ORIGINAL ARTICLE

A STUDY ON STRUCTURE AND THICKNESS OF ISTHMUS OF CARTILAGE OF PINNA

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ABSTRACT: INTRODUCTION: A variety of organic and inorganic materials is used as grafts in Ossiculoplasty and reconstruction of the outer attic wall and posterior wall of External Auditory Meatus. Tragal cartilage, Conchal cartilage and septal cartilages are frequently used as auto grafts during Tympanoplasty surgery for reconstruction of Ossicular chain. Cartilage grafts used for Ossicular replacement should be thick, sturdy, easily sculpted and without much elasticity. If the graft has elastic nature it tends to reduce the conduction of sound vibrations. Auricular cartilage is accessible through the same post aural incision used for the mastoid surgery. If the auricular cartilage is palpated for the thickness, one would find that the thickest part is the isthmus. It is felt below and posterior to the inter tragal sulcus. The present study is to measure the thickness of the isthmus part of the auricle cartilage. It also includes study of histology of the cartilage of isthmus to observe the stacks of cells present between the two layers of the perichondrium. **MATERIALS AND METHODS:** The cartilage of isthmus from 36 cadavers is dissected to measure its thickness and for histology study. Cartilage of isthmus from 36 patients undergoing Modified Radical Mastoidectomy is measured for their thickness and histology is studied. A sterile steel calipers is used to measure the thickness of the cartilage, after exposing the cartilage from posterior aspect during surgery. The tips of the calipers are kept touching the perichondrium on both sides. Thin histology sections are taken after embedding the cartilage in paraffin moulds. Hematoxyline and Eosin stain is used to study the histology. The thickest portion of the cartilage is sculpted to be used as a strut in Type III Tympanoplasty. **OBSERVATIONS:** The thickness of the cartilage varied from 2.1 to 3mm. The number of stacks of chondrocytes varied from 5 to 7. The physical nature of the cartilage is sturdy and easily sculpted. **CONCLUSIONS:** Cartilage of the isthmus of the auricle is accessible through the same post aural incision used for Mastoid surgery. The thickness and sturdiness is suitable for use as an Ossicular replacement strut.

KEYWORDS: Auricle, concha, isthmus of the auricle, Tragus, EAM, Tympanoplasty, Mastoidectomy.

INTRODUCTION: The Cartilage of auricle is a fibro elastic type of cartilage and its thickness varies in different parts.[1] The cartilage of auricle is continuous with the cartilage of External auditory Meatus (EAM) by a narrow isthmus (Isthmus cartilaginis auris).[2] It is also defined as a narrow junction where the cartilage of the EAM and tragal lamina meets auricular cartilage.

It measures about 8–9 mm in length. The isthmus corresponds laterally to the deepest part of inter tragal fissure and medially it forms the outer boundary of a deep fissure incisura

terminalis auris which separates the cartilage of pinna and cartilage of Meatus. (Fig. 1). The thickest part of the isthmus cartilage can be easily felt on deep palpation with index finger below and posterior to inter tragal sulcus. The isthmus of the auricular cartilage is easily exposed through post aural incision as in Mastoidectomy surgery. Review of literature showed very few papers on measurement of this part of auricular cartilage. Usually cartilage contains a gelatinous ground substance called chondroitin sulfate.[3] Nitsche O giving his report on 2500 surgeries quotes that autologous cartilage was usually used for interpositions.[4] Tu Ty studying the long term histology changes of grafted auricular cartilage pieces in rabbit tympanic bullae found a space-filling mass effect with minimal resorption of the cartilage pieces was observed in the perichondrium-removed group. In addition to this mass effect, the progenitor cells in the preserved perichondrium allowed active bone tissue regeneration and cartilage resorption in the perichondrium-preserved group. Embedded within the ground substance are collagen and elastic protein fibers. Together, these components form a matrix that is flexible, yet very durable and also resistant to compression forces. Cartilage is formed by chondroblasts. These are cellular progeny of mesenchyme cells. As a result, chondroblasts are typically found along the edges of cartilage plates just under the perichondrium where new appositional growth occurs. They are arranged in linear stacks under the perichondrium. The thickness is based on the number of layers of these stacks. Histology of the isthmus cartilage shows 5 to 6 layers of chondrocytes covered with perichondrium. In other areas of concha the cell layers vary from 3 to 4 in number. In surgical Procedure for chronic otitis media reconstruction of Ossicular chain is a must to restore the Function of the Ear. The aim of this presentation is to look at the feasibility of using Tragal cartilage in Ossiculoplasty, as it is available at the incision site during Tympanoplasty.

