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WOUND HEALING STRATEGIES FOR AURICULAR DEFECTS WITH EXPOSED CARTILAGE: A LITERATURE REVIEW

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ABSTRACT

Auricular defects with exposed cartilage require durable wound coverage while preserving the framework that determines ear contour. Management becomes particularly challenging when exposure follows autologous microtia reconstruction, because loss of soft-tissue coverage can compromise a surgically constructed cartilage framework. This narrative review examines treatment strategies across native auricular wounds and exposed autologous frameworks. Targeted web-based searches identified primary anatomical and clinical studies, which were synthesized according to wound-bed requirements, reconstructive purpose, and reported outcomes. Secondary intention can achieve healing in selected native auricular defects, including some with exposed cartilage. Skin grafts are established coverage options when a vascularized recipient bed is available, but outcomes from general auricular graft series cannot be assumed to represent completely denuded cartilage. Local flaps provide vascularized coverage, while temporoparietal, posterior auricular, and mastoid fascial flaps are important options for threatened reconstructed frameworks. Small clinical series also describe acellular dermal matrices and negative-pressure wound therapy, although their comparative effectiveness remains uncertain. Post-Mohs wounds, traumatic composite defects, and exposed microtia frameworks represent different clinical problems and should not share an undifferentiated treatment algorithm. Selection should integrate cartilage viability, perichondrial status, wound location and extent, infection, available donor tissue, and structural requirements. Current evidence favors context-specific reconstruction rather than a universally preferred technique. Future studies should distinguish native cartilage from grafted frameworks and assess lasting contour and framework preservation alongside epithelial closure.

Keywords: Auricular defects; Exposed cartilage; Wound healing; Microtia reconstruction; Fascial flaps; Skin grafts

1 INTRODUCTION

Auricular An auricular wound with exposed cartilage presents two related goals: restoring a stable soft-tissue envelope and preserving the framework beneath it. These goals become especially important after microtia reconstruction. In that setting, vascular compromise of the skin envelope can expose autologous cartilage, with subsequent resorption and distortion of the reconstructed ear [1]. The clinical endpoint is therefore more demanding than surface closure alone.

The phrase exposed cartilage encompasses several different problems. A native ear may retain its framework after loss of overlying skin; a traumatic composite defect may lack both skin and cartilage; and a reconstructed ear may develop breakdown over a carved costal-cartilage framework. These categories differ in local tissue availability, structural vulnerability, and the consequences of contraction. Treating them as equivalent risks transferring results between populations that were never directly compared.

This review evaluates wound healing and coverage strategies for auricular defects with exposed cartilage, with emphasis on the reconstructive implications of perichondrial loss and autologous framework exposure. Secondary intention, grafting, local and fascial flaps, acellular dermal matrices, and negative-pressure wound therapy are considered. The review addresses salvage of exposed cartilage rather than the complete technique of primary microtia reconstruction.

2 MATERIAL AND METHODS

A focused narrative literature search was performed using web-based retrieval of PubMed records, accessible PubMed Central articles, publisher pages, and institutional publication repositories. Search combinations included auricular defects, exposed cartilage, perichondrium, secondary intention, skin graft, postauricular flap, microtia reconstruction, framework exposure, fascial flap, acellular dermal matrix, and negative-pressure wound therapy. No publication-year restriction was imposed.

Primary human clinical studies were selected when they reported auricular wound coverage, management of cartilage exposure, or reconstruction of an exposed autologous ear framework. An anatomical study was included to explain vascular considerations. General auricular reconstruction studies were retained as contextual evidence when cartilage-exposure outcomes were not separately reported. Studies restricted to congenital reconstruction without relevant exposure management, tympanic membrane repair, or unrelated anatomical sites were not used to infer auricular treatment effects.

For each selected study, the design, population, defect context, intervention, and reported outcomes were reviewed. Bibliographic information and digital object identifiers were checked against PubMed or publisher records. Accessible full texts were used when available; otherwise, interpretation was limited to the indexed or publisher abstract. Findings were organized thematically without pooling complication rates. This was not an exhaustive systematic review, and no formal risk-of-bias assessment or meta-analysis was performed.

