Auricular Helical Root Composite Graft for Nasal Alar Free-Margin Reconstruction

Abstract

Background: Auricular helical root composite grafts provide a single-stage option for reconstruction of nasal alar free-margin defects, although graft survival remains a concern particularly in larger defects. This study evaluated the aesthetic and functional outcome of auricular helix root composite graft and identify a size threshold associated with an increased risk of complications.

Methods: This retrospective single-center study included adult patients who underwent nasal alar or columellar reconstruction with a chondrocutaneous composite graft harvested from the auricular helix root between June 2013 and December 2024. Patient demographics, defect characteristics, surgical technique, and postoperative outcomes were analyzed. Complications included graft necrosis, nostril notch, nasal stenosis and/or valve collapse, and surgical revision. A supplementary operative video illustrates the surgical technique.

Results: Fifty-eight patients were included. Most defects involved the nasal ala (91.4%) and the median maximum diameter was 15 mm (IQR 15–17). Overall graft survival was 89.6%. Partial graft necrosis occurred in 24.1% of patients, predominantly resulting in nostril notching without requiring surgical revision. Surgical revision was required in 10.4% of patients and was associated with deferred reconstruction (OR 16.3; 95%CI, 2.26–118.28; p=0.046). Nasal stenosis and/or valve collapse was associated with larger defect size (OR 2.08 per 5-mm increase; 95%CI, 1.06–4.11; p=0.034).

Conclusions: Auricular helical root composite grafts should be considered as a simple first-line option for alar free-margin reconstruction and provides reliable aesthetic and functional outcomes in a single-stage procedure with minimal donor-site morbidity. Defects exceeding 2

cm should be approached with caution because of the increased risk of functional complications.

Introduction

The aesthetic of the nasal ala subunit plays a critical role in facial harmony and overall nasal appearance [1]. Therefore, reconstruction of nasal alar defects that involve the free-margin represents a therapeutic challenge. In this reconstruction, cartilaginous support plays a key functional role by restoring alar contour and maintaining structural stability of the rim, thereby reducing the risk of notching and external nasal valve collapse [2–4]. According to the size and location of the nasal alar defect, surgeons commonly use local or free flaps frequently supplemented with cartilaginous strut grafts [5–7]. However, these reconstructive approaches frequently require two or three surgical stages to achieve satisfactory functional and aesthetic outcomes, and may be associated with substantial donor-site morbidity [8].

First described by König in 1902, chondrocutaneous composite grafts are a therapeutic option for oncologic- or traumatic-related nasal reconstruction, rhinoplasty, or congenital cleft[9–12]. In alar reconstruction, several auricular donor sites have been described, including the helix root, concha, or antihelix, which are most commonly selected for their structural and aesthetic compatibility with nasal tissues [9,13–15]. This surgical technique allows effective single-stage reconstruction with minimal donor-site morbidity and excellent match in nasal color, dermal thickness, and texture [16,17]. It provides an optimal balance between rigidity and flexibility, which is essential for functional support of the nasal ala. Its main limitation remains the relatively high rate of complete graft failure due to total necrosis (6–50%), which has been related to limited familiarity with the surgical technique and inadequate vascularization of the recipient site. Other commonly reported aesthetic and functional complications include nostril notching and nasal stenosis, or external nasal valve compromise

[9,13,14]. However, in case of failure, subsequent salvage reconstruction with a local or regional flaps is not compromised. The presence of cartilage within composite grafts may limit early inosculation between the recipient bed and the dermal vascular plexus, thereby impairing graft integration; this effect may be exacerbated by the higher metabolic requirements inherent to multilayered graft constructs [14].

The choice of auricular composite graft depends on the location of the nasal defect. The helical root closely reproduces the convex contour of the alar rim and allows for three-dimensional reconstruction of the free margin, a key feature in achieving facial symmetry. However, concerns remain regarding graft survival and postoperative complications, particularly in larger defects, likely related to the reduced vascular surface area of the recipient bed. Moreover, the reported graft survival rates may be influenced by the inclusion of non–full-thickness or partially transfixing defects, which are associated with more favorable vascular conditions [13,14]. Therefore, the primary objective of this study was to evaluate the aesthetic and functional outcomes of chondrocutaneous composite grafts harvested from the auricular helix root for reconstruction of the nasal ala or columella free-margins. The secondary objective was to investigate whether defect size was associated with postoperative complications and to identify a clinically relevant size threshold for composite graft reconstruction.

