AURAL GRAFTS

ESSAY SUBMITTED IN

PARTIAL FULFILMENT FOR

MASTER DEGREE OF E.N.T.

BY: AHMED MOHAMED MOHAMED SAAD ELDIN

UNDER SUPERVISION OF:

PROF. DR. EZZ ELDIN ESSAMMA

FACULTY OF MEDICINE

AIN SHAMS UNIVERSITY

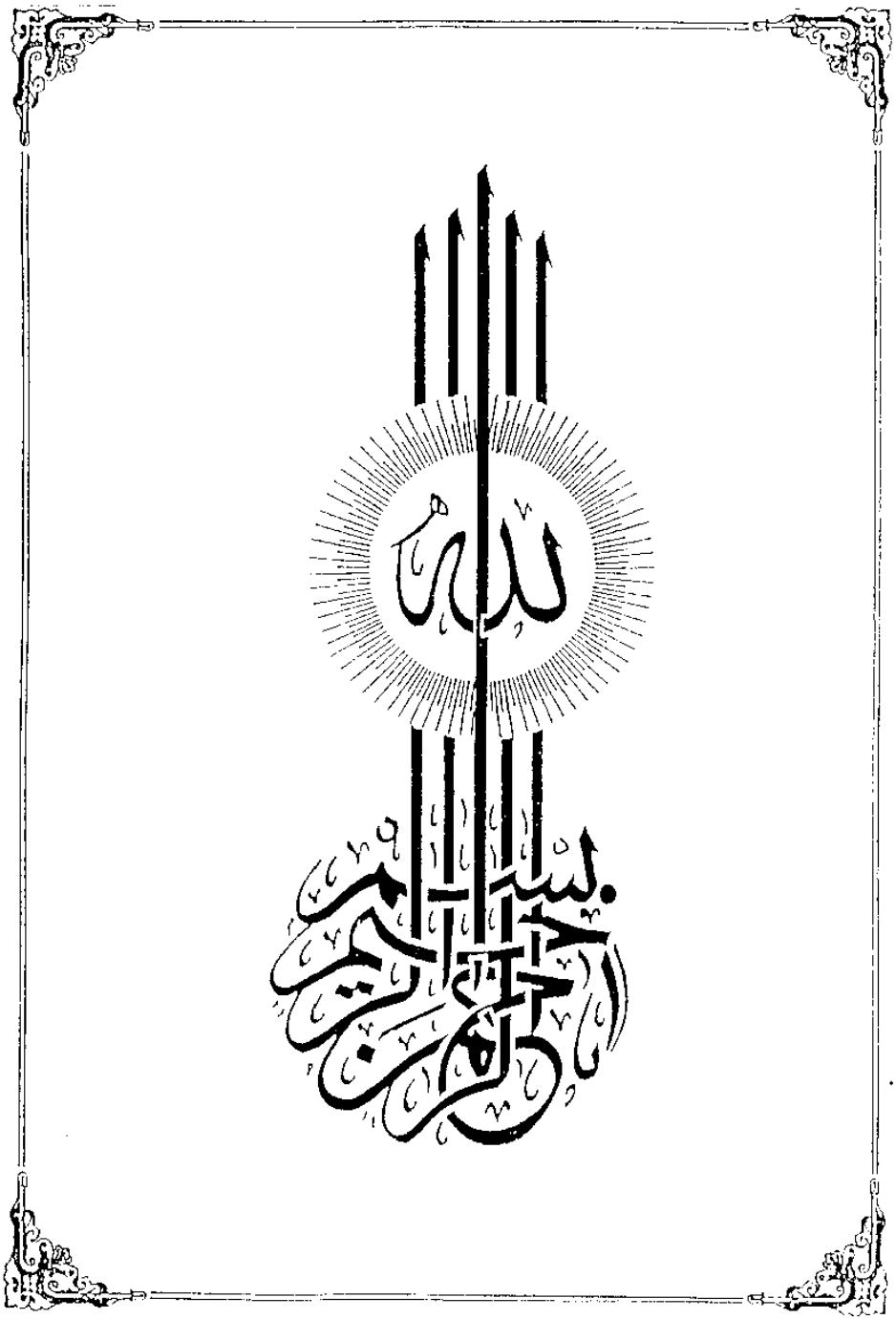
1982

ACKNOWLEDGEMENT

I would like to express my deep appreciation to Professor DR. EZZ EL DIN ESSAMMA Professor of otolaryngology, Faculty of Medicine AIN SHAMS University for suggestion the subject of this essay and for his constant guidance and supervision.

