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Review Article

Cartilage-sparing otoplasty: a review with long-term results

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Abstract
Prominent ears are the most frequent congenital deformity in the head and neck region. Anatomy of normal and prominent ears as well as the psychological aspects of prominent ears are reviewed. Two types of surgical technique are described with emphasis on the cartilage-sparing technique.

A sound pre-operative analysis, focusing on all parts of the deformity, and surgical techniques which are gradually applied to these deformities should result in pleasing, permanent changes for the vast majority of patients. In our opinion, a combination of cartilage-sparing techniques augmented with cartilage-weakening procedures give predictable long-term results with a natural appearing ear and concomitant few, easily treated complications.

Key words: Ear cartilages, surgery

Introduction

Prominent ears are the most frequent congenital deformity in the head and neck region. Anatomy of normal and prominent ears as well as psychological aspects of prominent ears will be briefly reviewed. For the correction of this congenital deformity essentially two different techniques can be distinguished: cartilage-sparing and cartilage-cutting techniques. However, only a few of the enormous number of publications on surgical techniques for prominent ear correction report on long-term results (more than one year) (Ohlsen and Vedung. 1980: Nielsen *el al,* 1985; Rasinger *el al.* 1993). Only two of these (Ohlsen and Vedung, 1980: Nielsen *'ei aL* 1985) used objective criteria for evaluatiön. both of cartilage cutting techniques. The purpose of this article is to explore a series of 43 patients in whom 80 ears were operated upon, using a carlilage-sparing technique almost exclusively with a minimal follow-up of one year. Objective criteria accordins to McDowell (1968) and Wright (1970) were used for evaluatiön purposes.

Anatomy

The typical analomical structure of the lateral side of the pinna is depicted in Figure 1. The shape of the pinna is derived from a cartilage plate which during growth and, particularly in adults. becomes ihicker and stiffer. The concha in particular plays a role in the interception of sound waves (Becker. 1949).

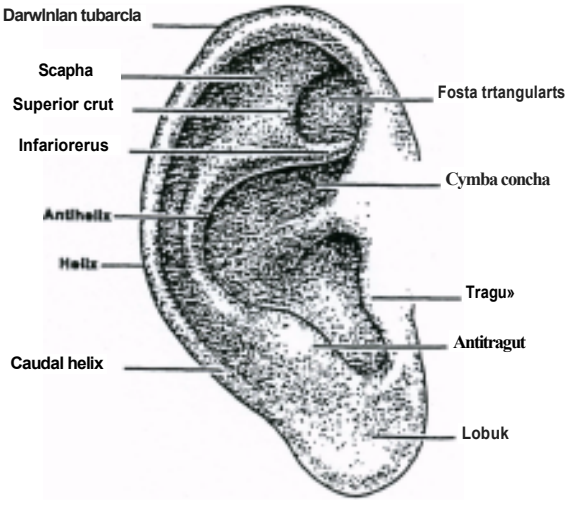

FIG. 1
Anatomical landmarks of the normal ear (laieral side) (reprimed with permission of J. P. Lippincott Co. From: *Aesihetic Facial Surgery,* (1991) Chapler IV. p709. Fig. 40-1).

One-third of the medial surface of the auricle is directly attached to the skull. An anterior and posterior ligament provides stability to the pinna (Webster and Smith. 1980). The vascular supply of the ear arises principally from the posterior auricular, superficial temporal and occipital artery. The vascular support of the auricle is substantial. rarely being of concern for any surgical technique.

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At one year of age the ear measures approximately five cm in verticaJ height. This is only one cm smaller than the adult ear (Mallen, 1974). Adamson *el al* (1965) has shown that 85 per cent of the auricular growth has been achieved at three years. In contrast to the growth of the cartilaginous part of the nose, auricular cartilage growth is thus nearly completed at the age of five or six years. This permits corrective surgery from five years on. Fears of diminished growth after surgery are unfounded (Balogh and Millessi, 1992).

Aesthetic parameters

It should be noted that 'normal' ears often are asymmetrie with respect to position, size and degree of protrusion. The auriculocephalic angle varies from 25 to 30 degrees. An angle of more than 40 degrees is often considered abnormal (Mallen, 1974). The distance from the helix to the skull varies from 15 to 20 mm. The distance of less than 10 mm is unnatural and gives a 'glued-on' appearance. In A-P view and on lateral view the helix and lobule should form a flowing line without obvious interruption.

