



# Dermal Regeneration Template Generated Skin Can Be Raised as A Flap: A New Dimension in Aesthetic Restoration

Alok Sharma<sup>1</sup>  Manashree Sankhe<sup>2</sup>

<sup>1</sup> Department of Plastic Surgery, DY Patil Medical College, Pune, Maharashtra, India

<sup>2</sup> Department of Aesthetic Facial Surgery, Canterbury Christ Church University, Kent, United Kingdom

Address for correspondence Alok Sharma, MS, MCh (Plastic Surgery), Department of Plastic Surgery, DY Patil Medical College, Pimpri, Pune 411018, Maharashtra, India (e-mail: sharma.dralok@gmail.com).

Indian J Plast Surg 2024;57:515–519.

## Abstract

Childhood scars can lead to hideous aesthetic and functional deformities in young adults, which can be particularly distressing when involving the face and the breast in a female. Aesthetic restoration requires replacement of the whole or a part of the scarred skin by soft, pliable, and texture-matching skin, which nearly always is in short supply. Dermal regeneration templates (DRTs) can help in skin regeneration that is almost always aesthetically superior to most flaps. Aesthetic demands at the time of final restoration may require the regenerated skin to be moved as a local flap. As regenerated skin from dermal templates is known to match the vascularity of normal native skin, raising it as a flap should follow logically. This, however, has never been attempted to the best of our knowledge after a thorough literature search. We report a case of successfully using DRT-generated skin raised as a flap for aesthetic reconstruction of a postburn scarred breast in a young female. This adds a whole new dimension to the use of DRTs and points to a new field of research in scar management and aesthetic restoration.

## Keywords

- ▶ skin flaps
- ▶ dermal regeneration template
- ▶ breast reconstruction

## Introduction

Burn injuries sustained in childhood can cause extensive deformity with growth, with severe denting of self-image when involving the face and the breast in females. Aesthetic restoration mandates replacement of a scar with good-quality skin and tissues. Excessive scar often limits what can be replaced.

Split skin grafts are commonly used after release of postburn contractures,<sup>1</sup> but recurrence is common.<sup>2</sup> Aesthetic quality of the replaced skin remains an issue even without recurrence. Flaps offer a better restoration option

although not necessarily superior, due to characteristic differences in skin color, quality, and contour. Local flaps are seldom available and flaps raised in scar tissues are always a suspect for necrosis and inability to meet the aesthetic demands.<sup>3</sup> Distant or free flaps rarely, if ever, meet the aesthetic demands adequately.

Synthetic dermal regeneration template (DRT) is an efficient and important tool for regenerating soft, pliable, and texture-matching skin.<sup>4</sup> The regenerated neo-dermis from these templates almost matches the quality of native dermis.<sup>5–7</sup> This offers an efficient and minimally invasive alternative to more extensive and demanding reconstructive

article published online  
October 1, 2024

DOI <https://doi.org/10.1055/s-0044-1791260>.  
ISSN 0970-0358.

© 2024. Association of Plastic Surgeons of India. All rights reserved. This is an open access article published by Thieme under the terms of the Creative Commons Attribution-NonDerivative-NonCommercial-License, permitting copying and reproduction so long as the original work is given appropriate credit. Contents may not be used for commercial purposes, or adapted, remixed, transformed or built upon. (<https://creativecommons.org/licenses/by-nc-nd/4.0/>)  
Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

procedures while simultaneously precluding donor site morbidity, and often surpassing flaps in the quality of outcome.<sup>8</sup> The availability of DRTs like Integra®, Biobrane®, BTM™, and Matriderm® is a definite boon in the plastic surgeon's armamentarium.

We hypothesized that if the normal unscarred skin can be raised as a random flap, so can the DRT-regenerated skin, provided we stick to the flap dimensions mandated by the region. This would be logical and plausible since the vascular density and structure of the neo-dermis after revascularization have been shown to be comparable with the normal native dermis.<sup>6</sup> The hypothesis was proven true in a young woman with severe postburn contracture of the breast, following an early childhood burn trauma.

We report here the first ever use of DRT-regenerated skin as a local flap. It could add a whole new dimension to our knowledge and understanding of the role of DRT in scars and contractures.