I am also grateful to DR. AMIN EL KHODARY Professor and head of E.N.T. Department Faculty of Medicine, AIN SHAMS University for his kind approval to register the subject of this essay.

I should like to thank also the E.N.T. consultants of the military hospitals for their continuing support and advice.



CONTENTS

Page

List of figures

Introduction

Development of the ear 1

Anatomy of the ear 6

Physiology of the ear 29

General consideration of the graft 32

Graft materials 43

External ear: 55

- Congenital anomalies 55
- Traumatic 61
- Inflammatory 63
- Neoplastic 66

Middle ear: 71

- Congenital anomalies 71
- Traumatic 74
- Inflammatory 91
- Otosclerosis 105
- Neoplastic 107
- Traumatic facial nerve 109

Inner ear: 111

- Labyrinthine fistula 111
- Surgical treatment of the Méniere's disease 113
- Acoustic neuroma 115
- Disabling vertigo of peripheral origin resistant to medical treatment 116

Conclusion 118

Summary 124

References 125

Summary in arabic 135

LIST OF FIGURES

	Page
Fig. (1)	8
Fig. (2)	8
Fig. (3)	13
Fig. (4)	14
Fig. (5)	25
Fig. (6)	25
Fig. (7)	49
Fig. (8)	49
Fig. (9) (A - B - C)	58
Fig. (10)	58
Fig. (11)	65
Fig. (12)	68
Fig. (13)	68
Fig. (14)	69
Fig. (15)	69
Fig. (16)	73
Fig. (17)	73
Fig. (18)	76
Fig. (19)	76
Fig. (20)	76

LIST OF FIGURES (Cont'd)

	Page
Fig. (21)	76
Fig. (22)	83
Fig. (23)	90
Fig. (24)	90
Fig. (25)	90
Fig. (26)	90
Fig. (27)	90
Fig. (28)	106
Fig. (29)	106

INTRODUCTION

Permanent restoration of normal shape and hearing function, is the ultimate goal of the otologist. These problems have stimulated many of the plastic and otologic surgeons to describe many techniques to overcome these problems.

With development and expansion of plastic and ear surgery techniques during this century, much has been done to alleviate distress due to external, middle, and inner ear affection. The cooperation between plastic surgeons, audiologists and otologists allows the goal to be achieved in the management of ear diseases.

The aim of this work is to review the literature written about aural grafts used by members of otologic and plastic surgeons group. The essay also includes a note on the development, anatomy and physiology of the ear, and general consideration of the grafts.

DEVELOPMENT OF THE HUMAN EAR

During the early stages of fetal development,a series of six visceral arches appear on the lateral aspect of the head. These mesenchymal arches form ridges on overlying ectoderm and corresponding projections in the entoderm of the pharynx. The ridges become separated from one another by a series of furrows where ectoderm and entoderm come together. The ectodermal furrows form the visceral cleft. The entodermal furrows form the pharyngeal pouches.

I. The External Ear

(1) The auricle

The auricle arises from the outer part of the first visceral cleft where six cartilaginous tubercles appear towards the end of the first fetal month, three on the first (mandibular) arch; three on the second (hyoid) arch. The tubercles are clearly evident in the third month of fetal life, when rapid changes occur. It is at this time the greater number of malformations are produced.

(2) The external auditory canal.

It is a funnel shaped tube formed from the ectoderm of the first visceral cleft from which the cartilaginous meatus and small portion of the bony canal are formed.From this tube

a solid core of epithelium extends inwards, but this core eventually hollows out to form the inner portion of the canal, the blind end of which form the outer epidermal layer of the tympanic membrane.

(3) The tympanic membrane: it has three layers:

(A) an outer epithelial layer from the ectoderm of the visceral cleft.

(B) middle fibrous layer from the mesoderm between the first visceral cleft and tubotympanic recess.

(C) an inner mucosal layer from a part of the recess.

(John Ballantyne, 1979)

