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Enhancement of Aesthetic Outcomes in Patients with Bilateral Microtia

EMAN NAGY MOHAMED, M.D.; AHMED ELSHAHAT, M.D. and RIHAM LASHIN, M.D.

The Department of Plastic, Reconstructive and Maxillofacial Surgery, Faculty of Medicine, Ain Shams University

ABSTRACT

Background: Microtia is a complex and challenging condition for plastic surgeons, especially when it is bilateral, due to lack of a standard contralateral ear that could be used as a guide to achieve proper size and position of the newly reconstructed ear. Usually in bilateral cases each side is operated separately in two stages, with an overall four operative times for both sides.

Objective: In the current study, we aim at reconstruction of bilateral ears in only three stages, taking into consideration the aesthetic outcomes, similarity of both sides, and overall patient satisfaction.

Patients and Methods: In the current study, 12 patients with bilateral microtia underwent bilateral total ear reconstruction in three stages. The first and second stages are completed separately, one side at a time with one month interval. Then, the third stage is performed for both sides at the same time, three to six months after the second stage. According to the length of a line between the eyebrow and tip of the nose, a 3D model of a patient with a previously reconstructed ear will be selected, with the model length that should match the length of this line. This model will be used as a template in total auricular reconstruction. In the first stage reconstruction of one side was done. Then, in the second stage reconstruction of the other side was performed. In the third stage separation of both sides was done simultaneously. The aesthetic outcome, similarity of both sides, cost saving, postoperative complications and patient satisfaction were assessed.

Results: The patients were followed-up for 1 year postoperatively. The aesthetic outcome shows good patient satisfaction and similarity of frameworks between both sides. There was a decrease in the number of surgical stages without an increase in the rate of complications or donor site morbidity. Also, reduction in the surgical cost is considered one of the advantages.

Conclusion: Management of patients with bilateral microtia is feasible and effective in a three stages reconstruction. It is considered both time and cost-effective treatment modality with a significant aesthetic outcome, and high patient satisfaction.

Key Words: *Auricular reconstruction – Bilateral – Microtia – Segmented 3D.*

Correspondence to: Dr. Eman Nagy Mohamed
E-Mail: e.nagy@hotmail.com

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Ethical Committee: Institutional Review Board (IRB) ethical approval and patient consents were obtained in Ain Shams University, Faculty of Medicine.

INTRODUCTION

Total auricular reconstruction remains one of the most challenging problems that confront a reconstructive surgeon, especially in bilateral cases. The success in restoring the natural anatomy of both shape and position of bilaterally reconstructed ear including a thin, soft tissue coverage of a complex, flexible framework projecting off the mastoid, depends on the patient's soft tissue characteristics as well as the surgeon's creative skills in sculpting a 3D model that is nearly resembles the normal ear **[1]**.

Microtia is a congenital small or malformed external ear with absent parts. It occurs either isolated or syndromic, bilateral cases account for 10% of microtia cases. Bilateral microtia occurs with an incidence of 1:25000 births **[2]**. The external ear is an essential structure for overall aesthetic balance of the face, and minor abnormality of the ear is easily detectable **[3]**.

The technique of microtia reconstruction has developed over the years with Tanzer **[4]** using autologous costal cartilage for total auricular reconstruction, followed by the progressing efforts to improve the technique by Brent **[5]**, Nagata **[6,7]**, then Firmin and Marchac **[8,9]**.

Reconstruction of bilateral microtia is more difficult than its unilateral counterpart, due to lack of reference ear that could be used to reconstruct the other side. Also, it needs both soft tissue and cartilaginous framework that is designed to reconstruct the remnant of both ears on either side **[2]**.

Recently segmentation of the 3D printed mirror image model into auricular subunits was found to ease the modeling and carving of the scaffold, with precise dimensions and thickness **[10]**.

The usual surgical approach is used to reconstruct each side independently in separate operative sessions, two stages for each side with at least 3-6 months interval with overall 4 stages for both sides, with required time a minimum of 2 years to complete the reconstruction process of both sides. Leading to an increase in the time lost from school or from work for the parents. Furthermore, the cost of treatment represents an essential point that should be taken into consideration to reach an optimal cost-effective surgical management **[11]**.

However, up to the knowledge collected from reviewing the literature, the published literature contains relatively little information about auricular reconstruction in bilateral microtia. Some authors prefer to reconstruct each side separately in two different stages. Whereas, in this study, we present an operative technique to reconstruct both sides in three stages instead of four. This technique enables carving of bilateral ear frameworks of symmetrical shape and size, it also saves time and cost.