Materials and methods

Study design, patients, data collection, and ethics

A retrospective, observational, single-center study was conducted in an academic maxillofacial surgery department. The inclusion criteria were: patients of at least 18 years old, presenting with nasal alar rim or columella defects who received autologous chondrocutaneous composite grafts from auricular helix root between June 2013 and December 2024, and had at

least a 6-month follow-up. Patients were excluded from the study when their procedures have been performed in other departments, in case of incomplete medical records, or when rhinoplasty has been performed in conjunction with the surgical procedure. All reconstructions were performed by an experienced attending maxillofacial surgeon. Reconstruction could be immediate or deferred after complete histological analysis (7-10 days).

Data collected from patient medical records included age, sex, smoking and diabetic status, blood thinners, immunosuppressants medication, history of head and neck radiotherapy, and nasal cutaneous surgery. In addition, the location and size of the defect, the skin cancer type, the type of anesthesia, the type of closure of the ear, and postoperative treatments were also collected as well as time of reconstruction (immediate/deferred). The occurrence of surgical revision and postoperative complications comprising infection, hematoma, nostril notch, stenosis and/or nostril valve, partial necrosis < 50%, partial necrosis > 50%, and total necrosis were collected. Patients were evaluated by the experienced attending maxillofacial surgeon for aesthetic (nostril notch, skin coloring, volume) and functional (stenosis and/or nostril valve) outcomes at the 6-month follow-up. An excellent outcome was defined by the experienced attending maxillofacial surgeon as well-matched nasal color, dermal thickness, and texture without nostril notch and functional symptoms.

Surgical procedure

In each case, the cutaneous tumor was excised while considering the oncologic safety margins provided by the histopathological analysis **(Figure 1)**. A step-by-step surgical technique video is available (**Video 1)**

The donor site was systematically selected on the ipsilateral side of the lesion to facilitate graft harvest. A template of the final defect was created, matching the exact size and shape of the excised nasal tissue, and subsequently placed on the helix root of the auricle.

Local anesthesia with lidocaine and adrenaline was administered both at the recipient site and along the margins of the composite graft, with particular care taken to avoid hydrodissection between the skin and cartilage components of the graft. Tumor excision had to result in clean, regular margins, that included the alar rim; the excision was consistently performed as a partial full-thickness resection of the free alar rim while preserving at least 50% of the nasal mucosal lining relative to the cutaneous defect. Hemostasis at the recipient site was achieved with caution to avoid compromising local vascularization. The composite graft was harvested from the helix root, including a cartilaginous strut. After gentle rinsing with saline solution, the graft was immediately placed into the alar defect and secured with simple interrupted 5-0 polypropylene sutures placed circumferentially. One or two transfixing sutures were placed through the center of the graft across the nasal vestibule, without excessive tension, to promote graft stabilization and revascularization.

Postoperative local care consisted in topical antibacterial ointment applied for 10 days to reduce the risk of bacterial colonization from the nasal mucosa. Sutures were removed on postoperative day 10 and extended to day 14 when necessary.

Statistical analysis

Categorical data were expressed as count and percentages. Continuous data were expressed as median and interquartile range (IQR). Comparisons between outcome complications were performed using the Wilcoxon rank-sum test for continuous variables and Fisher's exact test for categorical variables. To estimate the strength of associations, univariate logistic regression analyses were conducted for each complication of interest, including nostril notch, surgical revision, partial or total graft necrosis, and nasal stenosis. Results are reported as odds ratios (ORs) with their corresponding 95% confidence intervals (95% CIs). A p-value

<0.05 was considered statistically significant. All statistical analyses were conducted in RStudio (The R Foundation, Vienna, Austria).

Results

A total of 58 patients were included; their median age was 68 years (IQR 57–78) and 36 (62.1%) were female. Among them, 49 (84.5%) patients underwent tumor excision for basal cell carcinoma, squamous cell carcinoma, or melanoma, and in 53 (91.4%), the defect involved the nostril nasal ala. The defect size ranged from 8 × 4 mm to 38 × 20 mm, and the median maximum diameter was 15 mm (IQR 15–17). No patient received radiotherapy **(Table 1)**.

