The Role of Tissue Expansion in the Management of Large Congenital Pigmented Nevi of the Forehead in the Pediatric Patient

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The authors present a cohort of 21 consecutive patients who had congenital pigmented nevi covering 15 to 65 percent of the forehead and adjacent scalp and who were treated at their institution within the last 12 years. All patients were treated with an expansion of the adjacent texture- and color-matched skin as the primary modality of treatment. The median age at presentation was approximately 1 year; mean postoperative follow-up was 4 years. Nevi were classified according to the predominant anatomic areas they occupied (temporal, hemiforehead, and midforehead/central); some of the lesions involved more than one aesthetic subunit.

The authors propose the following guidelines: (1) Midforehead nevi are best treated using an expansion of bilateral normal forehead segments and advancement of the flaps medially, with scars placed along the brow and at or posterior to the hairline. (2) Hemiforehead nevi often require serial expansion of the uninvolved half of the forehead to minimize the need for a back-cut to release the advancing flap. (3) Nevi of the supraorbital and temporal forehead are preferentially treated with a transposition of a portion of the expanded normal skin medial to the nevus. (4) When the temporal scalp is minimally involved with nevus, the parietal scalp can be expanded and advanced to create the new hairline. When the temporoparietal scalp is also involved with nevus, a transposition flap (actually a combined advancement and transposition flap because the base of the pedicle moves forward as well) provides the optimal hair direction for the temporal hairline and allows significantly greater movement of the expanded flap, thereby minimizing the need for serial expansion. (5) Once the brow is significantly elevated on either the ipsilateral or contralateral side from the reconstruction, it can only be returned to the preoperative position with the interposition of additional, non–hair-bearing forehead skin. Expansion of the deficient area alone will not reliably lower the brow once a skin deficiency exists. (6) In general, one should always use the largest expander possible beneath the uninvolved forehead skin, occasionally even carrying the expander under the lesion. Expanders are often overexpanded. (Plast. Reconstr. Surg. 107: 668, 2001.)

Although the exact incidence and timing of malignant degeneration in large congenital pigmented nevi remains a topic of controversy, there is little debate regarding the aesthetic deformity presented by large congenital pigmented nevi in the facial area.1–4 Early excision and reconstruction provide significant benefits in both these areas of concern; however, the literature has paid little attention to reconstruction of the forehead after nevus excision in the pediatric population. Traditional methods such as skin grafting, although providing acceptable coverage for forehead reconstruction in the adult population, rarely result in optimal results in children, even when the entire aesthetic unit of the forehead is grafted.5

Tissue expansion has given surgeons the ability to harvest large flaps of color-, thickness-, and texture-matched skin while simultaneously minimizing donor-site defects.6 Since its introduction, tissue expansion has been used to solve a wide variety of reconstructive problems, with a significant increase in the refinement of its application.7–13 In this article, we describe the evolution of our techniques for the excision and reconstruction of large and giant congenital pigmented nevi of the forehead and the positive effect specific modifications in technique have had on the final aesthetic outcome. Our current approach is based on a review of a large series of patients in whom tissue expansion provided the necessary tissue to reconstruct this challenging area. The material presented is based on lessons learned early in this series and the changes in tech-
nique that have allowed a more predictable outcome.

Patients and Methods

Patients

The patients presented in this review were classified as having large or giant congenital nevi based on the amount of total body surface area involved and the inability to primarily excise and close these lesions.\(^1^4,^1^5\) We selected 21 consecutive patients who had nevi covering 15 to 65 percent of the forehead, with many having additional extension of the nevus into either the scalp or adjacent facial areas. This patient base was accumulated over a 12-year period by the senior author and represents a subset of 220 patients with large or giant nevi covering 2 to 50 percent of the total body surface treated who were followed for the past 20 years. Eighty of the patients in this larger series had nevi involving the head and neck. The group reviewed in this article ranged in age from 6 months to 3.5 years at the time of initial presentation.

Surgical Technique

Rectangular expanders with remote fill ports were used in all patients. In the majority of cases, 200- to 325-cc expanders were used. Expanders were filled with 100 to 550 cc of liquid. An average of 2.4 expanders was used per patient, and patients averaged 1.5 courses of expansion to complete the nevus expansion and reconstruction. The incisions were generally made within the border of the nevus or posterior to nevi in the midforehead, and expanders were placed in the subgaleal and subfrontalis plane. Then, 19-gauge butterfly drains were placed (one for each expander) in each patient. The wounds were closed using 4-0 clear nylon sutures in the galea and dermis and running 4-0 nylon in the skin. At the completion of the procedure, the expanders were injected to a comfortable intraoperative fill to ensure a smooth contour to the expander surface and to minimize dead space within the pocket.

