ORIGINAL RESEARCH

Use of Dermal Matrix Substitutes in Keloid and Hypertrophic Scar Management: A Case Series

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ABSTRACT
Keloids and hypertrophic scars are common dermal conditions characterized by excessive scar tissue formation, causing functional and aesthetic impairments. Traditional treatment modalities often yield suboptimal results and limited success. This paper presents a case series analysis of five patients, including three keloids and two hypertrophic scars, who underwent treatment with dermal matrix substitutes and skin grafting at the Department of Plastic Surgery, MGM Superspeciality Hospital. The outcome analysis, conducted after six months, revealed promising results for hypertrophic scars while highlighting the need for further treatment in keloids due to the development of peripheral hypertrophic scar rims. Triamcinolone injections were administered to address this issue effectively. This paper aims to evaluate the efficacy of dermal matrix substitutes in the management of keloids and hypertrophic scars, emphasizing their potential benefits and areas for improvement.

INTRODUCTION

Keloids and hypertrophic scars represent a dermal fibroproliferative response to tissue injury. The pathophysiology of keloids involves an exaggerated wound healing process, characterized by excessive collagen deposition and fibroblast proliferation beyond the boundaries of the original wound. This uncontrolled growth leads to the formation of raised, thick, and often painful scars. On the other hand, hypertrophic scars are confined to the wound site, but they also display increased collagen formation and myofibroblast presence. Both conditions can lead to functional limitations and considerable psychological distress for affected individuals.

PATHOPHYSIOLOGY OF KELOIDS AND HYPERTROPHIC SCARS

The pathogenesis of keloids and hypertrophic scars is complex and involves dysregulation in various cellular and molecular processes. The main differences between these two types of scars lie in the extent of tissue involvement and the depth of dermal injury.[1]

In keloids, an imbalance between pro-inflammatory and anti-inflammatory cytokines results in excessive fibroblast proliferation and collagen synthesis. Overproduction of transforming growth factor-beta (TGF-β) and platelet-derived growth factor (PDGF) further stimulates fibroblast activity and myofibroblast differentiation, contributing to the aggressive growth of keloids beyond the wound borders.[2]

Hypertrophic scars, on the other hand, exhibit a more confined proliferation of fibroblasts and collagen, typically limited to the boundaries of the initial wound. The hypercellular nature of hypertrophic scars is primarily driven by an excessive deposition of collagen type III relative to collagen type I, leading to an immature and less organized scar matrix.

CURRENT TREATMENT MODALITIES FOR KELOIDS AND HYPERTROPHIC SCARS

The current treatment modalities for keloids and hypertrophic scars aim to modulate the wound healing process, reduce inflammation, and inhibit collagen synthesis. These treatments include:[3,4]

1. Surgical Excision: Excision of keloids and hypertrophic lesions is done with an extra margin of up to 1 centimeter to minimize recurrence. The surgical technique involves a good depth of excision to remove the excess scar tissue while ensuring dermal matrix uptake. However, surgical excision alone may result in a higher risk of recurrence, especially for keloids, due to their aggressive nature.
2. Intralesional Steroids: Intralesional corticosteroid injections are commonly used to reduce inflammation and collagen synthesis within the scar tissue. While effective for hypertrophic scars, keloids may respond variably to this treatment, and repeated injections can be painful.
3. Cryotherapy: Cryotherapy involves freezing the scar tissue to induce cell death and reduce scar volume. It may cause skin depigmentation and is less effective for mature keloids.
4. Laser Therapy: Laser treatment aims to remodel the scar tissue and improve scar appearance. It can be expensive and may require multiple sessions for optimal results.
5. Pressure Therapy: Applying pressure to the scar tissue can help flatten and soften the scar. However, compliance with pressure therapy can be challenging, and it may be less effective for mature keloids.[5]
6. Radiation Therapy: Radiation is used as an adjuvant therapy to prevent keloid recurrence after excision. However, it comes with an increased risk of long-term complications and is usually reserved for severe cases.

