

Scalp reconstruction after Mohs surgery for dermatofibrosarcoma protuberans: optimizing aesthetic results with dermal substitutes

Abstract

Background: Dermatofibrosarcoma protuberans (DFSP) is a rare cutaneous sarcoma that infrequently involves the scalp but often requires wide resection due to its infiltrative growth pattern. Resulting defects may expose calvarium and pose reconstructive challenges because of limited scalp mobility and aesthetic considerations. While split-thickness skin grafts (STSG) and flap reconstruction are commonly used, dermal substitutes have only rarely been described in scalp DFSP reconstruction and are typically used as staged adjuncts prior to grafting.

Methods: We present a case series of three patients with scalp DFSP who underwent reconstruction using dermal regeneration templates, including Integra® and NovoSorb® biodegradable temporizing matrix (BTM). Clinical outcomes, reconstructive course, and aesthetic results were evaluated.

Results: The first patient underwent Integra placement over exposed calvarium followed by delayed STSG, achieving complete epithelialization. The second patient underwent staged reconstruction following Mohs surgery, including Integra placement with STSG and subsequent revision using BTM to improve contour and color match of the forehead and hairline. The third patient underwent BTM placement over a large occipital scalp defect and achieved complete epithelialization by secondary intention without the need for skin grafting. Across cases, dermal substitutes provided stable wound coverage and facilitated reconstruction in challenging defects with exposed bone.

Conclusions: Dermal substitutes represent versatile tools for reconstruction of complex scalp defects following DFSP excision. Integra may be advantageous in large defects with significant calvarial exposure, while BTM can facilitate wound closure with favorable color match and may allow healing without skin grafting in selected cases. These findings highlight dermal substitutes as valuable alternatives within the reconstructive armamentarium for scalp DFSP.

Keywords: dermatofibrosarcoma protuberans (DFSP), scalp reconstruction, dermal regeneration template, Integra, NovoSorb BTM, Mohs micrographic surgery

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Introduction

Dermatofibrosarcoma protuberans (DFSP) is a rare, slow-growing cutaneous sarcoma that originates in the dermis.¹⁻³ It most commonly occurs on the trunk and extremities, with less than 5% of cases involving the scalp.⁴⁻⁵ It is a slow-growing, painless tumor, and diagnosis is often delayed.^{6,7} About half of patients will experience recurrence with simple excision, thus the preferred treatment is Mohs surgery.^{8,9} Despite appropriate treatment, DFSP of the scalp demonstrates higher recurrence rates compared with DFSP at other anatomic locations.^{10,11}

Delayed diagnosis and the infiltrative growth pattern of DFSP often necessitate wide resections that can extend to or beyond the periosteum, creating complex scalp defects.^{10,11} Reconstruction of these defects presents a unique challenge given the limited tissue mobility of the scalp and the potential for exposed calvarium. Because scalp DFSP is rare, there are no standardized reconstructive guidelines; however, reconstruction most commonly involves split-thickness skin grafts (STSG), local flaps, or free tissue transfer depending on the size and depth of the defect.^{4,12}

Dermal substitutes have only rarely been described in the reconstruction of scalp DFSP and are most often used as adjuncts

in staged reconstruction prior to skin grafting.^{4,12} Reports of dermal substitutes serving as a primary reconstructive modality remain limited. In this report, we present three cases of scalp DFSP reconstructed using dermal substitutes—Integra® (Integra LifeSciences, Plainsboro, NJ, USA) and NovoSorb® BTM (PolyNovo Biomaterials Pty Ltd, Port Melbourne, VIC, Australia)—including cases in which these materials facilitated definitive wound closure without the need for subsequent skin grafting, highlighting their potential role as an alternative reconstructive strategy for complex oncologic scalp defects.

Case presentation: Patient #1

A 49-year-old white male smoker with a history of epilepsy presented with a large occipitoparietal scalp defect following excision of DFSP (Figure 1A). The calvarium was exposed. The patient was unsure whether the tumor had been removed via Mohs micrographic surgery or wide local excision. Given this uncertainty, he was taken to the operating room for re-excision with 1 cm margins. The resulting defect measured 63 cm².

