Scientific Research Publishing

Modern Plastic Surgery, 2022, 12, 61-75
https://www.scirp.org/journal/mps
ISSN Online: 2164-5280
ISSN Print: 2164-5213

High-Performance Macrotia Surgery

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How to cite this paper: Assis, M.S., Rosas, G. and Miranda, L.S. (2022) High-Performance Macrotia Surgery. *Modern Plastic Surgery*, **12**, 61-75.
https://doi.org/10.4236/mps.2022.124006

Received: August 23, 2022
Accepted: October 8, 2022
Published: October 11, 2022

Abstract

Many articles report that macrotia is a rare ear deformity, but this is not the reality that we encounter in our service. In accordance with anthropometric studies of the ears, we consider that an aesthetically normal ear measures 6.0 cm in length on the vertical axis and 3.7 cm on the horizontal axis in boys, with ear growth maturing at 13 years of age, and 5.91 cm in length on the vertical axis and 3.37 cm on the horizontal axis, with ear growth maturing at age 12 in girls. When the measurements exceed these averages, we consider that the patient has macrotia. The authors describe a new technique of surgical correction of macrotia that results in an average reduction of 1.7 cm on the vertical axis and 0.8 cm on the diagonal axis with an average surgical time of forty-five minutes, fast learning curve, and little scarring. This technique also allows it to be combined with otoplasty and correction of the lobe length. Because of these items we call the technique High-Performance Macrotia Surgery. Level IV: Evidence is obtained from multiple time series with or without the intervention, such as case studies.

Keywords

Ear, Acquired Ear Deformities, Ear Cartilage, Ambulatory Surgical Procedures, Macrotia, Plastic Surgery

1. Introduction

Macrotia is one of the causes of ear deformities although it is not as common as the protruding ear deformity. Exaggerated enlargement of the ears causes great discomfort for the patient, who may suffer from low self-esteem and bullying. According to Yuen [1], external proportions of the ears are divided into three sections: the upper third comprises 33% of the ear height, the middle third comprises 43%, and the lower third comprises 23%.

Anthropometric studies of the ears [2] [3] [4] show that the width of aesthetically normal ears is 3.0 to 4.5 cm (AB) and the length is 5.0 to 7.0 cm (XY) with asymmetric sides, both in women and in men [4] as can be seen in **Figure 1**.

According to Shireen [4], the right side is longer and wider in both sexes. In addition, anatomical studies by Leonardo da Vinci demonstrate proportional cephalometric measurements between the length and the base of the nose and the length and the base of the pinna (**Figure 2**).

Techniques for surgical correction of macrotia usually involve a reduction of the upper third with an incision on the inner edge of the helical rim, detachment

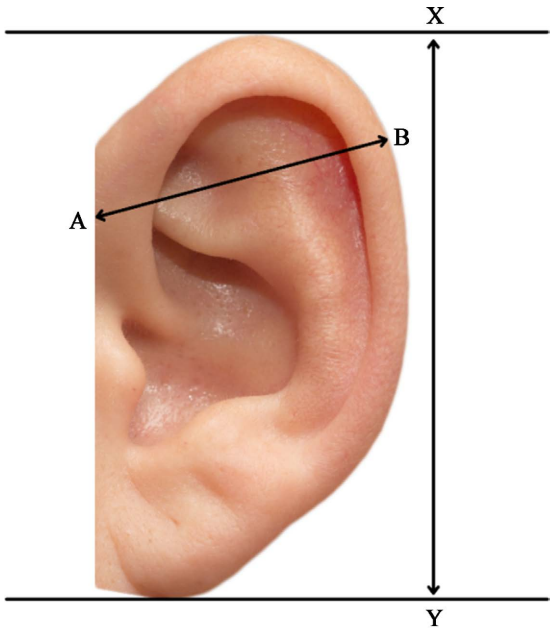

Figure 1. Normal anthropometric measurements of the ears. AB (width) and XY (length). Shutterstock image license 138021056.

Figure 2. Cephalometric studies by Leonardo da Vinci, 1490. Source: http://www.drawingsofleonardo.org.

of the skin to remove the kidney-shaped cartilage, with anterior or inferior rotation of the flap to accommodate the skin and remaining cartilage [5] [6] [7] [8]. This limits the overall reduction of the ears, as it causes an artificial anatomical alteration in the upper side of the pinna (**Figure 3**).

