Successful Reconstruction of Complex Pediatric Nasal Lesions: Improving Outcomes Using Dermal Regenerative Templates

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**Background:** Dermal regenerate templates are currently widely used in both adult and pediatric burn reconstruction. Despite this, the safety and efficacy of regenerate templates combined with full-thickness skin grafts for the reconstruction of pediatric facial defects traditionally treated with local flaps is not widely published. The aim of this study is to report the safety and efficacy of pediatric nasal defect reconstruction using regenerative templates/full-thickness skin grafts.

**Methods:** A retrospective review of one institution’s experience with pediatric nasal defects treated with regenerative templates was performed. All patients (n = 4) were treated with a multistage protocol. Two reviewers independently assigned Visual Analogue Cosmetic Scale (VACS) scores: 1 surgeon and 1 nonsurgical researcher not involved in patient care. Standardized photographs (anteroposterior, oblique, lateral, and worm’s eye view) were assigned VACS scores according to a 100-point scale: “abhorrent,” 0–24; “poor,” 25–49; “moderate,” 50–74; and “excellent,” 75–100. Statistical analysis was performed using Mann-Whitney U and Wilcoxon paired signed-rank tests.

**Results:** Four patients (2 boys and 2 girls, average age 6.8 yr) who met the inclusion criteria were identified. A total of 5 nasal lesions (2 spitz nevi, 1 vascular lesion, and 2 congenital nevi) were removed. The preoperative VACS score was 45.2 (range, 5–70), compared with 84.5 (range, 45–100) postoperatively (P <0.000). There was no significant difference between raters (preoperative, P = 0.346; postoperative, P = 0.678).

**Conclusions:** The reconstruction of complex pediatric nasal lesions using dermal regenerative templates and full-thickness postauricular skin grafts is safe and effective, and associated with low morbidity and significant improvement in VACS scores. (Plast Reconstr Surg Glob Open 2014;2:e107; doi: 10.1097/GOX.0000000000000033; Published online 11 February 2014.)

Management of full-thickness pediatric nasal defects following resection for large congenital nevi or symptomatic vascular lesions presents a unique reconstructive challenge. The goals of pediatric nasal reconstruction are similar to those for an adult, namely, to provide an aesthetic result with optimal contour and close color match. The additional goals of pediatric plastic surgery are to expedite the process with the fewest number of procedures possible, to minimize donor defects and scarring, and to complete the reconstruction with the least amount of psychological trauma to the child. These aforementioned variables in addition to the unique challenge of planning for facial growth...
in the undeveloped facial skeleton make reconstruction using dermal regenerative templates appealing. Currently, there are gaps in the literature detailing the optimal treatment and appropriate use of dermal regenerative templates in this unique population of patients.2,3

Traditional treatment of full-thickness nasal defects has included the use of local and regional flaps such as forehead flaps or bilobed flaps. The complete resurfacing of each subunit has also been advocated for optimal nasal reconstruction. To minimize morbidity, less invasive option such as partial subunit restoration using skin grafts alone has been advocated.4,5 Due to lack of skin laxity in pediatric patients, local and regional options can be limited.6,7 Limitations in full-thickness reconstruction using skin grafts may be ameliorated using dermal regenerative templates. Preliminary experience using Integra Bilayer Matrix Wound Dressing (Integra; Integra, Plainsboro, N.J.) and Bilayer Matrix Wound Dressing (Integra; Integra) for adult and pediatric burn indications has shown promising aesthetic results in full-thickness skin lesions.8 In addition to burns, Integra use in congenital nevi in the trunk and extremity has been reported.9 Integra, a bilaminar dermal regeneration template,10 has a superficial layer composed of silicone sheeting that mimics the protective properties of the epidermis. The underlying matrix is composed of a mixture of bovine collagen and glycosaminoglycans from shark chondroitin-6-sulfate. It serves as a framework for growth factors and cells during the 2–3 weeks it takes to become vascularized. Following ingrowth and vascularization, it can then be covered with a full- or split-thickness skin graft.11

For these unique full-thickness pediatric nasal defects, no standard protocol exists. The purposes of this article is to report and analyze the reconstruction of pediatric patients treated in our tertiary pediatric referral institution who underwent nasal reconstruction using dermal regenerative templates and full-thickness skin grafts. The use of a staged surgical approach, aesthetic outcome, and surgical morbidity will be highlighted.

METHODS

Patients referred to the Children’s Hospital of the University of Pittsburgh Medical Center pediatric plastic surgery center for evaluation and treatment of nasal nevi, vascular malformations, or neoplastic lesions were identified based on inclusion/exclusion criteria. Inclusion criteria included the following: syndromic and nonsyndromic children with nasal lesions who would require full-thickness (skin and subcutaneous tissue) reconstruction. Excluded from analysis were patients with partial thickness defects or those who had undergone primary skin grafting or local/regional flap reconstruction. Data collected were readily available to the investigators (via electronic medical and radiographic records systems) and were entered into an Excel database. At no time was anyone other than the principal and associate investigators able to access names or personal identifying information of the participating patients. This study was approved by the institutional review board of the Children’s Hospital of Pittsburgh of the University of Pittsburgh Medical Center and all patients had photographic consents obtained.