3 REVIEW CONTENT

3.1 Anatomical and Reconstructive Considerations

Auricular flap design depends on a vascular network that connects anterior and posterior territories. In a study of 16 human auricles, Zilinsky et al. identified a helical rim arterial arcade, an additional superior helical connection, and consistent posterior auricular perforators [2]. These findings support the anatomical rationale for local tissue transfer, but do not establish the viability of a particular flap in a scarred or previously operated ear.

Cartilage exposure should be described together with the condition of its covering tissues. Lei and Huang studied defects with cartilage exposure after tumor excision and partial perichondrial removal, illustrating that the wound bed is not adequately characterized by surface dimensions alone [3]. In practical assessment, residual vascularized tissue, viable wound margins, and the amount of structural support should be recorded separately.

Bittner et al. described several repair options after Mohs surgery and noted that loss of perichondrium can prolong secondary healing and make grafting less favorable. Cartilage perforation can provide access to underlying vascular tissue in selected wounds [4]. Such modification is a means of preparing a recipient bed, not an interchangeable substitute for replacing lost cartilage. Its use must account for the remaining auricular support.

3.2 Initial Assesment and Wound Bed Preparation

Treatment selection begins by identifying what has failed. In a native auricular wound, the principal issue may be skin coverage over a stable framework. After microtia reconstruction, the problem may instead involve compromised skin over an intricate cartilage construct. Infection, devitalized tissue, previous flap harvest, and the availability of adjacent skin can change the options even when the measured exposure is small.

A salvage series by Kim et al. illustrates the importance of the underlying material. Among 149 reconstructions, exposure occurred in three of 48 autologous-cartilage cases and 11 of 101 porous-polyethylene cases; salvage methods differed according to material and location [5]. These observational figures are not a comparative estimate of material superiority. More importantly for this review, porous polyethylene is not cartilage, so its exposure outcomes should not be pooled with autologous framework outcomes.

Preparation should support the intended reconstruction while conserving viable framework. Oyama et al. excised necrotic skin before transferring vascularized fascia over exposed cartilage [6]. This sequence demonstrates the relationship between removal of nonviable cover and definitive vascularized coverage. It does not imply that every exposed cartilage segment should be removed, nor does it establish a universal timing rule for all contaminated or ischemic wounds.

3.3 Conservative Care and Secondary Intention Healing

Secondary intention remains a reasonable option for selected wounds in the native auricle. Levin et al. followed 133 auricular defects after Mohs surgery; all healed within 10 weeks, and three infections occurred without permanent disfigurement. They concluded that cartilage exposure was not itself a contraindication and that wound location helped predict cosmetic outcome [7]. Their findings support selective observation with wound care, rather than mandatory flap coverage solely because cartilage is visible.

Hochwalt et al. compared 29 second-intention repairs with 18 full-thickness graft repairs for helical Mohs defects. Long-term cosmetic outcomes were comparable, without a significant difference in complications or patient-reported outcomes [8]. This selected clinical population should not be interpreted as evidence that secondary intention is equivalent to reconstruction for large composite defects or threatened microtia frameworks.

Direct evidence for small reconstructed-framework exposures comes from Cugno and Bulstrode. In their retrospective review of 230 autologous reconstructions, 15 framework exposures were identified. Exposures smaller than 10 mm^2 were managed conservatively, while larger areas received debridement and flap coverage; all were successfully treated [1]. The reported cutoff is specific to that series and should not become a universal rule. Tissue perfusion and structural risk may be more important than size alone.

The main practical limitation of conservative care is the interval during which the wound remains open. Selection should consider the feasibility of dressings, follow-up, and observation for deterioration. Evidence that epithelial closure can occur does not establish that prolonged observation will preserve every exposed framework or maintain the same contour as early coverage.

3.4 Skin Grafting and Recipient-bed Requirements

Skin grafts provide surface replacement without their own vascular pedicle. Their role therefore depends on the recipient bed, not merely on whether an auricular defect exists. In a retrospective series of 1,519 full-thickness grafts after Mohs surgery, Trufant et al. reported a 1.6% overall complication rate and 1.2% graft failure. Follow-up beyond three months was limited, and cosmetic outcomes were not assessed with a standardized tool [9]. These results support grafting in appropriately selected auricular wounds, but cannot be quoted as the expected success rate over entirely denuded cartilage.