The proposed technique leads to an average reduction greater than the techniques described and can be combined with otoplasty and lobuloplasty with inconspicuous scars. Together, this results in an optimized technique performed on an outpatient basis with local anesthesia and sedation, a shorter surgical time of forty-five minutes on average, a fast-learning curve, reduced scarring, and a satisfaction rate of 76.8%. The principle of the new proposed surgical technique for ear size reduction is the removal of a triangle of skin and cartilage on the diagonal of the upper third, with a base of 1.0 to 2.0 cm, with alignment of the edges and fixation in posterior inverted T until the projection of the anti-helix and the removal of a triangle of inferior base in the lobe, when lobuloplasty is indicated, as an auxiliary procedure in the global reduction of the ears.

To analyze the satisfaction of the 112 patients studied, we used the goals and outcome satisfaction, described by McDowell/Wright [9].

This technique is indicated for patients who wish to reduce the size of their ears or treat the anatomical curvature of the helical rim, whose main complaints are pointed (elf-shaped) ears or even Stahl's ears. The technique can be associated with a correction of prominent ears and the length of lobe when needs correction.

2. Materials and Methods

One hundred and twelve patients with a clinical diagnosis of macrotia were operated on in the period from 2019 to 2020. 49 women and 63 men, with a mean

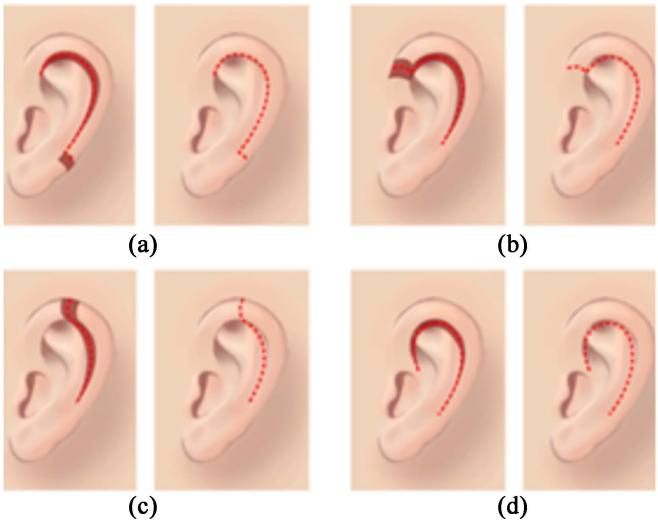

Figure 3. (a) Zenteno technique; (b) Argamaso technique; (c) Hinderer technique; (d) Davis technique. Basically all the techniques have the same principle of reducing the upper third with a comma incision, which limits the removal of cartilage, as it can compromise the anatomy of the ears. Source: personal drawing.

age of 36 years, underwent performance-optimized surgery to correct macrotia. Table 1 shows the adherence criteria adopted in the study during the 1-year period.

The most common alteration in macrotia occurs in the upper third of the ears [3] [4] [5]. But in our sample group, 99 patients were indicated for the correction of the scapha by the technique described, combined with otoplasty, where the antihelix region was treated in 90 patients, and conchal hypertrophy in 9 patients. Surgical correction of macrotia combined with lobuloplasty and otoplasty was performed in 13 patients.

All patients underwent the procedures on an outpatient basis, with local anesthesia and sedation, according to the technique described below. The patients were discharged from the hospital within an average time of 40 minutes following post-anesthesia recovery.

For the evaluation of the results of the new proposed technique, Mc Dowell/Wright's method was used during the period of one year [9].

3. Surgical Technique

We call this a "high-performance technique" due to the reduced surgical time and few supplies required to perform it. The scarring is reduced and inconspicuous compared to the other macrotia correction techniques. The technique also allows for associated otoplasty and lobuloplasty, thus resolving most complaints in our study of cases (Figure 4).

The objective of the proposed technique is to shorten the vertical and horizontal axes of the pinna, improving the anatomy of the helical rim curvature and reducing the width of the scapha, combined with antihelix removal treatment, which helps to shorten the region. This technique is also useful in the treatment of conchal hypertrophy, the indicated cases of protruding ears and reduction of the lobule, using the lower-base triangle technique [10].

Local anesthesia is performed on the retro auricular skin using 20 mL of saline solution, 7.0 mL of ropivacaine and 0.5 mL of adrenaline after the patient is

Table 1. Criteria adopted in the study during the 1-year period.