Typically, sutures were left in place throughout the expansion period unless there was an unusual amount of perisutture inflammation. Weekly injections began 7 to 10 days postoperatively and continued for a total of 5 to 12 weeks. Initially, most of the flaps were of a rotation/advancement design, but with increasing experience, transposition flaps of forehead skin were used for the lateral forehead, and temporal area and occipital transposition flaps were used for reconstruction of the temporoparietal scalp and temporal hairline. Patients with large or giant nevi extending into the periorbital area, eyelids, and nasal area were treated with either expanded or non-expanded full-thickness skin grafts. The grafts were typically staged after most of the forehead had been reconstructed.

Results

Follow-up for these patients ranged from a minimum of 2 to 9 years. All forehead reconstructions after tissue expansion were considered successful in that in each case, the nevus was completely excised and replaced with normal adjacent skin (Figs. 1 through 3). The aesthetic outcome was critically assessed by looking at symmetry, hairline/brow position, hair root direction, and scar appearance. Minor aesthetic abnormalities that were not treated surgically were still considered minor complications. The majority of the expanded flap procedures in the early half of the series consisted of advancement flaps; the latter half consisted of transposition flaps, particularly for temporal and hairline reconstruction (Table I).

Complications and Treatment

Two patients were excluded from the study. One patient had an initial nevus excision and reconstruction with a Washio flap that predated the senior author’s initial treatment. Another patient had other craniofacial anomalies that complicated management and outcome assessment. Complications were divided into those typical for tissue expansion in general and those unique to the forehead area.

In this study, two patients (9 percent) experienced typical expander complications of infection and exposure. The patient with an early infection had the expander removed and, subsequently, underwent uncomplicated reconstruction. The exposure in the second patient had no negative effect on the planned reconstruction.

Five patients (24 percent) had complications unique to the expansion of the forehead region, particularly brow elevation, brow ptosis, abnormal hair direction, or anterior hairline asymmetry. The rate of these minor aesthetic complications decreased from 29 percent to 14 percent when comparing the early half to the
FIG. 1. Midforehead and bilateral supraorbital forehead nevus. (Above, left) This 7-month-old child presented with a deeply pigmented congenital nevus covering approximately 65 percent of her forehead. Early biopsy demonstrated the extension
later half of the series. In the case of brow asymmetry, correction was delayed for at least 12 months after reconstruction to optimize scar maturation, allow natural relaxation of the surrounding tissue, and allow remodeling of any postexpansion cranial molding.

Subsequent procedures were performed, when necessary, to reestablish brow symmetry; all proved successful. These procedures included Z-plasty transposition of the elevated contralateral brow (Fig. 4) and, more commonly, crescent excision of skin above the brow to elevate a ptotic ipsilateral brow.

**DISCUSSION**

Tissue expansion is widely accepted as an invaluable adjunct for the reconstruction of the head and neck in adults and children. Reconstruction of the forehead in children presents distinctive challenges in addition to the ones typically seen in the adult population. Traditional methods such as skin grafting, although providing acceptable coverage for forehead reconstruction in the adult population, rarely result in optimal results in children, even when the entire aesthetic unit of the forehead is grafted. Thus, tissue expansion and flap design must be optimized to ensure that the landmarks of the forehead aesthetic unit will be disturbed as little as possible. Particular emphasis is placed on brow symmetry, temporal hairline position and hair direction, and scar orientation. This article is meant to provide a supplement to the existing literature, underscoring the importance of aesthetic considerations and outlining a systematic way of planning expander placement and flap design to minimize the distortion of the anatomic landmarks.

Although reconstruction of the entire forehead aesthetic unit may not be possible without a single sheet graft or distant flap when dealing with a large nevus of the central forehead, tissue expansion allows for donor tissue to be confined to the forehead aesthetic unit, without disrupting the periorbital, cheek, or midface. If the surrounding landmarks of brow and hairline are preserved or reconstructed symmetrically, then the central midline scar can still provide an acceptable outcome. Distortions of hairline and brow position tend to be more common when dealing with lesions of the hemiforehead, lateral forehead, and temporal region, and it is in these areas that modifications of the traditional advancement flap design are most important.

To our knowledge, this study represents the largest series with long-term follow-up that demonstrates a reliable approach to the treatment of forehead giant nevi. The goal of complete nevus excision while maintaining the anatomic relationship of the brow, hairline, and hair pattern was achieved in all patients. With the critical analysis of our earlier work, we have found some useful guidelines, which help simplify the preoperative plan and allow for more predictable results.