PATIENTS AND METHODS

Before participation in this study, written informed consent was taken from all patients after detailed explanation of the procedure. The study was conducted according to the Declaration of Helsinki Principles and was approved by the Ethical committee of the Faculty of Medicine, Ain Shams University.

A prospective study was conducted in the Plastic, Burns and Maxillofacial Surgery Department at "Ain-Shams University Hospitals", during a period from December 2020 - January 2022. 12 patients with isolated, bilateral microtia underwent bilateral total auricular reconstruction in three stages, were enrolled in the study, 4 females and 8 males, age is 6 years old or more with range (6-25) years old and with chest circumference more than 60 cm **[12]** to ensure adequate amount of the costal cartilage that will be used to reconstruct the cartilaginous framework. Exclusion criteria included patients with unilateral microtia, Hemifacial deformity, Syndromic form of microtia and patients who refused surgery.

Total auricular reconstruction in patients with bilateral microtia was done in three stages. Prior to the first stage of reconstruction full history taking and proper examination were done. There was no reference ear, that could be used as a template for the 3D printed mirror image model subunits to be done. So, we should use a measurement that is equal to the length of the ear as a reference, a vertical line between the eyebrow and the tip of the nose which represents the length of the ear was measured.

According to the length of this line a 3D model of a patient with a previously reconstructed ear will be selected, with the model length that should match the length of this line, this model will be used as a template that will help in the formation of segmented 3D printed subunits model, that will be used in the first stage of reconstruction on one side.

The width of the ear is approximately 55% of its length with Its top part aligns with the lateral brow, and the lobular tip aligns with the columella. So, the size and position of the ear on one side were determined.

Radiological assessment of the previously selected 3D ear model was done to express an ideal treatment plan, using a pre-operative CBCT scan, that was done using Planmeca 3D Mid CBCT scanner (Planmeca Oy, Asentajankatu 6, FIN-00880 Helsinki, Finland). The data from the CBCT scan were exported from the Planmeca Romexis 6 software in DICOM format, which was in turn imported into Mimics Medical 19.0 software (Materialise NV, Technologielaan 15, 3001 Leuven, Belgium) for virtual treatment planning Figs. (1,2).

The prepared 3D model is deconstructed into the Helix, the Antihelix, and the Concha subunits. All 3 models are exported into STL format Figs. (3,4). The models are 3D-Printed using the Anycubic Photon Mono X (MSLA) 3D printer (Hongkong Anycubic Technology Co., Ltd. 101-501, Building 11, Yinhai Industrial City, Shenzhen, China) using Photopolymer resin. Preceding surgery, the guide is immersed in a basin containing 2.4% activated glutaraldehyde solution (Cidex) for 20 minutes to achieve high level disinfection of the model to be used in the operating room.

The first stage of reconstruction involves reconstruction of the ear on one side using the new 3D printed model subunits as a preoperative template that help in the carving of costal cartilage framework. The costal cartilages from the 6^{th} to the 8^{th} and sometimes the 9^{th} ribs were harvested under general anesthesia through a skin incision on the same side of the affected ear's chest wall, subperichondial harvesting was done preserving

the perichondrium that will decrease the postoperative donor site morbidity.

The framework was fashioned guided by the previously formed 3D template model. The framework was carved into 3 subunits that includes helix, and tragus subunit, antihelix, antitragus and base with vertical part of concha subunit and transverse part of concha subunit. The 8th costal cartilage was used to form the helix that will be continuous with the lobule, whereas the 6th and 7th were used to form the antihelix and base, Tragus and antitragus were used to design conchal floor. Augmentation of the antihelix with a cartilage may help in conchal deepening. The cartilage subunits were held together using 4-0 prolene sutures to create the complete framework. Saline irrigation of the cartilage was done during the whole process.

A skin pocket was designed with retro positioning of the vestigial cartilage, then the 3D cartilaginous framework was inserted in the pocket with insertion of a small suction drain underneath the framework. The wound was closed by a tension-free suture. Earlobe transposition with dissection and rotation to adapt the cartilaginous framework was done Fig. (5).

The patient was discharged on antibiotics and analgesics on the 2nd postoperative day, then the drain was removed on the 5th postoperative day supposed that it drains less than 1cc, with removal of the sutures 7-10 days postoperative.

