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CLASSIFICATION OF CONGENITAL MIDDLE AND EXTERNAL EAR MALFORMATIONS: CT STUDY

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ABSTRACT

The authors used high-resolution computed tomography (HRCT) for studying 52 congenitally malformed ears in 45 children between five and 10 years of age. In six children the malformations were bilateral. The malformations clinically manifested as microtia, atresia of the external auditory canal and conductive deafness.

Analyzing anatomical details and pathological changes on HRCT axial sections the authors established three groups of malformations. In the first group, auditory assicles were malformed in almost all cases, in the second group besides deformed auditory ossicles in majority of cases, the mastoid was apneumatised, and in the third group there were malformed auditory ossicles and the mastoids were apneumatised and in more than half of cases cavum tympani was malformed or filled with mesenchyme.

These features have great importance in surgical reconstruction of congenital middle ear malformations.

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INTRODUCTION

Congenital ear malformations occurred in one per 10000-20000 newborns.[5] According to the data reported by Health Statistics Department in New York, in a 10-year period (1953-1962), 312 children with congenital ear malformations were born, i.e. 1/5000 newborns.[7] We surveyed 19070 newborns and found microtia and a bone atresia of the external auditory canal in one child.[12]

Congenital malformations of the middle ear maybe broadly classified into major and minor categories.[10] The minor malformations effect only the auditory ossicles, while the external auditory canal and cavum tympani remain unaffected. The major malformations involve the external auditory canal, ossicles and cavum

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Table I. Characteristics of Congenital Malformations of the Middle Ear

		Number	Percent
AUDITORY OSSICLES			
	normal	2	3.9
	deformed	46	88.3
	absent	4	4.8
CAVUM TYMPANI			
	present	40	76.8
	filled with mesenchyme	8	15.2
	deformed	4	7.8
MASTOID CAVITIES ANTRUM			
	present	38	73.0
	absent	14	27.0
CENTRAL TRACT			
	present	27	52.0
	filled with mesenchyme	2	3.9
	absent	21	40.0
PERIPHERAL TRACT			
	present	25	48.0
	absent	27	52.0

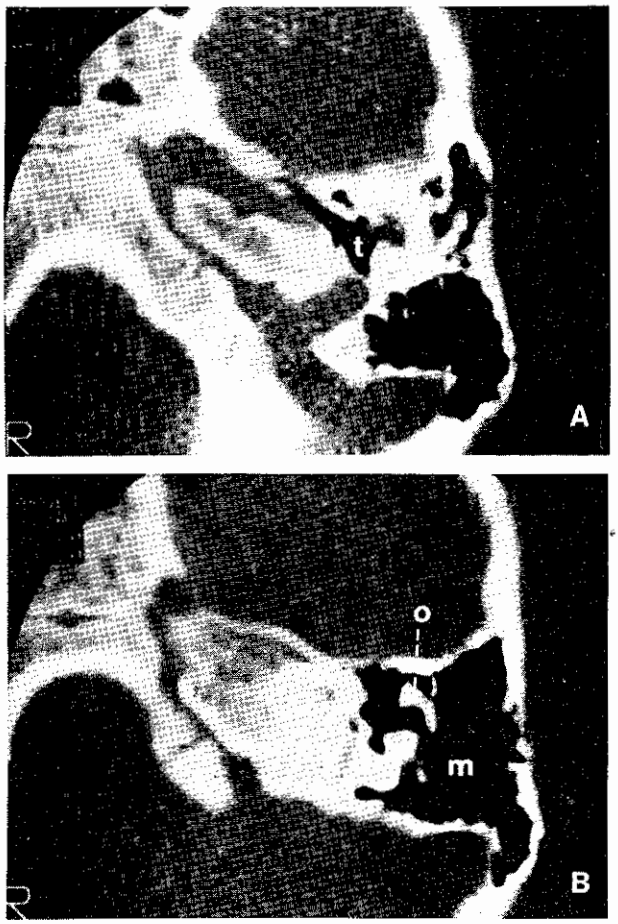

Fig.1. Well-developed pneumatization of the mastoid and normally developed tympanic cavity.
A. Section at the level of the carotid canal and hypotympanum.
B. A higher section showing deformed auditory ossicles fixed to the lateral wall of the tympanic cavity: t-tympanic cavity, O-auditory ossicles, m-mastoid.

