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The importance of costal cartilage framework stabilization in microtia reconstruction: Anthropometric comparison based on 216 cases

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Summary This study explored anthropometric changes in the reconstructed auricle and the contralateral normal ear in a series of 216 microtia patients using different stabilization methods. Our main personal modifications concerning the preparation of the framework were the following: 1. The individualized framework grafting was based on patients with different ages and different degrees of the strength and thickness of the rib cartilage. 2. The framework was stabilized as a "C" shape by using a piece of cartilage or suture to reinforce the two end points of the "C". In group A (the thickness of cartilage was more than 5 mm), a block of residual cartilage fixed by wire was added between the tragus and the base frame of the inferior crus by the modified method but was not applied in the original method. In group B (the thickness of cartilage was less than 5 mm), a 4-0 braided suture was used to reinforce the two structures but was not used in the original method. No significant differences were found in the height or width measurements of the cartilage framework and the contralateral normal side in either group at the time of implantation. At the follow-up, the height and width measurements were obviously increased in both groups operated on by the original method compared with the initial implanted or contralateral normal measurements. There were no significant differences in the height or width measurements by the modified method in either group. The authors' techniques produced acceptable results and generated some useful parameters for the growth study of the reconstructed auricle and the contralateral normal ear. The modifications in framework stabilization allow a harmonious outline of the

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reconstructed auricle to be attained, which is almost symmetrical to the contralateral normal auricle.

Introduction

Beyond all doubt, external ear reconstruction poses one of the most demanding challenges in plastic surgery because of its complex and convoluted silhouette. Many professional surgeons, such as Tanzer,[1] Brent,[2–4] Nagata,[5–8] and Firmin,[9] have improved the techniques over the past century. A successful outcome of auricular reconstruction depends on various factors,[10,11] with the auricular framework stabilization having an important role in the final result of the reconstructed auricle. In previous studies, numerous ideas have been advanced regarding framework fabrication.[4–12] Nevertheless, unfavorable results resulting in the lack of harmony and symmetry compared with the normal auricle have encouraged us to pursue individualized framework modification.

Another subject that remains controversial is the question of the growth potential of the cartilaginous framework. In 1978, Tanzer[13] offered the earliest report that the auricular height increased by 3.6 mm through a patient questionnaire. Thomson and Winslow[14] then showed a framework size increase between 7.5% and 8.4% during follow-up in 1988. A similar issue was addressed by Della Croce,[15] who reported a growth of 5 mm (10.4%) in the framework height and 2.75 mm (7.02%) in its width. Additionally, Kizhner[16] observed a significant decrease of 0.18 cm (3.1%) in the auricular height and an increase of 0.13 cm (4.0%) in the width.

Previous studies have offered valuable results, and similar results were also found in our studies. With respect to the reason for the change in the framework, we hypothesized that the technique of framework stabilization is one of the most important factors. Unstable fixation of the framework may also lead to looseness or "overgrowth" of the framework at follow-up. Therefore, the aim of this article was to introduce modified methods of framework stabilization according to the different thickness of the costal cartilage. Moreover, this study revealed the anthropometric changes in the reconstructed auricle and contralateral normal ear in a series of microtia patients using different methods of framework stabilization, thereby providing beneficial information for auricular reconstruction, especially for Asian patients.

Materials and methods

Patients and methods

A total of 216 unilateral microtia patients, ranging in age from 6 to 31 years, underwent auricular reconstruction using autogenous costal cartilage between 2007 and 2011. Bilateral or unilateral patients with severe syndromes such as hemifacial microsomia, Goldenhar or Franceschetti syndrome were excluded from this series. The follow-up time ranged from 18 to 35 months, with an average of 2.1 years. In total, 136 cases were right sided, and 80 cases were left sided. Additionally, 177 patients were male and 39 were female. According to accepted microtia classifications, 143 cases were sausage type, 71 cases were conchal type, and two cases were anotia. The patients were divided into two groups based on the thickness of the rib cartilage. In both groups, the original or modified method of framework fabrication was applied under the principle of randomization (Table 1). All protocols were approved by the research ethical committee of the hospital.

Harvesting the rib cartilage

We preferred to harvest the sixth, seventh, and eighth costal cartilage from the contralateral chest and to fabricate the auricular framework corresponding roughly to Brent's method.[2–4] The synchondrosis of the sixth and seventh cartilages was used for the base frame. The helical element, formed by the eighth costal cartilage, was placed on the top of the base frame. Bone cement was used as the support material during ear elevation; thus, extra costal cartilage harvesting and banking were unnecessary.

Table 1 Patient characteristics.

	No. of Patients (%)
Microtia	
Right	136 (62.96)
Left	80 (37.04)
Sex	
Male	177 (81.94)
Female	39 (18.06)
Type	
Lobule	143 (66.20)
Concha	71 (32.87)
Anotia	2 (0.93)
Groups	
A	
Original	50 (23.15)
Modified	50 (23.15)
B	
Original	58 (26.85)
Modified	58 (26.85)