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The Utility of Chondrocutaneous Advancement Flap in Conjunction with Postauricular SkinFlap for Reconstruction of Large Helical Rim Defects

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Introduction

The auricle›s complex surface anatomy, intricate architecture, and detailed topography present unique challenges for facial plastic surgeons during reconstruction procedures. The auricle›s shape and position play a significant role in contributing to the overall facial aesthetics. During reconstruction, surgeons must carefully consider the size, position, and contour of the new auricle to achieve harmony with other facial landmarks and restore a natural appearance. Beyond its aesthetic role, the auricle serves important functional purposes. For instance, it houses the ear canal, which is vital for sound transmission and hearing. The auricle provides a platform for wearing eyeglasses and hearing aids, which are essential accessories for many individuals. Reconstructive techniques aim to create an external ear that not only looks natural but also functions as closely as possible to a normal auricle. [1] Patients with auricular deformities can experience significant physical and psychological challenges. The aesthetic and practical functions of the ear are often taken for granted, but when they are compromised due to deformities, the impact on a person›s life can be profound. [1] Indeed, the impact of auricular deformity creates a challenging yet ultimately rewarding arena for both the reconstructive surgeon and the patient. The majority of acquired auricular defects are a result of trauma or surgical extirpation of cutaneous malignancies, particularly skin cancer [2,3].

Auricular skin cancer represents approximately 6% of all cutaneous malignancies in the head and neck area [4]. The pinna, also known as the auricular cartilage or external ear, is a common site for the development of cutaneous malignancies, especially due to prolonged sun exposure. The specific region of the pinna that is often vulnerable to these malignancies is the helical rim. The most common types of cutaneous malignancies that affect the ear, especially the helical rim, are squamous cell carcinoma (SCC) and basal cell carcinoma (BCC) [5,6]. These types of skin cancer are often associated with sun exposure and can present as non-healing sores, ulcers, or abnormal growths on the ear. The development of Mohs micrographic surgery has revolutionized the treatment of nonmelanoma skin cancers, particularly basal cell carcinoma (BCC) and squamous cell carcinoma (SCC). This specialized surgical technique allows for high cure rates while preserving as much healthy tissue as possible, making it especially beneficial for skin cancers occurring in aesthetically and functionally sensitive areas, such as the face, including the ear.

Mohs micrographic surgery can leave significant defects after tumor removal, especially in challenging locations like the ear [7,8]. Indeed, there are several options available for reconstruction, such as primary closure, secondary healing, vascularized cutaneous flap, split- thickness skin graft, full-thickness skin graft, and using a partial or total auricular prosthesis. Choosing the appropriate reconstructive

method is a decision that involves careful consideration of the individual patient›s needs, preferences, and overall health. In some cases, a combination of techniques may be used to achieve optimal results. Each reconstructive method has its advantages and is selected based on several factors, including the location and size of the defect, patient preference, and the need for ongoing tumor surveillance [9].

The Antia-Buch flap is a classic and well-known reconstructive technique used for chondrocutaneous ear defects. It was first described by Indian plastic surgeons, Dr. Surendra Kumar Antia and Dr. Rustom Jal Vakil Buch, in 1967. The Antia-Buch flap is particularly useful for reconstructing defects that involve both skin and cartilage, commonly seen in cases of ear deformities or cancer excisions [10,11]. The surgeon designs the flap by bisecting the ear into two flaps: an anterior skin-cartilage flap and a posterior skin flap. The anterior flap includes cartilage, which is essential for restoring the ear›s structural integrity. Indeed, during flap elevation in the Antia-Buch flap technique, a V-Y advancement flap is sometimes utilized to add more length to the medial flap, particularly at the base of the helical crus [11,12]. This additional length can be valuable in ensuring sufficient coverage of the chondrocutaneous defect and achieving better reconstructive outcomes.