CHARACTERISTICS	N = 112	NUMBERS (%)
SEX	Male	63 (56.25%)
	Female	49 (43.75%)
AGE AVERAGE		36
COMORBITIES	Large lobule	13 (11.6%)
	Prominent ears	99 (88.40%)
	Anti-helix erasure	90 (80.35%)
	Conchal hypertrophy	9 (8.03%)
UNILATERAL		0 (0%)
BILATERAL		112 (100%)

sedated. Sedation is performed with 0.05 mg/kg midazolam, 2.0 - 3.0 mcg/kg fentanyl, and 10 - 20 mcg/kg/min propofol. In anxious adult patients, 1.0 mcg/kg of clonidine, and in children, 0.5 - 1.0 mg/kg of ketamine is occasionally used.

The flap is delimited on the upper margin by the posterior projection of the anti-helix, approximately 1.0 cm from the outer edge of the ears, and by the retro auricular groove on its lower margin. The perichondral skin flap is retracted, and the first surgical procedure begins with chondrotomy on parallel islands in the anti-helix region [11], forming an inverted U, which helps in shortening the ears vertically (**Figure 5**).

In cases of conchal hypertrophy, the region is treated by removing the cartilage flap. The synthesis of the middle third is performed using absorbable 4.0 monocryl sutures, leaving the upper and lower third free for subsequently performing the macrotia technique. We preferred to use absorbable sutures, as described in the techniques of Burow [12] and Hinderer [13], because many patients travel long distances to perform the procedure and do not return to remove the stitches. Patient follow-up, with orientation and clarification of doubts, was done by telemedicine. The second surgical procedure begins with marking an upper-base triangle, with its central axis drawn in an imaginary 60˚ line

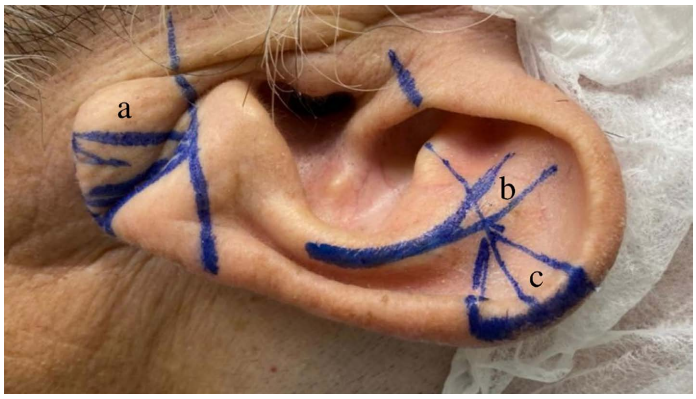

Figure 4. Prior marking of the ears by the technique described. (a) Lower base resection triangle on the lobe. (b) Marking of the antihelix for chondrotomy in parallel islands, which helps in shortening the scapha. (c) Upper base resection triangle for diagonal axis reduction. Source: personal archive.

Figure 5. Chondrotomies on parallel islands to form a new anti-helix design in the shape of an inverted U. Source: personal archive.

between the end of the anterior portion and the posterior edge of the helical rim.

Subsequently, total resection of the skin and cartilage is performed in a posterior-base triangle, around 1.0 cm opening or an angle of up to 60˚ to the inferior edge of the last chondrotomy island in the antihelix region. The cartilage edges are sutured using 4.0 monocryl thread for skin alignment and synthesis. Figure 6(a) and Figure 6(b).

The cartilage edges are synthesized in the posterior region by resecting a small lozenge in cartilage to accommodate the tissue (Figure 7(a) and Figure 7(b)).

Posterior fixation of the resected triangle with 4.0 monocryl on the surgical edge of the retro auricular groove, with the objective of reducing the recurrence of the upper third and stabilizing the resected triangle.

Whenever lobuloplasty is needed, a lower-base triangular resection is performed with an opening angle of around 45˚ or greater, when necessary. The posterior flap is fixated using 4.0 monocryl in an inverted T shape, for alignment and prevention of recurrence of the lobe projection (Figure 8).

We finalize the procedure by shaping the scapha and the concha using moist cotton, providing ear protection with cotton pads and placing an orthopedic tubular mesh, such as a cap, to stabilize the dressing. An elastic band is positioned underneath this bandage, without going through the neck, which remains closed for 5 days.

