery, the observation group had a significantly higher overall rate of excellent hand function recovery than the control group ($P < .05$). Early plastic surgery contributes to better hand function recovery by preventing skin tissue tightening and fibrous tissue regeneration. This maintains a more normal and functional position of the affected limb, reducing the incidence of hand deformities and improving hand aesthetics. Additionally, early reconstructive surgery facilitates skin graft integration and healing, improving blood supply and enhancing affected limb function recovery.

Early plastic surgery also reduces the risk of complications and improves overall surgical outcomes. The observation group had a lower overall incidence of complications and higher treatment efficacy compared to the control group ($P < .05$). Early reconstructive surgery promptly removes inflammatory mediators and cytokines improves blood circulation and facilitates wound healing. It also prevents tendon and joint adhesions and contractures through early rehabilitation exercises, improving skin elasticity and mobility in the graft area. These factors contribute to a lower overall complication rate and higher surgical efficacy in the observation group[15].

Conclusion and Future Directions

In conclusion, early plastic surgery treatment of deep hand burns effectively reduces pain promotes wound healing, improves hand function recovery, and lowers the risk of complications. These findings highlight the importance of early intervention in maximizing outcomes for burn patients. In the context of early reconstructive surgery for deep hand burns, future research should focus on addressing unresolved issues and uncertainties. This entails exploring more refined surgical techniques to minimize pain, expedite wound healing, and enhance hand function recovery in individuals with deep hand burns. Furthermore, there is a need to refine postoperative rehabilitation strategies, including physical therapy and rehabilitation training, to improve overall patient outcomes. Future investigations should also deepen our understanding of the intricate physiological and molecular mechanisms underlying deep hand burns, possibly identifying molecular targets related to inflammation, fibrosis, and granulation tissue formation during the healing process. To guide clinical practices more effectively, future research should consider conducting larger-scale, multicenter clinical trials to validate the efficacy of early reconstructive surgery across a range of deep hand burn cases, enabling the development of tailored and more effective treatment protocols. In summary, forthcoming research holds the potential to advance our understanding of deep hand burn treatment, ultimately leading to enhanced recovery and improved quality of life for affected individuals.

Limitations

This study has certain limitations that should be acknowledged. Firstly, it is essential to recognize that this research is based on a single-center study with a relatively small sample size. As such, the findings may not be entirely representative of the broader population of individuals with deep hand burns. Additionally, while the results indicate the potential benefits of early reconstructive surgery, the study's retrospective design may introduce bias and limitations in data collection. To obtain more robust and generalizable results, future research efforts should prioritize larger-scale, multicenter studies with randomized and double-blind methodologies. Furthermore, this study primarily focused on short-term outcomes such as pain reduction and wound healing within a limited postoperative timeframe. Future investigations should aim to assess long-term outcomes and address any potential complications that may arise beyond the scope of this study. Overall, recognizing these limitations highlights the need for continued research to provide a more comprehensive understanding of deep hand burn treatment and outcomes.

CONCLUSIONS

In conclusion, our study highlights the substantial benefits of early plastic surgery in managing deep hand burns. This approach significantly reduces pain, expedites wound healing, enhances functional recovery, and lowers the risk of complications, particularly skin graft necrosis. Its clinical impact is noteworthy, improving patients' quality of life and potentially reducing healthcare costs. We strongly recommend healthcare providers consider early plastic surgery as a primary therapeutic strategy for deep hand burns, and future research should focus on refining implementation protocols. In summary, early plastic surgery plays a pivotal role in transforming deep hand burn

management, offering patient-centered care and cost-effective outcomes, and should be more widely adopted in burn treatment practices.