## Case Report

A 24-year-old woman presented for correction of the breast asymmetry on account of right breast postburn contracture. The trauma occurred from deep scalds managed conservatively when the patient was 4 years old. A scar contracture extending from the right infraclavicular region to the hypochondrium and severe scarring in the right infra-axillary trunk were noted. The breast was completely flattened and the nipple-areola complex (NAC) was buried under the scar. The scar was hypopigmented in the right hypochondrium (►Fig. 1). Staged reconstruction was planned with (1) release of the contracted and flattened right breast to reconstruct a breast mound matching the contralateral side

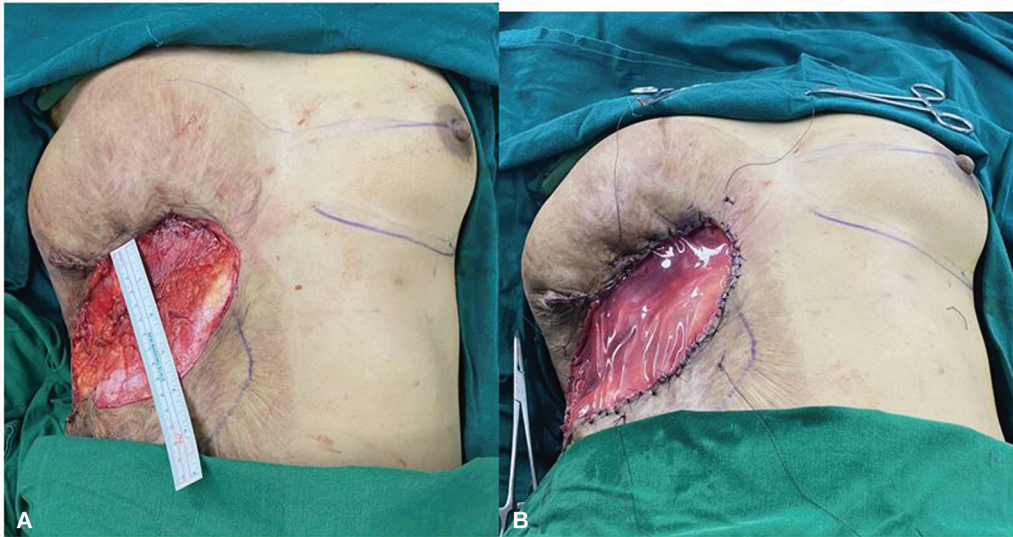
and (2) creation of the right inframammary fold (IMF) and NAC to match the other breast as much as possible. There was limited affordability for DRT. Locoregional flaps were not available.

The hypopigmented contracted scar over the right hypochondrium was excised and the breast tissue was released to create a breast mound and an inframammary crease. The resultant soft-tissue defect was covered by a 10 × 10 cm sheet of bilaminar Integra® Dermal Regeneration Template (I-DRT)—marketed in India by Dr Reddy's Laboratories, which was tailored to the defect (►Fig. 2). The DRT took well and regenerated neo-dermis was split skin grafted after 2 weeks (►Fig. 3). Graft uptake and maturation of the neo-dermis were uneventful, with soft, pliable, and evenly textured and pigmented skin (►Fig. 4).

At 6 months, the patient was taken up for the final aesthetic restoration by remodeling the right breast mound to achieve breast symmetry and an aesthetically pleasing shape as well as NAC reconstruction. Breast mound shape restoration was achieved by lifting the breast from the neo-IMF and approximating the medial and lateral pillars. This necessitated, as anticipated, raising a part of the regenerated skin at the IMF as a flap. A hypertrophic scar in the neo-IMF and towards the midline was excised leaving a skin defect of approximately 4 × 11 cm, which needed a flap cover to maintain the aesthetic restoration. The absence of fascia under the regenerated skin on account of initial burn injury, and the excision of the scar, mandated raising the flap as a cutaneous flap. The flap was raised with the base on the lateral and the inferior side and was moved diagonally to cover the defect. An 11 × 7 cm flap based on the lateral and inferior side of the quadrilateral was diagonally advanced. The edges of the flap showed healthy bleeding (►Fig. 4B).



**Fig. 1** Scar contracture with completely buried right breast. (A) Frontal view. (B) Lateral view.



**Fig. 2** (A) Soft-tissue defect after excision of hypopigmented scar and release of breast contracture with the creation of an inframammary crease corresponding to the contralateral side. (B) After placement of Integra bilayer Dermal Regeneration Template.

The NAC was found buried in the scar tissue at the inferolateral edge of the erstwhile breast mound. It was released and moved to the top of the breast mound. The areola was reconstructed using the full-thickness groin skin graft. An excellent breast symmetry was achieved subsequent healing was uneventful (→ **Fig. 5**).