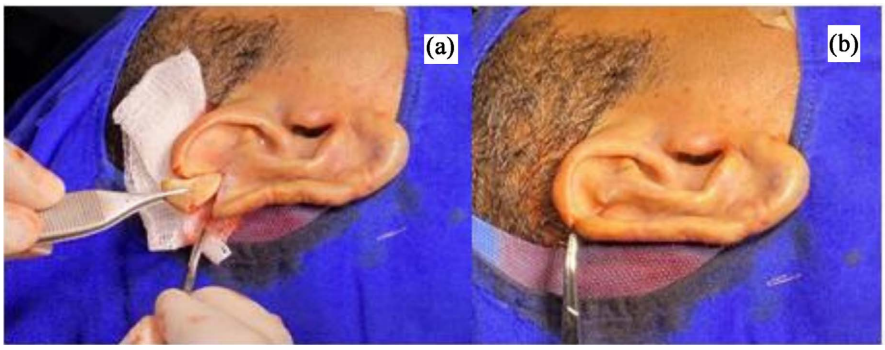

Figure 6. (a) Resection of a skin and cartilage triangle in the upper third. (b) Suturing of cartilage edges with absorbable thread. Source: Personal archive.

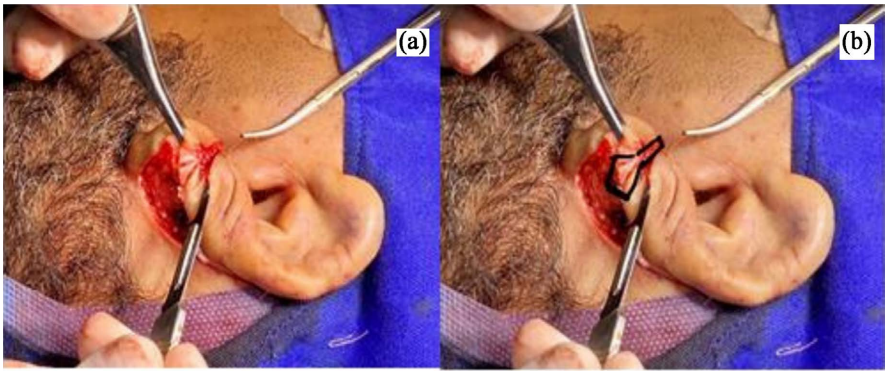

Figure 7. (a) Lozenge resection in the posterior region. (b) Detailed schematic drawing. Source: Personal archive.

On the fifth postoperative day, the bandage is removed, and we guide the patient on cleaning and caring for the ears. The patient is instructed to use only the elastic band for thirty days for sleeping at night.

Following are some postoperative results of the proposed technique (**Figures 9-12**).

4. Case Reports

MA, 63 years old, caucasian, 9 months postop. Complaint of large ears, large lobes and prominent ears, without conchal hypertrophy. Size of the ears: 8.0 cm (length), 4.2 cm (width), 2.3 cm lobes (width), as described in **Figure 1**.

Indicated surgical correction of macrotia by the HPMS technique, with bilateral otoplasty, with correction of anti-helix fold and bilateral lobuloplasty by

Figure 8. (a) Lobuloplasty with a lower-base triangle, and (b) Synthesis with posterior fixation in an inverted T shape. Source: Personal archive.

Figure 9. ((a), (b)) F.R.P. 28 years, before and 5 months after surgery. Reduction of 1.5 cm from the vertical axis and 0.3 from the horizontal axis. Source: Personal archive.

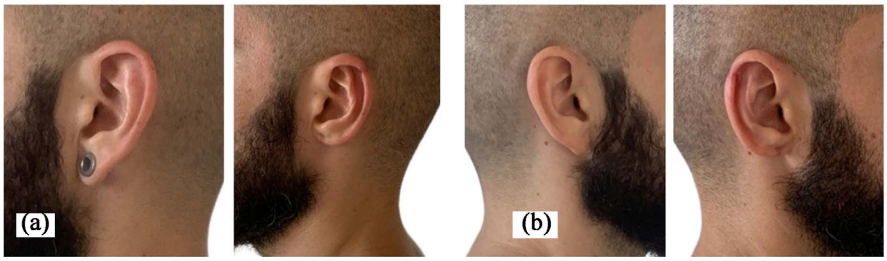

Figure 10. ((a), (b)) D.C.P. 31 years, before and 6 months after surgery. Reduction of 1.8 cm from the vertical axis and 0.4 from the horizontal axis. Source: Personal archive.

lower base triangle incision. The patient had a good postoperative period and had no complaints of pain. Scars with good evolution and reduction of 2.0 cm vertically and 0.7 cm diagonally. Patient is very satisfied with the result, although it has an asymmetry of 0.5 cm in size of the pinna. and did not request a surgical touch-up. At 1 year postoperatively, improvement in asymmetry is noted (Figure 13).