After successful identification of patients based on the above criteria, patient-related data variables were collected. The variables collected included (1) patient age, (2) patient sex, (3) unilateral or bilateral nasal defects, (4) date of surgery, (5) operative time, (6) hospital length of stay, (7) unilateral or bilateral Integra grafting and skin grafting, (8) perioperative complications, (9) perioperative mortality, (10) number of operations, (11) need for secondary surgery, and (12) cosmetic success based on criteria using a Visual Analogue Cosmetic Scale (VACS) from 0 to 100 units.12

Treatment Protocol

Pediatric patients identified with nasal lesions that would require full-thickness resection and defect reconstruction were treated in a 2-stage protocol. Stage I involved resection of the lesion with diagnosis appropriate margins, placement of a regenerative dermal matrix (Integra), and bolster dressing application in an operating room under general anesthesia. Patients underwent dressing change under anesthesia at 5-day intervals until the template had a color change from red/pink to white indicated neovascularization at the template. At stage II, the silicone epidermis layer of the template was removed and a full-thickness postauricular skin graft was secured to the surface of the template and a bolster was placed. After 5 days, the bolster was removed in the operating room under anesthesia. The patients were then evaluated at 3-month intervals and standard 2-dimensional photographic documentation was obtained.

Statistical Methods

VACS scores were independently assigned by 2 reviewers: 1 plastic and reconstructive surgeon and 1 nonsurgical researcher not involved in patient...
Preoperative and postoperative standardized photographs (anteroposterior, oblique, lateral, and worm’s eye view) were assigned VACS scores according to a 100-point scale: “abhorrent,” 0–24; “poor,” 25–49; “moderate,” 50–74; and “excellent,” 75–100.

Statistical analysis was performed for interrater differences and for preoperative vs postoperative VACS for each of the 4 views and for composite scores using Wilcoxon paired signed-rank tests, with significance $P < 0.05$. Mean, SD, and range were calculated for all operative times, graft area, and posttreatment follow-up from final surgery.

RESULTS

Four patients (2 boys and 2 girls, average age 6.8 yr) were identified who met inclusion criteria. A total of 5 nasal lesions (2 spitz nevi, 1 vascular lesion, and 2 congenital melanocytic nevi) were removed. All patients underwent a 2-stage procedure. Stage I included removal of the primary lesion and placement of a dermal regenerative template. Stage II included the removal of the silicone sheeting after adequate revascularization and full-thickness postauricular skin graft placement.

Case 1 was a 5-year-old girl with 2 rapidly growing atypical spitz nevi of the nasal ala. She underwent nonsubunit full-thickness excision of the 2 lesions from the nasal ala and dorsum with diameters measuring 0.8 and 1.0 cm, respectively. The residual defects were to the level of perichondrium of the lower lateral cartilages.

Case 2 was a 5-year-old boy with a rapidly growing pyogenic granuloma of the nasal ala. He underwent nonsubunit full-thickness excision of the lesion from the nasal ala defect measuring 0.8 cm. The residual defect was at the level of perichondrium of the exposed alar cartilage (Figs. 1 and 2).

Case 3 was an 11-year-old boy who had a congenital melanocytic nevus on his right ala and lateral nasal tip extending to the nasal rim and causing contour deformity. The nevus was excised down to the perichondrium of the lower lateral cartilage (Figs. 3–8).

Case 4 was a 7-year-old girl with a congenital melanocytic nevus of the entire right alar subunit extending down to the alar facial groove. The nevus was causing a mega-nostril on the affected side. Excision of the nevus included the entire alar subunit. The perichondrium over the lower lateral cartilage was left intact.

For stage I, operative time/lesion was on average 65.50 minutes (SD, 19.84 min; range, 45–83 min). For stage II, operative time/lesion was on average 93.25 minutes (SD, 38.25 min; range, 61–145 min). The average graft area was $1.53 \text{ cm}^2$ (SD, $1.53 \text{ cm}^2$; range, 0.8–2.0 cm²). Average posttreatment follow-up from stage II was 175.75 days (SD, 137.14; range, 51–328 d).

VACS scores between raters were compared using the Wilcoxon signed ranks test. There was no significant difference between rater scores for any individual view, nor for overall ratings: overall preoperative, $P = 0.346$; overall postoperative, $P = 0.678$; anteroposterior preoperative, $P = 0.581$; anteroposterior postoperative, $P = 0.713$; lateral preoperative, $P = 0.285$; lateral postoperative, $P = 0.593$; oblique preoperative, $P = 0.655$; oblique postoperative, $P = 1.000$; and worm’s eye view preoperative, $P = 0.655$; and worm’s eye view postoperative, $P = 0.655$.

