

REVIEW

## PARTIAL RECONSTRUCTION OF THE AURICLE

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**Abstract** Auricular reconstruction is often required for an auricular defect following tumor excision or trauma. It is important for the reconstructed auricle to maintain a complicated three-dimensional structure and to have structural strength against scar contracture. Many reconstruction methods for an auricular defect have ever been reported in the literature. Reconstruction methods using only soft tissues were common in early reports, but these methods cause postoperative deformity due to scar contracture. Therefore, reconstruction methods with a cartilage graft or using a chondrocutaneous flap are now preferred. Reconstruction using local flaps has an advantage over reconstruction using skin grafts because good color and texture match of the reconstructed auricle can be obtained. With elucidation of the hemodynamics of the auricle, various local flaps around the auricle have been developed, and the stability of blood supply of the flaps has improved. In this report, we classify the reconstruction methods and discuss the utility of each method, and we present our strategy for partial reconstruction of the auricle.

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**Key words:** Auricular Reconstruction, local flap, Cartilage graft, Chondrocutaneous flap.

### Introduction

The auricle is a site at which malignant skin tumors frequently occur. Therefore, reconstruction is often required after excision of the tumor. Also, the auricle is easily injured because of its protrusion, an reconstruction after an injury is often required. The mobility of auricular skin is poor because its thin subcutaneous tissue. Therefore, direct suturing of an auricular skin defect is sometimes difficult. Even if direct suturing is possible, care is needed to prevent distortion. Cartilaginous reconstruction is required to obtain an ideal structure and sufficient strength for maintaining the form of the auricle if cartilage is damaged. However, constructing an ideal structure with cartilage is sometimes very difficult because cartilage has a complicated three-dimensional structure. Many reconstruction methods that are suitable for different parts and sizes of an

auricular defect have been reported. Here, we classify these methods and discuss their utility, and we present our strategy for partial reconstruction of the auricle.

### Anatomy of the auricle

When reconstructing the auricle, understanding of the complicated three-dimensional structure of the auricle is needed. The helix forms outer frames of the auricle. The concha forms a deep fossa in the center of the auricle. The antihelix, the scapha and the triangular fossa form a complicated convexoconcave structure between the helix and the concha (Fig. 1). An understanding of the hemodynamics of the auricle is also important for auricle reconstruction. The report by Park<sup>1, 2)</sup> is very useful for safety elevation of auricular local flaps. The anteroauricular surface arterial flow is distributed from networks of arterial branches derived from the superficial temporal artery

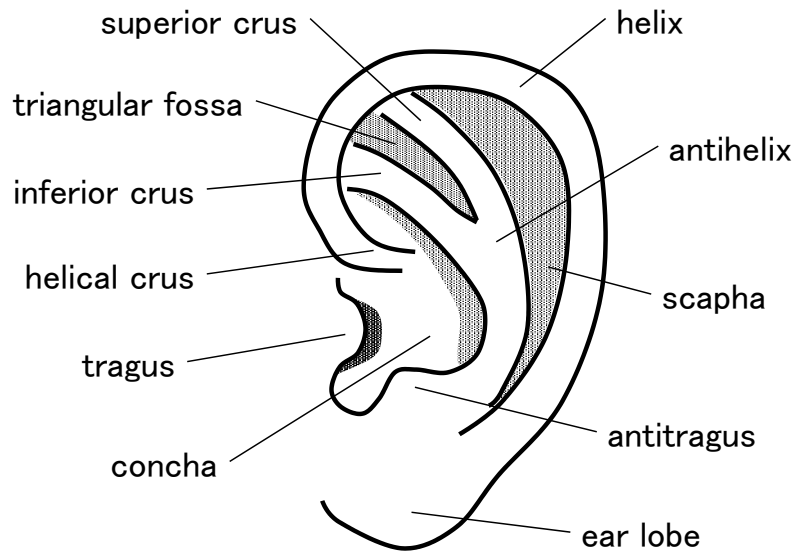


Fig. 1 Anatomy of the auricle

(STA) and the post auricular artery (PAA). The STA supplies the scapha, triangular fossa, antihelix and forms a triangular fossa-scapha network. The PAA supplies the concha and forms a conchal network. The post-auricular surface arterial flow is supplied from branches of the PAA. These blood supplies are needed in auricular local flaps to ensure the safety of the flaps. A long pedicled arterial flap can also be used if the flap contains a branch of the STA or PAA.