A number of deformities may be the cause of prominent ears. The most frequent deformity is lack of or underdevelopment of a normal antihelical fold. The concha and scapha are not separated by a definite fold, causing a protrusion of the upper part of the auricle. A high conchal wall can occur, either as a single deformity or in combination with underdevelopment of the antihelical fold (Figure 2). Finally, the lobule may be protruding, mainly caused by the lateral position of the cartilaginous helical tail (Beernink *et al,* 1979).

FIG. 2

Patiënt with underdeveloped antihelical fold, high conchal wall and protruding earlobe. (Reproduced with permission of person involved).

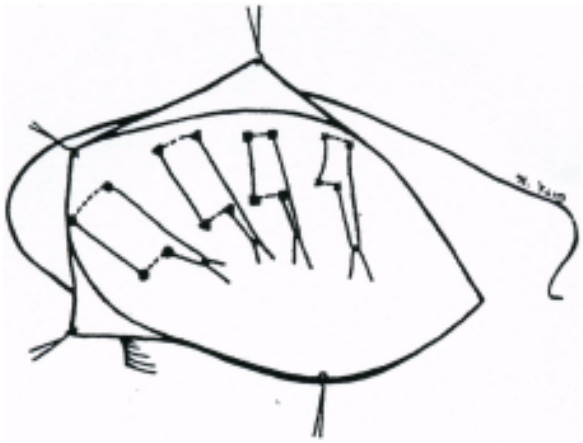
Psychology

Prominent ears occur in approximately five per cent of the Caucasian race (Appaix *et al.,* 1968). Two-thirds of the patients so affected have a positive family history (Rhys Evans, 1981). A large number of psycho-social publications stress the importance of appearance on judgement on first impression (Dion *et al,* 1972; Cash, 1980) and its role in daily social interaction (Reis *et al,* 1982). As early as 1949 a feeling of insecurity was said to be associated with prominent ears (Becker, 1949). However, adequate research on the psycho-social aspects of this frequently occurring congenital deformity is rare. Young children with prominent ears report a significantly higher level of teasing than the normal population (Bradbury *et al,* 1992) and this scienti-fically supports the idea that in Western cultures, prominent ears are often a cause of ridicule. In Bradbury's study, otoplasty was rated as extremely satisfying in 90 per cent of children and parents. Improvement or personal happiness was significantly greater than improvement in social experience. The measured social gains were probably a result of increased self confidence. However, evidence of marked social isolation and acute distress preoperatively may be poor selection criteria. Clinical studies (Becker, 1949; McGregor, 1978; Bradbury *et al.,* 1992) and our own observations confirm that prominent ears may indeed be considered as an aesthetic handicap. From a psychosocial perspective, otoplasty may be a satisfactory solution in the majority of cases (Bradbury *et al.,* 1992).

Diagnosis

As for any aesthetic procedure, the patiënt should clearly describe the defect, as well as his motivation and expectations for correction. In analysing prominent ears one should direct attention to the underdevelopment of an antihelical fold, the height of the conchal wall and the position of the lobule. One should also judge the stiffness of the cartilage and note any asymmetry. Medical history should cover bleeding disorders, keloid hypertrophic scars as well as any medical and psychological contra-indications for surgery. Photography is the basic documentation for facial plastic and reconstructive procedures and, for this deformity, A-P, lateral, three quarter and P-A views should be available.

The possibilities, impossibilities, as well as complications of surgery should be clearly discussed with the patiënt (Vuyk and Zijlker, 1995). Written information on this subject is of great importance for patiënt education. To further educate the patiënt with regard to the possible surgical result, the ears can be manipulated and set back with the patiënt looking in the mirror. Computer imaging is a form of interactive communication using video camera, computer and television screen which enables the anticipated results to be shown without the hands of the surgeon being in view. A video print may then be given to the patiënt.



Fic.3
Retroauricular mattress suturing after Mustardé for re-creation of the antihelix (reprinted with permission of *Journal of Otolaryngology,* Canada, 1987; 16 (4): 258-262.

The goal of otoplasty

The goal of otoplasty is normalization of shape and position of both pinnas with a certain symmetry. The distance measured from the free edge of the helix to the skull should be less than 20 mm, and ideally measures 15 mm (Wright, 1970). Some undercorrection of the lower part of the ear with normal correction of the upper pole is acceptable.

Overcorrection is not to be aimed for and the retro-auricular sulcus should be maintained to facilitate the use of glasses. Some asymmetry does occur between normal ears. The criteria mentioned above may be used for evaluating the results of surgical correction of prominent ears (McDowell, 1968; Wright, 1970) (Table I).

