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ORIGINAL ARTICLE

Double Helical Rim Advancement Flaps With Scaphal Resection: Selected Cases Over 10 Years and Review of the Literature

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Abstract
Background Auricular surgery is a challenging subject in plastic surgery due to the complicated surface topography of the external ear. Although various techniques for ear reduction and helical rim reconstruction have been reported in the literature, an ideal method is yet to be defined. Double helical rim advancement flaps with scaphal resection presented in this report represent a practical technique for correcting macrotia and reconstructing helical rim defects.
Methods The amount of full-thickness resection at the helical rim is planned according to the desired reduction or extent of tumor. After helical excision, an incision that transects all the layers of the ear is carried out along the helical sulcus inferiorly and superiorly to yield two advancement flaps. Using scissors, a crescent from the scapha is excised through the full thickness of the ear. The flaps are approximated and sutured to the scapha by means of stitches that pass through skin and cartilage.
Results The described technique has been performed successfully since 1998. It has been used for 12 cases of macrotia, 28 cases of tumor surgery, and 7 cases of ear reduction for asymmetric ears. No major complications have been encountered. Three cases are reported as examples of the procedure.
Conclusions Double helical rim advancement flaps with scaphal resection represent a versatile and safe technique that can be used for ear reduction, helical rim reconstruction, and correction for discrepancy in size of ears.

Keywords Macrotia · Double helical rim advancement flaps · Ear reduction · Helical rim reconstruction · Ear reconstruction

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"The main job of an ear is to sit on the side of the head and not draw attention to itself" remarked Mobley [13] in the preface he wrote for an edition of the *Facial Plastic Surgery Clinics of North America*. This quote gives us an idea about the main principle of auricular surgery, which is to achieve ears symmetric in size and shape and acceptable in terms of aesthetic appearance.

Surgeons operate on ears to reconstruct ear defects, correct a malformed auricle, reduce a discrepancy in size, or achieve an aesthetically more pleasing ear. Whatever the reason for the surgery, the external ear has an intricate surface topography that is a challenge to reconstruct. A vast number of surgical techniques for various purposes are reported in the literature, and an ongoing search for better shape and symmetry exists.

The double helical rim advancement flaps with crescentic excision from the scapha represent a practical technique that can be used for ear reduction, reconstruction of helical rim defects, and correction of ear size discrepancies. We previously published a brief description of this method [18]. With this article, we aim to describe the technique in more detail and provide a thorough discussion regarding its indications and outcomes. Evolution of current concepts of ear reconstruction also is discussed, and a comprehensive

review of existing methods, including advantages and disadvantages, is presented.

Since 1998, we have performed this technique for 12 cases of macrotia, 28 cases of tumor surgery, and 7 cases of asymmetric ears. Three cases are reported as examples of the procedure.

Patients and Methods

Surgical Technique

Preoperative planning for the patient begins with skin markings on the helical rim (Fig. 1). For patients undergoing tumor surgery, the lesion is marked with safe excision margins. For cases of macrotia and asymmetry, the resection at the helical rim is determined according to the required reduction in height or width. The helical sulcus also is marked on the anteroauricular surface in inferior and superior directions to guide the clinician during elevation of flaps.

A circumferential regional auricular anesthesia with additional infiltration of the helical rim and scapha is initiated. A full-thickness excision of skin and cartilage from the helical rim is made with the help of a no. 11 scalpel (Fig. 2). Next, an incision that again transects all the layers of the ear is made along the helical sulcus inferiorly and superiorly to yield two advancement flaps (Figs. 3, 4). The inferior helical flap can be extended to the upper limit of the lobule and the superior flap to the helical root at most (Fig. 5). The resulting double chondrocutaneous flaps then are approximated with the help of a transient fixation suture to determine the amount of scaphal cartilage to be resected (Fig. 6). The projection of the new helical rim on the scapha is marked, and a crescent-shaped excision from the scapha is planned and performed via scissors through the full thickness of the ear (Figs. 7, 8). This maneuver provides accurate approximation of helical rims without distortion and prevents cupping. It also yields proportionate reduction of the ear in both the vertical and horizontal dimensions.