Then, the second stage was performed one month after the first stage, based on the first one, using segmented 3D printed model of the previously reconstructed side as a template according to it, another segmented 3D printed mirror image model was designed and used as a scaffold for reconstruction of the other side, using the same radiological steps described before to form a 3D printed mirror image model and the previously described operative details in the 1st stage reconstruction Figs. (6,7). Taking into consideration that the framework was harvested from the same side of the ear to be reconstructed.

Then, 3-6 months after the second stage, the third stage was performed, and a separation of both sides was done simultaneously. During this stage elevation of the auricle from the head with creation of the auriculo-cephalic angle, using thick split thickness skin graft that was harvested from one thigh of the patient to cover the post auricular sulcus.

Preoperative and postoperative photos following each stage of reconstruction were taken during the follow-up visits. Subjective assessment and analysis of the aesthetic outcome as regards shape, position, and similarity of both sides was done. Assessment of the Complications if any were observed, further evaluation and management were done.

Also, patient satisfaction was evaluated using a patient satisfaction score that was based on a questionnaire to assess satisfaction regarding the reconstructed auricles. Assessment was provided on a five-point Likert-type scale ranging from 1-5 (1: very dissatisfied) and 5: very satisfied) **[13]**.

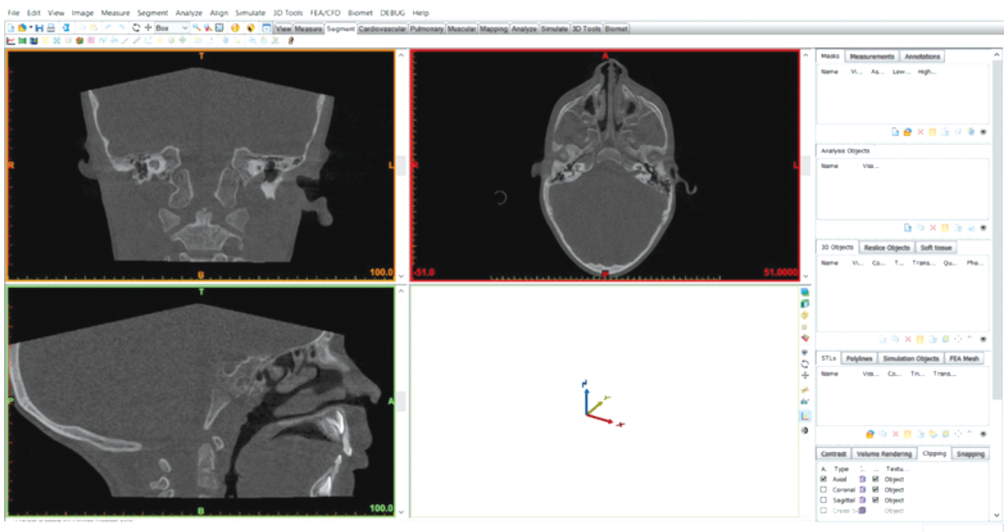

Fig. (1): Landing Page in Mimics Medical 19.0.

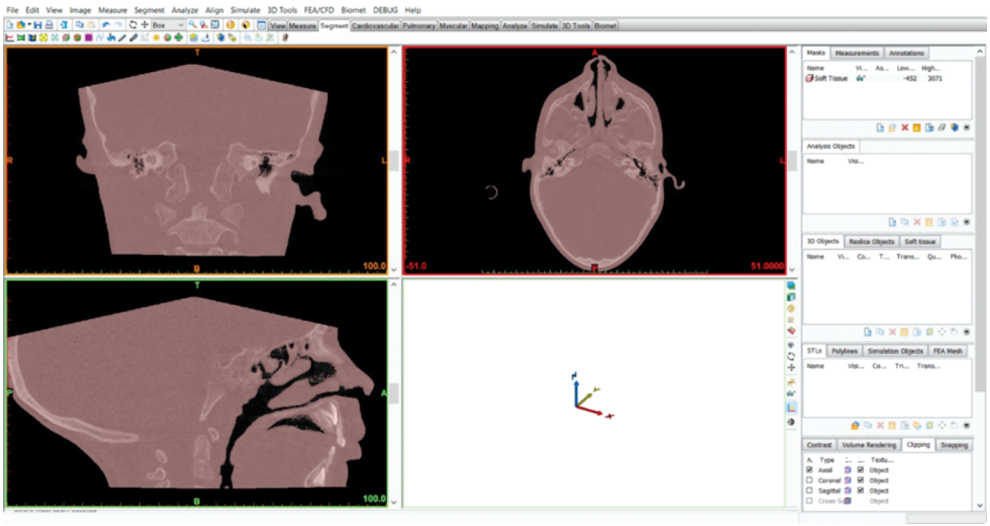

Fig. (2): New mask showing facial soft tissues.