## Discussion

Postburn scars from childhood may lead to hideous deformities in adults. Aesthetic restoration may become very demanding when aesthetically critical areas are involved. Postpubertal females may show severe breast deformity characterized by alteration in the NAC position, underdevelopment of the breast, and absence of IMF, due to scar contraction in the anterior chest

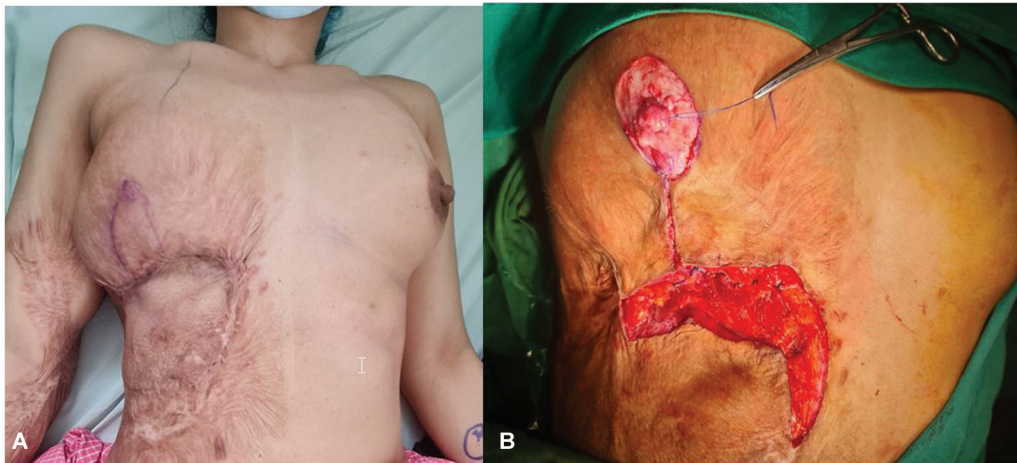
wall.<sup>9,10</sup> The unique problems in aesthetic restoration are usually not amenable to traditional techniques, and customized planning may be necessary.<sup>11,12</sup>

A split skin graft in the upper half of the breast may offer a better aesthetic prognosis of contracture release than that in the lower half and the IMF, which nearly always develops recontraction.<sup>12</sup> With the pliability, elasticity, and functional and aesthetically acceptable quality of regenerated neo-dermis comparable to native skin, the DRTs provide a viable solution to this problem.<sup>13</sup>

The DRT facilitates neo-dermis formation with “regenerative” rather than “inflammatory” healing.<sup>4</sup> Dermal substitutes have thus certainly modified the reconstructive ladder.<sup>14</sup> Several studies have assessed the histological and cellular changes that occur during neo-dermis creation from



**Fig. 3** (A) Matured dermal regeneration template (DRT) after 14 days. (B) Thin split-thickness skin graft applied after removal of the silicone top layer.



**Fig. 4** (A) Mature regenerated skin from dermal regeneration template (DRT) at 6 months. Note the well-defined inframammary crease, boxy shape of the breast mound, no nipple and areola, and a hypertrophic scar on the medial margin of the DRT-regenerated skin. (B) Soft-tissue defect after mobilization of the medial and lateral pillars of the breast and excision of the hypertrophic scar. Note the buried nipple has been released from under the scar and moved to a position matching with the contralateral breast.



**Fig. 5** An aesthetically pleasing breast mound matching the contralateral side created. The soft-tissue defect has been closed by advancing the dermal regeneration template (DRT) regenerated skin as a flap.

DRT, both quantitatively and qualitatively.<sup>15–17</sup> Real-time demonstration of Integra® dermal matrix neovascularization using confocal laser scanning microscopy suggested revascularization by neoangiogenesis.<sup>15</sup> It takes longer and is characterized (at least initially) by large-vessel, high-volume, rapid flow circulation in marked contrast to the inosculation process in skin grafts and the capillary circulation in normal skin.<sup>15</sup> Histologic analyses of dermal regeneration with Integra has shown that full vascularization of the neo-dermis occurred at 4 weeks. The new collagen laid down was histologically indistinguishable from dermal collagen in the normal native skin.<sup>17</sup> Reiffel et al in their study on qualitative analysis of cellular and vascular invasion in dermal scaffolds reported that Integra-regenerated skin demonstrated diffuse, extensive cellular infiltration as early as day 3, which increased steadily to reach the greatest level by day 14. The same study also

revealed blood vessel formation within Integra templates by day 14.<sup>18</sup>

It would be safe to assume that regenerated skin from DRT at least matches the native skin in its vascularity. A logical corollary will be the premise that raising such regenerated skin as a flap should not be fraught with dangers of flap necrosis after approximately 14 days. An extensive literature review, however, failed to show even a suggestion toward this. Our elevation of the DRT-regenerated skin as a flap was completely based on this knowledge and premise. The result not only has validated our hypothesis but also has opened new vistas for research and the use of DRT-regenerated skin in complex aesthetic restorations.

