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SCARS AND KELOIDS: A COMPREHENSIVE REVIEW OF CURRENT TREATMENT MODALITIES

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ABSTRACT

A skin scar is a result of the healing process of skin trauma. It can occur as a proper structure or as an abnormal growth, such as a hypertrophic scar and a keloid. Scar differs in surface, location, impact on other structures, and cosmetic view. Abnormal hypertrophic scar increases the risk of further irritation, scarring, disturbs the natural barrier, decreases in cosmetic view, and impacts daily life. There are different types of treatment for an excessive scar that can be applied in different cases. The steroid tapes, steroid injections, surgery, post-surgical radiation, dry needling, silicone materials, laser therapy, cryotherapy, massage, ACE inhibitors, and fat grafting.

KEYWORDS

skin Scar, Keloid, Hypertrophic Scar, Scar Treatment, Wound Healing

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Introduction.

Scar is a result of physiological healing of a damage in a skin barrier, caused by a wide verity of factors such as mechanical, thermal and chemical.. Wound healing is a dynamic, multi-stage process involving three overlapping phases: inflammation, proliferation, and remodeling [1,2]. The inflammatory phase, lasting up to approximately three days, is characterized by platelet activation and the recruitment of neutrophils and macrophages. These immune cells clear debris and pathogens, and release key growth factors such as PDGF and TGF-β. In the proliferative phase (days 3–10), fibroblasts proliferate and produce type III collagen, while angiogenesis—mediated by VEGF and FGF-2—establishes new capillary networks. Concurrently, keratinocytes migrate to restore the epidermal barrier. The remodeling phase can last weeks or months and involves the replacement of type III collagen with stronger type I collagen and the reorganization of the extracellular matrix, leading to the stabilization and strengthening of the scar. Abnormal healing can occur as Hiperthrophic scar or as a Keloid.

Types of scars

Hypertrophic scar is a outcome of an alternation in cutaneous wound healing, that has a proliferation of dermal tissue, excessive fibroblast-derived extracellular matrix proteins such as collagen by a prolonged inflammation and fibrosis[3]. However hypertrophic scar do not outgrowths wound borders and may disappear and decrease in size specifically when pressure on wound is provided.

Keloid is also a result of a prolonged inflammation process, differs form a hypertrophic scar by its growth that crocces the borders of a wound. Keloids are caused by a overgrowth of granulation tissue or a collagen type III in healing process. There is prolonged fibroblast activity and increased expression of growth factors, such as TGF-β and VEGF. Keloids are prone to recurrence, which can cause pain and itching, negatively affecting patients' quality of life.[18] Due to its genetic component prone to the keloids can by transmitted gentically[1-4].

Atrophic scars result from insufficient collagen synthesis during the proliferative phase of wound healing. They most often form during acne vulgaris, chickenpox, or post-trauma, particularly when there are defects in the dermis. They are characterized by skin volume atrophy, which leads to pitting below the level of the surrounding tissue.

Contractual scars are formed by excessive wound shrinkage during the healing process, which leads to significant skin and deeper tissue (e.g., tendons, joints) mobility reduction. They most often occur after deep

burns, wounds with significant tissue loss, and in areas with joints. Clinically, they manifest as hard, tense bands of scar tissue that deform the area and restrict function. In extreme cases, contractual scars can lead to permanent impairment of limb mobility or facial expressions.

The Psychological Impact of Scarring

Scars, particularly those located on visible areas of the body, can have a significant impact on patients' mental health and overall quality of life. Regardless of their etiology—whether traumatic, postoperative, acne-related, or keloidal—scars are often associated with reduced self-esteem, feelings of shame, and social withdrawal[33]. Numerous studies have shown that individuals with visible scarring are more likely to experience symptoms of depression, social anxiety, and isolation. These psychological effects tend to be especially pronounced among young people, women, and patients with burn-related scars. Therefore, scar management should address not only physical appearance but also emotional well-being.

Scar prevention and treatment

Prevention of excessive scar formation is possible to abstain by intervening with inflammatory response in healing process. Recent studies show that it can be achieved by injecting the botulinum toxin type A. This inhibits the fibroblast proliferation, TGF-β1expression and the angiogenesis. This supressed the hiperthrophic scar formation. The study was performed on rabbit ears [5]. Other study on human tissue was performed after obtaining material from 8 children in Shanxi Hospital. The study shows that the BTA inhibits the JAK2/STAT3 pathway leading to reduction of proliferation, migration and fibrosis. It prevented of collagen deposition also.