Grafting also involves a trade-off between early closure and discomfort. Bovenberg et al. prospectively observed 30 patients treated with split-thickness grafts or secondary intention. At one week, 87% of graft recipients were fully healed compared with 21% of the secondary-intention group. Early pain was greater after grafting, with mean pain scores on the night of surgery of 3.6 and 0.8, respectively [10]. The short follow-up and observational design limit conclusions about lasting contour or superiority in wounds with different degrees of cartilage exposure.

When direct grafting is unsuitable, a vascularized fascial flap can create coverage over which a skin graft is placed. This is a distinct reconstructive strategy: the fascia supplies vascularized tissue, while the graft supplies the epithelial surface. It should not be described as successful direct skin grafting onto bare cartilage.

3.5 Local Cutaneous and Postauricular Flaps

Local tissue transfer can provide coverage while retaining a vascular attachment. In anterior conchal reconstruction, Dessy et al. randomly allocated 40 patients to revolving-door flap or full-thickness graft repair. No total loss occurred in either group, but six graft recipients developed partial failure. Cosmetic scores and color and texture matching favored the flap [11]. These results are relevant to conchal defects after malignancy excision and do not establish the preferred treatment for all helical or reconstructed-framework wounds.

The local flap selected must have sufficient reach and perfusion. Fujioka et al. reported two microtia patients with four exposed areas. Recurrent exposure followed necrosis after some initial repairs; subsequent posterior auricular turnover flap coverage with skin grafting achieved salvage. The authors proposed temporal fascia for upper auricular exposure and posterior auricular turnover coverage for lower exposure [12]. Because this was a small report, the proposed location-based approach should be understood as a technical strategy rather than a validated comparative algorithm.

Local cutaneous flaps may avoid the additional graft required with fascial coverage, but their availability can be limited after previous operations. A convenient flap is not necessarily a durable flap if its length, scarring, or pedicle compromises perfusion. Thus, the apparent simplicity of local closure should be weighed against the consequences of another breakdown over the framework.

3.6 Fascial flaps for exposed autologous frameworks

Fascial coverage is particularly relevant when the reconstructive priority is to preserve an exposed cartilage framework. In the two cases reported by Oyama et al., an anteriorly based mastoid fascial flap was transferred over the exposure and covered with split-thickness skin graft. Graft take was satisfactory and auricular relief was preserved [6]. This provides direct clinical evidence of feasibility, although two successful cases cannot establish a complication rate or superiority over other donor tissues.

Kim et al. likewise reported salvage of all three autologous-cartilage exposures using temporoparietal fascia with skin grafting, with a local skin flap additionally used in one case [5]. Their series demonstrates why previous reconstructive stages matter: different fascial territories may be needed when the usual donor tissue has already been used. Findings from the polyethylene subgroup should remain separate from those for cartilage.

More recent evidence comes from He et al., who reviewed 853 patients undergoing reconstruction with an expanded two-flap method. Thirty-two developed cartilage exposure, and superficial temporal fascial flap coverage with skin grafting was reported to achieve satisfactory salvage without recurrent exposure. The study also identified associations with features of hemifacial microsomia [13]. Interpretation requires caution because the source contains inconsistencies between some descriptive counts and its tables; no incidence estimate is calculated here. Moreover, the salvage component lacked a comparison group.

Collectively, these reports support vascularized fascia as an important salvage resource, but they do not identify one universally superior fascial flap. Choice depends on the exposed region, required reach, prior harvest, and vascular anatomy. Maintaining coverage thin enough to preserve auricular definition is also part of the reconstructive objective, rather than an outcome captured by epithelialization alone.

3.7 Acellular dermal matrices

Acellular dermal matrices offer another approach for selected cartilage-exposed wounds. Lei and Huang prospectively treated seven post excision defects with a single stage bilayer matrix procedure; three lesions were auricular and four were nasal. Across the combined cohort, mean healing time was approximately 23.4 days, and no infection or contracture was reported [3]. The pooled result must not be presented as an ear-specific healing estimate.