The wound bed was debrided and, given inadequate periosteum, a water-cooled diamond burr was used to induce punctate bleeding prior to Integra placement (Figure 1B). Bolster dressing was applied

and removed one week later without evidence of infection (Figure 1C). Forty-seven days after placement, the silicone layer was delaminated (Figure 1D).

Eighty-nine days after Integra placement, the patient underwent STSG from the proximal thigh. One week later, the bolster was removed and the graft demonstrated no evidence of infection. Approximately two weeks after STSG placement, epithelialization was observed centrally with progressive peripheral healing (Figure 1E). By three weeks, the wound had completely healed (Figure 1F). In total, definitive coverage of the scalp defect was achieved 103 days after initial Integra placement.



Figure 1 A) The patient's occipitoparietal scalp defect after excision of dermatofibrosarcoma protuberans. There is exposed calvarium.

B) After Integra placement, the wound bed was secured with a sponge bolster to maintain contact between the sheet and the wound.

C) A week after the procedure, the patient's wound bed showed that Integra was integrating without signs of infection.

D) Forty-seven days after placement of Integra, the sheet was delaminated.

E) Two weeks after the placement of a STSG, the graft center had epithelialized.

F) Three weeks after STSG placement, the scalp defect was fully healed.

Case presentation: Patient #2

A 33-year-old white woman presented following Mohs micrographic surgery for DFSP with a 10 × 8 cm central forehead and scalp defect with exposed calvarium and absent periosteum (Figure 2A). Her primary concern was restoration of the frontal hairline. Given the elevated risk of local recurrence, a staged reconstructive approach was recommended.

She underwent calvarial burring followed by Integra placement with bolster dressing (Figure 2B). The bolster was removed one week later without evidence of infection. Forty-eight days after the initial procedure, an 8 × 8 cm split-thickness skin graft was placed over the defect with negative pressure wound therapy to promote graft adherence (Figure 2C).

Although the wound healed successfully, the reconstruction resulted in poor color match and a large non-hair-bearing region of the frontal scalp. Six months later, bilateral tissue expanders were placed adjacent to the hair-bearing scalp. After two months of expansion, advancement flaps were elevated and hair-bearing scalp was advanced to reconstruct the frontal hairline (Figure 2D).

Despite improved hairline position, persistent discoloration of the prior STSG and mild contour asymmetry remained. Five months

later, the epidermal layer of the discolored STSG was excised, an additional scalp advancement flap was elevated, and BTM was placed within the remaining forehead defect to optimize contour and color match (Figure 2E). Three months later, the BTM silicone layer was removed following successful integration of the matrix. The surgical site subsequently healed completely. The patient later underwent laser therapy to reduce residual erythema of the reconstructed area (Figure 2F), resulting in improved color match and overall aesthetic appearance.



Figure 2 A) Patient #2 presented with a 10 × 8 cm defect involving the central forehead and scalp after Mohs surgery for DFSP. The wound had exposed cranial bone with no overlying periosteum.

B) About a month after placement, the Integra has integrated into the patient's scalp wound.

C) The patient underwent STSG to the site where the Integra was initially placed. This resulted in poor color match and loss of a significant portion of hair-bearing scalp.

D) The patient underwent expansion of the forehead tissue. After tissue expanders were removed, a bilateral scalp advancement was performed to reconstitute her normal hairline.

E) Due to discolored forehead with asymmetry, the patient underwent excision of the previous STSG and placement of BTM on the resulting defect. This is the patient three months postoperatively.

F) Six months postoperatively, the patient's hairline is in a more natural position. The patient wanted to undergo laser treatment to improve the redness of her surgical site.

Case presentation: Patient #3

A 45-year-old South Asian woman presented with a 7 × 10.7 cm occipital midline scalp defect following Mohs micrographic surgery for biopsy-proven DFSP. BTM was trimmed to size and secured to the debrided wound bed with Monocryl sutures, and a nonstick dressing was applied. The dressing was removed one week later without signs of infection. Forty-nine days after placement, the silicone layer was removed. By 68 days, the BTM had fully integrated and the wound had epithelialized without the need for skin grafting. Although STSG was offered to expedite closure, healing by secondary intention was selected given the expectation of superior color match with the surrounding scalp. Approximately four and a half months after BTM placement, the patient developed a hypertrophic scar and was scheduled for intralesional triamcinolone injection (Figure 3A&3B).