After 6 months of follow-up, 65.5% of patients had excellent aesthetic and functional outcomes **(Figure 2)**. Graft healing consistently followed the expected sequence of an initial deep cyanotic phase lasting approximately 7 days, followed by progressive revascularization over 6 weeks **(Figure 3A).** In 14 (24.1%) patients, graft necrosis involved less than 50% of the graft, resulting in a minor secondary nostril notch that did not require surgical revision **(Figure 3B)**. In addition, while overall graft survival was found in 89.6% of patients, in 6 (10.4%), a graft necrosis greater than 50% or a total necrosis lead to surgical revision **(Figure 3C)**. A total of 20 (34.4%) patients experienced a nostril notch, of them, 6 underwent surgical revision. Only 2 patients had nasal stenosis and/or valve collapse; of note, these patients had larger tumor sizes (median diameter was 29 mm [IQR 20–38]). No case of postoperative infection was observed. A patient developed a hematoma without clinical consequences (**Table 1)**.

Deferred reconstruction surgery was significantly associated with surgical revision ($p = 0.046$), compared to other surgical approaches (OR 16.30; 95% CI [2.26, 118.28]). Nostril notch was significantly associated with graft necrosis, comprising both partial necrosis greater than 50% ($p = 0.043$) and total necrosis ($p = 0.014$). Nasal stenosis and/or valve collapse were significantly associated with larger tumor size, the odds ratio was 2.08 per 5-mm increase (95%

CI, 1.06–4.11; p = 0.034). Patient-related factors, including smoking status, diabetes, immunosuppressive medication, anticoagulant or antiplatelet treatment, and prior nasal surgery were not significantly associated with postoperative outcomes (**Table 2)**.

Discussion

The present study reported that chondrocutaneous composite grafts harvested from the auricular helix root for reconstruction of the nasal ala or columella with a free margin allowed reliable functional and aesthetic outcomes through a single procedure. Given its simplicity and low morbidity, we consider this composite free grafting technique as a first-line reconstructive option. The rate of postoperative complications was acceptable and a 2-cm surgical size threshold for composite graft harvesting could reduce the risk of postoperative complications.

Overall graft survival in the present series was excellent, approximately 90%, and similar to those previously reported for auricular composite grafts [13,14]. The postoperative course of the graft followed the classic sequence described in the literature, including an initial period of deep cyanotic discoloration during 7 days, followed by a gradual revascularization after 2 weeks, and then stabilization after 6 weeks[9,18]. This transient appearance, which is a matter of concern to both patients and surgeons early in the postoperative period, should be considered as part of the normal healing process rather than an early sign of graft failure. In approximately a quarter of patients, a partial graft necrosis, which involved less than 50% of the graft was found; it predominantly resulted in nostril notching that did not led to surgical revision given their location in the first postoperative weeks. They primarily involved dermal portion on the alar rim, likely reflecting a limited vascularization, particularly in the central portion of the free margin, leading to secondary alar retraction. Lower rates of partial or total necrosis have been reported in other recent series, in which reconstructions provided internal lining and did not exclusively involve the alar free margin, thereby providing improved

vascular support to the composite graft and resulting in higher graft survival rates [13,14]. However, one study reported a similar rate of nostril notching [13].

The most important limitation for survival is the size of the composite graft. The present data highlighted a significant increase in functional complications, particularly nasal stenosis and/or valve collapse, when defect diameter exceeded 2 cm. This finding aligns with the existing literature suggesting that composite grafts larger than 1.5 cm are associated with a higher aesthetic revision rate, but without a significant increase in complications [14]. Other series have also reported an increased failure rate for defects exceeding 1.5 cm [9,19,20]. In the literature, nasal defects greater than 1.2 cm in diameter and involving the alar and sidewalls were associated with lower incidence of postoperative nasal obstruction when a structural reinforcement technique was used during the nasal reconstruction [3]. Nevertheless, in the present series, no statistically significant association was observed between defect size and the occurrence of graft necrosis or nostril notching. Further studies focusing specifically on larger composite grafts would be required to better clarify this association.

In the present study, factors contributing to poor healing, such as smoking, diabetes, and immunosuppressive medications were not associated with increased complication rates, suggesting that local factors related to defect size and surgical technique play a more critical role than systemic comorbidities. In addition, the use of anticoagulant or antiplatelet treatments was not associated with a significantly higher risk of complications, as reported by Jeong *et al* [14]. Importantly, surgical revision was significantly associated with deferred reconstruction surgery, suggesting that delayed reconstruction or increased defect complexity may contribute to compromised graft survival. It can be hypothesized that after 7 to 10 days, increased inflammatory changes within the wound may contribute to impaired vascularization and reduced graft take. Composite graft is then recommended for immediate reconstruction [13,14].