Fig. 1 Preoperative skin markings are made on the helical rim and scapha

Fig. 2 Adequate resection is completed on the helical rim

Fig. 3 Double helical rim advancement flaps are mobilized

Fig. 4 Incision transects all layers of skin and cartilage

Fig. 5 Extent of flap elevation is demonstrated

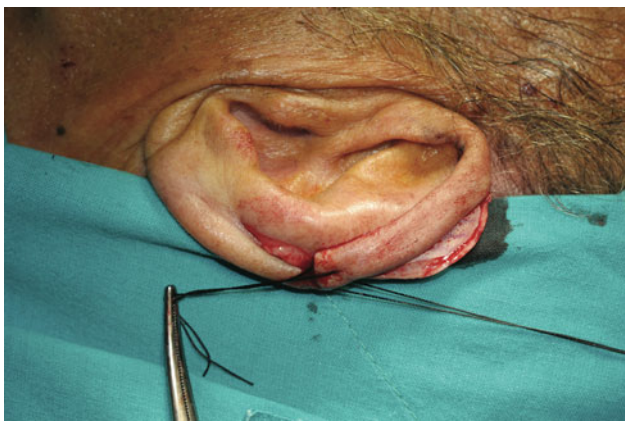

Fig. 6 Amount of scaphal resection is predicted

Fig. 7 A crescent-shaped cartilage from the scapha is excised

For correction of macrotia or asymmetry, the position of the crescentic resection can be arranged to achieve reduction in either the height or width of the ear. The edges of the helical rims are further trimmed in a tongue-and-groove fashion to avoid notching of the helical rim.

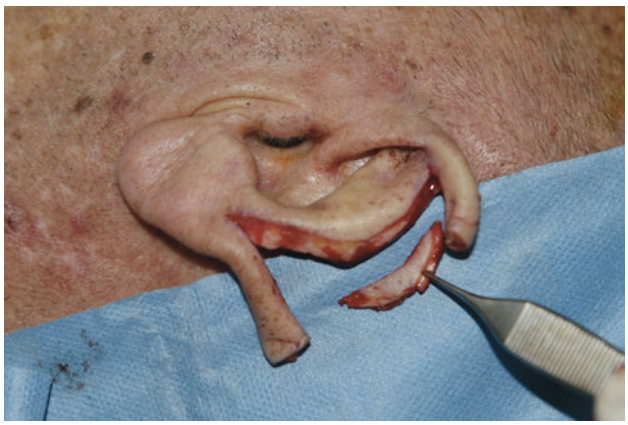

Fig. 8 Scaphal excision is demonstrated

Fig. 9 Flaps are sutured to the scapha

After mobilization of flaps and resection from the scapha has been completed, the flaps are approximated and sutured to the scapha by means of stitches that pass through skin and cartilage (Fig. 9). Additional cartilage-to-cartilage sutures can be used occasionally. In most cases, stitches that transect skin and cartilage together will provide sufficient strength and durability. A light dressing is applied that covers the suture lines. Postoperatively, the patient returns to his normal life within a short recovery period, and early results of the operation are satisfactory, with minimal edema and scarring.

Case 1

A 35-year-old man complaining about the vertical size of his ears underwent surgery for correction of macrotia. His ear height was 72 mm on the left and 75 mm on the right (Figs. 10, 11). After a successful operation, the ears were reduced to 66 mm. The incision scars were hidden in the helical sulcus, and the scar on the outer surface of helical rim was almost indiscernible (Figs. 12, 13).

Fig. 10 Case 1. The patient has macrotia, which is especially evident on the upper pole

Fig. 11 Scaphal resection is placed on the upper pole to correct the deformity

Fig. 12 The ear is reduced from 75 to 66 mm

Fig. 13 Late postoperative view

Fig. 14 Case 2. The patient has a keratoacanthoma on the helical rim

Case 2

An 80-year-old man with a keratoacanthoma on the helical rim underwent resection of the tumor. The resulting defect, approximately 12 × 20 mm in size, was reconstructed with double helical rim advancement flaps (Figs. 14, 15). The recovery period was short, and he was satisfied with the result (Fig. 16).

Case 3

A 15-year-old boy with a diagnosis of blepharophimosis was referred to the outpatient clinic for the asymmetric appearance of his ears. Preoperative evaluation showed protruding ears bilaterally and an additional cup ear deformity on the right side. The boy's ear height was measured as 52 mm on the right and 60 mm on the left

Fig. 15 The tumor is excised, showing a full-thickness defect

Fig. 16 Late postoperative view

Fig. 17 Case 3. The patient has a cup ear deformity on the right side

(Figs. 17, 18). He underwent surgery to reduce the vertical length of the left ear so it would match the contralateral ear, and the protruding ear deformity was corrected with conchascaphal sutures. The scaphal resection from the left

Fig. 18 The left ear is larger than the contralateral ear

Fig. 19 Early postoperative view with the cup ear deformity corrected

side yielded a cartilage graft in a crescent shape, which was sutured to the posterior aspect of the helical rim on upper pole of the right ear to address the cup ear deformity (Figs. 19, 20).