The most well-known effect of botulinum toxin type A (BTX-A) is temporary muscle paralysis, achieved through the inhibition of acetylcholine release at the neuromuscular junction. When injected into the area surrounding a scar, BTX-A immobilizes nearby facial muscles, reducing tension and mechanical stress on the healing wound. This, in turn, minimizes irritation and promotes more favorable healing conditions, often resulting in smaller and less visible scars. Notably, the most effective outcomes are observed when the toxin is administered shortly after the injury. In a placebo-controlled study, Gasnier et al. demonstrated significantly improved scar appearance in the BTX-A group after three months of healing [17]. The results are promising and further studies are needed[6].

In the different skin cells there is a concentration of a AT1 receptors, angiotensin II modulates a proliferation independently from plasma and is a important in wound healing due to its proinflammatory and profibbrotive response. The migration and proliferation of keratinocytes, fibroblasts and collagen production is mediated by different pathways such as IL6/TBF-β, activation of SMAD2/3, TAK1. Opposite impact have AT2 receptors. In Keloid there is a imbalance in AT1 and AT2 receptors expression. Studies show that a ARB and ACE can be useful in prevention in hypertrophic scar and keloid formation but further researches are needed[7].

Calcium channel blocker such as Verapamil affects the biosynthesis of a extracellular matrix, fibrous tissue by decreasing in production of a PDGF, VEGF, TGF-β and interleukin 6 in fibroblasts. Studies show that injections of verapamil can reduces risk of keloid and hypertrophic scar formation[8]. However other studies show that compered to the injections of triamcinolone verapamil can not be an alterative in treatment because of triamcinolone more rapid and fewer side efects[9].

Triamcinolone injections after surgery is a well known treatment for keloid. Triamcinolone increases fibroblast apoptosis by inhibiting TGF-β expression and it affects degradation of a-globulin collagenase[10]. However the injections should not by applied in the center of a hard compartments od growing tissue but on its borders where the inflammation continuous in progress and where steroid suppression of this process is more likely to reduce it and in a consequence lessen the size of forming connective tissue[11].

Silicones are among the most commonly used and extensively studied topical treatments for scars, particularly hypertrophic and keloid scars. They function by forming an occlusive barrier on the skin surface, which helps retain moisture and enhance epidermal hydration. This improved hydration plays a crucial role in regulating fibroblast proliferation and collagen synthesis. Silicone therapy has been shown to reduce redness, itching, and scar tension, while also improving scar elasticity and overall aesthetic appearance. Silicone gels and sheets have a favorable safety profile and can be used as monotherapy or in combination with other treatment modalities[19,20].

According to a 2021 article by Yang et al., the best efficacy among minimally invasive scar treatment methods was found to be the combination of triamcinolone and botulinum toxin type A[31].

However non pharmacological techniques can by applied in prevention of excessive scar formation such as usage of a adhesive zipper immediately after surgery. The main concept is the minimalization of a tension on wound borders by distribution it on wider area of a nearby skin. The main concern is the wound coverage that may by its contact and in consequence a consistent irritation that may induce excessive growth of the scar. However the surface od zippers contact area is only a part of the scar and studies show that a overall outcome of its application was positive and there was an improvement in scar overall formation[12].[

Usage of Microneedles can lessen the scar formation by decreasing fibroblast-generated mechanical stress and the SF MNs' induced impediment of mechanical communication between fibroblasts and the ECM. The softer integrin FAK mediated mechanical signaling pathways induces low stress microenvironment. The method is low both in cost and trauma. Due to it minimal invasion sand it is painless is a promising[13].

Chirurgical excision of proliferating tissue should be done completely in order to obtain no remnant core structures. This core proliferating remnants can regrow and disturb the proper outcome of excision of a proliferating keloid[14]. Keloids develop in the direction of the tension that is provided[15]. It means that technics that reduces that tension are needed to apply in post operative wound or after the excision. A specialy tension occur in the dermic layer is prone to keloid formation. That type of tension can by minimalized by applying a sutures in the adipose fibrous layer- superficial facial sutures. However usage of a deep facial sutures should by limited only when needed to lower the tension produces by muscles and deep motion due to its neuropathic tendency. Skin sutures such as z type and w type reduces significantly the horizontal type of wound tension. Every z type of suture should by placed on 2-4cm, W type of suture is more natural but not as easy to apply due to its minimal margin[16].

