

Autologous Auricular Reconstruction in Microtia: A Narrative Review of the Brent and Nagata Techniques

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ABSTRACT

Background: Autologous costal cartilage reconstruction for congenital microtia is considered to be the gold standard for congenital microtia. Brent (staged) and Nagata (two-stage) techniques are one of the most dominant autologous philosophies in present time. This review aims to compares principles, outcomes, and their indications.

Methods: A narrative review including studies across PubMed, Scopus, Web of Science, and Google Scholar between the year 1990–2026 was conducted, focusing majorly on landmark and contemporary studies with focus on operative methodology, complications, and patient-reported outcomes.

Results: Both techniques show durable yet satisfactory outcomes. Brent's four-stage approach supports gradual soft-tissue adaptation and has a gentler learning curve; Nagata's two-stage approach reduces the number of surgeries but shows superior projection and contour definition but requires greater technical consideration. This article empathizes that all total surgical

outcomes depends more on surgical precision, patient selection, and cartilage availability than on technique employed alone.

Conclusions: Neither technique is universally superior. Selection should be individualized by patient age, chest wall development, soft-tissue quality, and surgeon experience. Three-dimensional planning, CAD/CAM framework design, and tissue-engineered cartilage represent promising future directions.

Keywords: Microtia; Auricular reconstruction; Autologous costal cartilage; Brent technique; Nagata technique; Ear reconstruction.

INTRODUCTION

Congenital microtia is a craniofacial anomaly ranging from mild auricular hypoplasia to complete absence of the ear (anotia), with an estimated worldwide incidence of 0.83–4.34 per 10,000 live births and marked geographic and ethnic variation; prevalence is consistently higher in Hispanic, Native American, and some Asian populations, with a male predominance and right-sided preponderance ^[1]. Microtia may occur in isolation or as part of syndromes such as hemifacial microsomia, Treacher Collins syndrome, Goldenhar syndrome, and Nager syndrome. Beyond its anatomical impact, microtia affects psychosocial development; however, large data-linkage evidence has not shown a significantly increased risk of affective disorders or impaired educational attainment among affected children, underscoring the value of individualized, supportive care around the time of reconstruction ^[2].

Reconstructing the auricle is among the most technically demanding procedures in craniofacial surgery because of its intricate three-dimensional architecture. Tanzer first established autologous costal cartilage as the reconstructive material of choice in 1959 ^[3]. Brent

subsequently refined framework fabrication into a staged, four-operation sequence ^[4], while Nagata later introduced a comprehensive two-stage approach with a single, highly detailed cartilaginous framework ^[4,5,6]. These two philosophies remain the dominant autologous strategies worldwide. This review critically compares their principles, outcomes, advantages, and limitations to guide individualized technique selection.

METHODS

A narrative review including studies across PubMed, Scopus, Web of Science, and Google Scholar between the year 1990–2026 was conducted, focusing majorly on landmark and contemporary studies with focus on operative methodology, complications, and patient-reported outcomes Evidence were analysed in a narrative-review format.

Classification and Principles of Reconstruction

The Marx classification remains the most widely referenced grading system ^[7]:

Grade I	Mildly hypoplastic auricle with preserved landmarks.
Grade II	Partial development with helical/antihelical deficiency.

Grade III	Most common presentation, is a vertically oriented cartilaginous remnant ("Peanut ear") with external auditory canal atresia.
Grade IV	Epresents complete anotia.

The Weerda system similarly grades anomalies by embryological severity, and newer scoping-review data confirm the Nagata classification is now the most widely applied system internationally, although no single classification has achieved universal standardization ^[8].

Most surgeons advice to delay autologous reconstruction until 8–10 years of age, when the contralateral ear has reached to near about adult dimensions and costal cartilage volume is adequate for framework fabrication^[9]. Regardless of technique employed, reconstruction requires a template of the contralateral ear and meticulous cartilage carving for fromation of helix, antihelix, concha, tragus, and lobule with secure framework fixation, and vascularized soft-tissue coverage to achieve intimate skin–framework adherence.