CRV, 28 years old, latin, complaining of large scapha and prominent ears. Size of the ears: 7.5 cm (length), 3.7 cm (width), as described in Figure 1.

Indicated surgical correction by the described technique and otoplasty. We do

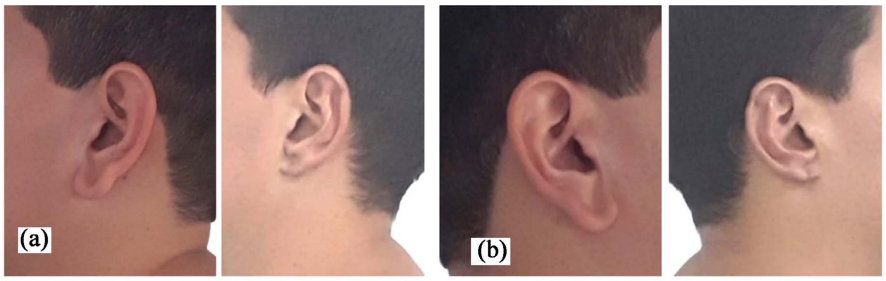

Figure 11. ((a), (b)) T.F.A.B. 37 years, before and 8 months after surgery. Reduction of 1.9 cm from the vertical axis and 0.6 from the horizontal axis. Source: Personal archive.

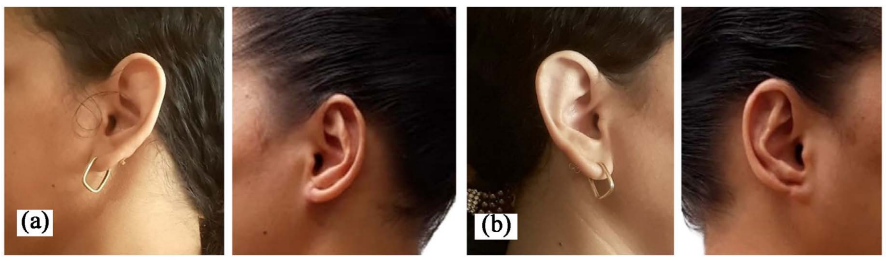

Figure 12. ((a), (b)) A.M.M.L 27 years, before and 6 months after surgery. 2.0 cm reduction from the vertical axis and 0.5 from the horizontal axis. Source: Personal archive.

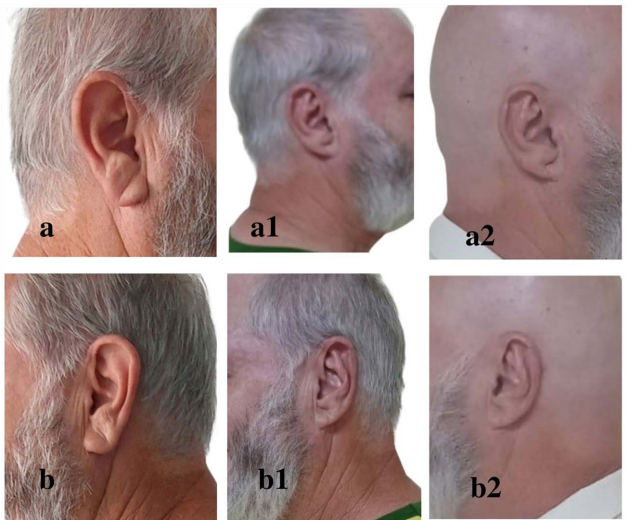

Figure 13. ((a), (b)) Before macrotia surgery. ((a1), (b1)). 3 months after macrotia surgery. ((a2), (b2)). 1 year after macrotia surgery. Source: Personal archive.

not indicate lobuloplasty because of the aesthetic size compared to the rest of the ears. Good postoperative evolution reported moderate pain until the fifth day and loss of sensation in tips, which improved after 60 days. He reported reddish appearance of the ears until the 90-day post-op, which resolved by 6 months, with an indication for topical corticosteroids. Scars with good evolution and reduction of 1.2 cm in the vertical axis and 0.5 cm in the diagonal axis. Patient is very satisfied with the result (**Figure 14**).

AD, 58 years old, latin, 1 year postop. Size of the ears: 8.5 cm (length), 4.2 cm (width), 2.5 cm lobes (width) as described in **Figure 1**.