While the Antia-Buch approach can be an effective method for providing adequate closure for defects up to 2 cm in size, it is essential to recognize that this technique may have some limitations and potential drawbacks, including the risk of a loss of ear height and unsatisfactory aesthetics [13]. The use of postauricular skin incision in combination with retroauricular advancement flaps is a modification that aims to address the potential drawbacks of the traditional Antia-Buch flap thecnique and avoid scaphal resection to prevent a decrease in ear height. In this modification, a postauricular skin incision is made behind the ear. The posterior flap of skin is then elevated from the postauricular region. The posterior flap is advanced toward the defect site, utilizing retroauricular advancement flaps [14,15]. These flaps allow for the mobilization of postauricular skin to help close the defect without resecting the scapha. The flaps are transposed and sutured into position to cover the chondrocutaneous defect, and appropriate dressings are applied. By utilizing retroauricular advancement flaps, the technique avoids the need for scaphal resection. This helps preserve the ear›s natural height and contours, minimizing the risk of ear height loss and maintaining aesthetics. As with any surgical procedure, the modified Antia-Buch flap technique requires careful patient selection and surgical expertise. The surgeon›s experience in performing this modified approach is essential to achieve optimal results while preserving the ear›s functionality and aesthetics.

Materials and Methods

The authors provide a description of a retrospective study conducted at the IRCCS - Centro di Riferimento Oncologico della Basilicata, in Rionero in Vulture (PZ), Italy. The study focused on ear reconstruction after cancer excision using the modified Antia-Buch technique in patients who underwent surgery between February 2019 and November 2022. The inclusion criteria involved auricle reconstruction after cancer excision and a minimum follow- up time of one year. This approach helps to ensure that the data collected is relevant and allows for a more comprehensive analysis of the patients› experiences and post-reconstruction outcomes. Exclusion criteria included smaller defects treated with primary closure, larger defects requiring major ear reconstruction, multiple-stage procedures, patients who missed follow-ups, and those lacking documentation. The study was conducted following the ethical standards of the Declaration of Helsinki, and patients provided informed consent, including a photo release section. Fifteen patients participated in the study, with each undergoing the modified Antia-Buch technique for ear reconstruction after cancer excision.

The patients› ages ranged from 54 to 89 years, with an average age of 76 years. Basal cell carcinoma was the leading reason for ear reconstruction in the study. The mean area of the defects was 3.4 cm2, with the helix being the most frequent location for these defects. The study ensured that the technical details, risks, and benefits of the procedure were thoroughly discussed with the patients during medical interviews, and they were required to provide informed consent before the surgery, which included reporting possible surgical and cosmetic risks. After a minimum follow-up period of one year, post-operative pictures were taken, and patients were reassessed for various aspects, including differences in skin pigmentation between the reconstructed site and adjacent areas, altered and depressed contour of the reconstructed site, constriction of the external auditory canal, and ear asymmetry. The procedure is performed under local anesthesia, where the posterior aspect of the ear pinna is infiltrated with a solution containing xylocaine 1% and epinephrine 1:100,000 [16,17].

This helps in numbing the area and minimizing bleeding during the surgery. Epinephrine is indeed not used on the anterior aspect of the ear pinna to avoid the risk of skin necrosis. Instead, xylocaine 1% may be infiltrated as needed to provide local anesthesia for the procedure. The initial steps are consistent with tumor resection, where the lesion is marked, and margins are determined accordingly (Figure 1). The excisional defect is then converted to a rectangular shape, and immediate reconstruction follows (Figure 2). In the Antia-Buch flap technique, incisions are made along the helical sulcus to create an anterior and posterior flaps. The anterior flap, which includes both skin and underlying cartilage, is advanced and rotated to cover the chondrocutaneous defect. Additionally, for larger defects, further mobilization of the upper segment can be achieved through a V-Y advancement flap of the helix root. The Antia-Buch flap technique can be effective for smaller defects, but for larger defects (>3 cm), a crescent chondrocutaneous scapha resection may be necessary, albeit with potential risks of auricular deformities. The modification, described in the study, involves a postauricular skin incision, which allows for the elevation and mobilization of the posterior flap of skin from the postauricular region (Figure 3).