#### Strategy for auricular reconstruction

When performing auricular reconstruction, it is important to select an appropriate reconstruction method according to the part and size of the defect. The auricle can be divided into three parts in consideration of reconstruction methods: the concha, helix and ear lobe. A cartilage defect of the concha does not affect the form of the auricle. However, a cartilage defect of the helix must be reconstructed with cartilage in order to avoid auricular deformity. The method for reconstruction of a helical defect should be decided with consideration of the

defect size. The ear lobe should be reconstructed with cartilage to maintain its form, even though ear lobe does not originally contain cartilage (Fig. 2).

#### Reconstruction of the concha and antihelix

A small defect of the concha or the antihelix can be directly sutured. However, it is sometimes difficult to directly suture the defect because the skin of the concha and the antihelix has poor mobility. A skin graft can be used if the perichondrium remains on the cartilage, but a deformity due to scar contracture may occur. It has been reported that contracture can be prevented by conchal reconstruction using a local flap. Park<sup>2)</sup> reported a retroauricular arterial flap that contains a branch of the PAA. Yotsuyanagi<sup>3-5)</sup> and Schonauer<sup>6)</sup> reported a retroauricular subcutaneous pedicled flap. The retroauricular subcutaneous pedicled flap has sufficient blood supply from the PAA. This flap can cover the concha, triangle fossa, antihelix and scapha. The flap can be elevated with conchal cartilage if cartilaginous reconstruction is required. On the other hand, Elsayh<sup>7)</sup> and

<p><b>Concha : retroauricular flap</b></p> <p><b>Helix</b></p> <p>    <b>Cartilage defect(-) : local flaps</b></p> <p>    <b>Cartilage defect(+)</b></p> <p>        <b>Defect less than 1.5cm : direct suture</b></p> <p>        <b>Defect from 1.5cm to 3cm : composite graft</b></p> <p>        <b>Defect about 1/3 of the helix : conchal chondrocutaneous flap + local flaps</b></p> <p>        <b>Defect over 1/3 of the helix : costal cartilage graft + TPF + skin graft</b></p> <p><b>Ear lobe : retroauricular chondrocutaneous flap</b></p>
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**Fig. 2** Our strategy for partial auricular reconstruction  
 TPF : temporoparietal fascial flap

Ramirez<sup>8)</sup> reported an antihelical advancement flap for antihelical reconstruction. Their method is useful if the defect is localized in only the antihelix, but a decrease in the size of auricle is a demerit of these methods. We usually use a retroauricular subcutaneous pedicled flap reported by Yotsuyanagi for reconstruction of the concha and the helix. Because this flap has good color and texture match with the anterior surface of the auricle, the donor site of the flap is indistinctive.

#### **Reconstruction of the helix without a cartilaginous defect**

When reconstructing the helix, it is important for the reconstructed auricle to have a sufficient size and a good three-dimensional structure. If there is no cartilaginous defect and the perichondrium remains, reconstruction with a skin graft can be performed. However, reconstruction with a local flap is better than reconstruction with a skin graft because a deformity due to scar contracture rarely occurs. The skin defect of the helix can be covered with a rotation or transposition flap from the post auricular region. Usually, the donor site of the retroauricular flap can be directly sutured,

but another skin flap or skin graft is required if direct suturing is not possible. Postoperative fixation using a bolster suture or splint is useful for maintenance of the reconstructed auricle.

#### **Reconstruction of the helix with a cartilaginous defect**

The reconstruction method should be selected according to the size of the defect. We categorized defects into four groups.

##### 1) A defect less than 1.5 cm

A small defect of the helix that is less than 1.5 cm can be directly sutured. Chondrocutaneous advancement flaps, which were reported by Antia<sup>9)</sup>, Fata<sup>10)</sup>, and Argamaso<sup>11)</sup>, are also useful for a defect only in the helix. When performing reconstruction with this flap, it is important to prevent deformation of the helix and antihelix. The demerit of this method is that the size of the reconstructed auricle will be reduced.

##### 2) A defect from 1.5 cm to 3.0 cm

A composite graft from the contralateral auricle is useful for a defect of 1.5 to 3.0 cm in size<sup>12)</sup>. The maximum size of a defect that can be reconstructed using a composite graft

is 3 cm because a defect of the donor site of more than 1.5 cm can not be directly sutured. The skin of the composite graft should be sutured to the skin of recipient site as much as possible in order to obtain sufficient blood supply. Blood supply to the composite graft can usually be observed one day after the operation. Congestion may occur, but it usually improves after about 5 days.

### 3) A defect about one-third of the helix

There are some reports of reconstruction using only a local flap without cartilaginous reconstruction<sup>13)</sup>, but post-operative deformity due to scar contracture may occur. Cartilaginous reconstruction is necessary for such reconstruction. Park<sup>14)</sup> reported a one-stage reconstruction method using a free cartilage graft, local flap, and skin grafting, but this method is slightly complicated. Reconstruction methods using a conchal chondrocutaneous flap that were reported by Donelan<sup>15)</sup> and Yotsuyanagi<sup>16,17)</sup> are useful.