Complaint of large ears, large lobes, and prominent ears. Indicated scapha reduction using the HPMS technique and otoplasty. Postoperative uneventful, painless. As the patient has very large ears, the techniques that remove cartilage in kidney shape, such as: Hinderer [13] and Yuen/Coombs [3] could be an option, as they allow associated surgeries, but result in larger external scars than the presented technique. Patient is satisfied with the surgery result but requested retouch to improve the symmetry of his ears. Reduction of 1.9 cm in the vertical axis and 1.0 cm in the diagonal axis (**Figure 15**).

RCM, 34 years old, latin, complaining of large ears, large lobes, and prominent ears. Size of the ears: 9.5 cm (length), 4.5 cm (width), 2.7 cm lobes (width) as described in **Figure 1**.

Indicated macrotia reduction, otoplasty and bilateral lobuloplasty. Postoperative uneventful. Reduction of 2.0 cm vertically and 1.2 cm diagonally. At 15 days postoperatively, the patient reported a small dehiscence in the superior resection triangle and helix retraction in the left ear. A touch-up was indicated at 90 days postoperatively, with resuture of the upper triangle and filling of the middle third of the helix with 10% polymethyl methacrylate (**Figure 16(a)**).

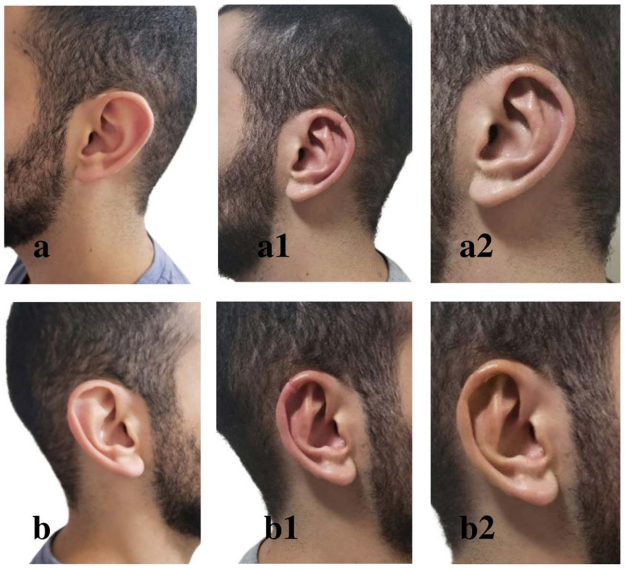

Figure 14. ((a), (b)). Before macrotia surgery. ((a1), (b1)). 3 months after macrotia surgery with reddish appearance. ((a2), (b2)). detailed photos of 6 months after topical corticosteroids. Source: Personal archive.

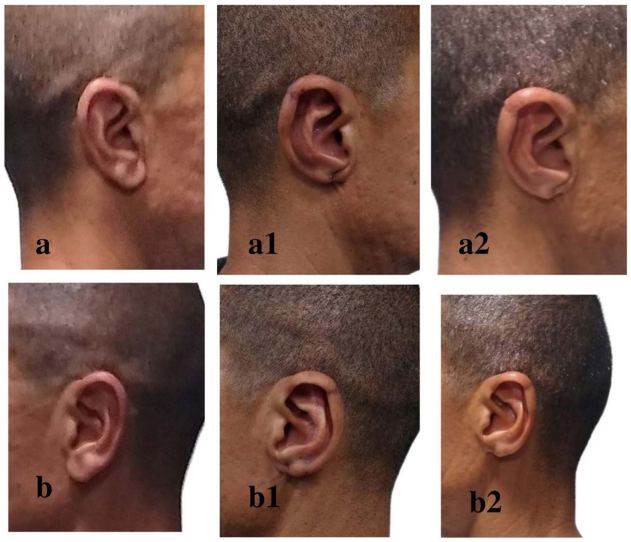

Figure 15. ((a), (b)). Before macrotia surgery. ((a1), (b1)). 3 months after macrotia surgery. ((a2), (b2)). Retouch after 1 year after macrotia surgery. Source: Personal archive.

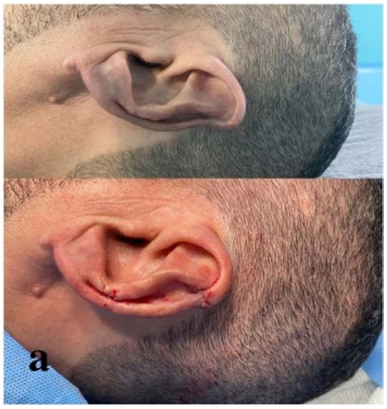

Figure 16. (a) Resuture of upper base triangle with filling of middle third of the helical rim with 10% methacrylate after 3 months of surgery. Source: Personal archive.

