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Original Research Article

A clinical study of external ear reconstruction: a study of 20 cases

Priyank K. Katwala[1]*, Vishal A. Pawar[2], Palak P. Katwala[3], Ketan H. Parmar[2]

[1]Department of Plastic Surgery, Sumandeep Vidyapeeth and Dhiraj Hospital, Vadodara, Gujarat, India
[2]Department of Plastic Surgery, [3]Department of Anaesthesia, SSG Hospital, Vadodara, Gujarat, India

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***Correspondence:**
Dr. Priyank K. Katwala,
E-mail: pkk_108@yahoo.co.in

ABSTRACT

Background: Auricular defects pose one of the most difficult challenges in reconstructive surgery of the head and neck. The reason is the unique three-dimensional anatomical architecture of the auricle, with its multiple concavities and convolutions of the cartilage and the thin, delicate skin cover. Acquired auricular deformities commonly result from traumatic injuries, burn trauma or tumour extirpation. These vary in severity from simple lacerations to complete auricular avulsions. Congenital ear deformity (microtia) occurs in every 1 out of 6000 live births. The goal of reconstruction is the precise duplication of the missing anatomical part with regard to size, orientation and anatomical landmarks.
Methods: Range from healing by secondary intention to complete replacement with autologous rib cartilage and/or auricular prosthesis. Total auricular reconstruction was done by two methods: (1) Nagata and (2) Brent's method. Nagata's technique is commonly performed in this study. The present study aimed to evaluate the reconstruction of auricular defects using autologous rib cartilage graft with or without temperoparietal fascia flap covered by split-thickness skin graft.
Results: Excellent cosmetic result can be obtained with adequate skills and training in carving the cartilage for auricular framework. This improves confidence and gives psychological support to microtia patients.
Conclusions: With training and method, results in ear reconstruction using autologous rib cartilage are excellent and reproducible.

Keywords: Ear reconstruction, Microtia, Rib cartilage, Auricular deformities

INTRODUCTION

Total auricular reconstruction with autogenous tissues is one of the greatest technical challenges that a reconstructive surgeon may encounter. It is one of the most complex procedures.

While an inherent understanding of sculpture and design influences surgical success, strict adherence to basic principles of plastic surgery and tissue transfer is of equal importance.[1]

During the years, ear reconstruction has stimulated the imagination of many surgeons who have provided countless contributions.

It is the surgeon's task to present the most sound option for the individual situation depending on several factors such surgeon's experience with the technique; anatomic site; adjacent structures; previous surgeries and patient expectation.[1]

Ultimately, however the decision to reconstruct must be in the accordance with the patient's wishes. Traumatic

ear defects are mostly a consequence of minor traffic accidents, injuries at the workplace, and/or accidents at home, assault, human/animal bites, etc.[2,3] Ear deformities/loss also arise in patients with facial burns.

Both traumatic and congenital type of ear deformities are encountered of which traumatic ear deformities are more common.

The main objective of this study is to evaluate and treat various auricular defects due to any cause.

METHODS

Study type: Descriptive study.

Study place and period: Study conducted at Baroda Medical College and SSG Hospital, Vadodara from November 2014 to December 2016.

Inclusion criteria

Inclusion criteria were post traumatic or post assault ear deformities with loss of ear or its parts; congenital ear deformities like anotia, microtia, hypoplasia of auricle; post burns and post infective ear deformities.

Exclusion criteria

Ear deformities due to multiple ear piercing, keloid/ hypertrophic scar over ear, acute ear infections, neurofibroma, split ear lobe, etc.

Congenital ear deformities like cup ear, lop ear, cryptotia, etc. are also excluded. Patients with age less than 7 years are excluded from study.

Method of surgery

Auricular reconstruction is usually done using autologous rib cartilage after age of 7 years. In this study, all patients are more than 7 years of age. But it can be done by variety of methods.

Total auricular reconstruction is usually done by two methods:

Brent's technique (involves four stages) and Nagata's method (involves two stages).

Both methods utilize autologous rib cartilage graft for ear reconstruction. Chest circumference should be more 60 cm according to Nagata at level of xiphisternum.[4]

Weight of the patient should be more than 60 kg and age more than 6 years.

Nagata's method is usually performed.[5-7] Brent's method is not done in this study.