Radiotherapy is recognized as an effective treatment option for keloids and hypertrophic scars, particularly in cases resistant to conventional therapies. It is most commonly employed as an adjuvant treatment following surgical excision of the scar, aiming to reduce the risk of recurrence by inhibiting fibroblast proliferation and collagen synthesis. Several studies have demonstrated that combining surgical removal of keloids with postoperative radiotherapy significantly lowers recurrence rates compared to surgery alone. For instance, one study reported a reduction in recurrence rates from 29.3% to 14.0% after implementing an updated postoperative radiotherapy protocol [25]. The selection of appropriate radiation dose and fractionation schedule is critical to maximizing treatment efficacy. Although concerns remain regarding the potential risk of secondary malignancies induced by radiotherapy, current evidence indicates that this risk is very low, especially when adjacent tissues are adequately protected and modern radiotherapy techniques are utilized [26].

Laser therapy is also used in the treatment of scars. Its mechanism of action involves the stimulation of collagen remodeling, improvement of microcirculation, and modulation of the inflammatory response, leading to enhanced skin texture and elasticity. Several types of lasers are utilized in clinical practice.

Ablative lasers, such as CO_2, are classified as more invasive devices. They remove the epidermis and part of the dermis, thereby stimulating tissue regeneration and renewal. Although they are highly effective, they are associated with a longer recovery period and a higher risk of complications, particularly when not used properly.

Non-ablative lasers, such as Nd: YAG, penetrate deeper layers of the skin but are generally less effective in scar treatment. However, they offer the advantage of significantly shorter healing times.

Studies have shown that early initiation of laser therapy, particularly within the first month following surgery, can significantly reduce the risk of hypertrophic or unaesthetic scar formation. Furthermore, combining laser therapy with other modalities, such as the administration of growth factors or vitamin C, can enhance therapeutic outcomes[22,23]. It is important to note that the best results are typically achieved through repeated treatments.

Cryotherapy is also employed as an adjunctive method in scar management. It involves the local application of extreme cold using liquid nitrogen. Exposure to a temperature of −196°C induces fibroblast death and halts excessive collagen production. Additionally, cryotherapy causes destruction of blood vessels supplying the scar, leading to its gradual regression. These processes result in a reduction of scar volume[27,28]. However, cryotherapy may be associated with side effects, including pain at the treatment site, discoloration, and the formation of blisters.

In a 2022 study, half of the 170 participants were treated with a combination of cryotherapy and intralesional triamcinolone injections, while the other group received CO_2 laser therapy combined with topical betamethasone. Both groups demonstrated a clear therapeutic response. However, patients treated with the CO_2 laser experienced significantly greater aesthetic improvement and reported less pain[32].

One of the newer approaches to scar treatment is autologous fat grafting[30]. The procedure involves taking the patient's fat and injecting it into the scar area. The basis for the action of ATR is the presence of adipose-derived stem cells in the collected material[29]. They stimulate skin regeneration and improvement of its quality, support angiogenesis, collagen remodeling. By injecting fat into the scar site, the gaps in atrophic scars are filled. Reductions in pain, itching and skin tension have also been observed. This is a new approach to scar treatment and requires more research.

Conclusions

Scars represent a common and often distressing cosmetic concern, frequently requiring long-term management. Beyond aesthetic issues, they may cause pain, itching, and, in some cases, restricted mobility. Lesions located on the face, neck, and décolleté are particularly problematic, as they can lead to significant psychological distress and lowered self-esteem[33].

Although the exact mechanisms of scar formation remain incompletely understood, numerous treatment modalities have been developed. Among minimally invasive approaches, the combination of triamcinolone injections with botulinum toxin type A has yielded the most favorable outcomes. Laser therapies—particularly CO_2 lasers—also demonstrate excellent efficacy in scar treatment. In many cases, therapeutic strategies are successfully combined to enhance overall effectiveness.

Given the high prevalence of scarring and its clinical impact, further comparative studies are essential. Such research will help identify the most effective treatment approaches and contribute to the development of standardized, evidence-based therapeutic protocols.