Figure 3 A) Patient #3's initial scalp defect after Mohs measured 7 × 10.7cm.

B) The patient's scalp defect five months after placement of BTM. The site healed well, but patient wanted to receive a steroid injection for the hypertrophic scar.

Surgical technique

Prior to inset of Integra or BTM, the wound bed must be debrided of all non-viable tissue to ensure uniform vascularity and optimize template incorporation. If there is exposed bone, a water-cooled round diamond cutting burr is used to induce punctate bleeding, which is critical when periosteum is absent or inadequate. The skin substitute is trimmed to the size of the defect and secured with 4-0 Monocryl sutures on a PS-2 needle, with tacking sutures placed centrally to ensure full contact while avoiding folds in the sheet.

After Integra inset, a sterile surgical sponge treated with antibiotic ointment is sutured or stapled over the template as a bolster, which the patient keeps dry for 4 to 7 days until removal in clinic. After BTM inset, the sheet is treated with antibiotic ointment and covered with a non-stick dressing; no bolster is required. The patient keeps the dressing dry until removal in clinic at 4 to 7 days.

Discussion

DFSP of the scalp is a rare and challenging entity that demands both oncologic rigor and thoughtful reconstructive planning. The infiltrative growth pattern of DFSP, combined with the limited tissue mobility of the scalp, frequently results in complex defects with exposed calvarium and absent periosteum.^{10,11} Because scalp DFSP is uncommon, there are no standardized reconstructive guidelines, and the literature describing dermal substitutes as a primary or adjunctive reconstructive modality in this setting remains limited.

Although existing reports describe the use of dermal substitutes in staged reconstruction prior to skin grafting,⁴ reports describing dermal substitutes as a definitive reconstructive modality—particularly BTM facilitating complete healing by secondary intention—remain scarce. The three cases presented here contribute to this limited body of literature and highlight the versatility of both Integra and BTM in scalp DFSP reconstruction. Integra is a bilayer with a silicone outer layer that protects from infection while maintaining moisture and an inner layer derived from bovine tendon collagen crosslinked with chondroitin-6-sulfate.^{13–15} BTM is a synthetic polyurethane bilayer with an outer sealing membrane and a biodegradable inner foam matrix that acts as a scaffold.^{16–20} Both facilitate wound healing by promoting the growth of a neodermis.^{13–20}

Although STSGs remain a conventional method for reconstructing large scalp defects, their use is associated with well-recognized limitations. STSGs frequently produce suboptimal color and contour match compared with the surrounding scalp, particularly in patients

who have undergone multiple excisions or radiation.²¹ In addition to hypopigmentation and scalp concavity, STSGs are prone to contraction and alopecia, and their thinness and lack of adnexal structures make subsequent hair restoration unpredictable.^{22,23} In contrast, dermal regeneration templates generate a vascularized neodermis that more closely resembles native dermis and have been used successfully as a recipient bed for hair micrografting.²⁴ In our experience, BTM in particular appears to offer a superior color match and less wound contraction compared with STSG, making it an appealing option when aesthetic outcome is a primary concern.²⁵

In our practice, the choice between Integra and BTM is guided primarily by the size of the defect and the extent of calvarial exposure. Integra has been our preferred matrix for large defects with substantial exposed calvarium and absent periosteum, as its use in this setting is supported by a long clinical track record and numerous reports demonstrating reliable neodermis formation when punctate bleeding has been induced via bone burring.^{26,27} Our first case, which involved a 63 cm² defect with significant bone exposure in an active smoker, reflects these advantages. Despite the unfavorable vascular environment, Integra integrated successfully, and staged STSG resulted in complete epithelialization.

Conversely, BTM is our preferred substitute for defects with preserved periosteum or limited bone exposure. BTM's fully synthetic composition eliminates the risk of cross-species immune reaction and has demonstrated excellent resistance to infection in several studies.^{28–31} Our third case illustrates that BTM can facilitate complete wound closure by secondary intention without the need for skin grafting, provided sufficient time is allowed for integration and epithelialization. Although healing time with BTM may be longer than with Integra or STSG,³² this tradeoff was acceptable given the superior color match and reduced surgical burden. The second case further demonstrates the versatility of BTM in the revision setting, where it was used to improve contour and color match following a prior STSG reconstruction, underscoring its utility not only as a primary reconstructive tool but also as an adjunct in staged aesthetic refinement.