AIM: The aim of the study is to measure the thickness of the thickest portion of the isthmus Conchal cartilage in living patients and cadaver dissections. To study and compare the histological pattern of the tragal cartilage collected during surgery and in cadaver; to evaluate the uses and benefits of using tragal cartilage in Ossiculoplasty.

CONCLUSIONS: Cartilage of the isthmus of the auricular cartilage.

MATERIALS AND METHODS: In a cross sectional study of patients who underwent Tympanoplasty and Modified radical Mastoidectomy procedures with chronic otitis media, a study is conducted to measure the thickness of cartilage of isthmus of the auricle. The Total number of Cartilage Specimens studied are 72 (n=72). Out of which 36 are from Cadaveric dissection in fresh cadavers with the help of forensic department of Kurnool Medical College and department of Anatomy. The remaining 36 are from live mastoid surgeries. In the cadaveric group males are 25 and females are 11. In the live surgical group males are 21 and females are 15. Post aural incision invariably allows access to the thick cartilage of the isthmus of the auricle, posterior to the inter tragal fissure. The thickness is measured with a sterile steel calipers. Harvested cartilages are studied under light microscopy with Eosin and Hematoxyline stains for their histology. The number of stacks of cells between the two layers of perichondrium is counted for the purpose of knowing the relation between thickness and the number of stacks of cells.

REVIEW OF LITERATURE: Structure of Pinna and EAM shows that it is made of Fibro- elastic Cartilage. Its thickness varies depending upon the different sites like cavum concha, tragus, isthmus, crus of helix and pinna proper. It is found to be Thickest in the floor (Tragus) and the Conchal bowl thickness ranged 1.9- 3.4mm. Conchal extension at helical root the thickness was found to be 3.5+/-0.4 mm. Antero inferior aspect of the Conchal bowl is 3.3+/- 0.9mm. Elastic cartilage: fairly closely resembles in its structure with Hyaline Cartilage. The properties of elastin and the fibres it forms give elastic cartilage its ability to be deformed and to spring back into shape immediately. The chondrocytes are more tightly packed together than in Hyaline cartilage.

OBSERVATIONS: Totally 72 cartilages are measured for thickness; 36 cartilages from Modified Radical Mastoidectomy surgery (live) and 36 from cadaveric dissections. In Live dissection of cartilages 21 are males and 15 are females. Similarly in cadaveric dissections males are 25 and females are 11. The measurement is done with a sterile steel calipers during surgery (Table 1). All the 72 patients are classified according to age groups from 05 years to 60 years at an interval of 10. The youngest patient is aged 12 years and the eldest patient is 54 years with a mean age of 37.6 years.

	Live		Cadaver	
Age Group	**Male (21)**	**Female (15)**	**Male (25)**	**Female (11)**
05-15	06	04	04	02
15-30	06	05	08	04
31-45	05	05	06	03
46-60	04	01	07	02

Table 1: Showing the age distribution (n=36X2=72)

The thickness of the cartilages varied from 1.8 mm to 3.9 mm.

	Cadaver		Live	
Thickness in mm	**Male (25)**	**Female (11)**	**Male (21)**	**Female (15)**
1.6-2.0	03	02	01	03
2.1-2.5	05	02	02	02
2.6-3.0	06	02	06	03
3.1-3.5	08	04	05	03
3.6-4.0	03	01	07	04

Tale 2: Showing the thickness of cartilage in relation to the sex (2X36=72)

There is no significant difference between males or females in relation to the thickness of the cartilage in the cadaver group. The chi- square statistic is 0.4414. The P value is 0.978. The result is not significant. There is no significant difference between males or females in relation to the thickness of the cartilage in the live group also. The chi- square statistic is 2.3844. The P

value is 0.665445. Hence it can be deduced that there is no statistical difference in thickness of cartilage of males or females either live or cadaveric cartilages. (Predicted P value taken as <0.05).