II. The middle ear cleft

It is developed from the entoderm of tubotympanic recess which is pushed out from the first pharyngeal pouch to approach the surface between the first and second visceral arches. Towards the end of second fetal month, the eustachian tube is clearly seen as a relatively direct extension from the primitive pharynx, but at this stage the middle ear is only a potential cavity being solidly filled with mesenchyme in which the ossicles are embedded. The mastoid antrum appears during the sixth or seventh month as a dorsal expansion of the middle ear cavity, but the mastoid air cells do not begin to form until the end of fetal life. The ossicles may be defined in the eighth week, embedded in a solid mesenchyne. The Meckel's Cartilage

which is formed from the mesoderm of the first visceral arch. At its aural end it bears two swellings, one of which is conventionally thought to form the malleus and the other to form the incus. The hyoid bar is formed in the mesoderm of the second visceral arch and from it come the head, neck and crura of the stapes, the styloid process and the stylohyoid ligament Between the third and seventh fetal months, the gelatinous tissue of the middle ear cleft is gradually absorbed. At the same time the primitive tympanic cavity develops by the growth of an endodermal-lined fluid pouch into the cleft extending from the eustachian tube. Four primary sacs then bud out. They are the saccus anticus, the saccus medius, the saccus superior and the saccus posterior. Where these pouches contact each other, mucosal folds are formed. Between the mucosal layers of the folds are remnants of the mesoderm, including the blood vessels which supply the viscera of tympanic cavity. (John Ballantyne, 1979).

III. The inner ear

The inner ear is developed from ectoderm in the region of the hindbrain. A thickening of the ectoderm, the auditory (otic) placode, becomes invaginated to form the auditory (otic) vesicle. This is detached from the surface and carrying a layer of mesoderm around it, it sinks into the mass of mesoderm which is the rudiment of the petrous bone. As it sinks into the petrous mass, the vesicle draws a tail behind

it which is the rudiment of the ductus endolymphaticus. The saccus endolymphaticus develops as an expansion of the distal end of the ductus endolymphaticus. The membranous labyrinth if formed from the otic vesicle and it is the first part of the ear mechanism to appear. By the sixth week of embryonic life, the three semicircular canals are well formed, the ampullated expansions being clearly defined and the crus commune established. At this stage, the dependent portion of the vesicle has not only elongated as the cochlear pouch, but has begun to assume its snail-shell coil. The first perilymphatic space to form is that space just within the oval window in the vestibule, the cisterna perilymphatica. In the human embryo this occur in the end of the third fetal month. The second perilymphatic space begins to form just within the round window. This is scala tympani. Following the appearance of this scala, the scala vestibuli forms as an extension of the cisterna perilymphatica in the basal portion of the cochlea. The aqueductus cochleae develops relatively late as an out pouching from the subarachnoid space. The neuroepithelial structures of the membranous labyrinth are basically similar in type but they become modified in form in accordance with their final respective function. The maculae develop from the utricular and saccular epithelia at the points where the nerves enter their walls. This begins at the seventh week and by the twelfth week, the hair cells and supporting cells can be differentiated. Between the fourteenth and sixteenth weeks otoconia have appeared in the gelatinous layer. The ampullary cristae also form

at the points where the nerve fibres enter the ampullae of semicircular canals. They begin to develop at the same time as the maculae but instead of remaining flat, they become elevated into a ridge covered by a gelatinous cupula. The epithelium of the cochlear duct begins to differentiate in the basal turn at about eight weeks and is followed by the middle and appical turn. The organ of corti and tectorial membrane are recognizable in the basal turns by the twelfth week, and at the fourth month the cochlea is almost in its adult form. The hair cells and supporting cells of the organ of corti can be differentiated by the twelfth week, and the gelatinous tectorial membrane is seen to lie on their free surface. The tunnel of corti can be recognized by the fifteenth week.

The otic capsule: it develops in the mesoderm which surrounds the membranous labyrinth. The mesoderm changes to precartilage and later to true cartilage, and at the end of second fetal month, the membranous labyrinth is embedded in cartilaginous ear capsule. This in turn becomes dedifferentiated, and in the fifth fetal month ossification of the otic capsule occurs by a process of incrustation. From this time onwards, the otic capsule is known as petrosa, forming one of the four component parts of the temporal bone. (John Ballantyne, 1979).

ANATOMY OF THE EAR

I. External ear: it consists of two parts, the auricle and the external auditory meatus.

(1) The auricle: it consists of a single irregularly-shaped thin plate of yellow fibro cartilage about 0.5 - 1 mm. in thickness, covered with skin and connected with the surrounding parts by ligaments and muscles. The helix forms the outer rim of the auricle. It begins at the concha and ends at the lobule. The tragus is a small lid that overlaps the concha anteriorly. The cartilage is continuous with that of the external auditory meatus and it extends throughout the entire auricle, except in the lobule and the part between the tragus and the helix as shown in fig. (1). The blood supply of the auricle is derived from small branches of the external carotid artery, the posterior surface being supplied by the posterior auricular artery, the anterior surface by the anterior temporal artery. The veins of the auricle enter the superficial temporal and posterior auricular veins. The nerve supply of the auricle is derived from the second and third cervical spinal nerves and from the trigeminal nerve. The lymphatic drainge from the posterior surface drains into the glands at the mastoid tip, from the tragus and from the upper part of the anterior surface to the parotid lymph glands, and from the inferior part to glands beneath the ear.

