ABSTRACT

Reconstruction of human ear is one of the greatest technical and aesthetic challenges, facing the plastic, reconstructive and aesthetic surgeon. The three dimensional nature of the ear with many curls, peaks, and valleys makes this one of the most elegant body parts. The rigid nature of cartilage along with its elastic nature is a testament to its unique properties which makes it very difficult to reproduce. In this study we are presenting the ear deformities resulting from trauma and the methods of reconstruction followed in our department over a three year period. We have treated 43 patients with various types of flap cover. Ear lobule was the commonest part affected in our study. Primary reconstruction of ear deformities achieved better results than delayed or secondary reconstruction.

KEYWORDS

Ear injuries, Converse flap, Post auricular flap, Diffenbach procedure

Introduction:
Reconstruction of the ear can be a complex process. In certain cases staged reconstruction may be needed. Though reconstruction can be traced back to era of eighth century B.C. as recorded in Sushruta Samhita now even after advent of autologous tissue, alloplastic material, tissue engineering, tissue expansion, prelaminated free flaps, ear reconstruction has been a great challenge.

It is difficult to match the flexibility of the ear while maintaining the rigidity and skin covering. Even minor deformities of pinna cause psychological distress. Functional loss of pinna is a disability as ear supports glasses, head phones, Bluetooth headsets.

AIM OF STUDY:
- To assess the various causes of acquired pinna defects.
- To study the age, sex distribution of the patients
- To evaluate results, outcome of various surgical procedures.
- To study the complications of various procedures.
- To evaluate the advantages of primary reconstruction over secondary reconstruction.

Surgical anatomy of auricle
The external ear is composed of auricle or pinna, external auditory canal and lateral surface of tympanic membrane. The auricle is typically oriented at an anteroposterior rotational angle of 15-20°. The height corresponds to the height of the nose. The pinna is about 6cm from the lateral canthus and about 6-7 cm height from helical crus to lobule. The normal protrusion of pinna from the skull is about 25-30°.

Helix forms the prominent auricular rim. Antihelix forms the prominence anterior to helix and has 2 crura superior and inferior. Triangular fossa is the space between the superior and inferior crura of antihelix. Scaphoid fossa is the space between helix and antihelix. Concha is a deep cavity posterior to external auditory meatus. The conchal cavity is divided into cymba concha superior to crus of helix and cavum concha inferior to crus of helix. Tragus is anterior to concha and partially covers the external auditory meatus. Antitragus is present posterior to the tragus separated by intertragic notch. Lobule is present inferior to the antitragus. The pinna is attached to the temporal bone by fibrocartilaginous tissue.

Blood supply
Auricle is highly vascular and has intercommunication between Posterior auricular artery, superficial temporal artery and Occipital artery. Venous drainage is by the corresponding veins.

Lymphatic drainage
Lymphatics from ear drain into preauricular, postauricular, parotid nodes and subsequently in upper deep cervical nodes in level II nodes.

Nerve supply

Etiology of acquired auricular defects
1. Trauma
   - Road traffic accident
   - Assault
   - Human / Animal bites
   - Gunshot injuries

2. Infection
3. Tumour
   - Benign
   - Malignant

4. Burns
   - Thermal
   - Electrical
   - Chemical
   - Radiation

5. Others

Classification of acquired auricular defects
I. Based on amount of loss
   o Partial loss
   o Total loss

II. Based on component loss
   o Skin
   o Cartilage
   o Both

III. Based on area
   o Upper third
   o Middle third
   o Lower third
   o Combination

IV. Based on parts of the ear
   o Helix
   o Antihelix
   o Concha
   o Scaphoid fossa
   o Triangular fossa
   o Lobule
   o Combination

The greater auricular nerve supplies most of the auricle from posterior to anterior aspect of lobule, helix and antihelix. The auriculotemporal nerve is a branch of the mandibular division of trigeminal nerve and supplies tragus, helical crura, skin superior to auricle. Lesser occipital nerve supplies skin posterior to auricle. Vagus nerve supplies, posterior external auditory canal. Facial nerve supplies cavum concha.
Principles of reconstruction:
The auricle may be divided into zones and the components lost to plan for various methods of repair

Helical rim and lobule: Creates overall appearance of ear. Mild defects can create largest cosmetic asymmetry. Care is taken to maintain continuity, height and to prevent step deformity. Cartilage graft should be planned wherever necessary.