Middle third ear defects are reconstructed using Dieffenbach's technique.

Lower third ear defects are reconstructed using Converse two flap technique.

Mustardee's technique is done in 1 patient for antihelix reconstruction with 8th rib for helix reconstruction.

First stage

The rib cartilage harvest, carving of cartilage into auricular framework with implantation, tragus construction, and lobule transposition are all performed in the first stage. Rib cartilage was harvested from 6-7 rib cartilage synchondrosis by transverse incision on 7th rib and framework was prepared by carving with knife no.15 and instruments. Helix is usually prepared from floating 8th rib cartilage and framework resembling tempelate is prepared. Prepared auricular framework with missing parts is implanted below skin after making pocket aided by negative suction drain.

Planning and preparation

Preoperative study photographs are obtained and an X-ray film or thin plastic film pattern is traced from the opposite normal ear.

This pattern is reversed and a framework pattern is designed for the new ear to be reconstructed and then they send for sterilization.

The reconstructed ear's location is predetermined by first noting the topographical relationship of the opposite, normal ear with facial features and then duplicating its position at the proposed reconstruction site.

Figure 1: Carved auricular framework prepared from costal cartilage.

Distance between the lateral canthus, lateral end of brow and nasal ala and the normal ear's helical root is noted and duplicated on opposite (affected) side.

In this study, auricular framework was prepared by suturing parts of framework by stainless steel wire no 36 or with prolene no. 4-0 (reverse cutting) suture with knots placed on undersurface of framework.

Second stage

The ear was separated from the head at the second stage (After 6 months) with a block of cartilage (harvested by entering the chest for a second time) to create auriculocephalic angle which is covered by a temperoparietal fascia flap (TPF) and skin graft.

Instead of TPF, periosteal flap can be elevated to cover postauricular sulcus.

Required carved costal auricular framework can also be covered by expanded superficial fascia of retroauricular and mastoid region.[9]

In our study, single stage ear reconstruction have been done in 4 patients using autologus cartilage framework and temperoparietal fascial flap covering cartilage with full thickness skin graft.

Figure 2: Carved auricular framework covered with temperopariteal fascia with full thickness skin graft over it.

While 8 patients were operated by Nagata's two stage technique among which in 6 patients, second stage of cartilage elevation with coverage by TPF flap or split thickness graft (STSG) is left to be done and in remaining 2 patients second stage consisted of elevation of auricular cartilage framework with STSG.

In this study, all cases of ear reconstruction are done under general anaesthesia except one case of lobule reconstruction who was operated under local anaesthesia.

Some minor corrections may be required after second stage.

In this study, 3 patients were there with post traumatic middle one third helical defect.

Figure 3: Retroauricular flap by Dieffenbach's technique.

In these patients, two stage reconstruction was done using Dieffenbach's technique with retroauricular flap in first stage and division and inset of flap in second stage.

In this study, lobule reconstruction (lower one third) was done in two patients using Converse two flap technique.

Figure 4: Postoperative picture of right ear lobule reconstruction by Converse technique.

In present study, 2 patients were treated by Mustardee's repair for reconstruction of antihelix (horizontal mattress sutures taken from post auricular side) and cartilage graft (8th costal cartilage) was harvested for helical reconstruction.

Prosthetic reconstruction was not done in this study.[10] Postoperatively, dressings were done on 2nd day with stitch removal on 10-12 days.

Negative suction drain was removed on 5-8 days depending upon drainage. STSG dressing was done on 7th post-operative day.

Patients were evaluated post operatively for complications like discharge, infection, cartilage exposure, flap necrosis, skin flap blackening, chest wall deformities, hypertrophic scarring, graft rejection, etc.

Patients were evaluated postoperatively with satisfaction score based on the shape, contour and colour of their reconstructed ear and overall treatment where '0' indicates not satisfied, '1' indicates mild satisfaction, '2' indicated moderate satisfaction and '3' suggests highly satisfied.

The patients are followed up at 2 weeks, 4 weeks and 6 weeks of interval to document the recovery, satisfaction score and any complications at each visit.

Informed consent from patients and from parents or guardians of minors was taken preoperatively regarding enrollment in study.

Ethical approval

Ethical committee approval for conducting study was taken from Baroda Medical College and SSG Hospital, Vadodara, Gujarat, India where study was conducted.