The following is the result of the touch-up after 10 months of surgery, where there was an improvement in the contour of the upper third and in the filling of the pinna border.

The patient was satisfied with the second procedure but requested further ear reduction. We are waiting 1 year postoperatively to reevaluate the technical possibility of further reduction.

5. Results

5.1. Post-Surgery Follow-Up

There were no anesthetic or surgical complications. All patients underwent the procedure using local anesthesia and sedation and were discharged after an average of forty minutes. The average reduction of the ears was 1.7 cm on the vertical axis and 0.8 cm on the horizontal axis. In 88.4% of the patients, surgical correction of macrotia was performed combined with otoplasty. In 77.7% of the

patients, lobuloplasty was performed for reduction. In 11.6% of the patients, only the upper third technique was performed, as the complaint was an increase in the diagonal axis, with enlargement of the scapha or elf-type pointed ears, or other complaints related to the curvature of the helix, such as small congenital deformities.

5.2. Recovery

We followed up with the 112 patients in the postoperative period up to one year, with a questionnaire about pain in the postoperative period, recovery from surgery and satisfaction with the result, based on Mc Dowell/Wright's method [9]. 51.2% reported mild pain, 35.8% moderate pain, and 7.7% severe pain. 48.7% of the patients reported that recovery from surgery went well, 28.2% reported moderate recovery, and 15.4% a difficult recovery period. All patients were monitored by the patient support team, with follow ups at 4, 15, 30 and 90 days postoperatively. In cases where there was major discomfort due to pain, we prescribed tramadol, 50 to 100 mg every 4 to 6 hours as needed for pain. One patient reported discomfort with hypersensitivity in the upper third scar and 3 others with temporary hyposensitivity, with resolution within 6 months postoperatively.

5.3. Satisfaction

Satisfaction with the postoperative result was: 33.3% reported being very satisfied, 43.5% satisfied and 15.4% dissatisfied. The cases of dissatisfaction were due to visible external scarring (15.4%), recurrence of asymmetric positioning in the upper third (57%) or an unattained reduction in size (27.6%). For the cases of dissatisfaction, we conducted touch-ups from 90 days after the operation, with two complaints of hyperchromic scarring up to that point, that bleaching cosmetics were indicated. After the touch-up surgery, the dissatisfaction rate dropped to 4.46%.

In 2 cases, we solved the step in the upper third of the helix with filling of small amount of 10% polymethyl methacrylate, without the need of a new surgical procedure. In one of these cases, there was dehiscence of the suture of the triangle of the upper third, with hypotrophy of the helix until the middle third, also corrected with 10% polymethyl methacrylate filling.

6. Discussion

Regarding the external anatomy of the ears, in this study, we are basically interested in three parts: the helix and antihelix complex, the auricular concha, and the lobe.

The most common alteration in macrotia occurs in the upper third of the ears [3] [5]. But in our sample group, 99 patients were indicated for the correction of the scapha by the technique described, combined with otoplasty, where the antihelix region was treated in 90 patients, and conchal hypertrophy in 9 patients. Surgical correction of macrotia combined with lobuloplasty was performed in 87

patients.

31 citations on macrotia were found in the PubMed and Google Scholar search, and 11 articles with publications on surgical techniques for ear size reduction were found.

The first described reduction technique was in 1856, described by DiMartino [14] and in 1903 by Gersany [14], with excisions in external triangles, with well-exposed scars. In 1970, Ver Meulen [14] proposed the same resection in the upper third, but with a posterior approach [14]. Burow's triangles technique also denudes the upper third for removal of triangles for reduction, but there are limitations of cartilage removal, due to skin remnants in the anterior portion [12].

In the techniques of skin and cartilage removal with kidney-shaped excision at the inner edge of the helix, as in the Hinderer [13], Argamaso [5], Gault [3], and Yauser [3] techniques, there are also limitations in shortening the scapula, due to the possibility of resulting in a pointed shape in the upper portion of the ears. In the Yuen [3] technique, which also removes skin and cartilage at the anterior edge of the helix, the incisions extend from the lobe to the shell, resulting in large, apparent scars and a risk of necrosis. This technique also can be combined with otoplasty, a frequent complaint of patients, and the correction of other ear deformities, such as: pointed (elf) ears, Stahl's ears, and small congenital defects in the upper third of the ears. **Table 2** shows a comparison of the presented technique with the main techniques of macrotia.