The mean thickness of the isthmus cartilage in cadavers is found to be 2.85, median 2.9 and the mode is 2.9 with a standard deviation of 0. 60211. Using the observations from the two groups of measurement of thickness of the cartilages from cadavers and living individuals T value is calculated using the student T test calculator for 2 independent means. It is found that the T value is 1.5140 and the P value is 0.06. The result shows that there is no significant difference between the two observations of thickness of both the cadaveric dissected cartilage and live dissected cartilage. (Table 3)

Overall Thickness of the isthmus cartilage of the auricle					
Age Group	**1.6-2.0**	**2.1-2.5**	**2.6-3.0**	**3.1-3.5**	**3.6-4.0**
05-15	03	06	04	02	01
15-30	03	04	06	07	03
31-45	02	04	04	06	03
46-60	01	01	05	05	02

Table 3: Showing the overall (Cadaveric+ Live) thickness of the cartilage in relation to the age groups (n=72)

The study showed the thickest portions of dissected and excised parts of isthmus cartilage showed the number of chondrocytes stacks between 2 to 8 in number. In 61.11% the number of stacks is between 4 to 6 and in 12.5% the number of stacks is 6-8.

Number of stacks of Chondrocytes	**Cadaveric cartilage (36)**	**Live cartilage (36)**	**Percentage %**
2-4	10	09	26.38
4-6	21	23	61.11
6-8	05	04	12.5

Table 4: Showing the number of chondrocytes stacks in the specimen cartilages (n=72)

DISCUSSION: Tragus is a flap of cartilage covered with skin below the root of helix. It has a posterior projection overlapping the EAM orifice.[1,2] Anti tragus is a small tubercle of cartilage opposite to tragus and separated by inter tragal fissure. The cartilage of EAM is an 8 to 9 mm length cartilage. Its anterior wall continues as tragus.[5] Ibrahim Hizalan and Ugur Dakuzlar et al in their study of thickness of tragal cartilage described, the cartilage tissue between the tragal border and cartilaginis Meatus acoustici externi (Cartilage of External Auditory Meatus) is composed of two separate parts; one superolateral part named by them as surgical tragus and one infero medial part as tragal spare cartilage part with the dividing line being the incisura cartilaginis Meatus acoustici. They found the thickest part on the inferior part of the tragus (2. 20mm) and thinnest part on supero medial part of tragus (0.7mm). On dissection in the present

study it is found that the tragal spare cartilage described by the above authors is isthmus of the cartilage of the auricle.[4,5] Using tragal or Conchal cartilage is an old practice but renewed interest in using cartilage has increase since 2 decades. It is used for reconstruction of tympanic membrane, outer attic wall and as Ossicular replacement prosthesis. Cartilage grafts offer the higher mechanical stability in cases of chronic tubal dysfunction, Ossicular adhesions/ fixation.[6] Utech (1959, 1960, and 1961) first used cartilage as a strut to repair Ossicular continuity. This is followed by Jansen 1963 using a short T prosthesis in missing incus and intact stapes. Septal cartilage is used by many authors for these procedures. Review of literature showed two studies on the cartilage of the isthmus of the auricular cartilage, but the studies measured the mean height and width of the cartilage. In the present study the thickness is studied and the histology of the cartilage to observe the number of stacks of chondrocytes is made.[7] Pereira, Marques AF et al in their study compared the alar cartilage of the nose and the cartilage of the tragus, isthmus and cavum conchae. Their aim was to look at the feasibility to use the cartilage of tragus, isthmus and cavum concha en bloc to reconstruct the ala of the nose. They made a comparison between alar cartilage and auricular cartilage in relation with the distance, thickness and angle. This study is useful to enable the surgeon to use the cartilage which is easily accessible without leaving post-operative aesthetic deformity of tragal area. This cartilage can be sculpted to any shape as it has the gritty texture to be used as an Ossicular graft. Review of literature showed that the structure of cartilage under microscopy was compared with that of hyaline cartilage which has more layers of chondrocytes. The strength and elastic nature of the cartilage is found suitable for its use as a graft material for Ossiculoplasty.

CONCLUSIONS: Cartilage of the isthmus of the auricle is accessible through the same post aural incision used for Mastoid surgery. The thickness and sturdiness is suitable for use as an Ossicular replacement strut. The range of thickness of the cartilage is between 2.1 mm to 3.2 mm. Even though there is no evidence of similar study measuring the thickness of the isthmus of auricular cartilage, a larger study and long term results of using this cartilage as an Ossicular strut is required.