It is important to note that dermal substitutes are not without limitations. Potential complications include infection, delayed integration, and higher cost compared with conventional autografts.^{20,32} Additionally, BTM typically requires a longer time to achieve full integration compared with Integra,³² which should be factored into patient counseling and operative planning. Nonetheless, in appropriately selected patients, these considerations are outweighed by the benefits of reduced donor-site morbidity, improved pliability, favorable color match, resistance to contraction, and the potential for future hair transplantation into the regenerated neodermis.

Conclusion

This case series demonstrates that dermal substitutes, specifically Integra and BTM, are valuable reconstructive tools for complex scalp defects following Mohs surgery for DFSP. In our experience, Integra performs reliably in large defects with substantial calvarial exposure due to its robust evidence base and predictable neodermis formation, even in the setting of unfavorable vascular conditions such as active smoking. BTM offers distinct advantages including lower cost, elimination of biologic hypersensitivity risk, superior color match, and resistance to wound contraction compared with STSG, and can facilitate complete wound closure by secondary intention without the need for skin grafting in appropriately selected patients. These cases highlight the importance of individualized reconstructive planning based on defect size, depth, vascularity, and patient aesthetic goals.

Further prospective studies with larger patient cohorts are needed to provide definitive comparative data; however, both Integra and BTM represent effective alternatives to traditional grafting techniques and should be considered in the reconstructive armamentarium for scalp DFSP.

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Conflicts of interest

All authors declared that there are no conflicts of interest.

