Establishment of a Standardized Technique for Concha-type Microtia—How to Incorporate the Cartilage Frame into the Remnant Ear

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Background: We have already reported surgical procedures for lobule-type microtia that provide an excellent contour and shape of the ear with minimum sacrifice of the donor. We have succeeded in establishing a standard surgical technique for almost all types of concha-type microtia that effectively uses the remnant ear and can use a unified costal cartilage frame.

Methods and Results: The concept of our technique is that remnant cartilage should be used maximally but that the deformed area should be completely replaced by the costal cartilage frame. The differences between the cartilage frame for lobule-type microtia and that for concha-type microtia are that the lower half beneath the antihelical area and the concha cymba in the base frame are omitted in concha-type microtia. The area from the tragus to the incisura of the tragus in the antihelical-tragal frame is also omitted. The area of the helical crus in the helical frame and the lower half in the antihelix are not immobilized in the base frame and are free edges. On the other hand, the remnant cartilage outside the concha is removed, but the antitragus is preserved. When the cartilage frame and the remnant are incorporated, all of the components of the ear can be provided.

Conclusion: The ears created by our technique have a natural appearance and clear contour. (Plast Reconstr Surg Glob Open 2019;7:e2337; doi: 10.1097/GOX.0000000000002337; Published online 24 July 2019.)

INTRODUCTION

Recently, the surgical technique using costal cartilage grafting for lobule-type microtia has been greatly improved, and excellent results with a clearly refined contour and natural appearance can be acquired.1,2 We have also reported details of a surgical procedure that provides good results for lobule-type microtia.3,4 However, there have been only a few reports providing details of a surgical procedure for concha-type microtia. Therefore, there is no standard technique for treatment of concha-type microtia, especially regarding how to use the remnant ear and how to combine it with the costal cartilage frame. One of the reasons is that concha-type microtia has many variations in size and form. We succeeded in establishing a standard surgical technique for almost all types of concha-type microtia that effectively uses the remnant ear and can uses a unified costal cartilage frame.

METHODS

First Stage of Costal Cartilage Grafting

Preoperative Preparation

Two film patterns of the contralateral ear and the cartilage frame are prepared. A film pattern of the cartilage frame is modified from the film pattern of the contralateral ear. The differences between the film patterns for lobule-type microtia and the concha-type microtia are that the lower half beneath the antihelical area and the concha cymba in the base frame are omitted in concha-type microtia. The area from the tragus to the incisura of the tragus in the antihelical-tragal frame is also omitted. The area of the helical crus in the helical frame and the lower half in the antihelix are not immobilized in the base frame and are free edges. On the other hand, the remnant cartilage outside the concha is removed, but the antitragus is preserved. When the cartilage frame and the remnant are incorporated, all of the components of the ear can be provided.

Surgical Procedure

Procedure for the Remnant Ear

A skin incision is made on the anterior surface of the remnant ear from the helix to the concha to include the
remnant skin maximally for the reconstructed site. Until the remnant ear is enlarged sufficiently for the intended position and size, a skin incision is made along the inner side of the antihelix, while the remnant cartilage is undermined and pulled out from the skin. A U-shaped skin incision is made on the posterior surface. If the position of the remnant ear is high, a skin incision is made caudally along the temporoauricular sulcus to pull down the remnant ear (Fig. 2A, B).

Undermining of the cartilage from the skin is advanced near the external auditory canal until the antitragus is exposed caudally at the anterior surface. At the posterior surface, the cartilage should be undermined carefully so as not to injure the subcutaneous tissue. The soft tissue of this area is preserved as a subcutaneous pedicle to ensure blood supply of the skin as in the case of lobule-type microtia.