Previous research has explored the application of dermal substitutes in the treatment of keloids and hypertrophic scars. Building upon these previous studies, our research aimed to investigate whether the use of dermal substitutes could yield improved outcomes in managing these challenging conditions. By assessing the effectiveness of dermal substitutes in our study, we sought to contribute valuable insights to the existing body of knowledge and potentially offer more effective treatment options for patients with keloids and hypertrophic scars.[6,7,8]

METHODOLOGY

This case series analysis was conducted at the Department of Plastic Surgery, MGM Superspeciality Hospital. Five patients with keloids (n=3) and hypertrophic scars (n=2) were included in the study. The treatment protocol involved the use of a dermal matrix substitute following scar excision. The surgical techniques employed for excision of keloids and hypertrophic lesions were standardized and involved the following steps:

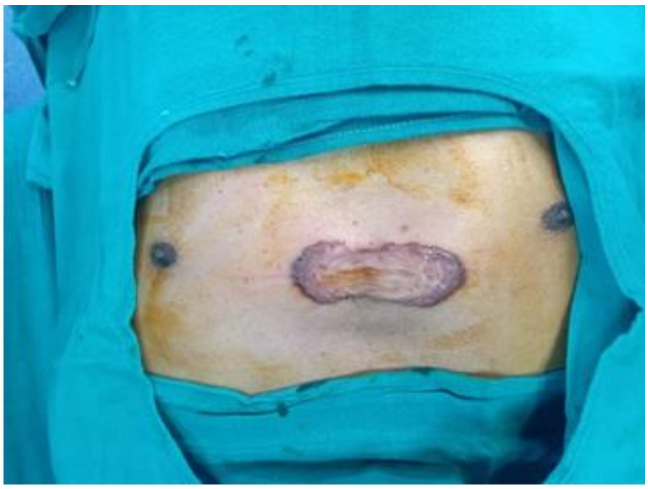
- **Preoperative Assessment**: Each patient underwent a thorough preoperative assessment, including medical history, scar evaluation, and photographic documentation.
- **Anesthesia**: Local anesthesia with lidocaine and epinephrine was administered to the surgical site to achieve adequate pain control and hemostasis.
- **Excision of Keloids and Hypertrophic Lesions**: The keloids and hypertrophic scars were excised with an extra margin of up to 1 centimeter beyond the visible borders of the scar tissue. This approach aimed to remove the entire scar tissue, including the surrounding fibrotic tissue, to minimize the risk of recurrence.
- **Good Depth of Excision**: The excision was performed to a depth that ensured complete removal of the hypertrophic scar tissue down to the subcutaneous fat layer. Achieving a good depth of excision was crucial to prevent residual scar tissue and encourage optimal dermal matrix uptake.
- **Hemostasis**: Hemostasis was meticulously achieved during the excision to minimize bleeding and ensure a clean surgical field for Dermal Matrix Substitute Application.
- **Dermal Matrix Substitute Application**: Following the excision, a dermal matrix substitute was applied to the wound bed. The dermal matrix acts as a scaffold for cell migration and tissue regeneration, promoting better wound healing outcomes.
- **Skin Graft Placement**: After 21 days of dermal matrix substitute application, a skin graft was placed over the dermal matrix. The graft was harvested from a donor site, such as the thigh or upper arm, and secured to the wound bed.
- **Dressings and Follow-up**: Regular dressings were applied to the surgical sites, and patients were advised on scar improvement modalities, including pressure therapy and scar massage.
- Follow-up evaluations were performed at regular intervals over a six-month period.