Preoperative and postoperative VACS score analysis was performed using both raters’ scores. Average overall VACS score preoperatively was 45.23 (SD, 24.34; range, 5–70), whereas average overall VACS postoperatively was 84.46 (SD, 17.00; range, 45–100). Average preoperative VACS scores for each view were anteroposterior, 53.75 (SD, 53.75; range, 15–70); lateral, 45 (SD, 21.88; range, 5–65); oblique, 38.75 (SD, 18.78; range, 5–65); and worm’s eye view, 35.00 (SD, 17.53; range, 5–60). Average postoperative VACS scores for each view were anteroposterior, 85.88 (SD, 17.53; range, 50–100); lateral, 84.00 (SD, 17.05; range, 50–97); oblique, 90.00 (SD, 0; range, 90–90); and worm’s eye view, 81.33 (SD, 18.18; range, 45–98).

VACS scores before and after treatment were compared using the Wilcoxon signed ranks test for each individual view and for overall scores. There was significant increase in VACS score overall and for each individual view postoperatively: overall VACS score, $P < 0.000$; anteroposterior, $P = 0.011$; lateral, $P = 0.012$; oblique, $P = 0.011$; and worm’s eye view, $P = 0.012$. There were no wound infections, bleeding requiring reoperation, or mortalities.

DISCUSSION

The optimal treatment for pediatric full-thickness nasal defects has yet to be determined. Traditional care. Preoperative and postoperative standardized photographs (anteroposterior, oblique, lateral, and worm’s eye view) were assigned VACS scores according to a 100-point scale: “abhorrent,” 0–24; “poor,” 25–49; “moderate,” 50–74; and “excellent,” 75–100.
treatments, such as full-thickness skin grafts alone, have been criticized for secondary contraction and distortion particularly in the alar region. Local and regional flap reconstructions, despite exhibiting minimal secondary contraction, have been less than desirable due to significant donor site morbidity and scarring especially in the pediatric patient where donor scars may be more visible. The use of dermal regenerative templates along with full-thickness skin grafts has not been well reported. Our reported experience with Integra and full-thickness skin grafts has improved aesthetic results, and this method compares favorably with the limited reports in the literature.1,3-5 This is likely due to several reasons one of which is the minimal contraction seen with composite Integra and skin grafting compared with skin grafting alone. In addition, placement of the Integra in the wound bed provides an additional deeper laminate layer of tissue that ameliorates the otherwise concave deformities that are apt to develop in deep or crater-like defects. Finally, the lack of donor site morbidity, which is usually seen with forehead flaps, nasolabial, or bilobed flap reconstruction, is avoided. This is critical because the option of local flap coverage is not as versatile in the pediatric population as they are in the adult or elderly. The lack of skin laxity, increased dermal elasticity and skin recoil, and the absence of rhytids can necessitate wide undermining to obtain closure of seemingly small defects with minimal ability to camouflage donor incisions in preexisting rhytids.

Flaps have been previously considered the optimal reconstructive option for full-thickness defects due to their ability to reintroduce subcutaneous fat

Fig. 2. One-year postoperative result after excision and placement of the regenerative template and full-thickness postauricular skin graft.

Fig. 3. Frontal view of an 11-year-old boy with a congenital melanocytic nevus on the right ala and lateral nasal tip.

Fig. 4. Lateral view of the patient shown in Figure 3.

Fig. 5. Worm’s eye view of the patient shown in Figure 3.
and full-thickness skin into the defect. In this series of patients with lesions on the nose where there is minimal tissue laxity and significant contour considerations, the stacking effect of the template and the full-thickness skin graft minimized contour irregularities. In addition, several of the defects treated were near full-thickness defects with cartilage exposure where immediate skin graft coverage would have resulted in a concave deformity and a more prominent irregularity at the graft to normal skin interface. With the incorporation of a dermal regenerative template, the concavity is eliminated and the full-thickness graft is better incorporated. The major advantage of full-thickness skin graft reconstruction is its single stage. Although our treatment protocol required a 2-stage procedure, we did not demonstrate increased operative or anesthetic morbidity. In addition, the secondary retraction, contour abnormality, and significant color mismatch often seen in primary skin grafting were not found in our patient population and compare favorably with the literature.\textsuperscript{13,14}

Our average cosmetic result was considered excellent based on the VACS scale with an average score of 84, which was a significant improvement from 45 preoperatively. This compares favorably with the literature regarding full-thickness nasal reconstruction using local and regional flaps. We demonstrated minimal morbidity with no reoperations for bleeding, skin graft loss, or dermal regenerative template loss. The major side effect in our patient population was prolonged surgical site rubor. This finding significantly improved in our patients by 4 months postoperatively.

**CONCLUSIONS**

The application of Integra for reconstruction of pediatric defects has been underrepresented in
the literature. We have demonstrated a simplified reconstructive option with minimal donor site morbidity using regenerative templates. Limitations of our current study include its small sample size, retrospective nature with inherent selection bias, and moderate follow-up. Despite these limitations, the use of regenerative templates is a safe and effective treatment for full-thickness pediatric nasal defects.

PATIENT CONSENT

Parents or guardians provided written consent for the use of the patients’ image.

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