Discussion

Auricular surgery is a demanding procedure, whether performed for aesthetic or reconstructive purposes. It is difficult to mimic external ear contours, and the surgeon must maintain the normal appearance and curvature of auricular components. Symmetry of shape, size, and protrusion; compatible dimensions; and smooth transitions between anatomic landmarks have to be acquired. Careful analysis of the deformity, appropriate reconstructive decisions, and meticulous dissection ensure favorable outcomes.

In the literature, various surgical techniques relating to ear reduction and helical rim reconstruction have been

Fig. 20 Early postoperative view with the ear reduced from 60 to 53 mm

discussed, but an ideal method to serve all needs is yet to be defined. Double helical rim advancement flaps with scaphal resection is presented as an alternative technique that can be used for both correction of macrotia and reconstruction of helical defects.

Knowledge of vascular anatomy precedes any attempt at flap surgery of the auricle. Cadaver studies by Park et al. [14] have shown that the auricle has a well-developed vascular system with interconnections of arterial branches. The postauricular surface is supplied mainly by the posterior auricular artery, whereas the anteroauricular surface is supplied by the superficial temporal artery, which has ascending subbranches to the helical rim. Constant perforators from the posterior auricular artery can be identified on the anterior auricular surface of the helical root, earlobe, concha, and triangular fossa. Thus, helical flaps with minimal or no bridge of postauricular and anteroauricular skin can be nourished if these perforators and subbranches are preserved [14].

Our experiences with the technique of double helical rim flaps have shown that the blood supply of the flaps was not compromised in any of the patients. No necrosis was seen on helical flap margins. This observation parallels those of other studies in which helical rim flaps with no posterior attachment were safely elevated [4, 10]. Preserving the posterior skin pedicle for nourishment of chondrocutanous flaps as advocated by several authors is not essential.

Ears congenitally oversized are defined as macrotia, and although this can be a displeasing condition for some individuals, the number of patients seeking a solution for this specific deformity is not high. As a result, ear reduction is not a commonly performed operation.

One of the first defined methods for ear reduction is simple wedge excision and direct closure, but this approach often results in cupping of the ear [2, 21]. If additional triangular or crescent-shaped segments are removed to prevent cupping, cruciform scars are visible on the lateral surface of the ear [2, 4, 21].

In 1967, Antia and Buch [1] described the chondrocutaneous advancement flap technique for reconstruction of upper pole defects of the ear. With this method, the helical rim is incised through the anterior skin and cartilage, whereas the posterior auricular skin remains intact to supply the composite flap. The postauricular skin is freed completely from the conchal cartilage and postauricular sulcus to achieve advancement of the flap. This technique was adapted for ear reduction by Argamaso [2], Gault et al. [7], Davis [5], Zenteno [23], and Yuen and Coombs [22]. These authors used the principle of elevating helical rim flaps based on the posterior skin pedicle but further modified the technique by variable incisions and additional resections.

The skin elevation methods mentioned earlier have mutual problems resulting from extensive dissection of postauricular skin such as hematoma, increased operation time, prolonged postoperative edema, persistent ecchymosis, and delayed recovery. Unintended breaking of cartilage during dissection also is a concern. Additionally, the preserved postauricular skin pedicle causes incomplete mobilization of the helical flaps. Another important difference between these methods and ours is that the final result is not instantly shown during the operation without redraping of the skin flaps.

Yuen and Coombs' [22] method of ear reduction emphasizes the importance of a proportionate reduction. Although the majority of macrotia cases have excess in the upper pole [7], the lobule also can be of inappropriate length. The authors perform a scaphal resection while elevating the helical rim on a posterior skin pedicle to address the upper one-third of the ear. The ear lobe also is raised as a posterior pedicled flap, and resection is performed according to the desired reduction and elevation of the lobule. Our technique also has a similar elevation effect on the ear lobe because the intact attachment of the inferior helical rim flap to the lobule causes the lobule to move superiorly when the flaps are sutured.

Another ear reduction method reported by Hinderer et al. [8] consists of a triangular resection from the upper pole, with the base of the triangle on the superior helical rim. The skin and cartilage excisions are performed at different sites to avoid superposition of suture lines.

