Otoplasty Using a Modified Anterior Scoring Technique

Standardized Measurements of Long-term Results

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**Objective:** To evaluate long-term results of otoplasty using standardized measurements.

**Methods:** We performed a retrospective study of patients who underwent otoplasty using a modified anterior scoring technique combined with postauricular fixation sutures. Two hundred twenty-two consecutive patients (421 primary otoplasties) were included. Each auricle was examined before surgery, after surgery, and at a long-term follow-up visit, and the distance between the lateral helical rim and the mastoid surface was measured at 3 points. In addition, patient satisfaction was evaluated using a questionnaire.

**Results:** Seventy-two percent of 222 patients were examined at a long-term follow-up visit. Follow-up of 301 auricles was on average 6.25 years (range, 44-106 months). The mean preoperative measurements among all auricles were 23.3 mm at the uppermost point of the helix, 28.6 mm at the middle, and 25.9 mm at the lobule; these values were 14.2, 14.0, and 16.1 mm, respectively, at the end of the operation and 16.0, 17.5, and 17.4 mm, respectively, 6 years later. Long-term data revealed a median 2-mm lateralization of the auricle. The aesthetic result of otoplasty was rated as “very good” by 71.8% of patients and as “good” by 19.4% of patients; 6.9% of patients thought the result was “satisfactory” and 1.9% “unsatisfactory.” Complete recurrence of the protrusion was seen in 7 ears (2.3%) and partial recurrence within the upper third of the pinna in 26 ears (8.6%).

**Conclusions:** Otoplasty using a modified anterior scoring technique combined with postauricular fixation sutures provides long-term improved results in 91.2% of cases. Complications and sequelae are few, and rates are comparable to those of other long-term studies. A 2-mm lateralization of the auricle may be expected. Standardized measurements of the auricle are important because they supplement the overall aesthetic evaluation of the corrected ear and provide an objective baseline for long-term follow-up.

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**Correction of protruding ears remains a challenge for otolaryngologists and for pediatric and facial plastic surgeons.** Successful operation addressing individual conditions frees the patient from the stigma of an unusual face and gratifies the surgeon who performs the intervention. The literature describes a wide range of surgical techniques that comprise the following 3 concepts: (1) incision-suture technique such as that by Converse, (2) suture-only technique by Mustardé, and (3) cartilage-softening scoring technique by Stenstroem, Ju et al, and Chongchet. At our clinic, we use a modified anterior scoring technique for antihelixplasty combined with postauricular fixation sutures. In the case of conchal hyperplasia, additional concha-mastoid sutures are placed with or without excision of conchal cartilage. Long-term results are particularly relevant because most otoplasties are performed in children. In contrast to numerous descriptions of operating techniques, long-term data on results are often lacking. In most studies of long-term results, patients score their satisfaction by postal survey, without follow-up examination by a physician. To verify our surgical results, we performed follow-up examinations of our patients for a mean of 6.25 years after otoplasty and documented long-term outcomes using standardized measurements of the distance from the auricle to the mastoid.

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**Preoperative Evaluation**

This study included all patients who underwent primary otoplasty in the Department of Otorhinolaryngology–Head and Neck Surgery at Kantonsspital Luzern, Lucerne, Switzerland, between January 1, 2000, and December 31, 2004. There were 222 consecutive patients.
Figure 1. Standardized measurements of the postauricular distance between the lateral helical rim and the mastoid surface at the following 3 points: at the uppermost point of the helix, at the midpoint of division between the crus superius and inferius, and at the lobule.

Figure 2. Landmarks of ear cartilage.

Table. Goals of Otoplasty

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<tr>
<th>Aesthetics</th>
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<tr>
<td>Symmetry (&lt;3-mm difference between sides)</td>
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<td>No upper-third protrusion of the auricle</td>
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<td>The helix should be lateral to the antihelix when viewed from the front</td>
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<td>No significant narrowing of the postauricular sulcus</td>
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<td>Corrected auricle should not be too close to the head</td>
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<td>Distance from the anterior helical rim to the posterior mastoid surface should be &lt;17 to 20 mm</td>
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a Modified from work by McDowell and Weerda.

parents (for the pediatric population) expectations and indications for surgery were recorded. Each auricle was analyzed for the following: angle of protrusion, concha hyperplasia, inadequate folding of the antihelix fold (particularly the lack of a crus superius), lobular protrusion, combinations of these abnormalities, quality and spring of auricular cartilage, and asymmetries. These findings were recorded in the patient’s medical record and were documented by a standardized series of photographs.