DATA AVAILABILITY

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTIONS

XL, YJ and DY designed the study and performed the experiments, JZ and HZ collected the data, HF and LW analyzed the data, XL, YJ and DY prepared the manuscript. All authors read and approved the final manuscript. Xiuzhong Li and Yong Jiang contributed equally to this work

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REFERENCE

1. Serra R, Buffone G, de Franciscis A, et al. Skin grafting followed by low-molecular-weight heparin long-term therapy in chronic venous leg ulcers. *Ann Vasc Surg*. 2012;26(2):190-197. doi:10.1016/j.avsg.2011.04.008
2. Irwin PJ, Whithear K, Lavelle RB, Parry BW. Acute bronchopneumonia associated with Mycobacterium fortuitum infection in a dog. *Aust Vet J*. 2000;78(4):254-257. doi:10.1111/j.1751-0813.2000.tb11748.x
3. Takabayashi Y, Ishihara M, Kuwabara M, et al. Improved Survival of Full-Thickness Skin Graft With Low-Molecular Weight Heparin-Protamine Micro/Nanoparticles Including Platelet-Rich Plasma. *Ann Plast Surg*. 2017;78(5):562-568. doi:10.1097/SAP.0000000000001051
4. Zhao L, Wang K, Li W, Soteyome T, Xiao H, Hu Z. Protective effects of polyphenolic extracts from longan seeds promote healing of deep second-degree burn in mice. *Food Funct*. 2019;10(3):1433-1443. doi:10.1039/C8FO02330A
5. Dumville JC, Munson C, Christie J. Negative pressure wound therapy for partial-thickness burns. *Cochrane Database Syst Rev*. 2014;2014(12):CD006215. doi:10.1002/14651858.CD006215.pub4
6. Ahn HN, Kang HS, Park SJ, Park MH, Chun W, Cho E. Safety and efficacy of basic fibroblast growth factors for deep second-degree burn patients. *Burns*. 2020;46(8):1857-1866. doi:10.1016/j.burns.2020.06.019
7. Gacto-Sanchez P. Surgical treatment and management of the severely burn patient: review and update. *Med Intensiva*. 2017;41(6):356-364. doi:10.1016/j.medin.2017.02.008
8. Yan D, Liu S, Zhao X, et al. Recombinant human granulocyte macrophage colony stimulating factor in deep second-degree burn wound healing. *Medicine (Baltimore)*. 2017;96(22):e6881. doi:10.1097/MD.0000000000006881
9. Zhang C, Peng Y, Luo XQ, et al. [Epidemiological investigation and analysis of etiological characteristics of infection on 3 067 hospitalized pediatric patients with burns]. *Zhonghua Shao Shang Za Zhi*. 2021;37(6):538-545. doi:10.3760/cma.j.cn501120-20210201-00044
10. Shen C, Deng H, Sun T, et al. Use of Fresh Scalp Allografts From Living Relatives for Extensive Deep Burns in Children: A Clinical Study Over 7 Years. *J Burn Care Res*. 2021;42(2):323-330. doi:10.1093/jbcr/iraa155
11. Lengyel P, Frisman E, Kubasovsky J. Electrical Burn with an Extensive Deep Defect of the Fronto-Orbital Region. *Acta Chir Orthop Traumatol Cech*. 2019;86(3):220-222. doi. doi:10.55095/achot2019/034
12. Mene A, Biswas G, Parashar A, Bhattacharya A. Early debridement and delayed primary vascularized cover in forearm electrical burns: A prospective study. *World J Crit Care Med*. 2016;5(4):228-234. doi:10.5492/wjccm.v5.i4.228
13. Dukes K, Baldwin S, Hagedorn J, et al. "More than Scabs and Stitches": An Interview Study of Burn Survivors' Perspectives on Treatment and Recovery. *J Burn Care Res*. 2022;43(1):214-218. doi:10.1093/jbcr/irab062
14. Daigeler A, Kapalschinski N, Lehnhardt M. [Therapy of burns]. *Chirurg*. 2015;86(4):389-401. doi:10.1007/s00104-014-2919-3
15. Xiao M, Li L, Li C, et al. Role of autophagy and apoptosis in wound tissue of deep second-degree burn in rats. *Acad Emerg Med*. 2014;21(4):383-391. doi:10.1111/acem.12352