Antihelix and antitragus: This gives support to ear framework. Loss leads to lop ear deformity. So flaps with cartilage support should be planned.

Cavum concha: This does not give support to the ear. So cartilage support is not needed. It will be enough if skin cover alone is given. The preauricular and post auricular sulcus should be preserved to give the ear normal projection.

Pre-op planning:
Template of pinna defect made and defect quantified by comparing with unaffected pinna or with pinna of same age and stature person if both pinna are lost. Debridement and removal of foreign body wherever necessary has to be done. Cartilage graft wherever necessary either from conchal or costal cartilage. Rule of Firmin has to be followed to plan for site of cartilage graft. For <25% defect ipsilateral or contralateral conchal cartilage can be used. If ≥25% loss of cartilage and biplanar defect is present we have to use costal cartilage graft.

Skin cover can be done using surrounding skin, fascia, skin graft or distant or free flaps. Suction drain should be used wherever necessary. Skin should be sutured using 4-0 or 5-0 polypropylene or ethilon.

Reconstructive options:
Primary closure: Simple laceration involving skin only can be closed in a single layer. In complex laceration involving full thickness layered closure has to be done. Small skin defects of helix and antihelix can be closed by undermining and advancement. Small defects of <1.5cm involving helix and antihelix may be amenable to primary closure by converting to wedge excision.

Skin grafts: Skin grafts are useful in skin loss in lateral or medial surface when perichondrium is intact. Contralateral postauricular skin can be harvested as full thickness skin graft. Defects between 1.5 – 2 cm involving helix and antihelix can be reconstructed by using composite grafts.

Local and regional flaps: Local flaps provide good colour and texture match. Preauricular, postauricular, retromandibular and cervical skin have been used. Temperoparietal fascial flap provides a well vascularised flap in vicinity for reconstruction.

Helical defects: Upper third defects
- Defects <2cm: Antia Buch’s chondrocutaneous advancement flap and Composite grafts
- Defects >2cm: Staged tube flap from postauricular skin-Eave’s procedure, Converse tunnel procedure, Creckelair banner flap, Cartilage framework covered with temperoparietal fascia with skin grafting or using local flaps.

Middle third defects: Composite graft, Staged tubed flap, Bipedicle flap, Antia Buch chondrocutaneous advancement flap, Converse tunnel procedure, Diffenbach procedure and Cartilage graft with temperoparietal fascial flap with skin grafting

Scaphoid fossa and triangular fossa
- Defects <2cm: Primary closure
- Defects >2cm: Composite graft

Antihelical defect: Composite grafts, Advancement flaps and Transposition flaps

Tragus and Helical crus: Cartilage graft covered with preauricular skin.

Cavum concha
- Local skin flap
- Skin grafts

Lobule defect: Preauricular flaps, Post auricular flaps, Auriculomastoid flap, Lateral neck skin flap, Zenteno Alanis technique, Gavello flap, Two flap technique of Converse, Wynn method, Nelaton and Ombredanne method and Double cross skin flap of Fadi sleilati.

Subtotal or total loss of pinna: Replantation, Staged reconstruction, Single staged reconstruction using cartilage or alloplastic framework with temperoparietal fascia and skin graft or Prosthesis implantation.

Complications: Haematoma, Seroma, Infection, Perichondritis, Flap necrosis and Keloid formation.

Materials and method:
The study was conducted in the department of plastic surgery, Government Rajaji Hospital, Madurai Medical College, Madurai. Patients with acquired auricular defects were included in the study. Patients with no tissue loss and managed by primary suturing were not included in this study.

