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Management of chest deformity caused by microtia reconstruction: Comparison of autogenous diced cartilage versus cadaver cartilage graft partial filling techniques

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KEYWORDS

Irradiated cadaver cartilage;
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Summary *Background:* Efforts to prevent chest wall deformity after costal cartilage graft are ongoing. In this study, we introduce a new method to prevent donor site deformation using irradiated cadaver cartilage (ICC) and compare this method to the autogenous diced cartilage (ADC) technique.

Methods: Forty-two pediatric patients comprised the ADC group (n = 24) and the ICC group (n = 18). After harvesting costal cartilage, the empty perichondrial space was filled with autologous diced cartilage in the ADC group and cadaver cartilage in the ICC group. Digital photographs and rib cartilage three-dimensional computed tomography (CT) data were analyzed to compare the preventive effect of donor site deformity. We compared the pre- and postoperative costal cartilage volumes using 3D-CT and graded the volumes (grade I: 0%–25%, grade II: 25%–50%, grade III: 50%–75%, and grade IV: 75%–100%).

Results: The average follow-up period was 20 and 24 months in the ADC and ICC groups, respectively. Grade IV maintenance of previous costal cartilage volume was evident postoperatively in 22% of patients in the ADC group and 82% of patients in the ICC group. Intercostal space narrowing and chest wall depression were less in the ICC group. There were no complications or severe resorption of cadaver cartilage.

Conclusions: ICC support transected costal ring and prevented stability loss by acting as a spacer. The ICC technique is more effective in preventing intercostal space narrowing and

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chest wall depression than the ADC technique.

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Introduction

The probability of chest wall deformation ranges widely from 16% to 50%.^{1–3} Despite full knowledge of possible postoperative complications, young patients and their parents often complain of postoperative donor site deformity.

Autogenous diced cartilage (ADC) insertion in the empty perichondrial pocket after costal cartilage harvest for microtia patients is a recent method of choice for the prevention of postoperative chest wall deformity. However, freedom from chest wall deformity is not an absolute guarantee because of deficit in surgical skill or presence of hematoma.⁴

Irradiated cadaveric cartilage (ICC) has been used for the augmentation rhinoplasty,⁵ knee cartilage reconstruction, and reconstruction of the ear. The results using cadaver costal cartilage for the reconstruction of microtia have been inconclusive, while an aesthetic appearance equivalent to the autologous situation has been achieved in some patients.⁶

We introduce a new technique of ICC insertion in the empty perichondrial pocket to minimize chest wall deformity rather than using it for the reconstruction of the ear. The purpose of this study is to compare the preventive effect of the ICC and ADC techniques on donor site deformation with clinical imaging and rib cartilage targeted three-dimensional computed tomography (3D-CT).

Patients and methods

Study population

After approval by the Samsung Medical Center institutional review board, 42 patients with microtia were enrolled between March 2009 and October 2010. Exclusion criteria included age younger than 7 years and older than 19 years, and congenital or acquired chest wall deformities. Parents chose their preferred technique after explanation of the advantages and drawbacks of each method.

Surgical techniques

All operations were performed by the senior author (Kap Sung Oh), who has performed over 600 rib cartilage grafts.

Group I: filling the donor site with autologous diced cartilage

A 5–7 cm horizontal skin incision was made on the upper margin of the seventh costal cartilage level. After division

of the rectus muscle, the submuscular plane was dissected until all targeted costal cartilages were exposed. When costochondral junctions were revealed, a periosteum incision was made 5 mm from the costochondral junction using monopolar electrocautery. Initiation at the periosteum and not the perichondrium was done to prevent costal cartilage injury. Subperichondrial dissection was performed with a Freer elevator, taking care to avoid tearing. Because the costal cartilage of children is not usually big, Doyen rib raspator was not used. The sixth and seventh costal cartilages were harvested en bloc, and the superomedial portion was preserved by cutting the cartilage 1 cm superomedially from the template margin. The distal 5-mm portion of the costal cartilage was also preserved, with care taken not to damage the growth center of the costochondral junction. After framework fabrication and banking of the cartilage block for later auricular elevation, the remnant cartilages were cut into 2–3 mm cartilage blocks and returned to the empty perichondrial pocket. This dicing technique was performed as previously described.⁴

Group II: filling the donor site with cadaver cartilage

Costal cartilage was harvested as described above. ICC (AlloCartilage™; CGBio, South Korea) was inserted instead of diced cartilage. ICC consisted of the sixth, seventh, and eighth costal cartilages from adult donors, and synchondrosis between the sixth and seventh cartilages was maintained. ICC was sculpted using the harvested costal cartilage as the template for the shape and was positioned in the empty perichondrial pocket (Figure 1A and B). ICC was secured to the patient's costal cartilage using 4-0 prolene. The perichondrium was closed by suturing with 3-0 vicryl similar to that for group I (Figure 2).

Outcomes

Patient data including medical records regarding age, height, weight, and details about the harvested rib cartilage were collected on a custom-designed datasheet. Any adverse event within 30 days from surgery was recorded as a perioperative complication. Digital photographs were planned to be taken 24 months postoperatively. Costal cartilage was assessed preoperatively and 24 months postoperatively by rib cartilage imaging using 3D-CT. Since all patients were children, the dose used was below the reference and was filtered to reduce radiation exposure as we have previously described.⁷ The same author compared the pre- and postoperative costal cartilage volumes using 3D-CT and graded the volumes (grade I: 0%–25%, grade II: 25%–50%, grade III: 50%–75%, and grade IV: 75%–100%), with 0% denoting the postoperative absence of costal

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