This evidence is promising but narrow. Defects were small, the cohort was uncontrolled, and the treatment was performed after tumor excision rather than framework breakdown following microtia reconstruction. The study therefore does not show that a matrix can replace vascularized fascia in a threatened reconstructed ear. Its value is better framed as an additional coverage option for selected wounds, with uncertainty about comparative effectiveness and durability.

3.8 Negative-pressure wound therapy

Negative-pressure wound therapy has been described specifically for exposed microtia frameworks. Sasaki et al. reviewed seven exposure wounds in six patients, with defect areas of 1–24 mm^2. All wounds healed within 8–39 days and all frameworks survived; however, partial cartilage atrophy remained in four cases and a secondary infection occurred in one case [14]. Framework survival therefore did not mean absence of structural consequences.

The authors advised considering surgery when improvement was absent within seven days [14]. This is a recommendation from a small retrospective experience, not a validated treatment threshold. NPWT should consequently be presented as a selected adjunct or salvage approach requiring reassessment, rather than as established definitive treatment for every exposure. Optimal application parameters and comparative benefit remain uncertain.

3.9 Structural loss and combined reconstruction

Coverage alone cannot restore cartilage that has already been lost. Youssif et al. studied 20 unilateral upper-third defects reconstructed with a conchal cartilage graft and postauricular flap. Follow-up was six months; 85% of patients reported high satisfaction and 90% received an excellent assessment by the treating doctors [15]. These findings support the feasibility of combining support and coverage for composite defects, but do not compare that method with other reconstructions.

This distinction is important when interpreting all strategies discussed above. A dressing, matrix, or skin graft may close a surface defect without reconstructing a missing helical segment. Conversely, an exposed but intact framework may chiefly require reliable soft-tissue coverage. The operative plan should specify whether it is intended to achieve epithelial closure, framework salvage, structural replacement, or a combination of these goals.

3.10 Integrating strategy selection

Table 1: Clinical context and reconstructive priorities

Clinical context	Options supported by the reviewed literature	Main qualification
Selected native auricular wound	Secondary intention or skin grafting [7–10]	Assess recipient vascularity and contraction risk
Anterior conchal defect after excision	Revolving-door flap or graft [11]	Comparative findings are subunit specific
Small autologous framework exposure	Selected conservative care [1]	Published size threshold is not universal
Threatened autologous framework	Local or fascial flap with appropriate skin coverage [5,6,12,13]	Account for donor availability and prior operations
Selected small cartilage exposure	Dermal matrix or NPWT [3,14]	Small studies; limited comparative evidence
Composite skin and cartilage loss	Cartilage reconstruction plus vascularized cover [15]	Coverage alone does not replace support

Treatment selection should integrate the extent of exposure, recipient vascularity, cartilage viability, available donor tissue, and patient preferences. In native auricular wounds, closure and contour are key outcomes; after microtia reconstruction, durable framework salvage is an additional priority. Table 1 summarizes context-specific options rather than a validated treatment algorithm.

The evidence is limited mainly to retrospective cohorts and small case series, with few comparative studies. Differences in perichondrial status, defect location, prior operations, and outcome assessment prevent reliable pooling or ranking of treatments. In particular, results from native post-Mohs wounds cannot be directly transferred to exposed microtia frameworks. Future studies should distinguish these populations and report long-term framework preservation, re-exposure, contour, and patient-reported outcomes alongside epithelial closure.

4 CONCLUSION

Wound healing strategies for auricular defects with exposed cartilage should be selected according to the wound context and the framework at risk. Secondary intention and grafting are supported for selected native auricular wounds, while exposed autologous microtia frameworks may require prompt vascularized coverage to preserve their constructed form. Local and fascial flaps remain important reconstructive resources; matrices and NPWT have more limited evidence and should be interpreted accordingly. Cartilage loss requires structural reconstruction in addition to coverage. Current studies support individualized selection but do not establish a single best strategy for all exposed-cartilage defects.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

There is no conflict of interest.

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