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References

1. Zhou MH, Stirrat TP, Alam M, et al. Dermatofibrosarcoma protuberans: a clinical review of diagnosis and management. *J Am Acad Dermatol*. 2026.
2. Thway K, Noujaim J, Jones RL, et al. Dermatofibrosarcoma protuberans: pathology, genetics, and potential therapeutic strategies. *Ann Diagn Pathol*. 2016;25:64–71.
3. Hao X, Billings SD, Wu F, et al. Dermatofibrosarcoma protuberans: update on the diagnosis and treatment. *J Clin Med*. 2020;9(6):1752.
4. Kuhlmann C, Ehrl D, Taha S, et al. Dermatofibrosarcoma protuberans of the scalp: Surgical management in a multicentric series of 11 cases and systematic review of the literature. *Surgery*. 2023;173(6):1463–1475.
5. Li Y, Wang C, Xiang B, et al. Clinical features, pathological findings and treatment of recurrent dermatofibrosarcoma protuberans. *J Cancer*. 2017;8(7):1319–1323.
6. Torresetti M, Brancorsini D, Goteri G, et al. An unusual case of dermatofibrosarcoma protuberans misdiagnosed as vascular malformation for over 30 years: a case report. *Int J Surg Case Rep*. 2024;116:109407.
7. Tanwar P, Singh A, Pratap S, et al. Dermatofibrosarcoma- an uncommon entity, commonly mismanaged: a case report. *Int J Surg Case Rep*. 2021;87:106385.
8. Fields RC, Hameed M, Qin LX, et al. Dermatofibrosarcoma protuberans (DFSP): predictors of recurrence and the use of systemic therapy. *Ann Surg Oncol*. 2011;18(2):328–336.
9. Behbahani R, Patenotre P, Capon N, et al. To a margin reduction in the dermatofibrosarcoma protuberans? Retrospective study of 34 cases. *Ann Chir Plast Esthet*. 2005;50(3):179–188.
10. Barnes L, Coleman JA Jr, Johnson JT. Dermatofibrosarcoma protuberans of the head and neck. *Arch Otolaryngol*. 1984;110(6):398–404.
11. González A, Etchichury D, Rivero JM, Adamo L. Treatment of dermatofibrosarcoma of the head and neck with Mohs surgery with paraffin sections. *J Plast Reconstr Aesthet Surg*. 2021;74(5):1061–1070.
12. De Guzman J, Makhzoumi Z, Silverman RP. Two-day Mohs excision of large scalp dermatofibrosarcoma protuberans reconstructed with a rotation flap. *Cureus*. 2026;18(1):e100911.
13. *Integra® Dermal Regeneration Template*. Plainsboro, NJ: Integra LifeSciences; 2024.
14. Cheshire PA, Herson MR, Cleland H, et al. Artificial dermal templates: a comparative study of NovoSorb™ Biodegradable Temporising Matrix (BTM) and Integra® Dermal Regeneration Template (DRT). *Burns*. 2016;42(5):1088–1096.
15. Bassetto PF, Lopez-Gutierrez PJC, Giunta PR, et al. Integra's legacy unveiled: expert panel recommendations summarizing 25 years of experience in head and neck reconstruction. *JPRAS Open*. 2025;44:233–245.
16. *NovoSorb BTM*. Port Melbourne, VIC: PolyNovo Pty Ltd; 2025.
17. Wagstaff MJ, Schmitt BJ, Coghlan P, et al. A biodegradable polyurethane dermal matrix in reconstruction of free flap donor sites: a pilot study. *Eplasty*. 2015;15:e13.
18. Greenwood JE, Dearman BL. Comparison of a sealed, polymer foam biodegradable temporizing matrix against Integra® dermal regeneration template in a porcine wound model. *J Burn Care Res*. 2012;33(1):163–173.
19. Wagstaff MJ, Schmitt BJ, Caplash Y, et al. Free flap donor site reconstruction: a prospective case series using an optimized polyurethane biodegradable temporizing matrix. *Eplasty*. 2015;15:e27.
20. Greenwood JE, Schmitt BJ, Wagstaff MJD. Experience with a synthetic bilayer Biodegradable Temporising Matrix in significant burn injury. *Burns Open*. 2018;2(1):17–34.
21. Hicks K, Thomas JR. Skin and composite grafts. *Plast Aesthet Res*. 2022;9:2.
22. Blackwell KE, Rawnsley JD. Aesthetic considerations in scalp reconstruction. *Facial Plast Surg*. 2008;24(1):11–21.
23. Mahjour SB, Ghaffaripasand F, Wang H. Hair follicle regeneration in skin grafts: current concepts and future perspectives. *Tissue Eng Part B Rev*. 2012;18(1):15–23.
24. Spector JA, Glat PM. Hair-bearing scalp reconstruction using a dermal regeneration template and micrograft hair transplantation. *Ann Plast Surg*. 2007;59(1):63–66.
25. Li H, Lim P, Stanley E, et al. Experience with NovoSorb® biodegradable temporising matrix in reconstruction of complex wounds. *ANZ J Surg*. 2021;91(9):1744–1750.
26. Dibbs RP, Depani M, Thornton JF. Technical refinements with the use of biologic healing agents. *Semin Plast Surg*. 2022;36(1):8–16.
27. Chang DK, Louis MR, Gimenez A, et al. The basics of integra dermal regeneration template and its expanding clinical applications. *Semin Plast Surg*. 2019;33(3):185–189.
28. Greenwood JE, Wagstaff MJ, Rooke M, et al. Reconstruction of extensive calvarial exposure after major burn injury in 2 stages using a biodegradable polyurethane matrix. *Eplasty*. 2016;16:e17.
29. Šuca H, Čoma M, Tomšů J, et al. Current approaches to wound repair in burns: how far have we come from cover to close? A narrative review. *J Surg Res*. 2024;296:383–403.
30. Tam SSC, Taylor K, Patel P, et al. Case series of reconstruction applying Novosorb biodegradable temporising matrix: preliminary practice and findings in the United Kingdom. *Eplasty*. 2025;25:e20.
31. Wilson S, Muscat E, Smith O, et al. Biodegradable Temporizing Matrix (BTM) resilience to wound infection: a consecutive case series. *JPRAS Open*. 2025;48:95–105.
32. Jou C, Chepla KJ. Reconstruction of complex upper extremity wounds with Novosorb biodegradable temporizing matrix versus integra collagen-chondroitin silicone: a cost analysis. *Eplasty*. 2024;24:e38.