Statistical analysis

Analysis of data was done using Microsoft Excel software.

RESULTS

Sex distribution

A total of 20 patients were included in the study with 11 males and 9 females with mean age of 21.95 years (range from 7-47 years), median for age is 20.

Lowest minimum age of patient included in study is 7 years and maximum age is 47 years.

Age distribution

In this study, 8 patients were less than 8 years of age and 12 patients were more than 18 years of age.

In this study, right side affection was present in 11 patients, 6 patients on left side and bilateral affection in 3 patients.

In this study, 12 patients had either underdeveloped ear, 7 patients had abnormal looking ear and 1 patient had absent ear.

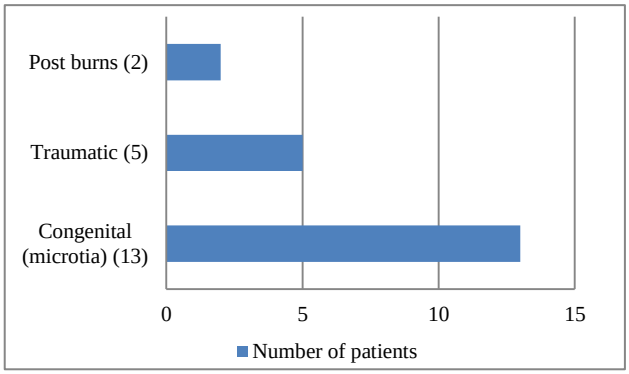

Figure 5: Cause of defect.

In our study, there are 2 patients (10%) who were operated in past for opposite ear reconstruction. In present study, range of chest circumference is from 42-79 cm.

In our study, patients with weight from 17 kg to 72 kg were taken and median for weight is 48 kg.

In this study, among 13 patients of microtia, 4 patients (20%) had other congenital anomalies like ulnar polydactly, microcephaly, genitourinary anomalies, speech difficulties, etc.

Table 1: Position of affected ear.

Position of affected ear	Number of patients	Percentage (%)
Low set ear	6	30
Posteriorly placed ear	1	5
Normal	13	65
Total	20	100

In our study, external auditory meatus was present in 18 and absent in 2 patients. Out of 13 patients of microtia, 12 had low hairline on affected side (92.30%). Occlusion was neutral in all patients of microtia. Hemifacial microsomia was present in 6 out of 13 microtia patients.

In our study, in 12 out of 13 congenital cases, there was moderate to severe hearing loss on affected side on audiometry.

In present study, external ear reconstruction was done by Nagata's technique in 8 cases (40%), by Dieffenbach's technique in 3 (15%) cases, by single stage using

temperoparietal fascial flap in 4 cases (20%), by Converse technique in 2 patients (10%), by Mustardee's repair along with costal cartilage in 2 cases (10%) and debridement with cartilage banking in retroauricular space done in 1 (5%) patient.

Table 2: Facial nerve weakness or palsy.

Facial nerve weakness/ palsy in microtia patients	Number of patients	Percentage (%)
Present	6	46.15
Absent	7	53.85
Total	13	100

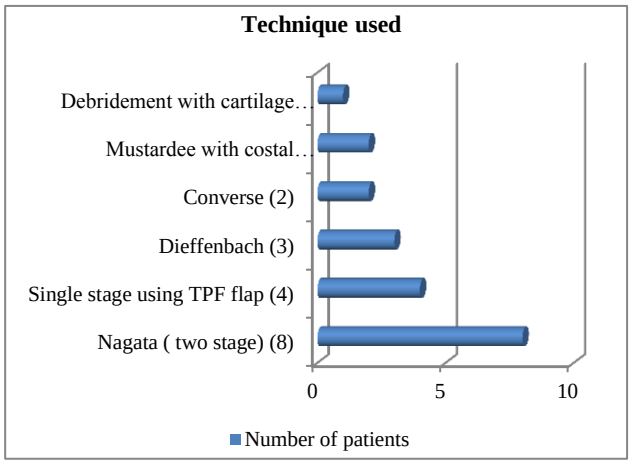

Figure 6: Technique used for external ear reconstruction.

In our study, transverse incision was used on right side of chest in all cases where costal cartilage was harvested for carving auricular framework except in 1 case where left side transverse incision was kept as right side incision was used for cartilage harvest for other ear reconstruction in past.