The remnant skin of the area for which a symmetrical shape cannot be obtained for the contralateral ear is removed. Remnant cartilage outside the concha is also removed, but the antitragus is preserved (Fig. 2C). For

![Fig. 1. Differences between the film patterns for lobule-type microtia (A) and concha-type microtia (B). The lower half beneath the antihelical area and the concha cymba in the base frame are omitted in concha-type microtia.](image)

![Fig. 2. Case 1: an 11-year-old girl with right concha-type microtia. A, Preoperative appearance. B, Design of the skin incision in the first stage of the costal cartilage grafting. A U-shaped skin incision is made on the posterior surface (red line). The skin incision on the anterior surface is made on the inner side of the antihelix (red dotted line). If the position of the remnant ear is high, the skin incision is elongated caudally to pull down the remnant ear (yellow dotted line). C, Undermining of the cartilage from the skin is carefully performed so as not to injure the subcutaneous pedicle (area shown by arrows). D, Remnant cartilage outside the concha is removed. E, Fabricated cartilage frame. The edges of the helical crus and the antihelix are not immobilized in the base frame and are free. F, The cartilage frame was grafted and immobilized with the remnant cartilage. The free edge of the helical crus was inserted into the slit of the remnant concha. The free edge of the antihelix was inserted beneath the remnant antitragus. The subcutaneous pedicle of the skin flap was passed through the antihelix and concha. G, Appearance at the end of the first-stage operation.](image)
cases in which the depth of the tragal incisura is not sufficient, correction is performed at the second stage of ear elevation.

**Fabrication and Grafting of the Costal Cartilage Frame**

Two blocks of VII and VIII costal cartilage are usually harvested. The VII cartilage is divided into 2 pieces and combined as the base frame, and the VIII cartilage is used for the helical frame. The remaining cartilage pieces are used for the antihelix and as a block for ear elevation. The helical crus and lower half of the antihelix are not immobilized in the base frame as mentioned above (Figs. 1, 2D).

Incorporation of the cartilage frame and the remnant cartilage is the most important procedure in this operation. To acquire the same size as that of the contralateral ear, the antihelical cartilage and the remnant concha are temporarily attached by using, for example, injection needle and the position is carefully decided. To prevent step deformity, it is recommended that the antihelix be placed higher than the remnant concha and that the caudal free edge of the antihelical cartilage be inserted beneath the remnant antitragus. The free edge of the helical crus is inserted into the slit made by cutting at an appropriate point of the conchal cartilage. All of the borders of the grafted cartilage and remnant cartilage are fixed by wire. These procedures make it possible to integrate the grafted cartilage and remnant cartilage and maintain a good shape after ear elevation. The subcutaneous pedicle is usually passed through between the base frame and the antihelix (Fig. 2E). For cases in which the skin has tension, it can be passed through the antihelix and concha.

After adequate trimming of the skin, all of the wound is sutured (Fig. 2F). However, we recommend that some of the excessive skin left in the operation and removed 8–10 days later when blood supply of the skin is considered to have become stable.

**Second Stage of Ear Elevation**

Almost all procedures in this stage are similar to those for lobule-type microtia. However, we recently prefer to use a mastoid fascial flap rather than a skin flap for coverage of the cartilage inserted into the temporoorauricular sulcus for both concha-type and lobule-type microtia. The reason is that the skin tension may trach the ear caudally and cause drooping of the ear position postoperatively in some cases in which a skin flap is used. In addition, a mastoid fascial flap has sufficient blood supply, which is advantageous for survival of skin grafts. The cartilage block for insertion into the posterior concha does not need to be as large as that for lobule-type microtia. Because concha-type microtia has a rigid conchal wall, a small cartilage block can support the angle of the conchal wall. The cartilage block is fabricated to be wedge-shaped and is immobilized on the posterior concha so as to be symmetrical with the contralateral ear (Fig. 3). For cases in which the depth of the tragal incisura is not sufficient, we perform Z-plasty between the tragus and tragal incisura and transpose the earlobe caudally in this stage.

**Report of Cases**

**Case 1**

The patient was an 11-year-old girl with right concha-type microtia (Figs. 2, 3). Because the remnant ear was at a high position, a skin incision was made caudally along the temporoorauricular sulcus and the ear was pulled down and sutured with the temporal skin. The earlobe remained unnaturally protruding from the ear in the first stage of the operation. The cartilage frame could be made from 2 blocks of VII and VIII costal cartilage. The conchal size in the remnant ear was adequate to incorporate with the costal cartilage frame without any correction of size. One year later, the ear was elevated. The angle of the earlobe was corrected in this stage. There were no complications during the healing process after the operations. Over a 2-year follow-up period, the constructed ear acquired a clearly refined shape. There was no sign of resorption, distortion, or step deformity with the remnant cartilage in the grafted cartilage.