Technique

The surgical technique should be individualized to the patiënt Each of the three anatomical deformities of the prominent ear (underdevelopment of the antihelical fold, high conchal wall and prominent lobule) should be evaluated separately and treated. Surgical correction of prominent ears in adults may

TABLE I
GOALS OF OTOPLASTY ACCORDING TO MCDOWELL/WRIGHT

1. All tracé of protrusion in the upper one third of the ear must be corrected. (Some remaining protrusion in the middle third or lower portions may still be acceptable, provided the superior aspect is thoroughly corrected; however, the reverse does not hold true).
2. From the front view, the helix of both ears should be seen beyond the antihelix (at least down to the mid-ear, and preferably all the way.
3. The helix should have a smooth and regular line throughout.
4. The postauricular sulcus should not be markedly decreased or distorted.
5. Protrusion should measure between 15 and 20 mm from the helix to the head.
6. Position of the two ears (i.e., distance from the lateral border to the hcad) should be within 3 mm at any given point.

Fic.4
Post-operative detail of left ear of patiënt depicted in Figures 2 and 3 (reprinted with permission of person involved).

be performed under local anaesthesia and sedation, but in children general anaesthesia is always used. Surgery is done as a day-case.

Using a lenticular excision redundant retro-auricular skin is first removed. The posterior perichondrium is then stripped bare of subcutaneous tissue to facilitate post-auricular scar formation in the posterior trough formed by the neoantihelical fold. Following Mustardé's description (1963), we prefer the use of permanent sutures to recreate the antihelix. Three to four retroauricular positioned mattress sutures reaching under the lateral skin and incorporating perichondrium and cartilage are used (Figure 3). A round, naturally curved antihelix may be created depending on the position and tension on the sutures. Onlyin the case of very weak auricular cartilage is it possible to medialize a high conchal wall by incorporating it in the lower part of the newly created antihelical fold. Scoring of perichondrium and cartilage can cause irregularities but may be indicated in cases of thick, stiff cartilage in adults.

The height of the concha is lowered by excising the soft tissues lying between the conchal bowl and the skull as well as by shaving off the prominentia of the concha and fossa (Webster and Smith, 1980). Following Furnas' description, the concha may be set back and repositioned closer to the skull using

several permanent mattress sutures reaching from the conchal wall to the periosteum of the mastoid (Furnas. 1968). Repositioning is possible while preventing any distortion of the introitus of the cartilaginous ear canal. The suture material used should be strong enough and long-lasting enough to hold the cartilage in shape and position until scar tissue forces take over, and should be clear or white to prevent any discolouration under the skin.

The lobule may be corrected using skin excision and incision of the helical tail; sometimes it may be necessary to combine this with mattress sutures to the concha to medialize the helical tail as well as the lateral surface of the lobule. The lobule can only be corrected to a certain degree. Overcorrection may give an aesthetic deformity of the lobule. A prominent lobule may be a limiting factor in the correction of prominent ears.

The retroauricular skin excision is closed with 5-0 fast absorbing vicryl. A head dressing is used in adults for one day and in children for three days: the ears are subsequently supported using a headband.

Patiënte and materials

Out of a series of 120 patients operated upon for prominent ears from 1989 till 1994,43 were followed up for a minimum of 12 months. This series includes 31 males and 12 females. The age varied from 4.5 to 49 years (with a mean of 16 years). A unilateral deformity was found in six patients and a bilateral deformity in 37. A total of 80 ears was studied. Six ears (four patients) were operated upon previously elsewhere and revised to be included in this series. In two ears a suture granuloma was removed in the first stage, before definitive surgery was undertaken to the prominent ear.

Underdevelopment of the antihelical fold, high conchal wall and prominent lobule were diagnosed respectively in 77, 78 and 18 ears. Thickness of cartilage varied, but seemed to increase with age. In 77 ears. the antihelical fold was formed using mersilene in 34 cases and gortex sutures in 43 ears. To decrease tension on the sutures, cartilage strength was diminished along the projected antihelical fold using Stenström scoring technique in six ears (Stenström, 1963).

The high conchal wall was lowered in 78 ears, using Mersilene sutures in 73 and Goretex sutures in five ears. To decrease the tension on these concha-mastoid sutures soft tissues were removed from under the concha in 58 ears, while cartilage was shaved off the undersurface of the concha in 28 of the 78 ears.