In present study, carved auricular framework parts were assembled using SS wire no.40 in 4 patients out of 12 patients in which auricular framework was carved and in other cases, ethilon 4-0 reverse cutting suture was used.

Among the complications, raw area due to graft loss was found in 1 patient (5%), cartilage exposure in 1 patient (5%), blackening of suture line and skin was found in 2 patients (10%) and necrosis of TPF flap was found in 1 patient (5%) on 2 weeks follow up.

On follow up of 4 weeks, raw area due to graft loss was found in 2 patients (10%), 2 patients were lost to follow up while 16 patients had no complications.

On follow up of 6 weeks, no complications were found in 18 patients and 2 patients were lost to follow up.

2 patients were lost to follow up after 2 weeks. 1 patient showed improvement in satisfaction score from 2 at 2 weeks to 3 at 4 weeks due to STSG over raw area due to full thickness graft loss.

Table 3: Satisfaction score at 2, 4 and 6 weeks follow up.

Satisfaction score	No. of patients at 2 weeks	No. of patients at 4 weeks	No. of patients at 6 weeks
0	1	1	1
1	3	3	3
2	9	7	7
3	7	7	7
Total	20	18	18

In this study, out of 7 patients among 20 patients with satisfaction score '3', 3 patients were operated by Dieffenbach's technique, 2 patients by Nagata's technique, 1 patient by single stage reconstruction using TPF flap and 1 patient by Mustardee's repair with costal cartilage.

DISCUSSION

In present study, there are 12 patients above age of 18 years and 8 patients below age of 18 years. Lowest minimum age of patient included in study is 7 years and maximum age is 47 years. External ear reconstruction by costal cartilage in microtia is done after 7 years. Before 7 years, costal cartilage has not grown adequately in size for its harvest for framework fabrication. Moreover, ear reaches 85-90% of adult size after age of 7 years.

In present study, 11 were males and 9 patients were females. In series by Chauhan et al, 17 patients were males and 10 were females.[11] Thus in all studies, males were more than females.

In this study, right side affection was present in 11 patients, 6 patients on left side and bilateral affection in 3 patients. So right:left:bilateral ratio is 11:6:3. In study by Pavuluri et al, 18 patients had unilateral microtia while 7 patients had bilateral affection.[12]

In this study, among 13 patients of microtia, 5 patients (25%) had other congenital anomalies like unilateral radial polydactly in 1 patient, microcephaly with short stature in 1 patient, congential PUJ obstruction in 1 patient, proximal penile hypospadias with rectourethral fistula in 1 patient and speech difficulty in 1 patient.

In study by Pavuluri et al, 6 patients had associated congential anomalies like syndactly, facial palsy,etc.[12]

In our study, facial nerve weakness/paralysis was present in 6 patients (46.15%) out of 13 microtia patients while in study by Pavuluri et al, 1 patient had facial palsy.[12]

In our study, hemifacial microsomia was present in 6 patients (46.15%) out of 13 cases of microtia which is high while in study by Pavuluri et al, 4 patients had hemifacial microsomia out of 25.[12]

In study by Pavuluri et al, cartilage harvest was done from contralateral side.[12]

In our study, patients with weight from 17 kg to 72 kg were taken and median for weight is 48 kg.

In present study, external auditory meatus was absent in 2 patients (10%) on affected side (2 out of 13 patients of microtia). Canaloplasty was not done in our study.

Out of 13 patients of microtia, 12 had low hairline on affected side in this study. In study by Pavuluri et al, 8 patients had low hairline among 25 patients.[12]

In present study, 3 patients had microtic contralateral ear. In our study, 2 cases got operated in past for contralateral ear reconstruction.

In present study, there are 13 congenital cases of microtia, and 5 traumatic cases and 2 are post burns ear deformity patients. Among 5 traumatic cases, 1 was animal bite and 1 case was of post human bite auricular defect (acquired 7 cases of auricular deformity).

In present study, score of '0' denotes not satisfied, '1' denotes mild satisfaction, '2' denotes moderate satisfaction and '3' denotes highly satisfied.

At each follow up, satisfaction score was recorded for evaluation of results.