Composite graft reconstruction, despite its apparent simplicity, requires precise surgical planning and delicate tissue handling during graft harvest and placement to achieve reliable results. Careful graft design with precise matching of the alar rim contour and adequate cartilage support is essential to maintain nostril shape and prevent postoperative collapse [21,22]. Meticulous handling of the graft, including avoidance of excessive thinning or trauma, is critical to preserve the perichondrial blood supply. The absence of aggressive hemostasis at the recipient site was intentionally favored to promote early revascularization [22]. A preclinical study that investigated composite graft vascularization on a rabbit model supports the importance of close skin graft-to-perichondrium contact and minimal disruption of local microcirculation [23]. Therefore, local anesthesia should not cause hydrodissection between the cartilage and the skin graft. In addition, ischemia time for composite grafts should be minimized by positioning the graft directly over the defect after rapid washing with saline solution. A mucosal lining may facilitate wound healing and graft revascularization by increasing the contact surface between the graft and the recipient bed. Suturing with a few skin stitches and a transfixing stitch that is not too tight ensures proper application of the composite graft for better revascularization. Postoperative care must include avoiding compression or cold on the composite graft. Topical antibacterial ointment was applied every day during 7 days on the graft, confirming the absence of infection in the present series. One total graft necrosis was observed, which occurred when the nurse forgot to apply the antibacterial ointment. The hypothesis would be that nasal bacterial colonization reduced revascularization of the graft [24]. While various adjunctive therapies such as hyperbaric oxygen therapy, topical vasodilators or fluorescent light energy have been proposed to enhance graft survival, the available clinical evidence remains limited and underpowered [25–27].

The choice of auricular helix root as a donor site represents a major strength of this reconstructive approach. It provides a favorable combination of cartilage rigidity and skin

quality that closely matches the alar rim [8]. The majority of donor sites were closed using a preauricular advancement flap, resulting in excellent aesthetic outcomes without auricular deformity at 6 months of follow-up, as reported in the literature regarding ear reconstruction [28,29]. Notably, patients were able to resume wearing glasses without discomfort or functional limitation, an important consideration in older populations.

Several limitations should be considered, including the single-surgeon and retrospective design of the series, which may limit generalizability and introduce selection bias. Consequently, the present results should not be interpreted as defining an absolute maximum size threshold for composite graft use. Finally, the aesthetic outcomes were evaluated clinically and were not assessed using a standardized or validated scoring system. Nevertheless, the present study reported the largest single-center series to date focusing specifically on nasal alar or columella reconstruction involving the free margin using a chondrocutaneous composite graft harvested from auricular helix root. These results contribute to provide meaningful data to the limited existing literature and help refine indications as well as technical considerations for composite graft reconstruction of the nasal alar free-margin defects.

Conclusion

Chondrocutaneous composite grafts harvested from the auricular helix root should be considered as a simple first-line option for alar free-margin reconstruction. This technique provides reliable aesthetic and functional outcomes in a single-stage procedure with minimal donor-site morbidity. Defects exceeding 2 cm in diameter are associated with an increased risk of functional complications and should be treated with caution. In case of failure, subsequent flap reconstruction is not compromised.

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Table 1. Characteristics of the patients: demographics, alar rim defect, and postoperative complications

	Total population (N = 58)
Age, Median (IQR)	68 (57 – 78)
Sex, n (%)	
Male	22 (37.9)
Female	36 (62.1)
Smoking status, n (%)	9 (15.5)
Immunosuppressive medication, n (%)	8 (13.8)
Diabetes, n (%)	7 (12.1)
Blood thinners†, n (%)	13 (22.4)
Previous nasal cutaneous surgery, n (%)	11 (19)
History of head and neck radiotherapy, n (%)	0 (0)
Location of defect, n (%)	
Nostril	53 (91.4)
Columella	2 (3.4)
Soft Triangle	3 (5.2)
Size of defect	
Maximum diameter (mm), Median (IQR)	15 (13 – 17)
Surface (mm^2), Median (IQR)	12 (10.2 – 13.6)
Minimal size (mm x mm)	8 x 4
Maximal size (mm x mm)	38 x 20
Skin cancer type, n (%)	
Basal Cell Carcinoma	41 (70.7)
Squamous Cell Carcinoma	4 (6.9)
Melanoma	4 (6.9)
Non-tumor	9 (15.5)
Time of reconstruction, n (%)	
Immediate	52 (89.6)
Deferred	6 (10.4)
Anesthesia, n(%)	
Local	40 (69)
General	6 (10.4)