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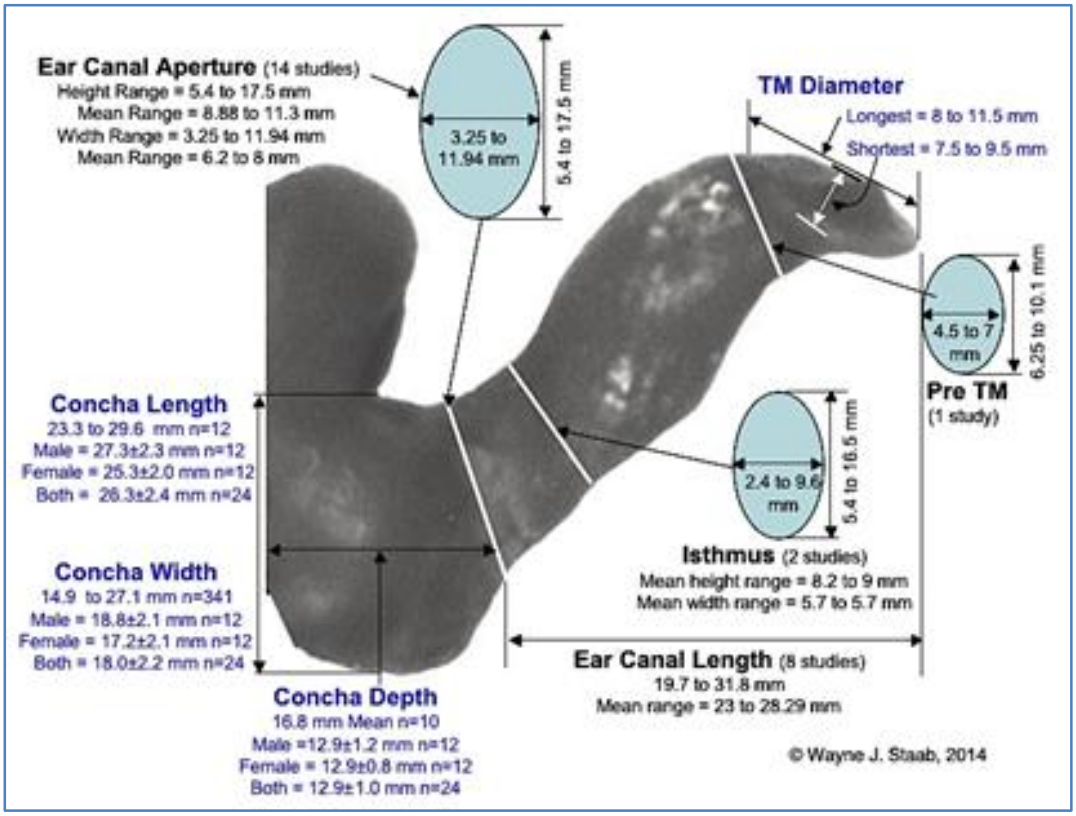

Fig. 1: Showing the parts of isthmus of auricular cartilage and the number of studies conducted on different parts

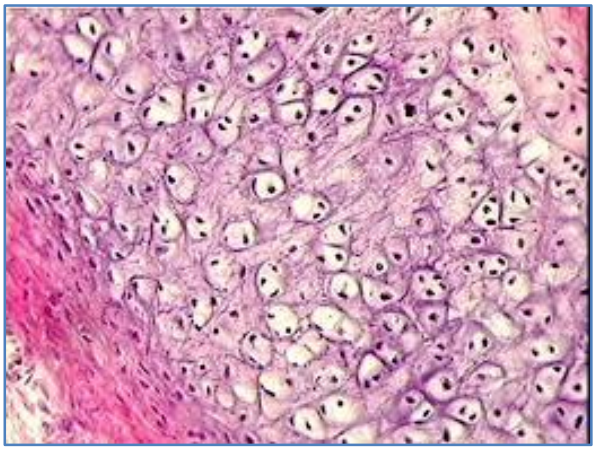

Fig. 2: Showing the rows (stacks) of chondrocytes between two layers of perichondrium

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