

# Optimizing scalp reconstruction after Mohs surgery: a case-based comparison of dermal templates and traditional techniques

## Abstract

Scalp defects following Mohs micrographic surgery pose reconstructive challenges due to limited adjacent tissue mobility and the frequent presence of exposed calvarium. Dermal substitutes such as Integra® Dermal Regeneration Template and NovoSorb® Biodegradable Temporizing Matrix (BTM) have broadened reconstructive options by enabling reliable neodermis formation over both vascularized soft tissue and carefully prepared bone. Although both matrices are well documented in the literature, direct comparisons specific to scalp reconstruction are lacking.

We present two cases illustrating differences in clinical course, healing time, and reconstructive advantages between Integra and BTM in scalp defects of varying size and depth. The first case involved a large (63 cm<sup>2</sup>) occipitoparietal defect with extensive bone exposure in an actively smoking 49-year-old man. Integra achieved successful integration and definitive coverage after staged split-thickness skin grafting, with complete healing by postoperative day 103. The second case involved a smaller (11.9 cm<sup>2</sup>) parietal defect with a limited area of exposed bone in a 78-year-old man with multiple comorbidities. BTM integrated uneventfully and epithelialized without the need for grafting, achieving full healing by day 74.

These cases demonstrate that Integra remains advantageous for large defects with substantial calvarial exposure, while BTM offers a cost-effective, fully synthetic alternative that performs well in smaller wounds with preserved vascularity. Individualized defect assessment—including size, vascularity, comorbidities, and degree of bone exposure—remains critical in selecting the optimal matrix for scalp reconstruction. Further comparative studies with larger cohorts are warranted.

**Keywords:** scalp reconstruction, Mohs micrographic surgery, integra, biodegradable temporizing matrix, dermal substitute, exposed calvarium, neodermis formation, split-thickness skin graft

**Abbreviations:** MMS, Mohs micrographic surgery; BTM, biodegradable temporizing matrix; STSG, split-thickness skin graft

## Introduction

Skin cancer on the scalp is due to the scalp's large surface area and high cumulative sun exposure.<sup>1-3</sup> The gold standard for treatment is Mohs micrographic surgery (MMS) which can result in a scalp defect that is small and superficial or large with exposed calvarium.<sup>4</sup> The size and depth of the defect determine the reconstructive method of closure. Historically, small scalp defects have been closed primarily or with skin grafts, while large defects can require complex methods such as local and/or free flaps.<sup>3-7</sup>

Newer reconstructive options for scalp defects include the biologic agent Integra® Dermal Regeneration Template (Integra LifeSciences, Plainsboro, NJ, USA) and the synthetic dermal substitute NovoSorb® Biodegradable Temporizing Matrix (BTM) (PolyNovo Biomaterials Pty Ltd, Port Melbourne, VIC, Australia). These dermal substitutes offer consistent, reliable results with few disadvantages.<sup>3,4,8</sup> Integra is a bilayer with a silicone outer layer that protects from infections while maintaining moisture and an inner layer derived from bovine tendon collagen crosslinked with chondroitin-6-sulfate.<sup>9-11</sup> BTM is a

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synthetic, polyurethane bilayer that has an outer sealing membrane and a biodegradable inner foam matrix that acts as a scaffold.<sup>12-16</sup> Both Integra and BTM facilitate wound healing by promoting the growth of a neodermis.<sup>9-16</sup>

Integra and BTM are well documented reconstructive adjuncts for scalp defects.<sup>3,17-19</sup> Studies comparing Integra and BTM as reconstructive methods for wounds on various body parts are also well documented.<sup>10,14,20-23</sup> However, there are not studies that compare outcomes between Integra and BTM for scalp reconstruction. We present two case reports to illustrate differences in clinical course, healing time, advantages, and limitations for scalp reconstruction.

## Materials and methods

A retrospective chart review was conducted on two patients who underwent scalp reconstruction (one patient using Integra and one using BTM) after MMS by a single surgeon at a tertiary academic hospital. Patient demographics such as age, gender, ethnicity, race, and BMI were recorded. Smoking status, radiation history, chemotherapy history, use of anticoagulants, and other medical comorbidities were recorded for each patient. Details about the scalp defect, reconstructive surgery, complications, and healing time were also collected.

## Results

### Case report #1- Scalp reconstruction with Integra

A 49-year-old male smoker with epilepsy presented with a large defect of his occipitoparietal scalp after excision of dermatofibrosarcoma protuberans (Figure 1A). The calvarium was exposed. The patient was unsure if the tumor was removed via Mohs excision or a direct excision. Given the uncertainty, he was taken to the operating room and the lesion was re-excised with 1 cm margins. The resulting defect was 63 cm<sup>2</sup>.



**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.

The wound bed was debrided with a Penfield to ensure that it was uniformly clean and vascularized to maximize contact of the dermal substitute template to the wound and optimize incorporation. Since there was exposed bone and suboptimal periosteum, a water-cooled round diamond cutting burr was used to induce punctate bleeding. This was a crucial step because skin substitutes require adequate blood supply for integration. After presoaking Integra according to the manufacturer's recommendation, it was trimmed to the size of the defect. The sheet was sewn in place on the defect with opposing Monocryl suture. A sterile surgical sponge bolster treated with antibiotic ointment was then stapled over the skin substitute to ensure contact with the wound bed (Figure 1B).