Type of closure of the ear, n (%)	
Preauricular flap	44 (75.8)
Anti-Buch flap	14 (24.2)
Postoperative radiotherapy, n (%)	0 (0)
Complications, n(%)	
Nostril notch	20 (34.4)
Hematoma	1 (1.7)
Infection	0 (0)
Partial necrosis < 50 %	14 (24.1)
Partial necrosis > 50 %	3 (5.2)
Total necrosis	3 (5.2)
Stenosis and/or nostril valve collapse	2 (3.4)
Surgical revision, n(%)	6 (10.3)
Forehead flap + free conchal cartilage graft + septal mucosal flap	3 (5.2)
Mesolabial flap + free conchal cartilage graft + mucoseptal flap	3 (5.2)

Abbreviations: IQR, interquartile; †

Table 2. Post-operative outcomes in patients undergoing composite chondro-cutaneous grafts in nasal reconstruction

Outcomes complications	**Surgical revision**		**Necrosis**		**Nostril notch**		**Stenosis and/or nostril valve**	
	N = 6	***p-value*[1]**	**N = 20**	***p-value*[1]**	**N = 20**	***p-value*[1]**	**N = 2**	***p-value*[1]**
Age, Median (IQR)	71 (60 – 76)	0.91	69 (57 – 79)	0.83	70 (60 – 79)	0.48	80 (68 – 91)	0.25
Sex, n (%)		0.23		0.17		0.83		0.14
Men	1 (17.7)		10 (50.0)		8 (40.0)		2 (100)	
Female	5 (83.3)		10 (50.0)		12 (60.0)		0 (0)	
Tobacco use, n (%)	2 (33.3)	0.17	5 (25.0)	0.26	5 (25.0)	0.26	0 (0)	>0.99
Immunosuppressive medication, n (%)	2 (33.3)	0.17	3 (15.0)	0.70	4 (20.0)	0.24	0 (0)	>0.99
Diabetes, n (%)	2 (33.3)	0.16	3 (15.0)	0.70	4 (20.0)	0.24	0 (0)	>0.99
Blood thinners**, n (%)	1 (17.7)	>0.99	6 (30.0)	0.32	7 (35.0)	0.10	1 (50.0)	0.39
Previous nasal cutaneous surgery, n (%)	2 (33.3)	0.62	6 (30.0)	0.18	6 (30.0)	0.18	1 (50.0)	0.36
Location of defect, n (%)								
Nostrils	5 (83.3)	0.51	17 (85)	0.34	18 (90.0)	>0.99	2 (100)	>0.99
Columella	0 (0)	>0.99	1 (5.0)	>0.99	1 (5.0)	>0.99	0 (0)	>0.99
Soft Triangle	1 (17.7)	0.34	2 (10)	0.55	1 (5.0)	>0.99	0 (0)	>0.99
Size of defect								
Median diameter (mm), Median (IQR)	17 (14 – 18)	0.50	16 (13 – 18)	0.30	16 (14 – 20)	0.10	29 (20 – 38)	0.037*
Surface (mm), Median (IQR)	14.7 (12.6 – 16.4)	0.49	14.2 (11.0 – 16.4)	0.55	14.6 (11.4 – 16.7)	0.16	22.7 (17.9 – 27.6)	0.040*
Deferred reconstruction, n (%)	3 (33.3)	0.046*	3 (15)	0.69	3 (15.0)	0.69	0 (0)	>0.99
Complications, n (%)								
Nostril notch	6 (100)	<0.004*	18 (90.0)	<0.001*	-	-	2 (100)	0.13
Hematoma	0 (0)	>0.99	0 (0)	>0.99	0 (0)	>0.99	0 (0)	>0.99
Infection	0 (0)	>0.99	0 (0)	>0.99	0 (0)	>0.99	0 (0)	>0.99
Partial necrosis < 50 %	1 (16.7)	>0.99	14 (65.0)	-	11 (55.0)	<0.001*	1 (50.0)	0.42
Partial necrosis > 50 %	2 (33.3)	0.040*	3 (15.0)	-	3 (15.0)	0.043*	1 (50.0)	0.11
Total necrosis	3 (50.0)	0.001*	3 (15.0)	-	4 (20.0)	0.014*	0 (0)	>0.99
Stenosis and/or nostril valve	0	>0.99	2 (10.0)	0.13	2 (10.0)	0.13	-	-

