



Defect Closure In Areas With Tissue Limitations Due To Abnormal Scarring

Almas Mirza Murastomo^{1*}

Affiliation:

1. Department of Surgery, Faculty of Medicine/Universitas Sebelas Maret Hospital, Universitas Sebelas Maret, Surakarta, Indonesia 5712

Correspondence:

Almas Mirza Murastomo,
almasmirza@staff.uns.ac.id
Department of Surgery, Faculty of Medicine/Universitas Sebelas Maret Hospital, Universitas Sebelas Maret, Surakarta, Indonesia 5712

Received: 25/10/2024

Accepted: 1/2/2025

Published: 1/2/2025

ABSTRACT

Introduction: The management of defect closure in anatomical regions affected by abnormal scarring such as keloids or hypertrophic scars poses substantial surgical challenges, largely due to the restricted extensibility of tissue and compromised vascular supply. These conditions frequently result in both functional limitations and aesthetic concerns, thus requiring the development of advanced reconstructive techniques.

Case Report: We describe the case of a 21-year-old man who presented with a post-traumatic soft tissue defect on the left anterior cruris, further complicated by extensive hypertrophic scarring. The patient's medical history was notable for delayed wound healing and repeated unsuccessful attempts at primary closure. A customized reconstructive plan utilizing local advancement flaps, supplemented by adjunctive therapies, was implemented.

Results: A thorough preoperative evaluation was conducted, including clinical assessment, ultrasonographic measurement of scar thickness and vascularity. The surgical intervention consisted of meticulous excision of hypertrophic scar tissue, followed by the design and transposition of local tissue flaps while conserving adjacent healthy tissue.

Conclusion: Effective closure of defects in scarred regions necessitates individualized strategies tailored to overcome inherent tissue limitations and prevent recurrence. Combining local flap techniques with adjunctive therapies, together with preoperative preparation, is essential for optimal outcomes.

Keyword: Abnormal scarring, defect closure, local flap, tissue limitation.



Creative Commons Attribution 4.0
International (CC BY 4.0)



INTRODUCTION

Abnormal scars, including keloids and hypertrophic scars, represent frequent sequelae following trauma, surgical procedures, or burns, often leading to significant functional impairment and psychosocial distress [1-8]. The underlying pathophysiology is characterized by dysregulated wound healing, typified by excessive collagen deposition and abnormal fibroblast activity [9-10]. These pathological scars not only diminish tissue elasticity and extensibility but also compromise the local vascular supply, thereby presenting considerable obstacles to effective surgical defect closure [6].

The management of soft tissue defects in regions burdened by abnormal scarring is inherently complex [11-13]. Conventional primary closure techniques may prove inadequate because of the limited mobility and suboptimal quality of scarred tissues, which increases the likelihood of wound dehiscence, recurrence, and further scarring [1]. Consequently, reconstructive surgeons are often compelled to adopt innovative strategies, such as local or regional flap procedures, tissue expansion, skin grafting, and adjunctive therapies to achieve optimal results [9].

Recent advancements in imaging modalities have facilitated preoperative planning by enabling precise evaluation of scar thickness and vascularity [5]. This progress has enhanced the selection of reconstructive techniques appropriate to the patient's unique anatomical and functional requirements [5]. Additionally, a multidisciplinary approach involving surgeons, dermatologists, and rehabilitation specialists is paramount in addressing both functional and aesthetic objectives, ultimately improving patient satisfaction [7].

The present case report exemplifies the challenges associated with defect closure in regions with substantial tissue limitations due to abnormal scarring. Through comprehensive preoperative assessment, individualized surgical planning, and the integration of adjunctive therapies, this case demonstrates a successful reconstructive outcome. The report underscores the importance of tailored strategies and collaborative multidisciplinary care in managing complex soft tissue defects associated with abnormal scarring.