Results

Evaluation of the results was performed using the criteria formulated by McDowell (1968) and Wright (1970) (Table I). The mean time to follow-up was 22 months (range 12-46 months). Asymmetry (criterium 6) was noticeable in 10 ears, and of these, seven were undercorrected and three were overcorrected

FIG. 5'
Two years post-operative result of patiënt depicted in previous figures (reprinted with permission of person involved).

in the upper pole (criterium 5). The mean age of the five patients with seven ears demonstrating under-correction was 29 years (range six to 49 years) and these included the only three patients within the 43 cases who were 36 years or older. In the seven ears showing undercorrection, the number of sutures used for antihelix formation or conchal repositioning were comparable to the number of sutures used in the rest of this series. One of the older patients (45 years) had a revision operation on both ears. In all other ears the helix was lying behind the antihelix in the A-P view while the helix showed a flowing curve. In 78 ears a normal retroauricular sulcus was noted. In one patiënt the retroauricular sulcus of both sides was obliterated after previous surgery at another institute, which was not worsened after our operation. The operative result in 70 of the 80 ears was considered successful since all the criteria of McDowellAVright were met post-operatively. Figures 2, 4 and 5 iilustrates one of the results in this series.

Complications

One patiënt developed a post-operative haema-toma which resorbed spontaneously. In a few patients the ear was slightly tender after surgery, especially in cold weather. Keloid or hypertrophic scars were not seen, and the retroauricular sulcus was maintained.

In one of the six ears, where Stenström scoring was used, the antihelical fold was slightly irregular. In 10 ears part of the suture was extruded and in a few patients this occurred with a concomitant, minor local infection. In Table II the number of different suture materials used is depicted according to location. For the creation of the antihelical fold Mersilene showed a higher extrusion rate than Goretex, while Goretex was more prone to be extruded when used for conchal repositioning. In every case the problem of suture extrusion could be

TABLE II
OVERVIEW OF PERMANENT SUTURE MATERIAL USED FOR OTOPLASTY IN THIS SERIES OF 80 EARS ACCORDING TO LOCATION, EXTRUSION AND FOLLOW-UP

Suture material	Location	Number of ears	Total extrusion (%)	Mean follow-up in months
Mersilene	Antihelix Concha Antihelix	34 73 43 5	5 3 1 1 (15) (4) (2)	23 21 19 17 (12-56) (12-56)
Mersilene Goretex Goretex	Concha		(20)	(12-32) (15-18)

solved simply by cutting the suture and treating the wound with antibiotic ointment, which was supplemented in some cases by the use of oral antibiotics. Overall, suture extrusion occurred two to 24 months post-operatively (mean 15 months) but, Goretex sutures were extruded earlier (two and three months) than Mersilene (18 months; 12-24 months). All sutures, except one, were extruded retro-auricularly. Cutting and partial removal of the sutures did not result in a recurrence of the deformity in these patients.

Discussion

A plethora of techniques for otoplasty are described in the literature. Out of a series of 60 publications we have reviewed, only a few have used objective criteria to assess their results (Minderjahr *et al,* 1980; Ohlsen and Vedung, 1980; Nielsen *el al.,* 1985; Adamson *et al,* 1991). Studies involving long-term follow-up (more than one year) are even more infrequent (Ohlsen and Vedung, 1980; Nielsen *et al,* 1985; Rasinger *et al,* 1993) and only two (Ohlsen and Vedung, 1980; Nielsen *et al,* 1985) used objective criteria after long-term follow-up. Ohlson and Vedung (1980) described a series of 48 patients with protniding ears after a modified perichondrioplasty combined with conchal cartilage resection. Subjective assessment showed 80 per cent of the patients very satisfied with an additional 15 per cent reasonably satisfied. Objective assessment was performed using McDowell's criteria (McDowell, 1968) and all McDowelFs criteria had been attained in 50 per cent of the patients. In an additional 45 per cent of the patients only one or two of the goals were not completely attained. Nielsen *et al.* (1985) described a series of 74 patients after Stenström (1963) otoplasty in combination with subcutaneous mattress suturing. Subjective success rate was good in 80 per cent and fair in 17 per cent. Using McDowell's criteria the complete success rate was nearly 60 per cent. Undercorrection and a sharp antihelix was one of the most frequent problems encountered.

The objective success rate of both studies is low compared to the subjective patiënt rating. This might particularly be due to McDowelFs suggested ideal distances from helix to mastoid which, in our mind, would present an unnatural overcorrected appearance. Indeed McDowell's distances are smaller and have a narrower range then the distances proposed by Wright which have been used together with the other criteria of McDowell in this study (Wright, 1970). In our series, encompassing 43 patients, a combination of cartilage-sparing techniques, gradually applied, resulted in 70 of the 80 ears (88 per cent) fulfilling the criteria of McDowellAVright after a minimal follow-up of one year. This percentage compares favourably with two other long-term follow-up studies (Ohlsen and Vedung, 1980; Nielsen *et al.,* 1985) using different operation techniques.