RESULTS

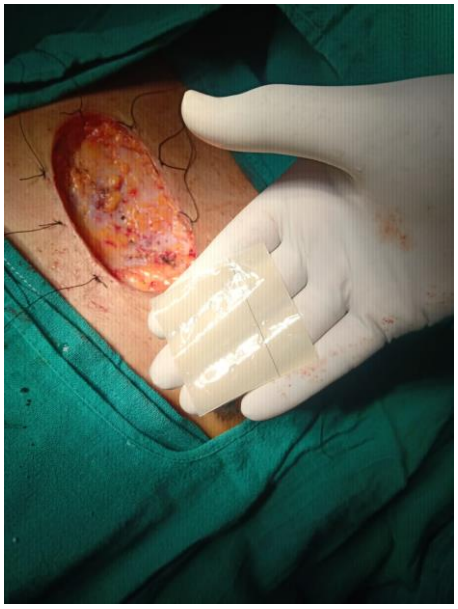
The outcome analysis showed promising results for both keloids and hypertrophic scars. In all cases, the grafts integrated well, resulting in subtle, pinchable scars of good quality. Hypertrophic scars exhibited significant improvement and were more aesthetically pleasing compared to the pre-treatment condition. However, it was observed that each keloid developed a peripheral rim of hypertrophic scar tissue, limiting the overall success of the treatment.

Patient	Age	Gender	Scar Type	Site	Vascularity	Height	Pliability	Pigmentation	Total VSS Score
P1	32	Female	Keloid	Sternum	2	2	2	2	8
P2	23	female	Keloid	Sternum	3	2	2	2	8

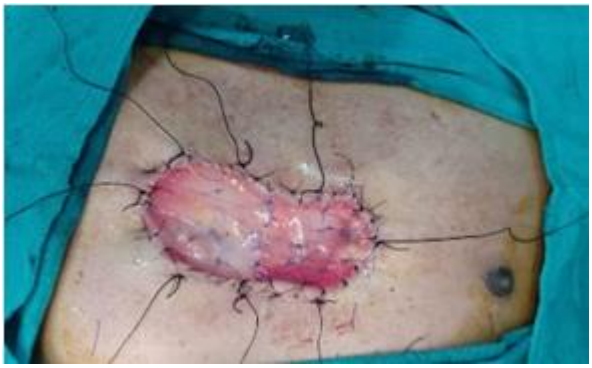
P3	45	Female	Hypertrophic Scar	Thigh	1	1	1	1	4
P4	28	Male	Hypertrophic Scar	Forearm	2	1	1	1	5
P5	55	Female	Hypertrophic Scar	Chin	1	2	1	1	5



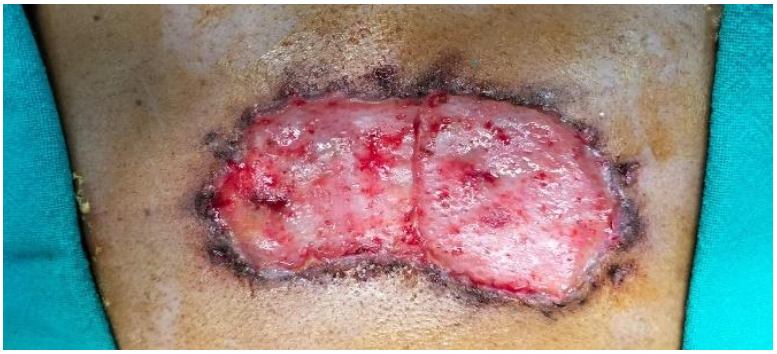
Keloid Scar on sternum



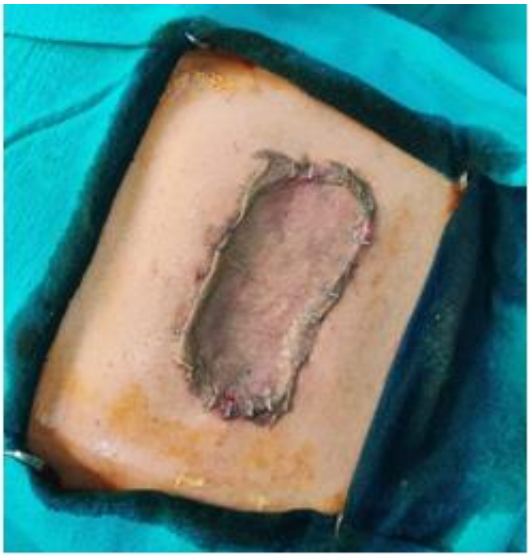
Dermal substitute with excised wound in background