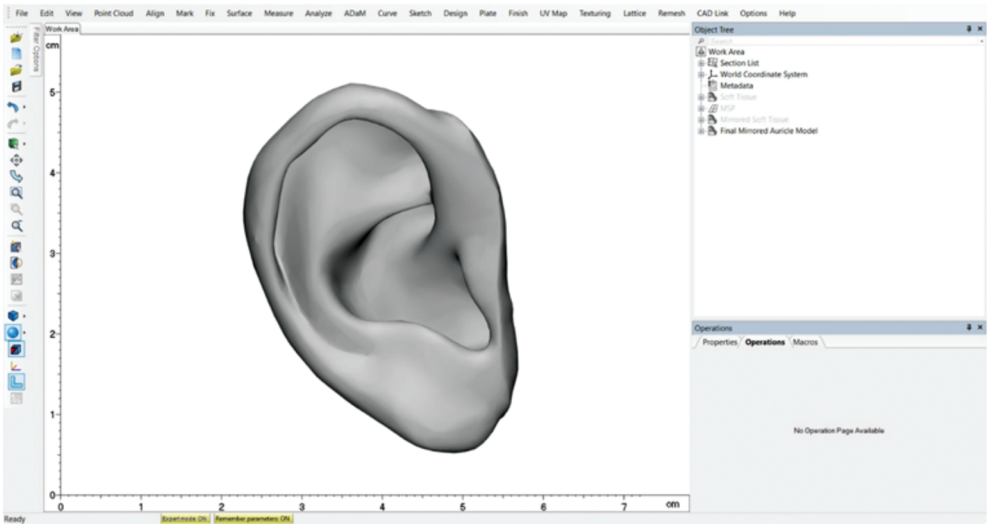

Fig. (3): Finished 3D Auricle Model.

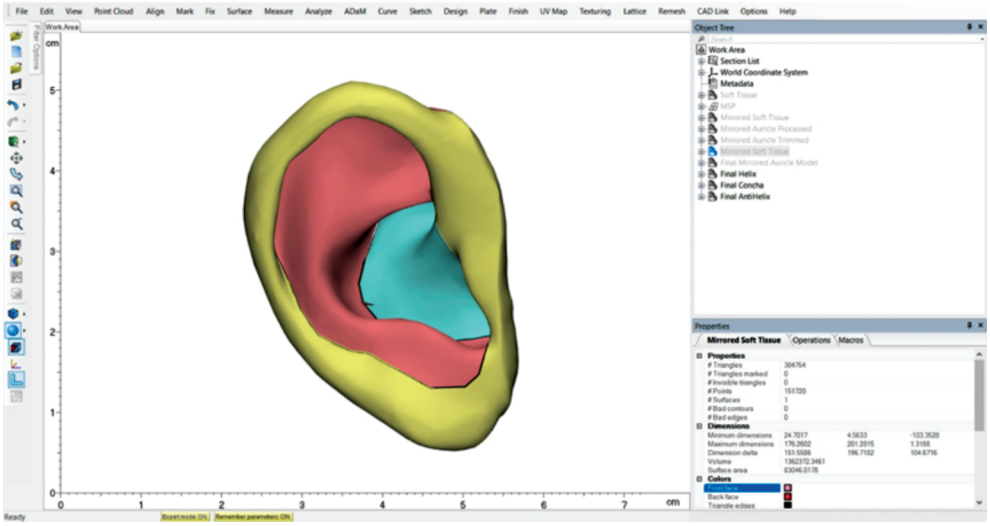

Fig. (4): 3D Model separated into Helix, AntiHelix, and Concha.

(A)  (B) 

Fig. (5): (A): Shows intraoperative photo of the carved 3D model. (B): Intraoperative photo of a patient after using the 3d model with insertion of small suction drain.