The interest in developing the technique presented occurred to seek a procedure that would have a reduction of the ears with reduced scarring and that could be associated with other ear surgeries, such as otoplasty, lobuloplasty, and small congenital deformities in the upper third, such as Stahl ears and skin appendages. Basically, there are two strategies in the techniques studied. Those that remove skin and cartilage through a kidney-shaped incision at the edge of the helix, as occurs in the techniques of Hinderer [13], Argamaso [5] and Yuen [3], and the removal of a triangle in the upper third, as in the techniques of HPMS,

Table 2. Comparison of HPMS with the main macrotia techniques. Source: personal drawing

	Average Reduction > 1.0 cm	Short Scars	Otoplasty Association	Short Learning Curve	Anatomical Distortial
HPMS	✓	✓	✓	✓	✗
dimartino/gersany	✗	✗	✗	✓	✓
ver meulen	✗	✓	✗	✗	✓
BUROW	✗	✓	✗	✗	✓
HINDERER	✓	✗	✓	✗	✓
ARGAMASO	✗	✓	✓	✗	✓
YUEN/COOBS	✓	✗	✓	✗	✗

Table 3. Complication occurrence, prevention and treatment of HPMS.

112 cases	Occurance	Prevention	Treatment
Dehiscence	1.40%	Reinforced Suture	Resuture
Infection	0.47%	Per And Post Operative Antibiotic	Ciprofloxacin
Unaesthetic Scar	0.47%	Reinforced Suture	Resuture
Hemorrhage	0.00%	Hemostasis Review	Hemostasis Review
Hypertrofic Scar	0.94%	Absorbable Stiches	Corticoid Cream

Burow [12], DiMartino [14], Gersany [14] and Ver Meulen [14].

Firmin [15] cites in his book his specific reduction technique for large scaphas, which can also be associated with otoplasty surgery, but results in a larger and more apparent scar on the anterior edge of the helix. The large scaphas can also be reduced with the technique presented and with a short scar in the anterior fold of the helix around 0.5 cm, with traction of the upper third closer to the head, with the fixation point, as shown in **Figure 7**. This point helps not to give recurrence of the upper third, common in otoplasties.

The first strategy results in extensive scarring and large skin detachments, with a higher risk of necrosis and distortion of the ear anatomy. The second strategy has smaller detachments, but with the disadvantage of having apparent scars. In the development of the technique presented in a fresh cadaver, we tried to remove the resection triangle of the upper third with a posterior approach, as in the Burow [12] and Argamaso [5] techniques, but there was a limitation of resection, because there was skin left in the helix.

When indicating surgical correction of macrotia, we talk a lot with patients about the apparent scar, but in most patients, the external scar is not a problem to consider. When the patient is overly concerned about the possibility of external scarring, we contraindicate the macrotia surgery.

We had 3 cases of suture dehiscence in the triangle of the upper third, where we resutured without problems, 1 case of mild infection, treated with ciprofloxacin 500 mg antibiotic, 4 cases of unaesthetic scar scarring at the edge of the suture on the edge of the helix, causing a step, being resolved with resection of the small triangle and resuture and 2 cases of hypertrophic scar treated with corticoid cream. **Table 3** shows the occurrence of complications, prevention and treatment in the cases studied.

The HPMS (high-performance macrotia surgery) technique proved to be efficient in overall reduction of the ears, both on the vertical and diagonal axis, with reduced scarring and no unsightly alteration of the shape of the ears, which most frequently occurs with the techniques presented.

The proposed technique is a good alternative for the correction of macrotia.

Ethics Approval

All procedures performed in studies involving human participants were in ac-

cordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The Human Investigation Committee (IRB) of Orelhinha Institute approved this study.

Informed Consent

Informed consent was obtained from all individual participants and parents/legal guardians in the case of minor participants included in the study.

Patient Consent

Patients signed informed consent regarding publishing their data and photographs.

The participant has consented to the submission of the case report to the journal.

Consent of Publication

Patients signed informed consent regarding publishing their data and photographs.

Availability of Data and Materials

The data sets used and/or analyzed during the current study are available from corresponding author on reasonable request.

Funding

This work was self-funded by the authors.

Acknowledgements

The study was supported by infrastructure provided by Nova Campinas Institute Day Hospital and the research was supported by the Orelhinha Institute.

Contributions

M.S.A. wrote the main manuscript, did the research and development work on the technique presented, and chose the photos. G.R revised the manuscript and prepared the photo. L.S.M. revised the manuscript and prepared the tables. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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