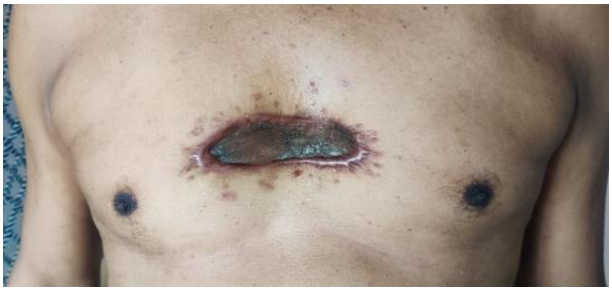
Application of Substitute

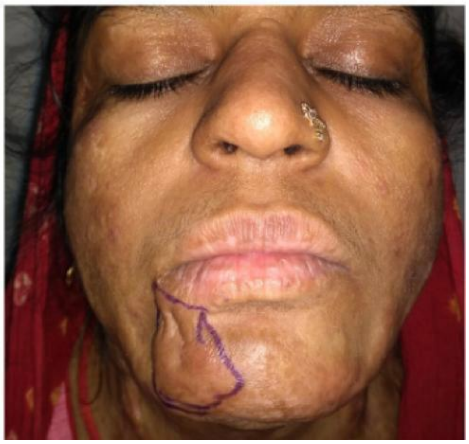


Wound ready for skin grafting

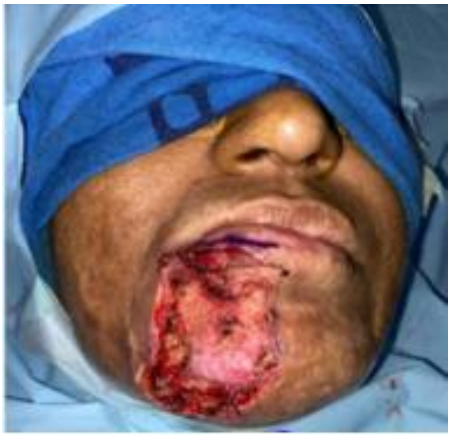


Skin graft application

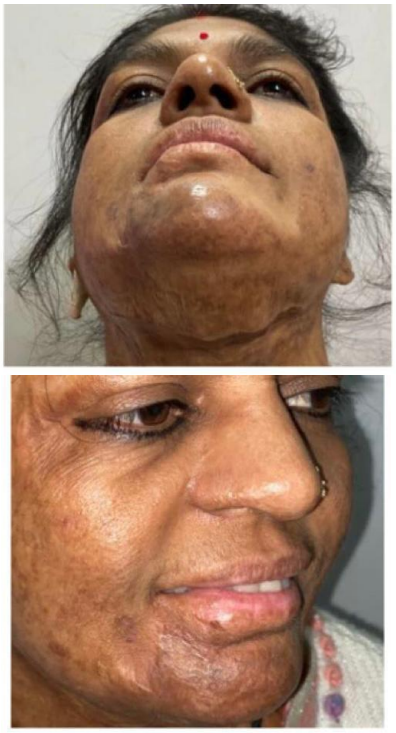




Marking of scar



Excsion of Scar



Outcome after 6 months

DISCUSSION

The use of dermal matrix substitutes in combination with skin grafting demonstrated positive outcomes for both keloids and hypertrophic scars. The enhanced scar tissue formation, improved texture, and cosmesis highlighted the potential of this approach in scar management. Hypertrophic scars showed marked improvement, with lower VSS scores indicating better scar quality compared to their pre-treatment states.

The results for keloids were also promising, with well-settled grafts and good-quality scars. However, the development of peripheral hypertrophic scar rims around each keloid raised concerns. These hypertrophic rims likely contributed to the higher VSS scores in the keloid group compared to the hypertrophic scar group. Such findings emphasize the importance of addressing not only the main scar but also its surrounding tissue to achieve optimal results in keloid management.

The possible cause of peripheral rim hypertrophy observed in this study could be attributed to the two instances of trauma inflicted on the periphery of the wound during the fixation of the dermal substitute and the subsequent skin graft. The trauma caused by these two procedures might have contributed to the exaggerated healing response in the peripheral area, leading to the development of hypertrophic scar tissue.