McDowell and Wright should be credited for establishing criteria for objective assessment of otoplasty results (McDowell, 1968; Wright, 1970). However, the measurements of ear protrusion themselves have a certain variability depending on the relative positions of the examiner's and patient's head as well as due to differences in position of the measuring tooi. Moreover, McDowell and Wright criteria do not account for differences in relationship between the shape of the head and position of the ear. For example a triangular-shaped face with normal ear position according to McDowell may still leave a sense of under-correction of both upper poles as they protrude more laterally than the lower poles. Furthermore, adults have a wide variability in head size and ear size, and therefore the degree of lateralization of the ear and size of the ear will also have an impact on the subjective sense of the position and shape of the ear. Moreover, hairstyles which extend at all from the side of the head obviously tend to make ear projection look less prominent.

A preliminary study (Vuyk *et al.,* 1994) including 62 patients after a relatively short follow-up (mean eight months, one to 29 months) showed a success rate of 92 per cent. The decrease in success rate after a longer follow-up is mainly due to the increased number of undercorrected ears. Adamson *et al.* (1991) using pre- in tra- and post-operative measurements showed that in the post-operative phase some loss of correction should be anticipated in nearly every patiënt. These findings, together with our slightly decreased success rate stresses the need for long-term follow-up for evaluation of otoplasty techniques. A loss of correction is possibly due to a cutting through of the cartilage and soft tissue by the suture material. In anticipation of this phenomenon, slight overcorrection of the upper fold in particular should probably be carried out. With regard to loss of correction, age-related cartilage stiffness does seem to be a significant factor. Indeed, the only revision operation was performed in an older patiënt with stiff cartilage in both ears and in those patients the chance of recurrence is significantly higher (Minderjahr *et al.,* 1980). In such patients conchal cartilage shaving or antihelix cartilage weakening with scoring is probably indicated to overcome the high tension on the sutures (Wright, 1970).

In this series, the problems of cartilage-sparing techniques used are mainly due to suture extrusion. In 10 (13 per cent) of the 80 ears sutures were extruded which was relatively easily solved in all cases. The object of unabsorbable suture material is to keep the cartilage ear in shape and in position over the long-term. The suture material should, therefore. keep its strength and be well accepted by the body. Only unabsorbable sutures seem to fulfill these criteria. In general monofilaments (nylon, Goretex) will give less reaction than woven material (Mersilene, silk). However, monofilament sutures are more difficult to tie while maintaining tension when compared to woven material. Moreover, a knot of Goretex (needing eight throws) is more bulky than the knot of Mersilene (four throws only). The volume of the Goretex knot may account for the \ higher extrusion rate when Goretex was used for conchal repositionüig. The knot normally lies halfway on the concha wall and remains relatively superficial under the skin. On the contrary, for antihelix reformation, the knot of the Goretex suture normally lies deep in the newly formed fold. The problems of extrusion with Mersilene and Goretex have not been serious and have not led to a recurrence.

The retro-auricular scar tissue probably forms the basis for eventual strength of repair while maintaining the shape and the position of the cartilaginous ear (Rigg, 1979; Tardy and Dennis, 1981; Adamson *er al.,* 1990). The success of Goretex as a biomaterial is probably due to the ingrowth of fibroblasts in its porous substance.

Controlling the degree and position of antihelix folding as well as the helical position, is a basic requirement in otoplasty. It is our opinion that cartilage-sparing techniques offer the surgeon the opportunity to achieve a good result without disrupting the structural integrity of the ear. With cartilage cutting. precise control of the point at which weakening will produce bending is difficult, and each increment of change is irreversible as shaping proceeds. Most importantly, cutting techniques irreversibly subject the antihelix area to unpredictable distortion by wound contraction forces long after the operation. Cartilage weakening techniques with incision. excision or aggressive scoring may also cause unattractive and painful ridging.

The goal of this study was to determine the value of cartilage-sparing techniques in terms of results and complications. This European study confirms previous publications (Tardy and Dennis, 1981; Adamson *ei ai.* 1991). It has not been the purpose of this communicalion to compare cartilage-sparing techniques to cartilage-incision techniques or lo champion one over the other. However, suture techniques have the advantage of modulating the degree of change in sequential increments and the changes remain reversible. The number of surgical revisions of otoplasty in general (Minderjahr *et al.*. 1980: Nielsen *et al.*. 1985: Adamson *et* «/., 1991) and the possible complications (Goode *et al.*. 1970; Adamson, 1985) compel us to pay respect to what is oflen considered a 'small operation'.

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