STANDARDIZED MEASUREMENTS

In addition to individual evaluation of the auricle, the distance between the lateral helical rim and the mastoid surface was measured in all patients at the following 3 points (Figure 1): at the uppermost point of the helix, at the midpoint of division between the crus superius and inferius, and at the lobule. These measurements were obtained before surgery, immediately after otoplasty, and at follow-up visits. For technical ease, we prefer to measure the distance and not the angle between the auricle and the mastoid at the 3 defined points.

POSTOPERATIVE FOLLOW-UP

Patients were routinely seen on the first and seventh postoperative days and 3 months later. Wound healing, final outcomes, and any complications were documented in the patient’s medical record.

All patients operated on between January 1, 2000, and December 31, 2004, were asked to come in for a follow-up visit. Patient satisfaction was evaluated using a questionnaire. Any complications were analyzed from the perspective of the patient or caregiver and from the documentation in the medical record. During subsequent examination by a physician, otoplasty results were assessed using a structured protocol (Table) that included the same standardized measurements as before surgery.

MODIFIED ANTERIOR SCORING TECHNIQUE

This modified anterior scoring technique is based on work by Stenstrom.1 Perichondrium on the front surface of the auricle is weakened by gentle pressure of scoring. Convex folding of the antihelix fold can be achieved without tension. The newly formed antihelix fold is fixed in the defined position with posterior sutures, combined if necessary with a conchal setback technique, lobuloplasty, or both.

LUCERNE TECHNIQUE

Five basic steps of the Lucerne technique are as follows: (1) postauricular skin incision (double ellipse), (2) anterior scoring to reshape antihelical cartilage, (3) contouring of the antihelix (postauricular fixation sutures), (4) correction of auricular position (cavum rotation with or without cartilage excision), and (5) refinements (eg, lobuloplasty and helical spine release).

At the beginning of surgery, the overall aesthetic impression is assessed, and the auricle is analyzed relative to cephaloauricular angle, auricular relief (deficient antihelical fold, absent crus superius, depth of cavum conchae, and lobular protrusion), and cartilage texture. Preoperative distances between the lateral helical rim and the mastoid surface are measured in the upper and middle thirds of the ear and at the lobule. This preliminary analysis is followed by local infiltration of a combination of 1% lidocaine hydrochloride (10 mg/mL) and epinephrine (0.01 mg/mL) (1:100,000). A double-elliptical skin excision is performed in the postauricular crease. This should be performed sparingly, as any excess skin and subcutaneous tissue can be resected at the end of the operation, although this is seldom necessary. The skin is undermined posteriorly to facilitate subsequent suture placement for cavum rotation. The skin and subcutaneous flap are dissected from the posterior surface of auricular cartilage, taking care to preserve the intrinsic auricular muscles and perichondrium. The dissection is carried far superiorly to aid in the subsequent creation of an absent crus superius. The antitragohellicine fissure is exposed inferiorly to provide a natural access site to the anter earcicular surface (Figure 2 and Figure 3). A small pair of...
dissecting scissors is passed through the antitragohelicine fissure to the anteroauricular surface, and the skin is undermined along the full length of the antihelix. The curve of the scissors tips is always directed towards cartilage to avoid perforating the skin (Figure 4). When the skin has been sufficiently undermined, a curved Lucerne double-ended rasp (Karl Storz Company, Tuttingen, Germany) is introduced into the tunnel (Figure 5). The narrow end is used in children and the broad end in adults. Perichondrium and cartilage on the anterior surface are uniformly scored with gentle pressure until an antihelical fold can be created without tension (Figure 6). The planned antihelical fold is marked with hypodermic needles, which are passed to the surgeon on a round sponge. To prevent injuries, the needles are removed before their position is marked with bipolar forceps. After anterior scoring, cartilage is malleable and is folded using 4 Mustardé-type nonresorbable sutures (Surgilon 3-0; Covidien Inc, Mansfield, Massachusetts) to create a new antihelix. Mattress sutures according to the technique by Mustardé are placed through the perichondrium 5 to 6 mm above and below the marked line of the antihelical fold. They are passed beneath the perichondrium but should not pierce the full-thickness cartilage. If necessary, the superior suture can be used to create an absent crus superius. Cartilage is slightly indented before the sutures are tied. After the knot is prepositioned, it is held in place using a smooth clamp for tightening with millimeter precision.