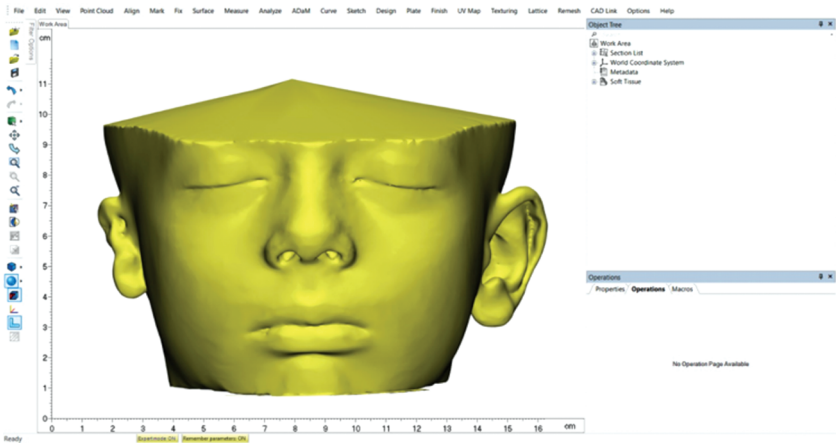

Fig. (6): Refined facial model imported in 3-Matic 14.0.

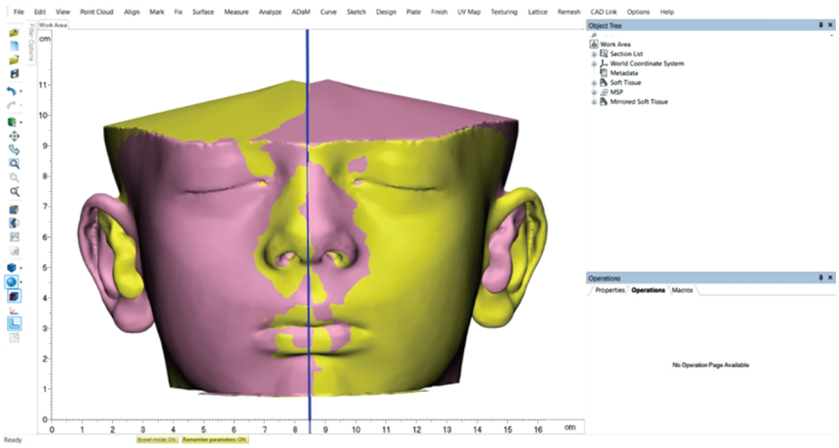

Fig. (7): MSP drawn, and facial soft tissues mirrored.

RESULTS

In the current study, a total number of 12 patients with bilateral, non-syndromic microtia were included. 4 (33.3%) females and 8 (66.6%) males, age was 6 years old or more ranging from 6-25 years with mean age ± SD (11.08±4.66), the patients were followed-up for I year postoperatively.

The aesthetic outcome shows good shape, position, and similarity of the frameworks of the reconstructed ears, with a decrease in the percentage of difference between both sides Figs. (8,9). There was a decrease in the number of surgical stages without an increase in the rate of complications or donor site morbidity. Also, reduction in the surgical cost is considered one of the advantages.

Fig. (8): 8 years old, male patient with bilateral microtia, photos (A, B, C and D) Showed preoperative photos in different positions. Photos (E, F, G and H) Showed postoperative photos after 3 stages bilateral reconstruction and 1 year follow-up.

