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# Auricular reconstruction using a novel three-flap technique improves the auriculocephalic angle

**Liu Jiafeng***, **Sun Jiaming**, **Li Xiaodan**

*Plastic Surgery Department, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, Hubei 430022, People's Republic of China*

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**KEYWORDS**
Three flaps;
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Measuring;
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**Summary** *Background:* Skin grafting is needed for traditional auricular reconstruction. As the skin grafts contract, the postoperative framework is distorted. This leads to a decrease in the auriculocephalic angle. The objective of this study was to test a new method to cover the reconstructive framework by using three skin flaps and a larger tissue expander than that normally used. This may reduce the distortion of the reconstructed ear and create a well-shaped auriculocephalic angle.
*Methods:* A large expander was inserted in the postauricular mastoid area. Three expanded flaps were then created to cover the anterior and posterior frameworks, with separate mastoid coverage. By measuring the height and angle at three different points on the reconstructed ear and comparing them with the contralateral normal ear, a system for measuring the auriculocephalic angle was established.
*Results:* The surface of the framework and the mastoid area were covered by three flaps developed from one large tissue expander. The appearance of the reconstructed ears was similar to that of the normal side by the patient's 6- to 12-month follow-up. The difference in the distance at the three points between the reconstructed and normal sides after the three-flap reconstruction was less than that following traditional reconstruction ($p < 0.05$). The variation in the angle measured at these three points in the three-flap group was also much smaller than that in the traditional group ($p < 0.01$).
*Conclusions:* The three-flap technique not only improves the appearance of the reconstructed ear, but helps shape a perfect auriculocephalic angle.


* Corresponding author. Department of Plastic Surgery, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, 1277 Jiefang Avenue, Wuhan 430022, People's Republic of China.
*E-mail address:* liujiafengfeng@126.com (L. Jiafeng).

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## Introduction

Because of the complex and fine contours of the ear, total auricular reconstruction presents one of the greatest challenges for plastic surgeons. The auricular framework and the skin covering it are two components critical to ear reconstruction. At present, restoring the auricular framework with autogenous costal cartilage is the gold standard for reconstructing the ear. However, the coverage of this framework remains a challenge for most surgeons. Regardless of whether an expander is used,[1–4] skin grafting is required for all traditional auricular reconstructions. As the skin grafts contract, the auricular framework can become distorted. This draws the framework of the ear closer to the cranium, leading to a decreased auriculocephalic angle. The skin graft can also result in obvious hyperpigmentation, which makes the cosmetic appearance of the reconstructed ear less than satisfying.

Auricular reconstruction using tissue expansions is widely practiced in China because of better appearance and the less amount of skin needed. Although there are some complications such as extrusion and infection during expanding, the complications could be rectified if treated in a timely and effective manner. Using the experience gained by treating more than 8000 patients, we have analyzed the risk factors of infection and necrosis of expanded postauricular flaps during auricular reconstruction and provided effective management strategies for complications derived from the tissue expansion of postauricular skin.[5] Our technique of implanting two skin expanders into the postauricular mastoid area, thereby allowing for flap coverage of the framework of the ear without the need for skin grafting, has been described.[6] We applied this to our practice and then evaluated a new method that involves the insertion of a larger than usual tissue expander into the postauricular mastoid area. In the first stage of ear reconstruction, a large expander was used to expand the skin around the mastoid area. In the second stage, we divided the expanded skin into three flaps, which were used to cover the front and back sides of the framework and the mastoid area separately. In this way, the framework can be fully covered by the flap. Because flaps contract significantly less than free skin grafts, the distortion of the reconstructed ear was reduced.

Because there is no uniform aesthetic standard for the auriculocephalic angle, we attempted to establish our own standard here. By measuring the auricular height and angle at three different points and comparing these measurements with the normal ear, we could quantitatively assess the appearance of the auriculocephalic angle of the reconstructed ears.

## Patients and methods

### Study population

A total of 65 patients (45 males and 20 females) underwent the three-flap reconstruction method. Patient age varied from 6.3 to 26.0 years (mean 11.5 years). All patients had unilateral microtia without a prior reconstruction. Of the microtia, 20 were classified as Grade I, 15 as Grade II, and 30 as Grade III. The skin over the mastoid area was healthy in all patients.

A total of 50 patients (33 males and 17 females) underwent traditional reconstruction. Patient age varied from 6.5 to 25 years (mean 10.8 years). All patients had unilateral microtia. Of the microtia, 15 were Grade I, 10 were Grade II, and 25 were Grade III. The skin over the mastoid area was healthy in all patients.

### Choice and implantation of the skin and soft tissue expander

In the first stage of surgery, a skin and soft tissue expander was implanted into the retroauricular region. The volume of the tissue expander depended on the size of the auricular remnant. We choose 100-mL rectangular expanders for all patients who had Grade I microtia and for most patients who had Grade II microtia (10 in the three-flap group and 7 in the traditional group). A 150-mL rectangular expander was used for those patients who had Grade II microtia with a large external ear on their normal side and for all patients with Grade III microtia. The insertion of a single large volume expander was a technique introduced by Zhuang.[3] The lowest point of the skin area to be expanded was 2 cm inferior to that of the lobe remnant, with an upper region that could be 2—3 cm above the highest point of the normal auricular structures. The drain and sutures were removed 3 and 7 days postoperatively, respectively. Saline was injected into the expanders once every 2—3 days postoperatively. The total volume of saline injected was 121 $\pm$ 6 mL in the 100-mL expanders and 183 $\pm$ 8 mL in the 150-mL expanders. The total number of injections is 10 times.

### Auricular reconstruction

Patients were allowed to stay at home during the static expansion phase for at least 1 month before the second stage of the procedure. Using a method previously described by our group, an auricular lobe flap and an extended flap "A" of the upper skin area were first created. The expander was then removed. The superficial fascia was exposed following dissection from underneath the scalp. A C-shaped incision was made in this fascia, allowing for dissection under this fascial flap up to a point 1 cm posterior to where the cartilage framework would be ultimately fixed. The postauricular fascial flap was then harvested. Subsequently, the autogenous rib cartilage was harvested and fabricated into a three-dimensional framework[4] that would be anchored to the cranium. After a drain was inserted, we kept dissecting underneath the fascial flap until the posterior edge on the base of the framework was reached. This new fascial flap was then used to wrap the posterior aspect and the helix of the framework. The anterior and part of the posterior side of the framework were covered by flap A. Flaps "B" and "C" were then designed and harvested. Flap B was used to cover the posterior side of the framework and part of its cranial aspect, while flap C was designed to cover the remaining part of the cranium (Figure 1). The margins of Flap B were sutured and packaged. A surgical drain was removed 5 days after this stage, and the sutures of the reconstructed ear