The final position of the auricle is corrected by cavum rotation. In patients with shallow cavum conchae, this can be accomplished using otopexy sutures without cartilage excision. The position of the otopexy sutures should be shifted slightly posteriorly to prevent narrowing of the meatal opening. In patients with a deep conchal bowl and thick cartilage, cavum rotation cannot be achieved with otopexy sutures alone, as the tension would be too great. These patients require crescent-shaped cartilage excision from the cavum conchae region. Needles can be used to define the depth of cavum conchae and the necessary extent of cartilage excision. Refinements are added depending on the individual situation. As described by Serger, a taut ligamentum auriculare anterius leads to tension in some patients. In this case, the spina helicis can be separated using dissecting scissors from the ligamentum auriculare anterius through a retroauricular tunnel and palpation. In the case of a prominent lobule, a lobuloplasty is performed. We use a technique similar to that described by Gosain and Ricono or by Siegert. Starting from the retroauricular incision, a suture is passed from the skin of the posterior aspect of the lobule into the mastoid fascia, and the lobule is approximated to the mastoid fascia. Alternatively, a subcutaneous pocket is prepared between the anterior and posterior sides of the lobule. Afterward, the subcutaneous layer of the postlobular skin is adjusted and fixed to the conchal cartilage using a mattress suture.

At the end of the operation, the surgeon again checks the ear for important details such as the absence of lobular protrusion and a natural appearance of the crus superius. The final check includes an assessment of the overall aesthetic impression and the position of the auricle. Postoperative measurements are obtained to supplement the aesthetic evaluation. The distance between the lateral helical rim and the mastoid surface is measured in the upper, middle, and lower thirds of the ear. This facilitates a symmetric result on the opposite side and provides an objective baseline for long-term follow-up. A soft dressing is applied to the corrected ear. On the first postoperative day, the dressing is changed. After 1 week, the dressing is removed. The patient is advised to wear a headband for another 4 weeks during sleep and sports. Figure 7 shows typical preoperative and postoperative.
views of a patient who underwent bilateral otoplasty using the Lucerne technique.

RESULTS

Between January 1, 2000, and December 31, 2004, a total of 421 primary otoplasties using a modified anterior scoring technique (Lucerne technique) were performed in 222 patients at our department by various surgeons (C.S.-W., G.P., W.M.) and fellows. The mean patient age was 11 years (age range, 3½ to 31 years) (Figure 8). The most common age was 6 years. Nearly 62% of patients were female (61.9%) and 38.1% male. After otoplasty, some patients had moved from the area without leaving a forwarding address. Seventy-two percent of patients contacted for this study were willing to be examined. Long-term data revealed median auricle lateralizations of 1.9 mm for the right side and 2.1 mm for the left side.

The aesthetic result of otoplasty was rated as “very good” by 71.8% of patients and as “good” by 19.4%; 6.9% of patients thought the result was “satisfactory” and 1.9% “unsatisfactory.” Most patients (92.5%) would undergo the same surgery again, 5.0% were uncertain, and 2.5% would not.

The mean preoperative distances between the lateral helical rim and the mastoid surface for right-sided auricles were 23.3 mm (range, 14-30 mm) at the uppermost point of the helix, 28.6 mm (range, 20-36 mm) at the midpoint of division between the crus superius and inferius, and 23.9 mm (range, 18-35 mm) at the lobule (Figure 9). Preoperative measurements for left-sided auricles were similar.

The mean upper, middle, and lower postoperative distances for right-sided auricles were 14.2 mm (range, 12-17 mm), 14.0 mm (range, 11-17 mm), and 16.1 mm (range, 12-18 mm), respectively, and were similar for left-sided auricles (Figure 9); the mean distances 6 years later for right-sided auricles were 16.0 mm (range, 12-23 mm), 17.5 mm (range, 12-26 mm), and 17.4 mm (range, 12-25 mm), respectively, and were similar for left-sided auricles. Long-term data revealed median auricle lateralizations of 1.9 mm for the right side and 2.1 mm for the left side.

The aesthetic appearance of auricles was analyzed by the examining physician using a list (Table). Adequate symmetry (<3 mm difference between the sides) was not achieved in 18 ears (6.0%). Upper-third protrusion of the auricle was found in 26 ears (8.6%). The position of the helical rim was medial to the antihelix when viewed from the front in 12 ears (4.0%). No significant narrowing of the postauricular sulcus was found in any patient. Overcorrection of the pinna toward the skull was seen in 7 ears (2.3%).

Early complications such as postoperative bleeding or hematoma formation occurred in 2.5% of ears. Change of dressing or spontaneous resolution made revision surgery unnecessary. Superficial skin ulceration in the area of the antihelix due to the pressure dressing or a local skin infection was seen in 3.8% of pinnas. All except 1 of these lesions healed within a few days after ointment treatment locally, without residual skin changes. One small ear scar (0.3%) persisted. Severe pain was reported by 4.4% of patients (almost all younger than 5 years), despite prescription of paracetamol (100 mg/kg of body weight daily). Chondritis or other serious complications did not occur.