**Guidelines**

Midforehead nevi are best treated with the expansion of bilateral normal forehead segments and advancement of the flaps medially, with scars placed along the brow and at or posterior to the hairline.

Hemiforehead nevi often require serial expansion of the uninvolved half of the forehead to minimize the need for a back-cut to release the advancing flap. Repeated expansion will also minimize the likelihood of contralateral brow distortion by focusing the area of second expansion closer to the site of remaining nevus in the temporal region.

Nevi of the supraorbital and temporal forehead are preferentially treated with a transposition of a portion of the expanded normal skin medial to the nevus. The transposed flap provides a pennant of tissue between the lateral brow and hairline, places the scars along the brow, and relaxes the skin tension lines on of the nevus into the frontalis muscle. The two 100-cc expanders were placed through an incision down the midline of the nevus. 

(Above, right) One of the two rectangular remote port expanders before placement. (Center) The child returned for nevus excision after 8 weeks of expansion. The nevus was completely excised except for a small strip in the midforehead and at the glabella. (Below, left) The results at 3 months after excision showing the hairline, brow position, and maintenance of non–hair-bearing temporal skin lateral to the brow. (Below, right) The result at 5 years after the initial excision and reconstruction and 4 years after the excision of the nevus that remained in the forehead and glabella and revision of the scars along the left medial brow. Reproduced with permission from Vistnes, L. (Ed.). *Procedures in Plastic and Reconstructive Surgery: How They Do It*. Boston: Little, Brown, 1991. P. 304.
the forehead and along the temporal hairline, thus avoiding the brow and hairline distortion often created by a direct advancement flap.

When the temporal scalp is minimally involved with nevus, the parietal scalp can be expanded and advanced to create the new hairline. When the temporoparietal scalp is also involved with nevus, a transposition flap (actu-
ally a combined advancement and transposition flap because the base of the pedicle moves forward as well) provides the optimal hair direction for the temporal hairline and allows significantly greater movement of the expanded flap, thereby minimizing the need for serial expansion.

Once the brow is significantly elevated on either the ipsilateral or contralateral side from the reconstruction, it can only be returned to the preoperative position with the interposition of additional non-Hair-bearing forehead skin. Expansion of the deficient area alone will not reliably lower the brow once a skin deficiency exists. Thus, one should err toward making the brow ptotic when exact brow symmetry cannot be ensured. The ptosis often resolves with time or is easily corrected with a minor excision of excess skin above the brow or endoscopically assisted brow suspension.

In general, one should always use the largest expander possible beneath the uninvolved forehead skin and occasionally even carry the expander under the lesion. Expanders are typically overexpanded as well.

Using these standard principles, with reproducible flap design and expander placement, these challenging lesions have been managed.

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**Fig. 3. Temporal nevus.** This 6-month-old child presented with a $9 \times 7$ cm congenital pigmented nevus of the left temporal area with extension into the parietal scalp. Photographs above, left and above, center show the nevus in the anteroposterior and lateral views, respectively, before placement of expanders. (Above, right) The child is shown with a 100-cc subfrontalis expander anteriorly and a 200-cc expander in the parietooccipital area shortly before nevus excision. The nevus was excised after 8 weeks of expansion, and the reconstruction was performed with a rotation-advancement of the expanded forehead skin into the temporal region and a transposition flap of the occipital scalp to reconstruct the temporal hairline. (Below, left) Result at 4 months postoperatively demonstrates the hairline reconstruction and completion of the aesthetic unit of the forehead. (Below, right) The result at 10 months postoperatively shows maintenance of symmetrical brow position and restoration of normal temporal landmarks.
with a lower overall major complication rate (9 percent) and acceptable aesthetic results. In addition, less than half of the minor aesthetic complications required a surgical revision. Our results compare favorably with other smaller series.19,20 Once the principles outlined above were applied in this series, we had fewer aesthetic complications. Although there are several options in the treatment of large/giant nevi, including simple excision and skin grafting, we think that the use of expanded local flaps provide the best aesthetic reconstruction. A careful plan, with the understanding of the potential pitfalls unique to the forehead, can provide reproducible and dependable results while minimizing complications.

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Fig. 4. Treatment of aesthetic complication. (*Above, left*) This girl had a left supraorbital/temporal nevus and was treated in the first part of the series with single expansion of the uninvolved forehead and advancement along the brow and backcut above the lateral contralateral brow. (*Below*) Note the postoperative contralateral brow elevation due to excessive back-cutting. (*Above, right*) View after treatment of right brow elevation with Z-plasty transposition of the stretched lateral supraorbital skin to restore brow symmetry.
REFERENCES