CASE REPORT

A 21-year-old man was referred to our tertiary care facility with a persistent soft tissue defect over the left anterior cruris. The defect emerged following a traumatic laceration sustained approximately one year earlier, which subsequently healed with extensive hypertrophic scarring. Several previous attempts at direct closure and conservative wound management failed, resulting in recurrent wound breakdown and further abnormal scar formation.

The patient underwent a comprehensive clinical evaluation, which included an assessment of scar characteristics—such as thickness, pliability, and color—along with precise measurement of the defect dimensions. High-resolution ultrasonography was performed to ascertain the depth of the scar and the status of underlying vascularity. Laboratory investigations were conducted to exclude systemic conditions that might hinder wound healing, such as diabetes mellitus or immunodeficiency syndromes.

Under local anesthesia, the hypertrophic scar was excised to ensure comprehensive removal of pathologic tissue. Extreme care was exercised to minimize trauma to adjacent tissues and to preserve the subdermal vascular plexus. A local advancement flap was then meticulously designed, based on the laxity of the adjacent skin, and careful dissection was performed to mobilize the flap.

Hemostasis was achieved meticulously, and the flap was advanced to cover the defect. Layered closure was achieved using absorbable sutures for the deep tissue layers and non-absorbable sutures for the skin. A closed-suction drain was positioned to prevent seroma formation and was removed following the resolution of drainage.

The excised hypertrophic scar measured 5×2 cm and was characterized by fibrotic tissue extending into the subcutaneous plane. The adjacent tissue exhibited moderate pliability, enabling the successful design and advancement of a local flap. Intraoperative bleeding was minimal, and no major vascular structures were encountered during the procedure. The flap remained viable throughout the immediate postoperative period, with no evidence of venous congestion or ischemia.

No postoperative complication were observed during the follow-up period. The patient expressed a high level of satisfaction with both the functional and cosmetic results.



Figure 1. Preoperative Design



Figure 2. Postoperative

DISCUSSION

The presence of abnormal scars, including hypertrophic scars and keloids, fundamentally disrupts the normal architecture and biomechanical properties of the skin [8]. This results in limited tissue mobility and impaired healing potential [8, 10]. The pathologically altered extracellular matrix, characterized predominantly by an excess of type III collagen, contributes to increased tissue rigidity and reduced elasticity, making surgical closure particularly challenging [6].

Traditional primary closure is frequently unsuccessful in scarred regions, mainly due to the inextensibility of tissue and suboptimal vascular support [1]. Local transposition flaps represent a viable alternative, as they facilitate the recruitment of healthy adjacent tissue with preserved blood supply, thereby minimising the risk of dehiscence and recurrence [9, 11]. The selection of an appropriate flap design must consider not only local tissue characteristics and defect size but also patient-specific anatomical factors [5].

Adjunctive modalities have demonstrated considerable efficacy in mitigating abnormal scar formation and enhancing surgical outcomes [7, 4]. Silicone gel sheeting

acts by hydrating the stratum corneum and modulating fibroblast activity [2,14], while pressure garments are thought to reduce capillary blood flow and collagen synthesis, thus limiting further scar proliferation [2, 15]. The favorable outcome in this case can be attributed to meticulous preoperative assessment, tailored surgical planning, and diligent postoperative care. The combination of a local advancement flap and adjunctive therapy resulted in durable wound closure, improved scar quality, and restoration of function. Long-term follow-up remains essential to detect any recurrence and to ensure sustained benefit [4].

The present report is limited by its focus on a single patient and a relatively short duration of follow-up. Further research involving larger patient cohorts and extended observation periods is necessary to validate the efficacy of combined surgical and adjunctive therapies in similar clinical contexts.

CONCLUSION

The closure of defects in regions with tissue limitations due to abnormal scarring demands comprehensive evaluation and individualized surgical strategies. Local advancement flaps, when combined with adjunctive therapies such as silicone gel and pressure garment application, can effectively address the challenges posed by scar rigidity and restricted tissue mobility. The importance of multidisciplinary collaboration and personalized care cannot be overstated in striving for optimal functional and aesthetic outcomes. This case exemplifies the successful integration of these principles, providing a practical framework for reconstructive surgeons confronted with complex defects in scarred regions.