The relative disadvantages of cost and the need for staged surgery notwithstanding, a reliable method of regeneration of robustly vascular skin with a capacity to be used as a local flap far outweighs them in aesthetic results as compared to locoregional or free flaps. Simultaneously, flap donor site morbidity is also avoided. The use of the DRT could thus be limited to only the critical areas and could be incorporated in “out-of-the-box” planning of complex aesthetic restoration. Since the possibility of DRT-generated skin as a flap has been ascertained, now it is essential to study the optimal size and timing for raising such local flaps. A new dimension in aesthetic, and functional, restoration in scars and contractures involving critical areas seems to have just opened up.

## Conclusion

Synthetic DRTs provide excellent-quality skin that has vascularity comparable to or better than the normal native skin. This quality of regenerated skin can help in its use as a local flap if required. Further objective exploration of this finding is needed to ascertain its use in aesthetic restoration.

**Funding**  
None.

**Conflict of Interest**

None declared.

**References**

- 1 Ananda Murthy K, Sarabahi S, Arumugam P, Babu M. ARC technique: an innovative method to assess true defect in postburn contracture release. *Indian J Burns* 2021;29(01):104
- 2 Harrison CA, MacNeil S. The mechanism of skin graft contraction: an update on current research and potential future therapies. *Burns* 2008;34(02):153–163
- 3 Goel A, Shrivastava P. Post-burn scars and scar contractures. *Indian J Plast Surg* 2010;43:S63–S71
- 4 Chang DK, Louis MR, Gimenez A, Reece EM. The basics of Integra Dermal Regeneration Template and its expanding clinical applications. *Semin Plast Surg* 2019;33(03):185–189
- 5 Leffler M, Horch RE, Dragu A, Bach AD. The use of the artificial dermis (Integra) in combination with vacuum assisted closure for reconstruction of an extensive burn scar—a case report. *J Plast Reconstr Aesthet Surg* 2010;63(01):e32–e35
- 6 Moiemem N, Yarrow J, Hodgson E, et al. Long-term clinical and histological analysis of Integra dermal regeneration template. *Plast Reconstr Surg* 2011;127(03):1149–1154
- 7 Gronovich Y, Maisel Lotan A, Retchkiman M. Post-burn breast reconstruction using an artificial dermis—a long-term follow-up. *Burns Trauma* 2016;4(01):12
- 8 Hamdan AM, Al-Chalabi MMM, Wan Sulaiman WA. Integra: an alternative option for reconstruction of extensive finger defects with exposed bones. *Cureus* 2021;13(07):e16223
- 9 Özgenel GY, Akın S, Kahveci R, Turan S, Özcan M. Reconstruction of burn-damaged female breasts. *Eur J Plast Surg* 2002;25(03):152–155
- 10 Neale HW, Smith GL, Gregory RO, MacMillan BG. Breast reconstruction in the burned adolescent female (an 11-year, 157 patient experience). *Plast Reconstr Surg* 1982;70(06):718–724
- 11 Bayram Y, Sahin C, Sever C, Karagoz H, Kulahci Y. Custom-made approach to a patient with post-burn breast deformity. *Indian J Plast Surg* 2014;47(01):127–131
- 12 El-Otiefy MAE, Darwish AMA. Post-burn breast deformity: various corrective techniques. *Ann Burns Fire Disasters* 2011;24(01):42–45
- 13 Hoinoiu T, Grujic D, Prilipceanu G, et al. The use of collagen-glycosaminoglycan biodegradable matrix (Integra®) in the management of neck postburn hypertrophic scars and contractures. *Appl Sci (Basel)* 2020;10(11):3731
- 14 Janis JE, Kwon RK, Attinger CE. The new reconstructive ladder: modifications to the traditional model. *Plast Reconstr Surg* 2011;127(suppl 1):205S–212S
- 15 Greenwood J, Amjadi M, Dearman B, Mackie I. Real-time demonstration of split skin graft inosculation and integra dermal matrix neovascularization using confocal laser scanning microscopy. *Eplasty* 2009;9:e33
- 16 Taupin P, Gandhi A, Saini S. Integra® Dermal Regeneration Template: from design to clinical use. *Cureus* 2023;15(05):e38608
- 17 Moiemem NS, Staiano JJ, Ojeh NO, Thway Y, Frame JD. Reconstructive surgery with a dermal regeneration template: clinical and histologic study. *Plast Reconstr Surg* 2001;108(01):93–103
- 18 Reiffel AJ, Henderson PW, Krijgh DD, et al. Mathematical modeling and frequency gradient analysis of cellular and vascular invasion into Integra and Strattice: toward optimal design of tissue regeneration scaffolds. *Plast Reconstr Surg* 2012;129(01):89–99