Author's contribution

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REFERENCES

1. J.M., R., & H., S. (2012). Wound Repair and Regeneration. https://doi.org/https://doi.org/10.1159/000339613
2. Agnieszka, L., Agnieszka, G., & Dominika, W. (2023). Effectiveness of various methods of manual scar therapy. https://doi.org/https://doi.org/10.1111/srt.13272
3. Bishara S., A. (2020). Nonsurgical Management of Hypertrophic Scars: Evidence-Based Therapies, Standard Practices, and Emerging Methods. https://doi.org/https://doi.org/10.1007/s00266-020-01820-0
4. P. P., N. (2021). Novel targets and therapies for keloid. https://doi.org/https://doi.org/10.1111/ced.14920
5. Zhiguo, Y., Yang, L., Zizheng, Y., Liuliu, C., & Dongsheng, C. (2022). Concentration-Dependent Inhibition of Hypertrophic Scar Formation by Botulinum Toxin Type A in a Rabbit Ear Model. https://doi.org/https://doi.org/10.1007/s00266-022-03008-0
6. Yan, F., Xuesong, G., Yu, T., Jie, L., & Hongwei, X. (2024). Botulinum toxin type A inhibits the formation of hypertrophic scar through the JAK2/STAT3 pathway. https://doi.org/https://doi.org/10.17305/bb.2024.10906
7. Keshvad, H., Nazgol-Sadat, H., Seyed Ali, Z., Hossein, K., Feizollah, N., & Ulrike Muscha, S. (2020). The renin-angiotensin system in cutaneous hypertrophic scar and keloid formation. https://doi.org/https://doi.org/10.1111/exd.14154

8. Ricardo Frota, B., Leonardo Frota, B., Bruno Luiz, G., & Glaucia Maria, M.-S. (2014). Topical Verapamil as a Scar Modulator. https://doi.org/https://doi.org/10.1007/s00266-014-0400-9
9. Robabeh, A., Pardis, S., Hamid Reza, M., Maryam, N., Amir, T., & Zahra, S. (2018). Comparison of intralesional verapamil versus intralesional corticosteroids in treatment of keloids and hypertrophic scars: A randomized controlled trial. https://doi.org/https://doi.org/10.1016/j.burns.2018.05.005
10. Jin Yong, S., & Jong Seung, K. (2015). Could 5-Fluorouracil or Triamcinolone Be an Effective Treatment Option for Keloid After Surgical Excision? A Meta-Analysis. https://doi.org/https://doi.org/10.1016/j.joms.2015.10.002
11. Rei, O., Teruyuki, D., Mamiko, T., Masayo, A., & Satoshi, A. (2020). The Latest Strategy for Keloid and Hypertrophic Scar Prevention and Treatment: The Nippon Medical School (NMS) Protocol. https://doi.org/https://doi.org/10.1272/jnms.jnms.2021_88-106
12. Zongan, C., Yunbo, J., Yun, Z., Yajing, Q., Li, H., & Lei, C. (2021). Scar Prevention With Prolonged Use of Tissue Adhesive Zipper Immediately After Facial Surgery: A Randomized Controlled Trial. https://doi.org/https://doi.org/10.1093/asj/sjab407
13. Qing, Z., Lin, S., Hong, H., Xingmou, L., Yong, H., & Dan, X. (2022). Down-Regulating Scar Formation by Microneedles Directly via a Mechanical Communication Pathway. https://doi.org/https://doi.org/10.1021/acsnano.1c11016
14. Yosep, C., Chan Woo, K., Yong Sung, K., Choong Hyun, C., & Tae Hwan, P. (2017). Complete excision of proliferating core in auricular keloids significantly reduces local recurrence: A prospective study. https://doi.org/https://doi.org/10.1111/1346-8138.14110
15. Akaishi S, Akimoto M, Ogawa R, Hyakusoku H. The relationship between keloid growth pattern and stretching tension: visual analysis using the finite element method. Ann Plast Surg. 2008 Apr;60(4):445-51. doi: 10.1097/SAP.0b013e3181238dd7. PMID: 18362577.
16. Teruyuki, D., Shigehiko, K., Mamiko, T., Masayo, A., Satoshi, A., & Rei, O. (2019). Z-plasty and Postoperative Radiotherapy for Upper-arm Keloids: An Analysis of 38 Patients. https://doi.org/https://doi.org/10.1097/gox.0000000000002496
17. Gassner, H. G., Sherris, D. A., & Otley, C. C. (2000). Treatment of Facial Wounds with Botulinum Toxin A Improves Cosmetic Outcome in Primates. Plastic & Reconstructive Surgery, 105(6), 1948–1953. https://doi.org/10.1097/00006534-200005000-00005
18. Kim, H. J., & Kim, Y. H. (2024). Comprehensive Insights into Keloid Pathogenesis and Advanced Therapeutic Strategies. International Journal of Molecular Sciences, 25(16), 8776. https://doi.org/10.3390/ijms25168776
19. O'Brien, L., & Jones, D. J. (2013). Silicone gel sheeting for preventing and treating hypertrophic and keloid scars. Cochrane Database of Systematic Reviews. https://doi.org/10.1002/14651858.cd003826.pub3
20. Wang, F., Li, X., Wang, X., & Jiang, X. (2020). Efficacy of topical silicone gel in scar management: A systematic review and meta-analysis of randomised controlled trials. International Wound Journal, 17(3), 765–773. https://doi.org/10.1111/iwj.13337
21. Khatri, K. A., Mahoney, D. L., & McCartney, M. J. (2011b). Laser scar revision: A review. Journal of Cosmetic and Laser Therapy, 13(2), 54–62. https://doi.org/10.3109/14764172.2011.564625
22. Kent, R. A., Shupp, J., Fernandez, S., Prindeze, N., & DeKlotz, C. M. C. (2020). Effectiveness of Early Laser Treatment in Surgical Scar Minimization. Dermatologic Surgery, 46(3), 402–410. https://doi.org/10.1097/dss.0000000000001887
23. Machado, B. H. B., Zhang, J., Frame, J., & Najlah, M. (2021). Treatment of Scars with Laser-Assisted Delivery of Growth Factors and Vitamin C: A Comparative, Randomised, Double-blind, Early Clinical Trial. Aesthetic Plastic Surgery. https://doi.org/10.1007/s00266-021-02232-4
24. Xu, Y., & Deng, Y. (2018). Ablative Fractional CO2 Laser for Facial Atrophic Acne Scars. Facial Plastic Surgery, 34(02), 205–219. https://doi.org/10.1055/s-0037-1606096
25. Ogawa, R., Miyashita, T., Hyakusoku, H., Akaishi, S., Kuribayashi, S., & Tateno, A. (2007). Postoperative Radiation Protocol for Keloids and Hypertrophic Scars. Annals of Plastic Surgery, 59(6), 688–691. https://doi.org/10.1097/sap.0b013e3180423b32
26. Ogawa, R., Yoshitatsu, S., Yoshida, K., & Miyashita, T. (2009). Is Radiation Therapy for Keloids Acceptable? The Risk of Radiation-Induced Carcinogenesis. Plastic and Reconstructive Surgery, 124(4), 1196–1201. https://doi.org/10.1097/prs.0b013e3181b5a3ae
27. Har-Shai, Y., Amar, M., & Sabo, E. (2003). Intralesional Cryotherapy for Enhancing the Involution of Hypertrophic Scars and Keloids. Plastic and Reconstructive Surgery, 111(6), 1841–1852. https://doi.org/10.1097/01.prs.0000056868.42679.05
28. Dhaliwal, K., Parks, T., Brewster, C., & Singh, S. (2025). Intralesional cryotherapy for treatment of keloid scars: patient-reported outcomes. Journal of Wound Care, 34(Sup4a), xliv—xlviii. https://doi.org/10.12968/jowc.2021.0087
29. Stachura, A., Paskal, W., Pawlik, W., Mazurek, M. J., & Jaworowski, J. (2021). The Use of Adipose-Derived Stem Cells (ADSCs) and Stromal Vascular Fraction (SVF) in Skin Scar Treatment—A Systematic Review of Clinical Studies. Journal of Clinical Medicine, 10(16), 3637. https://doi.org/10.3390/jcm10163637