ACKNOWLEDGMENTS

The authors extend their sincere gratitude to Universitas Sebelas Maret Hospital (RS UNS) for their invaluable support, provision of facilities, and the collaborative environment that greatly contributed to the successful management and reporting of this case.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCE

1. Al-Attar, A., Mess, S., Thomassen, J.M., Kauffman, C.L. & Davison, S.P. (2021). Keloid pathogenesis and treatment. *Plastic and Reconstructive Surgery*, 148(4), 639-650.
2. Bloemen, M.C., van der Veer, W.M., Ulrich, M.M., van Zuijlen, P.P., Niessen, F.B., & Middelkoop, E. (2017). Prevention and curative management of hypertrophic scar formation. *Burns*, 43(5), 974-985.
3. Brown, B.C., Moss, T.P., McGrouther, D.A., & Bayat, A. (2018). Skin scar preconceptions must be challenged: Importance of self-perception in skin scarring. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, 71(5), 722-728.
4. Gold, M.H., McGuire, M., Mustoe, T.A., Pusic, A., Sachdev, M., Waibel, J., & Weiss, E. (2020). Updated international clinical recommendations on scar management: part 1—evaluating the evidence. *Dermatologic Surgery*, 46(6), 834-847.
5. Li, Q., Xu, Y., Chen, W., Sun, S., & Wang, Y. (2023). The role of ultrasonography in the evaluation of hypertrophic scars and keloids: A systematic review. *International Wound Journal*, 20(1), 41-54.
6. Limandjaja, G.C., Niessen, F.B., Scheper, R.J., & Gibbs, S. (2020). The keloid disorder: Heterogeneity, histopathology, mechanisms and models. *Frontiers in Cell and Developmental Biology*, 8, 360.
7. Mustoe, T.A., Cooter, R.D., Gold, M.H., Hobbs, F.D.R., Ramelet, A.A., Shakespeare, P.G., ... & Téot, L. (2017). International clinical recommendations on scar management. *Plastic and Reconstructive Surgery*, 140(3), 471e-499e.
8. Ogawa, R. (2019). Keloid and hypertrophic scars are the result of chronic inflammation in the reticular dermis. *International Journal of Molecular Sciences*, 20(3), 606.

9. Shih, B. & Bayat, A. (2020). Scientific understanding and clinical management of hypertrophic scars and keloids. *Archives of Dermatological Research*, 312(3), 159-177.
10. Wang, Y., Beekman, J., Hew, J., Jackson, S., Issler-Fisher, A.C., Parungao, R., Lajevardi, S.S., Li, Z., & Maitz, P.K. (2020). Burn injury: Challenges and advances in burn wound healing, infection, pain and scarring. *Advanced Drug Delivery Reviews*, 146, 137-161.
11. Zhou, S., Wang, J., Wu, B., Chen, X., & Li, X. (2019). The use of local flaps in the reconstruction of post-burn scar contractures. *Journal of Burn Care & Research*, 40(5), 660-666.
12. Park, T.H., Rah, D.K., & Kim, D.J. (2018). Early postoperative complications after local flap surgery in the facial region: A 10-year retrospective study. *Annals of Plastic Surgery*, 80(4), 382-388.
13. Xu, J., Sun, S., & Wang, Y. (2024). Advances in the management of abnormal scars: A review. *Journal of Clinical Medicine*, 13(2), 215.
14. Ferreira, L.M., Gragnani, A., & Ferreira, M.C. (2020). Management of keloid and hypertrophic scars: Current and emerging options. *Clinical, Cosmetic and Investigational Dermatology*, 13, 887-897.
15. Lee, S.H., Jeon, Y.R., & Lee, S.Y. (2022). The role of pressure therapy in the management of hypertrophic scars and keloids: A systematic review and meta-analysis. *Wound Repair and Regeneration*, 30(1), 45-56.