The Brent Technique

Introduced by Brent in the 1970s and refined over more than 1,200 personal cases, the Brent technique distributes reconstruction across four stages: (I) fabrication and subcutaneous implantation of a costal cartilage framework fashioned from the sixth–eighth ribs; (II) lobule transposition; (III) auricular elevation with a posterior cartilage wedge and skin graft or fascial coverage to create the retroauricular sulcus; and (IV) final aesthetic refinement, including tragal construction and scar revision ^[2,3,4].

This staged philosophy minimizes chance of tension creation and vascular compromise at each step, also offers a comparatively forgiving learning curve, and gives the surgeon chance for correction of minor imperfections before subsequent stages. Though need for multiple operations and hospital admissions over an extended period, with added cumulative cost and psychological burden for pediatric patients remains its principal drawbacks .

The Nagata Technique

Nagata's two-stage technique, first described in 1993, condenses reconstruction by fabricating a comprehensive three-dimensional framework including the tragus and transposed lobule during the first operation, using cartilage harvested from the sixth through ninth ribs ^[4,5]. The framework is covered with well-vascularized tissue, often supplemented by a temporoparietal fascia flap and thin skin graft. Approximately six months later, the second stage elevates the auricle and reconstructs the posterior sulcus, with additional cartilage grafting to maintain long-term projection ^[6].

By integrating tragal reconstruction and lobule transposition into the first stage, the Nagata technique reduces the total number of procedures, achieves sharper helical definition and superior projection, and lowers the need for secondary revision ^[7]. It is technically demanding, requires larger cartilage harvests with corresponding donor-site considerations, and places greater demand on soft-tissue vascularity; it is therefore generally recommended for surgeons with substantial reconstructive experience ^[7,9].

Comparative Analysis

Feature	Brent Technique	Nagata Technique
Operative stages	Four	Two
Cartilage source	6th–8th ribs	6th–9th ribs
Tragus construction	Stage IV	Stage I
Learning curve	Moderate	Steep
Projection/contour	Good	Excellent
Revision requirement	Moderate	Lower
Preferred setting	Training / early experience	Experienced reconstructive centres

DISCUSSION

Autologous costal cartilage remains the reconstructive benchmark because of its biocompatibility, resistance to infection, and lifelong durability compared with alloplastic alternatives such as porous polyethylene frameworks, which avoid rib harvest but carry recognized risks of exposure and infection ^[8,9]. The Brent and Nagata techniques represent complementary rather than competing philosophies: Brent's gradual staging prioritizes biological safety and flexibility, whereas Nagata's comprehensive first-stage framework prioritizes efficiency and contour fidelity. Comparative series and single-surgeon experience spanning both

methods confirm that outcomes are driven at least as much by surgical execution, cartilage availability, and patient selection as by technique choice itself ^[9].

Emerging technologies three-dimensional imaging, virtual surgical planning, CAD/CAM-assisted framework design, and tissue-engineered or scaffold-based cartilage constructs are likely to reduce operative time and donor-site morbidity, and may eventually reduce dependence on rib cartilage harvest altogether ^[9,10,11]. Wider adoption will require evidence on long-term structural stability and cost-effectiveness before these approaches can be considered ready to challenge the autologous standard.

CONCLUSION

The Brent and Nagata techniques remain the two principal autologous strategies for auricular reconstruction in congenital microtia. Brent's staged approach offers a forgiving learning curve and flexibility for refinement; Nagata's two-stage approach offers fewer operations and superior contour definition when performed by experienced surgeons. Technique selection should be individualized according to patient age, chest wall development, soft-tissue quality, surgeon expertise, and available resources, rather than assuming universal superiority of either method. Multicenter prospective studies using standardized, validated patient-reported outcome measures are needed to strengthen the evidence base for technique selection.

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