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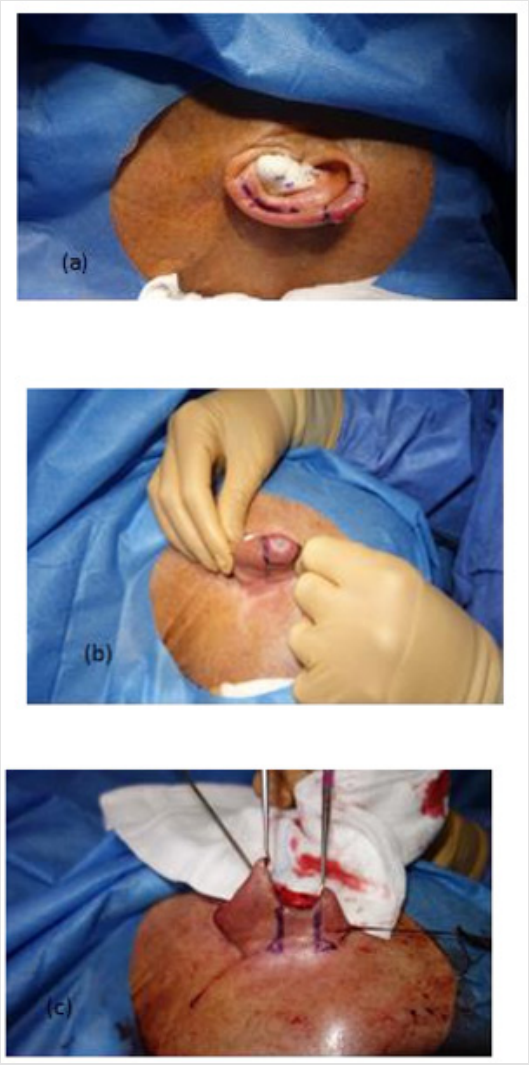

Figure 1: A clinical lesion and margin delimitation:
a) Design of the chondrocutaneous advancement flap.
b) A basal cell carcinoma, observed from a cephalic perspective, located on the upper part of the left ear.
c) Design of the retroauricular skin flap.

Figure 2: A full-thickness ear defect involving the superior pole of the ear.

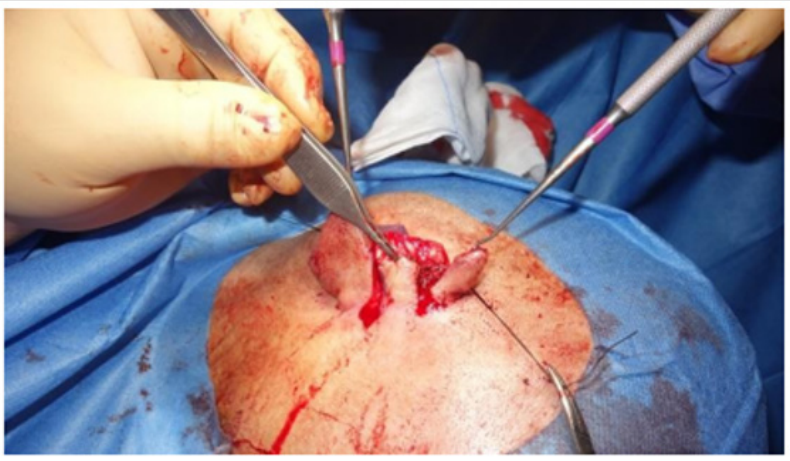

Figure 3: The lesion was surgically removed, and a retroauricular skin flap was raised.

The retroauricular advancement flaps are utilized to aid in the closure of the defect without the need for resecting the scapha. By utilizing these flaps, the surgeons can achieve effective coverage of the chondrocutaneous defect while preserving the natural anatomy of the ear (Figure 4). Regarding the follow-up process, patients either attended an in-person appointment or were contacted by telephone for a postoperative survey. Those who underwent the modified Antia-Buch approach were asked to complete an evaluative questionnaire, which was designed by the author in collaboration with a clinical psychologist (Table 1). This questionnaire likely aimed to assess the patients› satisfaction and outcomes after the surgery, including their cosmetic results and overall experience with the modified Antia-Buch technique [18,19]. The evaluative questionnaire used in the study consists of several scales to assess different aspects of the patients› experiences and outcomes after ear reconstruction using the modified Antia-Buch technique.