[1]Wilcoxon rank sum test; Fisher's exact test

Abbreviation : IQR, interquartile

*Denotes significance

** Blood thinner included direct-acting oral anticoagulants and antiplatelet agents.

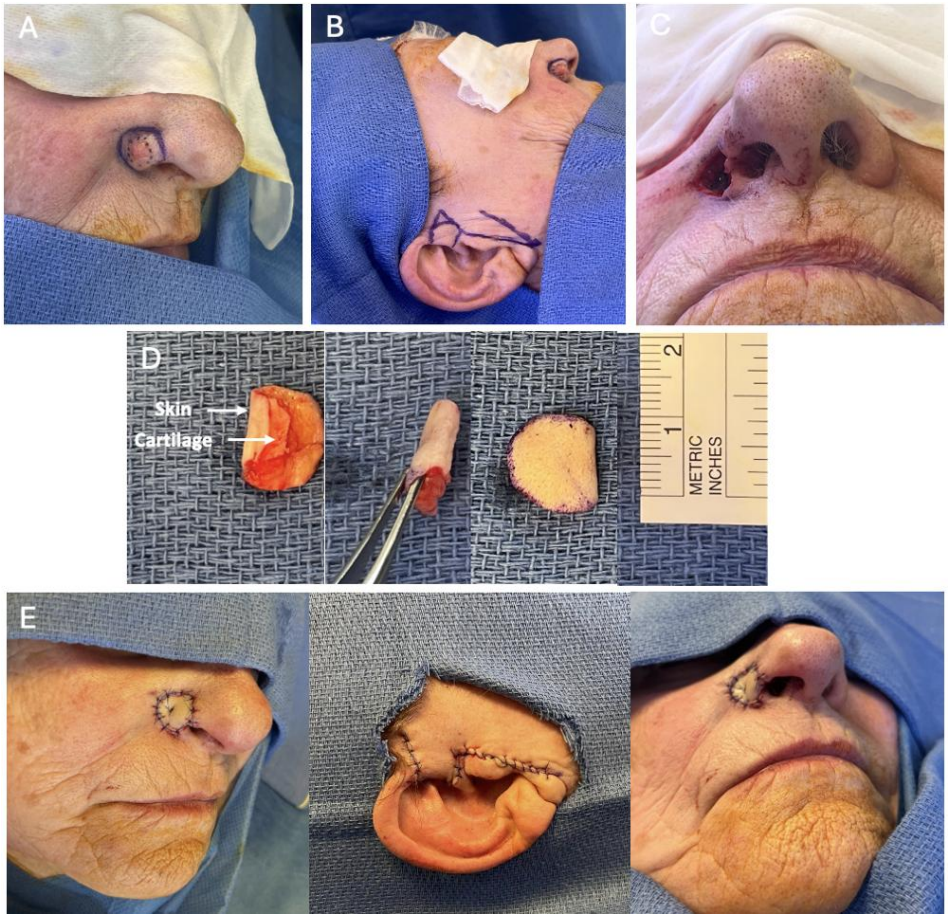


Figure 1. Planning and surgical technique of chondrocutaneous composite graft : (A) Design of excision of a basal cell carcinoma with 4-mm oncologic margins involving the alar rim. (B) Accurate transfer of defect measurements to the helical root, with simultaneous design of a preauricular flap for donor site closure. (C) Full-thickness excision limited to the free margin of the nostril, with preservation of the nasal mucosa. (D) Chondrocutaneous composite graft harvested from the root of helix auricular, including skin and cartilage. (E) Inset and fixation of the composite graft within the alar defect, with placement of a central transfixing suture.



Figure 2. Representative postoperative outcomes following nasal alar reconstruction with a chondrocutaneous composite graft harvested from the auricular helical root. (A, B) Long-term aesthetic outcomes of the reconstructed alar rim and auricular donor site after preauricular flap closure.



Figure 3. Clinical evolution of chondrocutaneous composite graft : (A) Normal evolution of the graft with an initial period of deep cyanotic discoloration during 7 days, followed by a gradual revascularization after 2 weeks, and then stabilization after 6 weeks; (B) Limited nostril notch; (C) Total graft necrosis resulting in a nostril notch and requiring reconstruction using a local flap

Supplementary Video 1. Surgical technique for nasal alar free-margin reconstruction using an auricular helical root chondrocutaneous composite graft, including defect templating, graft harvest, donor-site closure, and graft inset.