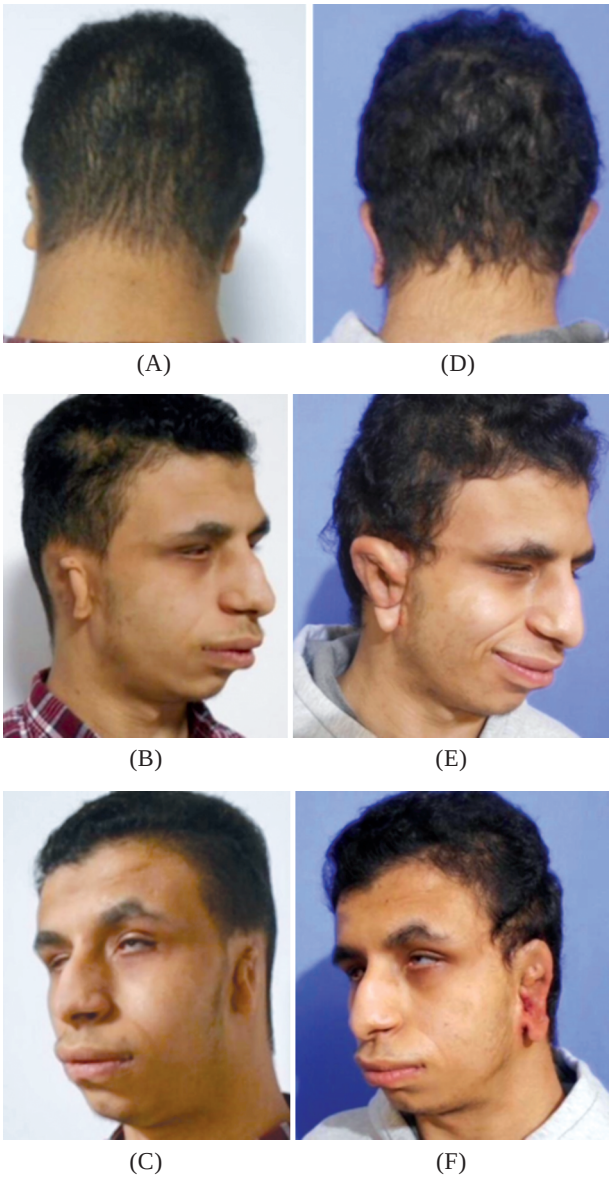

Fig. (9): 21 years old, male patient with bilateral microtia, photos (A, B and C) Showed preoperative photos in different positions. Photos (D, E and F) Showed postoperative photos after 3 stages bilateral reconstruction and 1 year follow-up.

Evaluation of the Patient satisfaction was assessed by patient satisfaction score (five-point scale: 1-5 : 1: Very dissatisfied and 5: Very satisfied). It was found that 3 patients were Satisfied, and 9 patients were very satisfied with no very dissatisfied patients were recorded Table (1). There were no major complications that necessitate operative intervention or affect the postoperative aesthetic outcome.

Table (1): Number of patients and percentage in the patient satisfaction score.

Score	Very dissatisfied (1)	Dissatisfied (2)	Neutral (3)	Satisfied (4)	Very satisfied (5)
No. of patients (%)	0	0	0	3 (25%)	9 (75%)

DISCUSSION

Reconstruction of the auricle in cases of microtia represents a great challenge for the plastic surgeon, due to its complex three-dimensional structure of the ear and the need to create a near normal external ear. In cases of bilateral microtia, lack of the reference ear represents a major challenge **[3]**.

The primary concept of auricular reconstruction in cases of microtia was introduced by Tanzer **[14]**, Since that many techniques and modifications have been evolved. Brent and Nagata developed the commonly used techniques for total auricular reconstruction in cases of microtia **[5,6]**. The use of autologous costal cartilage framework represents the best available method for auricular reconstruction, giving a good long lasting aesthetic outcome **[3]**. By time improvement of the Framework was accomplished by using 3D printed mirror image model, which creates template and certifies precise shape and symmetry of the reconstructed ear of both sides **[24]**.

Regarding the time of microtia reconstruction, there is no agreement among the reconstructive surgeons. Many factors are controlling the decision making of the reconstruction time. Patient psychological status and development of the rib cartilage must be considered, while deciding the appropriate age for reconstruction **[15]**.

Usually, in cases of bilateral microtia, reconstruction of each side is done separately in two stages with overall 4 stages of both sides over at least two years of extended treatment course **[16]**. However, in the current study, 3 stages of total auricular reconstruction were used. First stage, reconstruction of one side, then after one month the second stage, reconstruction of the other side. The 3rd stage was performed 3-6 months later which includes separation of both sides simultaneously.

In the current study, segmented 3D printed model of a patient with previously reconstructed ear was used. The model length should be equal to the length of a vertical line drawn from the eyebrow to the tip of the nose of the patient with bilateral microtia. This model was used as a guide to reconstruct one side, then the reconstructed side will be used to reconstruct the other side.

Contrary to another study in which reconstruction of both sides was done simultaneously in two stages technique with 6 months interval, each stage of bilateral microtia reconstruction is done in simultaneous fashion for both sides with acceptable aesthetic outcome with no increased incidence of complications **[16]**.

It was found that, in the multiple staged auricular reconstruction in cases of bilateral microtia, the reconstruction process was prolonged, with doubling in the operative procedure time as well as the hospital stay and follow up visits. Also, this will affect both the patients and parents lives with a bad impact on the psychological aspect of the patient due to the lengthy treatment procedure which may extend into adolescence. Moreover, there is a need to decrease the number of operative interventions in those patients as well as the cost burden **[16]**.

There are some limitations to this study, it was based on a small sample size and the need for further clinical studies for standardization of the evaluation of post operative aesthetic outcome after total auricular reconstruction.

Conclusion:

Management of patients with bilateral microtia is feasible and effective in a three stages reconstruction. It is considered both a time and cost-effective treatment modality with a significant aesthetic outcome, and high patient satisfaction.

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