7 patients had satisfaction score of '3' at 2 weeks, 4 weeks and 6 weeks and 9 patients had satisfaction score of '2' at 2 weeks and 7 patients had satisfaction score of '2' at 4weeks and 6 weeks. 2 patients were lost to follow up. 1 patient showed improvement of score from '2' at 2 weeks to '3' at 4 weeks follow up due to STSG over raw area due to full thickness graft loss over TPF.

In our study, satisfaction score is more is all post traumatic cases and in non-pediatric age group. In our study, overall low satisfaction score is due to dark skinned patients, hyperpigmentary changes over graft and color mismatch with rest of facial skin.

Moreover, remodeling of wound occurs at around 6-12 months post-surgery, so aesthetic outcome is low as compared to long term follow up.

In article by Pavuluri et al, grading scale was used for evaluating results as excellent (17), good (1) and satisfactory (7) among 25 patients.[12]

In study by Helel et al, score of '0' indicated no improvement and score of 3 indicated highly satisfied.[13]

In study by Helal et al, 14 patients of traumatic auricular defects were taken.[13]

In study by Elsonbaty et al, 14 cases of post traumatic ear defects were taken among 6 patients were of human bite, 4 patients were of burns and 4 were of traumatic lacerated defect.[14]

In present study, range of chest circumference of patients is 42-79 cm. Adequate cartilage harvest can be done if chest circumference is more than 60 cm.

In study by Liu et al, 21 cases of bilateral microtia were treated during same stage.[15] In our study, 1 side was treated at one time.

In present study, external ear reconstruction was done by Nagata's technique in 8 cases (40%), by Dieffenbach's technique in 3 (15%) cases, by single stage using temperoparietal fascial flap in 4 cases (20%), by Converse technique in 2 patients (10%), by Mustardee's repair along with costal cartilage in 2 cases (10%) and debridement with cartilage banking in retroauricular space done in 1 (5%) patient.

In study by Firmin et al, ear reconstruction is done in two stages but it gives classification systems of framework, projection pieces added to undersurface and for skin approaches.[16]

In article by Ottat, reconstruction of partial defects were done by mastoid cutaneous flap with or without cartilage graft or chondrocutaneous flap according to size of defect.[17]

In our study, right sided incision was kept on chest wall in 12 patients to avoid cardiac injury on left side. (Cartilage harvest done in total 13 patients). Left side incision was kept in only 1 patient who was already operated before with right side incision.

Transverse incision was kept in all cases as we have found minimal hypertrophic scarring with transverse scar than oblique scar.

Different parts were carved from 6^{th}-7^{th} synchondrosis according to the need and defect. Helix is prepared from 8^{th} costal cartilage in our study because 6^{th} and 7^{th} synchondrosis is not enough for helical reconstruction and good three dimensional (3D) framework is not possible to prepare with 6^{th} and 7^{th} synchondrosis.

In present study, follow up is taken at 2 weeks, 4 weeks and 6 weeks and satisfaction score of adult patient or parents at each follow up is recorded. Complications, if any, are noted and appropriate treatment was done.

In present study, raw area due to full thickness graft loss developed in 1 patient which was treated subsequently with STSG, cartilage exposure occurred in 1 patient

which was treated conservatively and got healed by secondary intention, necrosis of TPF flap developed in 1 patient which was treated by debridement of flap with banking of cartilage framework within abdomen, chest donor site emphysema in 0 patient and blackening of suture line or skin in 2 patients which was treated conservatively.

CONCLUSION

Microtia is major aesthetic and functional morbidity. Complete ear reconstruction is indispensable but it needs experienced reconstructive surgeon. Partial traumatic auricular defects are more common and ear reconstruction in these patients gives better aesthetic results. The use of autogenous rib cartilage is preferred method for complete auricular reconstruction. Ear reconstructed from auricular framework maintains its shape, contour and it does not undergo resorption. With temperoparietal fascia flap with full thickness skin graft, it is possible to reconstruct auricular defect as near normal as possible in single stage with minimal morbidity of donor site. Single stage ear reconstruction is well accepted by patients. Each defect and patient is unique and should be evaluated individually. Ear reconstruction using costal cartilage framework is cost effective method but it has learning curve. Expensive infrastructure is not required. Best aesthetic result should be expected at around 6-12 months after surgery due to adequate scar maturation and remodeling of wound. It enhances psychological behaviour and confidence among microtia patients.

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