To address this issue and potentially avoid the development of the peripheral rim, alternative methods of fixation for dermal substitutes and skin grafts could be explored. Implementing more gentle and minimally traumatic fixation techniques may help mitigate the risk of provoking an excessive healing response in the peripheral region of the wound.

For instance, using bioadhesives or tissue adhesives as an alternative to sutures for fixation could minimize tissue trauma and reduce the risk of hypertrophic scar formation in the peripheral area. Additionally, using advanced wound closure devices or specialized dressings that exert less tension on the wound edges during the healing process may also be beneficial in avoiding peripheral hypertrophic rims.

It is essential to conduct further research and comparative studies to evaluate the efficacy of these alternative fixation methods in reducing trauma to the wound periphery and preventing the occurrence of peripheral rim hypertrophy in keloids and hypertrophic scars. By adopting less traumatic fixation techniques, clinicians can potentially improve treatment outcomes and enhance the overall success of dermal matrix substitute application in scar management.

LIMITATIONS AND SHORTCOMINGS

Despite the positive outcomes, this study has several limitations. The small sample size of five patients might limit the generalizability of the results. Additionally, the study lacked a control group, making it challenging to compare the outcomes with standard treatment modalities. The need for multiple surgeries and the cost and availability of dermal matrix substitutes may also pose practical challenges in widespread application.

CONCLUSION

The findings of this case series analysis suggest that the use of dermal matrix substitutes in combination with skin grafting is a promising therapeutic option for managing keloids and hypertrophic scars. Hypertrophic scars showed marked improvement and better outcomes compared to keloids, as evident by their lower VSS scores. Addressing the peripheral hypertrophic scar rims in keloids with triamcinolone injections can be an effective strategy to achieve overall scar improvement.

However, it is essential to acknowledge the limitations of this study and consider conducting further research with larger sample sizes and comparative studies to validate these findings. The complexity and difficulty in treating keloids underscore the urgent need for the development of novel and more effective treatment approaches.

BIBLIOGRAPHY

1. Berman, B., &Maderal, A. (2017). Keloids and Hypertrophic Scars: Pathophysiology, Classification, and Treatment. Dermatologic Surgery, 43(Suppl 1), S3–S18.
2. Ogawa, R. (2017). Keloid and hypertrophic scars are the result of chronic inflammation in the reticular dermis. International Journal of Molecular Sciences, 18(3), 606.
3. Urioste SS, Arndt KA, Dover JS. Keloids and hypertrophic scars: review and treatment strategies. Semin Cutan Med Surg. 1999 Jun;18(2):159-71. doi: 10.1016/s1085-5629(99)80040-6. PMID: 10385284.
4. Zhu, J. Z., Dai, J. W., Huang, C. S., Huang, S. L., & Lu, W. S. (2019). The surgical treatment of keloids: a meta-analysis. Archives of Plastic Surgery, 46(3), 230-236.
5. Steinstraesser, L., Flak, E., Witte, B., Ring, A., Tilkorn, D., Hauser, J., ... & Al-Benna, S. (2012). Pressure garment therapy alone and in combination with silicone for the prevention of hypertrophic scarring: randomized controlled trial with intraindividual comparison. Plastic and Reconstructive Surgery, 129(4), 848-858.
6. Agostini, Tommaso & Perello, Raffaella & Pascone, Christian & Lonardo, Antonio. (2018). An Approach to Keloid Reconstruction with Dermal Substitute and Epidermal Skin Grafting. 10.1007/15695_2018_125.
7. Dantzer E, Braye FM. Reconstructive surgery using an artificial dermis (Integra): results with 39 grafts. Br J Plast Surg. 2001 Dec;54(8):659-64. doi: 10.1054/bjps.2001.3684. PMID: 11728107.
8. Clayman MA, Clayman SM, Mozingo DW. The use of collagen-glycosaminoglycan copolymer (Integra) for the repair of hypertrophic scars and keloids. J Burn Care Res. 2006 May-Jun;27(3):404-9. doi: 10.1097/01.BCR.0000216749.72080.89. PMID: 16679913