Late sequelae were recorded. Complete recurrence of the protrusion was seen in 7 ears (2.3%). Among these patients, the postauricular distance exceeded 20 mm at 2 or more measuring points. In 26 ears (8.6%), partial recurrence of 22 to 26 mm within the upper third of the pinna was observed. Recurrence occurred in 4 of these ears after 1 month, in 15 after 3 months, and in 7 after 12 months, as well as in another 7 ears after more than 12 months (Figure 10). Stitch extrusion occurred in 15 ears (5.0%). After removal of stitches, local infections healed rapidly in all patients without adverse consequences to the shape of the ear. Keloid or hypertrophic scar occurred in 7 ears (2.3%). Four patients underwent additional surgical procedures. Keloid was resected in 2 patients with primary wound closure, while full-thickness skin transplantation from the inguina was performed in the other 2 patients. One of these patients received postoperative radiation therapy to treat inflammation. No patient had keloid recurrence.

COMMENT

Otoplasty to correct protruding ears is standardized, with adjustment for individual conditions. The procedure generally includes the following 3 steps: creation of the antihelical fold, correction of the conchal hypertrophy, and fine-tuning of the lobule. The modified anterior scoring technique to create an antihelical fold is based on considerations by Stenström about the ability of injured car-
tilage to wrap away from an injured surface. Anterior scoring weakens perichondrium and cartilage only to the extent that it can be folded without tension. Postauricular fixation sutures help fix the desired cartilaginous fold in a precise position. In contrast to classic Mustardé-type sutures, they do not pull on cartilage because it has been weakened by anterior scoring. In our opinion, the combination of anterior scoring with postauricular fixation sutures enables stable and predictable long-term results. Tan13 documented fewer reoperations after otoplasty using anterior scoring (10%) compared with the method by Mustarde´ (24%). The anterior scoring technique may initially be more demanding than other techniques in addressing cartilage on the posterior side. However, once the antitragohelicine fissure is properly exposed and the anterior skin is undermined, the curved rasp can easily be introduced. We adapted the shape of the rasp so that either end fits in children and adults. Although anterior roughening of perichondrium may initially cause slight swelling, scoring results in a natural and rounded appearance of the antihelical fold. Thinning or excising cartilage from the posterior side may lead to sharp edges (Figure 11).

Our long-term analysis revealed complete recurrence of the protrusion in 2.3% of auricle corrections and partial recurrence in 8.6%. Recurrence rates vary between 10% and 15% in the literature.14 However, many data are based on short-term results (3-6 months). Partial recurrences in our series mainly affected the upper third of the concha. This has already been described in the literature 13,15. In recent years, we adapted our technique and recommend a triangularis-temporalis fascia suture as described by Adamson et al.15 This has significantly reduced partial recurrences in the upper third of the concha.

To our knowledge, there has been no broad long-term study of the results of otoplasty using standardized measurements. Some long-term investigations have been based on patient satisfaction questionnaires or subjective physician assessments. In a study by Messner and Crysdale,16 31 patients underwent otoplasty using a suture-only technique, with a mean follow-up period of 3.7 years. One-third of ears returned to their preoperative position, one-third remained in the postoperative position, and one-third were between the 2 positions. In contrast, long-lasting improved results were attained among our cohort of 222 patients with a mean follow-up period of 6.25 years who underwent otoplasty using a modified anterior scoring technique combined with postauricular fixation sutures. A median 2-mm lateralization of the au-
The article was observed. Therefore, slight overcorrection of 2 mm during surgery is recommended. We attempt to obtain intraoperative measurements of 13 mm at the upper pole, 14 mm in the middle, and 15 mm at the lobe. However, these intraoperative distances are only a guideline. The focus of the operative technique is always the overall aesthetic appearance.

Because of limited skin excision, no significant narrowing of the postauricular sulcus was documented at any long-term follow-up visit. Access via the postauricular sulcus requires slightly longer skin preparation on the rear surface of the auricle to display the antitragohelicine fissure and to place posterior fixation sutures of the antihelix fold. However, it provides advantageous exposure for cavum rotation or cavum reduction. Therefore, concha-mastoid sutures can be positioned far posteriorly, avoiding narrowing of the entrance to the external auditory canal.

In conclusion, otoplasty using a modified anterior scoring technique combined with postauricular fixation sutures provides long-term improved results in 91.2% of cases and an aesthetically appealing pinna with a natural crease of the antihelical fold. Complications and sequelae are few, and rates are comparable to those of other long-term studies. A 2-mm lateralization of the auricle may be expected but is too slight to be noticed by patients or caregivers. Standardized measurements of the auricle are important because they supplement the overall aesthetic evaluation of the corrected ear and provide an objective baseline for long-term follow-up.

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