International Journal of Pediatric Otorhinolaryngology 113 (2018) 82–87

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

# Simultaneous auricular reconstruction combined with bone bridge implantation-optimal surgical techniques in bilateral microtia with severe hearing impairment

Yue Wang[a,1], Wenshan Xing[a,1], Tun Liu[a], Xu Zhou[a], Jin Qian[a], Bingqing Wang[a], Shouqin Zhao[b,**], Qingguo Zhang[a,*]

[a] Department of Ear Reconstruction, Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China
[b] Otolaryngology Head and Neck Surgery Department, Beijing Tongren Hospital, Capital Medical University, Key Laboratory of Otolaryngology Head and Neck Surgery (Capital Medical University), Ministry of Education, Beijing, China

ARTICLE INFO

*Keywords:*
Congenital external and middle ear malformation
Auricular reconstruction
BoneBridge

ABSTRACT

*Background:* Congenital bilateral microtia with external ear canal (EAC)/middle ear malformation lead to severe appearance defects, hearing impairment and language barrier. Here we report an optimal integrated surgical technique for BoneBridge implantation and auricular reconstruction, which reduce time span of operation, total cost and patients' suffering as well.

*Method:* Seven patients with bilateral external and middle ear malformation received 2-stage auricular reconstruction (age from 7 to 11 years old). In the 1st stage, 6th, 7th, and part of 8th autologous costal cartilage were used to make main body and C-shaped base part of the framework. In 2nd stage of the operation, dissect and lift the framework, isolate postauricular fascia and periosteum, put the BoneBridge subperiosteally and fixed with titanium screw. The C-shaped cartilage base was further attached to the framework and retroauricular fascial flaps and a full-thickness skin graft obtained from the donor site was used to cover posterior raw surface.

*Results:* Patients were followed up for about 8 months post operation, all of them satisfied with the outcomes and symmetric shape on both sides about desirable 3D detail without adverse complications. Hearing test indicated the mean improvement of auditory threshold of 34.8 dB HL 3 weeks after BoneBridge implantation, with mean scores of speech recognition test ranging from 26% to 62%.

*Conclusion:* The combined 2-stage surgical techniques of simultaneous auricular reconstruction and BoneBridge implantation is safe and efficient for bilateral microtia with significant advantages in decreasing operation difficulties, shortening treatment span and relieving suffering for patients.

## 1. Introduction

Microtia is the 2nd leading congenital defect in the craniofacial anomalies with the prevalence of 1:10,000 to 10/10,000 [1–3]. Seventy-five percent of reported cases are associated with external ear canal (EAC)/middle ear malformation [4], among which 10% are bilateral microtia. The clinical manifestations include auricular malformation, external ear canal atresia or narrowing, malformation of middle ear, and even hemifacial microsomia. Patients with bilateral microtia involved not only anomaly of the facial appearance, but also the severe delay of speech development. Consequently, compared with unilateral microtia, bilateral microtia patients requires higher quality of auricular reconstruction and earlier hearing intervention as well. Nagata's two-stage techniques with patient's own rib cartilage is mostly used worldwidely in the field of auricular reconstruction [5–11]. On the other hand, the routine strategies for the treatment of hearing reconstruction in EAC malformation patients include EAC reconstruction, tympanoplasty, ossicular chain reconstruction, Bone-anchored hearing aids (BAHA), Vibrant SoundBridge (VSB) or BoneBridge (BB) implantations. The Bonebridge Implant System (MED-EL, Innsbruck, Austria) consists of the Amadé BB, an externally worn audio processor, and a surgically-inserted bone conduction implant (BCI) that lies

* Corresponding author. Department of Ear Reconstruction, Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Thirty-three Badachu Road, Shijingshan District, Beijing, China.
** Corresponding author.
*E-mail address:* doczhang2017320@sina.com (Q. Zhang).
[1] Yue Wang and Wenshan Xing are co-first authors.

https://doi.org/10.1016/j.ijporl.2018.07.004
Received 13 April 2018; Received in revised form 2 July 2018; Accepted 4 July 2018
Available online 19 July 2018
0165-5876/ 

**Fig. 1.** (above from left to right) Tragus carved from part of 7th rib cartilage. (below left, center) antihelix and antitragus carved from crescent-shaped cartilage removed from the base part. (below right) Each parts were assembled into auricular framework and C-shaped base part.

directly beneath the skin. The Bonebridge is intended for individuals with conductive or mixed hearing loss. With conductive or mixed hearing loss, sound cannot take the natural path through the outer and middle ear to the inner ear.

With the Bonebridge, the sound waves are transmitted via bone conduction directly to the inner ear, where they are processed as natural sound. BoneBridge® has been approved by China Food and Drug Administration (CFDA) and achieved EC Design-Examination Certificate, and implanted for the first case on 21st March. BB implantation is more popular because of minimal complications, simplicity of operation procedures, and wider clinical applicability [16], relatively. As is known to us, auricular reconstruction belongs to plastic surgery, but hearing reconstruction can only be conducted by otomicrosurgery, therefore, the whole procedure of auricle reconstruction and BB implantation are generally performed by plastic surgeon and otolaryngologist, separately. These comparative independent but interconnected procedures increase the operation times and the suffering for patients. Moreover, the operative incision position and postoperative scar caused by the former surgery might affect the latter operation design and outcomes due to the inadequate communications between different departments and surgeons from each operation procedure.

Over the past few years, our plastic surgeons and otolaryngologists devoted to looking for an appropriate way to combine the two procedures together. In this article, we focus on this two-stage auricular reconstruction combined with BB implantation can be completed simultaneously which provide good shapes of bilateral ears and hearing improvement at the same time. The combination techniques not only offer good clinical outcomes, but also had the significant advantages of fewer times of operations, short treatment span and less suffering for patients.

## 2. Material and methods

### 2.1. Clinical data

Total 7 bilateral microtia cases were enrolled including 5 males and 2 females with congenital aural atresia, whose average age ranged from 7 to 11 years old(means age is 8.4 years old). Among them, 6 cases were lobule type in both side, and one case was lobule type in one side, and concha type in the other. All the 7 patients were evaluated by High Resolution Computed Tomography (HRCT) to assess quantity of costal cartilage and whether the stapes are present or not. Then Jahrsdoerfer grade system [17] were used to assess development of mastoid process. Auditory assessment including Pure Tone Audiometry (PTA), Auditory Brainstem Response (ABR) and speech recognition test were also performed. Patients with following conditions were enrolled in our study: plenty volume of costal cartilage, Jahrsdoerfer scores $\leq 6$, bilateral conductive or mixed hearing impairment, PTA test showing Air-bone Gap (ABG) $>$ 50 dB HL. The whole operation procedures were performed in 2 stages. All procedures involving human participants conformed to the ethical standards of the institutional research committee and the World Medical Association Declaration of Helsinki (June 1964) and its subsequent amendments.

### 2.2. The first stage of the operation

Classic Nagata's techniques [12–15] was modified in our first operation stage due to the insufficient volume of costal cartilage in younger patients. The significant different from classic Nagata's techniques in this operation is how to manufacture the body of ear framework including helix, tragus and antitragus according to the different situation of each patient. Here, helix, tragus and antitragus were made