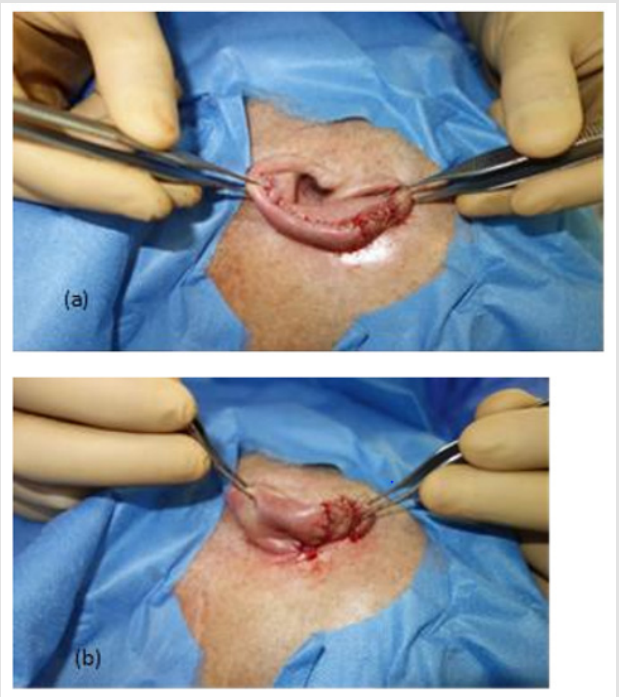

Figure 4: The surgical results are seen immediately after reconstruction: anterior (a) and posterior (b) aspect.

Table 1: Post-reconstructive evaluation questionnaire.

Do you find the aesthetic resultsatisfactory?
Do you notice a difference in the size of your ear since your surgery?
Do people comment on the size of your ears?
Do people notice that you have had surgery on your ear?
Do you find it difficult to wear glasses and/or hearing aids?
Overall, do you like the appearance of your ear?

These scales include:

1. Satisfaction with the appearance of the ear: This scale is used to measure how satisfied patients are with the cosmetic outcome of the reconstructed ear, compared to their expectations.
2. Excessive asymmetry with the contralateral ear: This scale evaluates whether there is any significant asymmetry between the reconstructed ear and the ear on the opposite side (contralateral ear).
3. Psychosocial well-being: This scale aims to assess the patients› emotional and psychological well-being following the ear reconstruction, considering any potential impacts on their self-esteem, body image, and overall quality of life.
4. Difficulty wearing glasses and ear devices: This scale focuses on any challenges or difficulties patients may experience when wearing glasses or other ear devices (e.g., hearing aids) after the reconstruction.

By incorporating these scales into the questionnaire, the authors can gain valuable insights into various aspects of the patients› postoperative experiences, functional outcomes, and overall satisfaction with the procedure. This information is crucial for assessing the success and effectiveness of the modified Antia-Buch technique from a patient-centered perspective.

Results

Patients

Between February 2019 and November 2022, a total of 18 patients underwent auricle reconstruction. Among these patients, three were excluded from the study as they passed away during the follow-up period, unrelated to the cause of reconstruction. Out of the remaining 15 patients included in the study, 9 were males, and 6 were females, with an average age of 76 years (range: 64 to 89 years). The most common reason for ear reconstruction was basal cell carcinoma, representing 20-43.5% of cases, followed by squamous cell carcinoma (16-34.8%) and precancerous lesions (10-21.7%). The standard excision limits for the primary lesions were set at ≥0.5 mm. The mean area of the defect was 3.4 cm^2, with the helix being the most frequent location of the defect. All patients underwent our modified Antia- Buch flap (Table 2).

Table 2: Patients.