Finally, there are posterior approaches for ear reduction in which ear cartilage is skeletonized through a posterior skin incision [20, 21]. Cartilage from the upper and middle poles can be either resected [21] or incised and overlapped [20]. The skin is redraped on the new cartilagenous framework [20, 21]. Although these techniques leave no scars on the lateral surface, the operation requires extensive dissection and delays recovery time. Risk of hematoma, infection, and prolonged edema also is high for the same

reason, and the cartilage reduction may not be fully projected to the final result. The uneven appearance of the underlying cartilage framework also is a concern [20].

Acquired helical rim defects resulting from trauma, burns, and tumor excision also can be addressed by the technique we describe. Such defects can be very noticeable and disfiguring for the patient, and it is a difficult task to duplicate the curl of the helical rim.

In the literature, various methods are described for reconstructing marginal defects of the ear [1, 3, 4, 6, 10–12, 15–17, 19]. Wedge excision is the simplest of the methods, but cupping deformity, notching of the rim, and visibly widened scars limit its use [4, 6, 12]. The concern for cupping may even compromise adequate margins of resection. In search of a better shape, helical rim flaps were developed, and superior results were achieved [1, 12, 16]. As discussed earlier, chondrocutaneous helical rim flaps based on a posterior skin pedicle constitute the base upon which similar techniques have been practiced [3, 4, 6, 10, 11, 16].

Calhoun et al. [4] published an article describing the biomechanics of helical rim advancement flaps. Their method consists of double rim flaps with no attachment to the postauricular skin. There also is additional excision of a Burow triangle from the upper pole of the ear and shaving of a few millimeters of scaphal cartilage. Their article mentions that this maneuver does not prevent cupping deformity.

With our technique, the amount of scaphal full-thickness resection is more (Fig. 8), and cupping deformity is avoided. The tension on the flap edges also is markedly reduced. Additionally, the resection can be placed in the upper or middle pole to arrange the amount of reduction in the height or width of the ear, respectively. An aesthetic result and high patient satisfaction with no compromise in safe resection margins can be achieved.

Finally, double helical rim flaps with excision from the scapha also can be used to correct ear size discrepancy. An existing asymmetry between ears can be corrected with reduction of the larger ear, as reported in the third case. An iatrogenic size discrepancy may occur after tumor surgery, and the larger contralateral ear can be reduced with this technique. We have been using this technique since 1998 without major complications. As stated previously, no necroses of helical flaps, chondritis, or dehiscences have occurred. Occasionally, we have encountered superficial wound-healing problems in elderly patients, all of which resolved with local wound care. Long-term follow-up evaluation of patients with macrotia shows a high level of satisfaction with the postoperative shape of the ear and the scars. Although we paid special attention to evert flap edges and used a tongue-and-groove method to avoid notching, two of the patients experienced a step deformity on the helical rim.

To achieve better results in application of helical advancement flaps, Holzman et al. [9] recommended a simultaneous z-plasty. They reported 20 cases in which a z-plasty was added to reduce tissue tension and make scars less noticeable. We also believe this adjunct procedure could be used to yield superior results. The follow-up care for a reconstructive group of patients also was satisfactory, and they were especially pleased with the quick recovery period. Secondary surgery was required for one of the patients who had positive tumor margins. He underwent reoperation for additional excision from the helical rim, and readvancement of the flaps was performed.

Double helical rim advancement flaps with scaphal resection has many advantages over various techniques dealing with macrotia or ear reconstruction. First, it is a simple and safe operation that can be performed easily in a single stage with the patient under local anesthesia. The anterior scar remains hidden in the helical sulcus and is not easily discernible. The posterior scar may be visible in cases with accompanying prominent ear deformity. Simultaneous correction of prominent ears could be recommended to achieve a better result, although this was not practiced in our series.

Another advantage of the technique is that wound closure tension is significantly lower and distributed equally to yield a narrow linear scar [4]. Special care must be taken to approximate the flap edges in a tongue-and-groove fashion or with interlocking step cuts to prevent notching of the helical rim. In addition, cupping deformity is prevented by scaphal excision. There is no undermining of posterior and anterior skin, so risks of hematoma, infection, and prolonged edema are minimized. This limited dissection also preserves a stable framework of skin and cartilage on which the helical rim flaps can be safely adapted. Finally, the technique is a multifaceted procedure that maintains symmetry and contour and finds many applications including ear reduction and helical rim reconstruction.

Conflict of interest None.

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