30. Negenborn, V. L., Groen, J.-W., Smit, J. M., Niessen, F. B., & Mullender, M. G. (2016). The Use of Autologous Fat Grafting for Treatment of Scar Tissue and Scar-Related Conditions. Plastic and Reconstructive Surgery, 137(1), 31e—43e. https://doi.org/10.1097/prs.0000000000001850
31. Yang, S., Luo, Y. J., & Luo, C. (2021). Network Meta-Analysis of Different Clinical Commonly Used Drugs for the Treatment of Hypertrophic Scar and Keloid. Frontiers in Medicine, 8. https://doi.org/10.3389/fmed.2021.691628
32. Rajashekar, T., & Nishi, N. (2022). A comparative study of effectiveness of cryotherapy with intralesional triamcinolone vs fractional CO2 laser with topical betamethasone for the treatment of keloids. Journal of Cutaneous and Aesthetic Surgery, 15(3), 254. https://doi.org/10.4103/jcas.jcas_54_22
33. Wu, J., Zou, J., Yang, Q., Wang, H., Tian, H., Chen, L., Ji, Z., Zheng, D., Li, Z., & Xie, Y. (2023). The effects of scar in psychological disorder: A bibliometric analysis from 2003 to 2022. International Wound Journal. https://doi.org/10.1111/iwj.14373