	Title 2
Characteristics	n(%)
Mean age (range)	76 (64 – 89)
Gender Female Male	6 9
Cause for ear reconstruction Basal cell carcinoma Squamous cell carcinoma Precancerous lesions	(20–43.5) (16–34.8) (10–21.7)
Mean area defect	3.4 cm2
Location defect	Helical rim

Post-Operative Complications

The study achieved a 100% rate of total excision of the tumor in all cases. Moreover, it›s remarkable that no complications, such as infection, bleeding, hematoma, wound dehiscence, ear cupping, or cauliflower deformity, were observed among the patients. The absence of surgical revisions in any of the patients further highlights the success and favorable outcomes of the modified Antia-Buch technique used for ear reconstruction after cancer excision. These positive results demonstrate the effectiveness and safety of the procedure in this particular study cohort.

Post-Reconstructive Evaluation

All the enrolled patients answered the evaluative questionnaire and reported positive outcomes. The morphologic results were rated as satisfactory or very satisfactory in all patients, with no self-image distortion or social obstacles resulting from the plastic reconstruction. This indicates that the modified Antia-Buch technique, which combines a helical chondrocutaneous advancement flap and a retroauricular cutaneous transposition flap, proved to be highly successful for ear reconstruction, even in cases with large defects of the superior ear.

Furthermore, the evaluative questionnaire demonstrated significant improvements in patient satisfaction across all four categories (satisfaction with the appearance of the ear, excessive asymmetry with the contralateral ear, psychosocial well-being, and difficulty wearing glasses and ear devices). This suggests that patients perceived notable positive changes in their overall results. The study›s findings support the effectiveness and viability of the modified Antia-Buch flap for ear reconstruction, providing encouraging results for patients who undergo the procedure to address large defects of the superior ear caused by tumor excision.

Discussion

Successful repair of auricle defects requires a well-designed framework and adequate vascularized tissue coverage. The ear›s blood supply comes from various auricular branches of the posterior auricular and superficial temporal arteries, while its sensory supply comes from nerves like the auriculotemporal, great auricular, lesser occipital, vagus, and glossopharyngeal nerves [20]. As mentioned, a significant proportion of auricular malignancies occur on the rim of the helix, and external ear defects can be classified based on location (superior, middle, or inferior third), thickness (partial or full), and size (small, medium, or large) [21]. When reconstructing helical defects, achieving a perfect approximation of the wound edges is crucial to prevent notching and contour irregularities, which can be highly noticeable in this area. Choosing the appropriate reconstructive method involves considering factors such as the size and complexity of the wound, the structures exposed, and the availability of local tissues.

The choice of reconstruction technique should be tailored to each patient›s specific case to achieve optimal functional and aesthetic outcomes [22]. Small skin defects in the upper third of the helix can often be closed directly or with minimal undermining and mobilization of native tissues [23]. Alternatively, geometric patterns, as described by Tanzer, can be used to approximate skin defects without tension [24]. The Antia-Buch auricular repair technique, introduced in 1967, is suitable for moderate-sized defects. This method involves creating a chondrocutaneous advancement flap by making an anterior incision along the helical sulcus to separate the helix and the scapha [25]. A superficial dissection is performed in the posterior auricle to create flaps that will converge at the wedge cut in the antihelix. Originally designed for helical rim defects up to 20 mm in size, this flap technique has been adapted and modified to repair larger defects.

One such modification involves V-Y advancement of the helical root, which extends the application of the technique to address larger defects. By employing these different approaches, surgeons can effectively reconstruct various sizes of auricular defects, providing better cosmetic and functional outcomes for patients [26]. The selection of the appropriate method depends on the size and complexity of the defect, ensuring a successful reconstruction with minimal complications. For even larger defects that extend beyond the helical rim of the upper third into the scapha and antihelix, the use of single-stage pedicled chondrocutaneous transposition flaps based on the root of the helix or the caudal part of the helix, as described by Davis, becomes a viable option [27].

While this technique can be used for the reconstruction of the entire superior pole of the ear, it requires a skin graft to the donor site. Another option is the Orticochea composite chondrocutaneous rotation flap, which is used for the reconstruction of the entire superior pole of the ear and is based on the lateral rim of the ear [28]. However, both of these techniques often involve multiple surgical steps and may require a higher level of surgical expertise to achieve successful outcomes. In contrast, the Antia-Buch flap, even though it was described more than 50 years ago, remains a reliable and effective option among the various techniques for helix reconstruction. Its simplicity, single-stage nature, and favorable outcomes contribute to its continued relevance in addressing defects in the helical region of the ear. While the classic Antia-Buch technique is effective for defects up to 2 cm in size, one potential drawback remains the risk of experiencing a loss of ear height and unsatisfactory aesthetics [29,30].