All patients included with acquired defects were due to road traffic accident, assault, human and animal bites, burns, infection and tumour. A total number of 43 cases were included in the study. In stable patients primary single staged repair was done or first stage of the staged reconstruction was done on the day of trauma.

In patients with associated injuries they were taken up after proper resuscitation. Procedures outcomes, complications were explained to the patients and informed written consent were obtained for all patients. Cases were followed up after 1 week, and 2 weeks then monthly for at least 3 months after the final stage of reconstruction.

ANALYSIS:
The data obtained were analyzed on the following factors:

Age and sex of patient, etiology, auricular defects depending on parts

RESULTS:

AGE: In the forty three patients included in the study the age range was between 14-65 years.

Table I

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Age group</th>
<th>Numbers affected</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>1</td>
<td>0-20</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>21-40</td>
<td>31</td>
<td>72</td>
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<td>3</td>
<td>41-60</td>
<td>8</td>
<td>18.6</td>
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<td>4</td>
<td>&gt;60y</td>
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</table>

Patients of third and fourth decades formed the major group. They formed about 72%.

SEX

Table II

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Sex</th>
<th>Number</th>
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<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>27</td>
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<td>2</td>
<td>Female</td>
<td>16</td>
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<tr>
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Male patients were affected more than female. The male to female ratio was 1.7:1.

ETIOLOGY
In our study the common causes of pinna defects were due to road traffic accidents, assault, human bite and burns. There were no cases of tumour excision in our study. Assault and human bite were the commonest causes followed by road traffic accident.

### SITE OF LESION

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Site</th>
<th>Number</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>1</td>
<td>Skin loss only</td>
<td>4</td>
<td>9.3</td>
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<tr>
<td>2</td>
<td>Composite defects</td>
<td>5</td>
<td>11.63</td>
</tr>
<tr>
<td>3</td>
<td>Upper third defect</td>
<td>5</td>
<td>11.63</td>
</tr>
<tr>
<td>4</td>
<td>Upper &amp; Middle third</td>
<td>5</td>
<td>11.63</td>
</tr>
<tr>
<td>5</td>
<td>Middle third</td>
<td>9</td>
<td>20.9</td>
</tr>
<tr>
<td>6</td>
<td>Middle third &amp; lobule</td>
<td>15</td>
<td>34.85</td>
</tr>
<tr>
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<td></td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

Lobule loss and lobule with lower third helical defects formed the predominant group of the study forming about 56% of total group. Skin loss alone was present only in 4 patients. Composite loss involving upper and middle third were present in rest of the patients.

### SIDE OF LESION

<table>
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<tr>
<td>2</td>
<td>Left</td>
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</tr>
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### SURGICAL PROCEDURES

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<tbody>
<tr>
<td>I</td>
<td>Post auricular flap</td>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td>II</td>
<td>Converse tunnel</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>III</td>
<td>Diffenbach</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>IV</td>
<td>Double cross</td>
<td>9</td>
<td>21</td>
</tr>
<tr>
<td>V</td>
<td>Temperoparietal fascia / SSG</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>VI</td>
<td>SSG</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

Of the various procedures inferiorly based post auricular flap was done in 35% patient followed by double cross skin flap in 21% of patients. The other flaps commonly used were superiorly based post auricular flap, Converse Tunnel, Diffenbach procedures and temperoparietal fascial flaps with skin graft. Skin grafting was done in 4 cases. Cartilage grafting were necessary in 7 cases. Cartilage graft were harvested from opposite concha in 3 cases and opposite synchondrosis in 4 cases.

### COMPLICATIONS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Complication</th>
<th>Number</th>
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<tbody>
<tr>
<td>1</td>
<td>Wound infection</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Partial graft loss</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Partial flap dehiscence</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Nil</td>
<td>40</td>
</tr>
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<td></td>
<td>43</td>
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</tbody>
</table>

There were no major complication in our study except for wound infection, partial graft loss and partial flap dehiscence in one case each.

Middle third defect – diffenbach procedure

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