**Case 2**

The patient was an 11-year-old boy with concha-type microtia (Fig. 4). The cartilage frame could be made from 2 blocks of VII and VIII costal cartilage. The conchal size in the remnant ear was adequate to incorporate with the costal cartilage frame without any correction of size. Eight months later, the ear was elevated. There were no complications during the healing process. Over a 5-year follow-up period, the constructed ear acquired a clearly refined shape. There was no sign of resorption, distortion, or step deformity with the remnant cartilage in the grafted cartilage, and he continued playing baseball actively.

**DISCUSSION**

Concha-type microtia refers to ear malformations of various degrees caused by underdevelopment of mainly the cephalad part including the helix and antihelix. Mild concha-type microtia is often considered as a synonym of constricted ear. Concha-type microtia has an advantage over lobule-type microtia for treatment because it has a large amount of remnant tissues that can be used for reconstruction. However, there have been only a few reports providing details of surgical procedures for concha-type microtia.

Surgical techniques for concha-type microtia that have been reported so far can be classified roughly into 2 types of treatment: treatment using the remnant ear itself (including conchal cartilage grafting) and treatment using costal cartilage grafting. For mild concha-type microtia, there have been reports of some cases treated by simple elongation of the helix using a skin flap and antihelical plasty by suturing cartilage. However, the results in some cases are not satisfactory, especially in cases with hypoplasia in the antihelix.

Grafting using a conchal cartilage graft is a useful technique for mild concha-type microtia as the graft has the original structural and morphological features of the ear. However, because conchal cartilage does not have sufficient intensity to support the upper ear and its obtainable
size is limited, conchal cartilage grafting is suitable only for very mild cases.

On the other hand, costal cartilage has a sufficiently large size and firm structure for construction of the ear. Madura reported a technique for anchoring the helical frame to the remnant cartilage by using only 1 strip of costal cartilage. This treatment is minimally invasive for patients, but it is very difficult for costal cartilage to maintain an ideal shape without firm immobilization on a rigid structure as it can easily warp due to its specific stability. Therefore, we think the use of a platform-based frame such as that reported by Brent and Nagata is most reliable.

In Brent’s method, which is similar to the method used for lobule-type microtia, almost all of the area of the platform-based frame is grafted into a subcutaneous pocket in the temporal skin. Most of the region of the helix and antihelix of the remnant is excised in a
spindle-shaped manner. Nagata recommended that the skin in the remnant be effectively used. We agree with his policy. However, Nagata actively removed almost all of the remnant cartilage and replaced it with a costal cartilage frame.\textsuperscript{13,14}

On the other hand, we should also be aware that costal cartilage has some disadvantages. Park reported that a conchal cartilage graft is useful for treatment of a constricted ear because most patients would not be satisfied with new thick and stiff ears reconstructed by costal cartilage grafting compared with their previous thin and resilient deformed ears.\textsuperscript{15} Therefore, we should consider using a technique that has both advantages of remnant cartilage and costal cartilage. Needless to say, a good shape and rigid structure of the ear need to be obtained. To do so, remnant tissues should be used as much as possible to maintain the original elasticity of the reconstructed ear and to prevent traumatic damage, and a deformed shape can be sufficiently replaced by costal cartilage to acquire an appropriate size and fine contour of the ear. In addition, remnant cartilage and grafted costal cartilage should be incorporated firmly to maintain the reconstructed shape.