(2) The external auditory canal: It is about 2.5 cm. in length in the adult from the bottom of the concha to the tympanic membrane which separates it from the tympanic cavity at its medial end.

It runs a tortuous S shaped course, generally it is directed inwards and slightly upwards and backwards in the outer cartilaginous part, inwards and slightly downwards and forwards in the inner bony part. The cartilaginous portion of the canal forms its outer one third. The cartilage is continuous with that of the auricle and it is deficient superiorly. The bony portion of the canal forms its inner two third and is formed by the tympanic and squamous portions of the temporal bone. Two constrictions occur in the external auditory canal (i) at the junction of the cartilaginous and bony portion. (ii) at the isthmus. The tympanic membrane closes the canal obliquely, so that, the anterior wall and floor are slightly longer than the posterior wall and roof. The skin of the external auditory canal is continuous with that of the auricle. It lines the whole canal and extends over the outer surface of tympanic membrane. The skin of the outer one third is thick and is closely adherent to the cartilage. This portion of the skin is provided with hairs, sebaceous glands and ceruminous glands as shown in fig. (2). The blood supply of the external auditory canal is derived anteriorly from the auriculotemporal branch of the superficial temporal artery, and posteriorly from the branches of the post-auricular division of the external

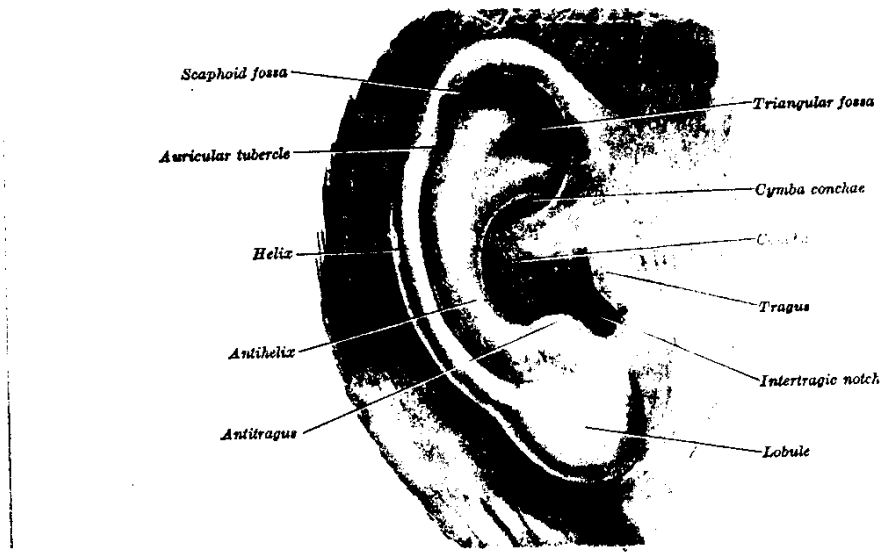


Fig. (1)

Anatomy of the auricle

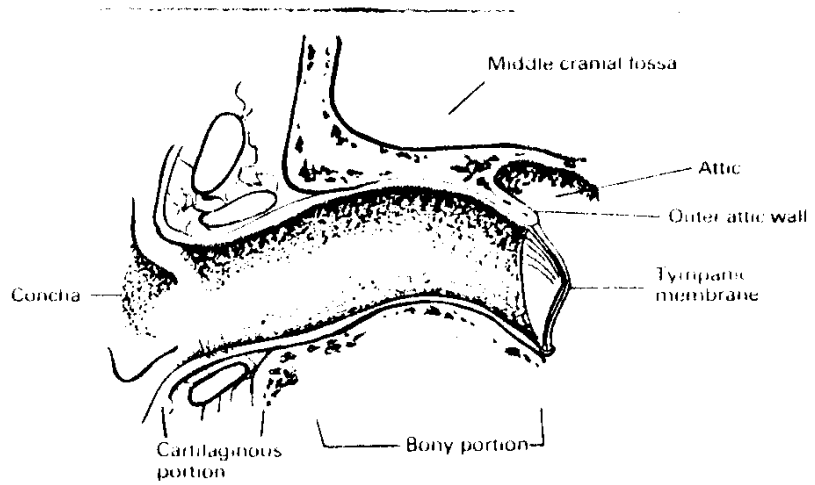


Fig. (2)

Anatomy of the external auditory meatus