As a result, modifications have been developed, including the addition of crescentic scaphal excision, Burrow›s triangle, and transposition flaps, with the goal of enhancing the overall aesthetic appearance of the reconstructed ear and minimizing complications like the loss of ear height [31,32]. The modification introduced in this study, combining a postauricular skin incision with retroauricular advancement flaps, was intended to avoid scaphal resection, which can lead to decreased ear height. The postauricular skin incision likely provided additional tissue mobility, while the retroauricular advancement flaps utilized skin from the retroauricular region to enhance coverage of the helical rim defect. Preserving the scapha is essential for maintaining the natural contour of the ear, and increasing flap mobility allows for better reshaping and positioning of the ear during reconstructive surgeries, contributing to improved aesthetics and symmetry [33]. The authors› modification, involving the incision of postauricular skin and the addition of a retroauricular advancement flap, has had favorable outcomes without the need for scaphal resection. This successful result emphasizes the potential benefits of the modified technique in achieving both good cosmetic outcomes and safety for patients.

Our experience further supports the effectiveness of this modified Antia-Buch flap for helical rim defects up to 3 cm wide. Such positive feedback is valuable in the field of ear reconstruction, and it indicates that the modified approach can provide reliable results for patients with larger defects in the helical region. Patient-reported improvements in satisfaction and quality of life indicate that the modified Antia-Buch technique, with the addition of the postauricular skin incision and retroauricular advancement flap, has been successful in achieving its intended goals. These improvements may include enhanced appearance and functionality of the reconstructed ear, leading to increased confidence and improved social interactions for the patients. Such positive results are valuable in guiding future treatment decisions and advancements in the field of ear reconstruction.

Conclusion

Helical rim defects can present complex challenges in ear reconstruction. While several other methods have been described for addressing these defects, they may involve more complicated

procedures compared to the modified Antia and Buch technique. Complex reconstructive methods may involve multiple stages, use of tissue flaps from distant donor sites, or involve intricate surgical maneuvers to restore the helical rim›s natural shape and contour [34-36]. These approaches can be effective in certain cases but may also carry increased risks and longer recovery times. The modified Antia and Buch technique offers a valuable single-stage option for repairing large helical rim defects, providing excellent cosmetic outcomes with technical simplicity and reduced risk of complications such as tip necrosis. This simplicity, coupled with its ability to preserve anatomical landmarks and achieve superior cosmesis, makes it a favorable choice for many surgeons and patients. The classic Antia-Buch chondrocutaneous advancement flap is well-suited for small- to medium-sized helical defects [37].

The addition of an incision in the helical root and closure as a V-Y advancement allows for obtaining additional length to close the helical rim. However, for deformities greater than 2 cm, auricular distortions may occur with this flap technique [38,39]. The modified Antia and Buch approach presented in the study provides a single-stage technique specifically designed for large (up to 3 cm) upper pole defects of the ear, resulting in a superior aesthetic appearance. By combining a postauricular skin incision with retroauricular advancement flaps, they aimed to avoid scaphal resection, which is known to lead to a decrease in ear height. The postauricular skin incision likely allowed for additional tissue mobility, while the retroauricular advancement flaps utilized skin from the retroauricular region to enhance coverage of the helical rim defect [40-43].

The technique›s advantages, including technical simplicity, low risk of tip necrosis, patient convenience, and superior cosmesis, make it an excellent choice for repairing many defects of the helical rim. By restoring anatomical landmarks and concealing scars in the natural concavities and convexities of the ear, the technique ensures a more natural and pleasing outcome for patients. Based on the positive outcomes and advantages reported, the authors highly recommend using this modified Antia and Buch technique for the reconstruction of defects in the helical rim.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest

The authors declare no conflict of interest.

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