A week later, the sponge bolster was removed and there were no signs of infection (Figure 1C). The patient was instructed to keep the surgical site completely dry and apply Vaseline to the perimeter of the surgical site twice a day. Forty-seven days after the patient's initial procedure, the silicone sheeting was delaminated (Figure 1D), and the patient was instructed to wash the surgical site with baby shampoo and warm water. Eighty-nine days after his initial procedure, the patient underwent a split-thickness skin graft (STSG). The STSG was harvested from his proximal thigh and sewn onto the scalp defect with opposing gut suture, and a surgical sponge bolster with antibiotic ointment was sewn in. A week later, the sponge bolster was removed and there were no signs of infection.

About two weeks after the patient's STSG procedure, the graft center had epithelialized, with peripheral progression (Figure 1E). Three weeks after the patient's STSG was placed, the wound bed was

fully healed (Figure 1F). It took 103 days for the patient's scalp defect to completely heal from the time of initial Integra placement to full, definitive coverage.

### Case report #2- Scalp reconstruction with BTM

A 78-year-old obese male with heart failure presented with a 11.9cm<sup>2</sup> defect on his parietal scalp with a small area of exposed bone after Mohs surgery for melanoma in situ (Figure 2A). In the operating room, the patient's wound bed was debrided with a Penfield to ensure it was uniformly clean and vascularized. A water-cooled round diamond cutting burr was used to induce punctate bleeding on the area of exposed bone. The BTM sheet was then trimmed to the size of the defect and sewn in place on the defect with opposing Monocryl suture. A sterile surgical sponge bolster with antibiotic ointment was stabled over the skin substitute to ensure contact with the wound.



**Figure 2** **A)** Patient #2's parietal scalp defect after MMS for melanoma in situ. **B)** Fifty-three days after BTM placement, the sheet was delaminated. **C)** Seventy-four days after BTM placement, the scalp defect was healed.

Five days later, the sponge bolster was removed and there were no signs of infection. The patient was instructed to keep the surgical site completely dry and apply Vaseline to the perimeter of the surgical site twice a day. Fifty-three days after the patient's initial procedure, the top layer of BTM was delaminated (Figure 2B), and the patient was instructed to wash the surgical site with baby shampoo and warm water. Seventy-four days after the initial application of BTM, the patient's scalp defect was fully healed (Figure 2C).

## Discussion

Scalp defects secondary to skin cancer are not infrequent due to the amount of sun exposure the scalp gets, and reconstructive options vary widely depending on the size and depth of the scalp defect.<sup>1-3</sup> Dermal substitutes such as Integra and BTM have expanded reconstructive options by enabling the formation of a neodermis over both well-vascularized wound beds that have sufficient periosteum and carefully prepared bone when periosteum is lacking.<sup>3,4,9-16</sup> Although the literature documents successful outcomes with both matrices in scalp reconstruction, there is a lack of direct comparative data specifically addressing scalp defect, making case-based analysis valuable.<sup>3,17,18</sup>

In our practice, the choice between Integra and BTM is guided primarily by the depth of the scalp defect and the extent of bone exposure. Historically, Integra has been favored for larger areas of exposed calvarium where there is little to no 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.<sup>24,25</sup> Our Integra case, which involved a large (63 cm<sup>2</sup>) defect with significant bone exposure, reflects these advantages. The matrix integrated successfully despite the patient's smoking history, and the staged skin graft resulted in complete epithelialization.

Conversely, in our practice BTM is preferred for scalp defects without substantial 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.<sup>12,26-29</sup> Although we typically reserve BTM for wounds with adequate soft tissue vascularity, our case illustrates that BTM can perform well even in the presence of a small area of exposed bone, provided the calvarium is burred to generate punctate bleeding. The smaller defect size and limited area of bone exposure likely contributed to the successful take and complete epithelialization without the need for grafting.

Comparing these two cases highlights several important distinctions. In our case the patient who received Integra (Patient #1) took a longer time to heal than the patient who received BTM (Patient #2). However, Patient #1 had a much larger defect and was actively smoking. Additionally, studies have shown that BTM typically takes a longer time to heal than Integra.<sup>30</sup> Although BTM takes a longer time to heal, it typically costs less than Integra.<sup>31</sup> In regard to application, both dermal substitutes are relatively simple to apply and take about the same amount of time to apply. For both substitutes, the surgeon must ensure adequate contact between the substitute and wound bed to optimize incorporation.

Further comparative studies with larger patient cohorts are needed to objectively analyze outcome differences, complication profiles, and cost-effectiveness between the two dermal substitutes in scalp reconstruction.

## Conclusion

Both Integra and BTM are valuable tools in scalp reconstruction, and their optimal use depends on careful patient and defect selection. In our experience, Integra performs reliably in large defects with substantial calvarial exposure due to its robust evidence base and predictable neodermis formation, even under challenging vascular conditions. However, BTM offers a cost advantage, avoids potential biologic hypersensitivity, and may demonstrate superior infection resistance. It is particularly well suited for defects with preserved periosteum or limited bone exposure.

These cases highlight the importance of individualized reconstructive planning rather than a one-size-fits-all approach. Future prospective studies with larger patient cohorts are needed to provide more definitive guidance regarding comparative healing times, complication rates, aesthetic outcomes, and overall cost-effectiveness. Until such data emerge, clinical judgment—guided by defect size, vascularity, comorbidities, and surgeon familiarity—remains central to selecting the most appropriate dermal substitute for scalp reconstruction.

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## Conflicts of interest

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