We previously used a platform-based frame including the helical part but not including the antihelix in the frame in accordance with our policy to utilize remnant tissues as much as possible. The antihelix was created by reformed remnant cartilage and was overlaid and grafted on the base frame. In this technique, however, a step deformity with the remnant and costal cartilage or an unnatural antihelical curve appeared in some cases. We therefore changed the technique to a technique in which the upper part of the antihelix is created from costal cartilage and is included in the frame. By connecting the caudal edge of the antihelix with the antitragus of the remnant, the step deformity is not conspicuous and a natural appearance can be acquired. In addition, a part of the helical crus is inserted into the conchal cartilage and the base frame is immobilized in the posterior concha, making it possible to integrate the grafted cartilage and remnant cartilage and provide all parts of the ear with a rigid structure. Although Brent reported that an alternative incision must be used and that a standard approach cannot be used for correction of concha-type microtia, our technique can be used as a standard technique for almost all types of concha-type microtia.\textsuperscript{12}

On the other hand, attention should be paid to the following points to acquire a more symmetrical appearance.

**Size of the Concha**

Because the concha of the remnant ear has many variations in size, consideration must be given to adjusting the size of the concha. Although Nagata divided conchas into 2 groups of concha-type and small concha-type, we defined the ordinary concha-type and small concha-type microtia as follows: the ordinary concha-type microtia means that the remnant concha has one half or larger compared with normal size of concha accompanied with normal shape of the antitragus and intertragic notch. The small concha-type microtia means more smaller concha with hypoplastic shape in lower one third of the ear. Our concept is that a procedure for small concha-type microtia should be similar to a procedure for lobule-type microtia, and the technique described in this article should not be used.\textsuperscript{13,14} The cartilage frame for small concha-type microtia should also provide all parts of the ear as in the case of lobule-type microtia, and the area of the small concha should be used only for a concave part such as the external auditory canal. Conversely, for a large concha, some of the conchal skin and cartilage should be removed because it is very difficult to integrate the cartilage frame and remnant.

![Fig. 5. Relationship between the cartilage frame and remnant cartilage. All of the components of the ear can be created by the cartilage frame and remnant cartilage.](image-url)
Position of the Remnant

The procedure differs depending on whether the position of the remnant is high or low. When the remnant ear is in a low position, the remnant conchal cartilage should be pulled up to the proper position and sutured rigidly with the underlying fascia or peristeum. For cases in which the remnant is in a high position, the earlobe will project anteriorly if the remnant ear is just pulled down and sutured on the temporal area (Fig. 5). In this situation, the earlobe shape can be improved by making a skin incision in the anterior proximal earlobe and repositioning it at a lower position in the second stage of ear elevation. For cases in which the depth of the tragal incisura is not sufficient, the result can be improved by performing Z-plasty between the tragus and tragal incisura.

Height of the Hairline

Lobule-type microtia requires removal of hair follicles included in the ear at the second stage of ear elevation for low-grade low hairline cases. This is because it is difficult to change the position of the ear later. The cartilage frame must, therefore, be grafted to the proper position in the first stage of cartilage grafting. A problem in this procedure is that congestion or skin necrosis sometimes occurs in the skin margin. On the other hand, the cartilage frame can be grafted at a lower position so as not to include hair follicles in the ear for concha-type microtia with low-grade low hairline. The ear can be rotated and pulled up to the proper position at the second stage of ear elevation because the remnant cartilage has mobility in its position. In this situation, a large area of hairless skin in the posterior side of the remnant ear can be effectively used, the long axis of the ear should be tilted posteriorly in the first stage of cartilage grafting. Of course, for severe low hairline cases, we should remove the skin including hair and graft the hairless skin in both lobule- and concha-type microtia cases. However, posterior skin in the remnant ear can be used for this in concha-type microtia.

CONCLUSIONS

The concept of our technique is that remnant cartilage should be used maximally but that the deformed area should be completely replaced by the costal cartilage frame. Because the cartilage frame can be usually created by only 2 cartilage blocks in our technique, the sacrifice for the donor site can be minimized compared with that in Nagata’s technique, which is performed by removal of the remnant cartilage and replacement of almost all of the area by the cartilage frame. An ear that has been created by using the remnant ear as much as possible has good elasticity. In addition, good and stable results can be obtained by a unified technique. Our technique can be applied as a standardized technique for almost all types of concha-type microtia.

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