#### a) A defect of the upper one-third of the helix

Some reconstruction methods have been reported for a defect of the upper one-third of the helix. Donelan<sup>15)</sup> reported a useful conchal chondrocutaneous flap that obtains blood supply from the helical crus as a pedicle. The flap is designed on the concha and elevated with conchal cartilage. Then the flap is rotated to the upper part of the helix. The skin defect of the donor site of Donelan's flap is covered with a skin graft. However, Yotsuyanagi<sup>16)</sup> covered a conchal skin defect with a retroauricular flap. The posterior surface of the reconstructed upper helix is covered with a retroauricular local flap. If the retroauricular flap can be advanced to the anterior surface of the helix, a natural helical form can be reconstructed.

#### b) A defect of the middle one-third of the helix

Several reconstruction methods using chondrocutaneous flaps have been reported. Millard<sup>18)</sup> reported a two-stage reconstruction method using a conchal chondrocutaneous flap and local flaps. Yotsuyanagi<sup>17)</sup> and Selçuk<sup>19)</sup> reported a one-stage reconstruction method using a conchal chondrocutaneous flap. Yotsuyanagi elevates the conchal chondrocutaneous flap as a subcutaneous flap and transfers it to the middle part of the helix. The conchal skin defect is covered with a retroauricular flap. The retroauricular skin defect is directly sutured if possible or covered with a local flap or skin graft. Selçuk reported a retroauricular chondrocutaneous transposition flap. The cartilage of the flap is revolved about 90 degrees in order to fit to the helical cartilaginous defect and covered with a skin flap. We usually use Yotsuyanagi's method for a defect of the middle one-third of the helix because more cartilage can be transferred than that by Selçuk's method, which is important for structural strength.

### 4) A defect of more than one-third of the helix

It is difficult to reconstruct a large defect of more than one-third of the helix with local flaps only. A large defect requires complicated reconstruction in accordance with the operation of microtia as reported by Tanzer<sup>20)</sup> and Brent<sup>21)</sup>. In such cases, a costal cartilage graft is necessary to maintain the size and form of the auricle. The grafted costal cartilage should be covered with a vascularized flap as a temporoparietal fascial flap, and its surface is covered with a skin graft. It is important to make a cartilage frame that has a high helix and deep scapha to make a fine three-dimensional structure.

### Reconstruction of the ear lobe

Many reconstruction methods using a local flap have been reported for an ear lobe defect. Alanis<sup>22)</sup> and Park<sup>23)</sup> reported a one-stage reconstruction method using local flaps without cartilage. Originally the ear lobe has no cartilage, but cartilaginous reconstruction is necessary to prevent postoperative deformity. Therefore, reconstruction with cartilage is the mainstream of ear lobe reconstruction instead of the previous methods. Brent<sup>24)</sup> reported two-stage reconstruction using a prefabricated chonchal cartilage graft. Ohsumi<sup>25)</sup> and Yotsuyanagi<sup>26)</sup> reported one-stage reconstruction using a conchal chondrocutaneous flap. We reconstruct the ear lobe with a conchal chondrocutaneous flap, and we wrap the cartilage with a skin flap. The donor site is usually directly sutured. The form of an ear lobe reconstructed with cartilage is maintained permanently.

### Cultured cartilage grafting

Cartilage is useful and necessary for auricular reconstruction. Conchal cartilage is useful for a relatively small cartilage defect, and a large cartilage defect requires costal cartilage. A costal cartilage graft has some demerits: it causes pain or deformity as sacrifice of the donor site. Such demerits can be overcome by tissue engineering. There have recently been clinical applications of cultured cartilage in several fields. Yanaga<sup>27, 28)</sup> reported a cultured cartilage graft for microtia, but long-term results have not yet been reported. Long-term stability against absorption is necessary for cultured cartilage to be used for auricular reconstruction, and the development of such cultured cartilage is being awaited.

### Conclusion

There are many reported reconstruction methods and each method has its merits and demerits. A suitable reconstruction method must

be selected for the defect with an understanding of its distinctions such as the part and size of the defect. Whichever method is selected, the most important thing is to reconstruct the auricle with a sufficient size and three-dimensional structure as complete as possible. Moreover, the reconstructed auricle should have structural strength against scar contracture. The remaining tissues should therefore be effectively used and cartilage should be used to maintain the form of the auricle for a long time. A chondrocutaneous flap is very useful for partial auricular reconstruction because it has structural strength and good color and texture match.

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