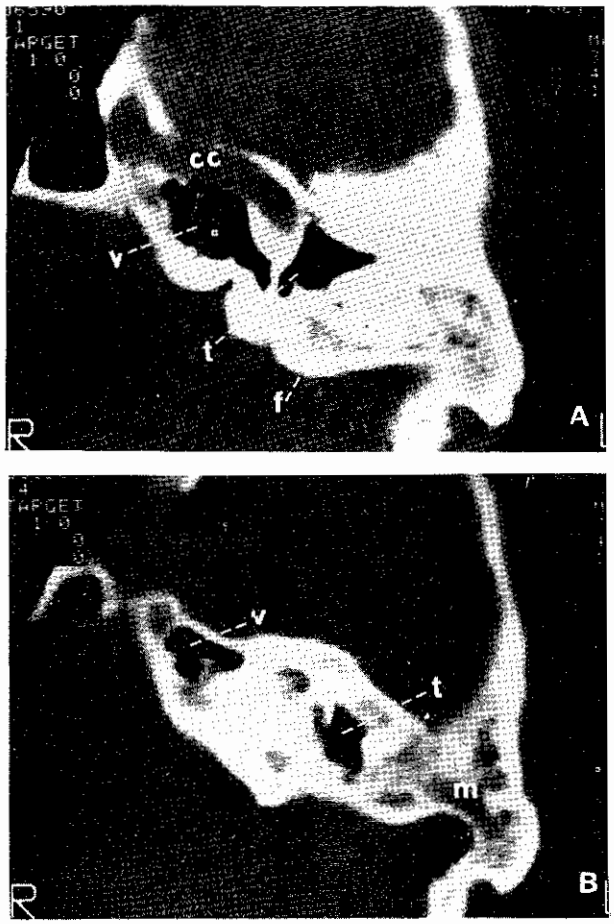

Fig. 2. Well-developed and pneumatized tympanic cavity.
The mastoid is totally apneumatized, but the pneumatic cells are present at the top of the pyramid and below the carotid canal.
A. Section at the level of the carotid canal and hypotympanum.
B. A higher section of the same temporal bone:
v- pneumatic cells at the top of the pyramid,
cc- carotid canal, t- tympanic cavity, f-facial canal, m- mastoid (apneumatized).

tympani. In the major malformation group, there is no involvement of the inner ear. The clinical aspects of the middle ear anomalies have been discussed in numerous studies.[1,3,4,8,9,11]

Development of ear microsurgery has made it possible to recover hearing successfully, i.e. to reconstruct the transmission apparatus composed of formation of external auditory canals, neomembrane and reconstruction of the auditory bone chain. Success of surgery mainly depends on the severity of malformations which can be precisely defined by radiological studies.

By introduction of HRCT much more precise diagnosis of congenital malformations of the middle ear anomalies has been made possible. Several authors have already indicated the importance of HRCT in evaluation of congenital malformations.[2,6,14] Our HRCT studies of congenital malformations of the middle ear have indicated significantly reduced distance between the facial canal and the temporomandibular joint as between the facial canal and the posterior wall of the cavum tympani.[13]

The purpose of the study was to investigate the features of auditory ossicles and to make a classification which can be of great importance for surgery.

MATERIAL AND METHODS

We have used GE 8800 CT/T Scanner for the temporal bone examination in patients, on target program for bone structures. The sections were determined from the level of the temporomandibular joint to the tegmen tympani parallel to the orbitomeatal plane at 1.5mm intervals. We examined 45 patients of which six had bilateral malformations of middle ear. Therefore, we analysed 52 ears. All children had

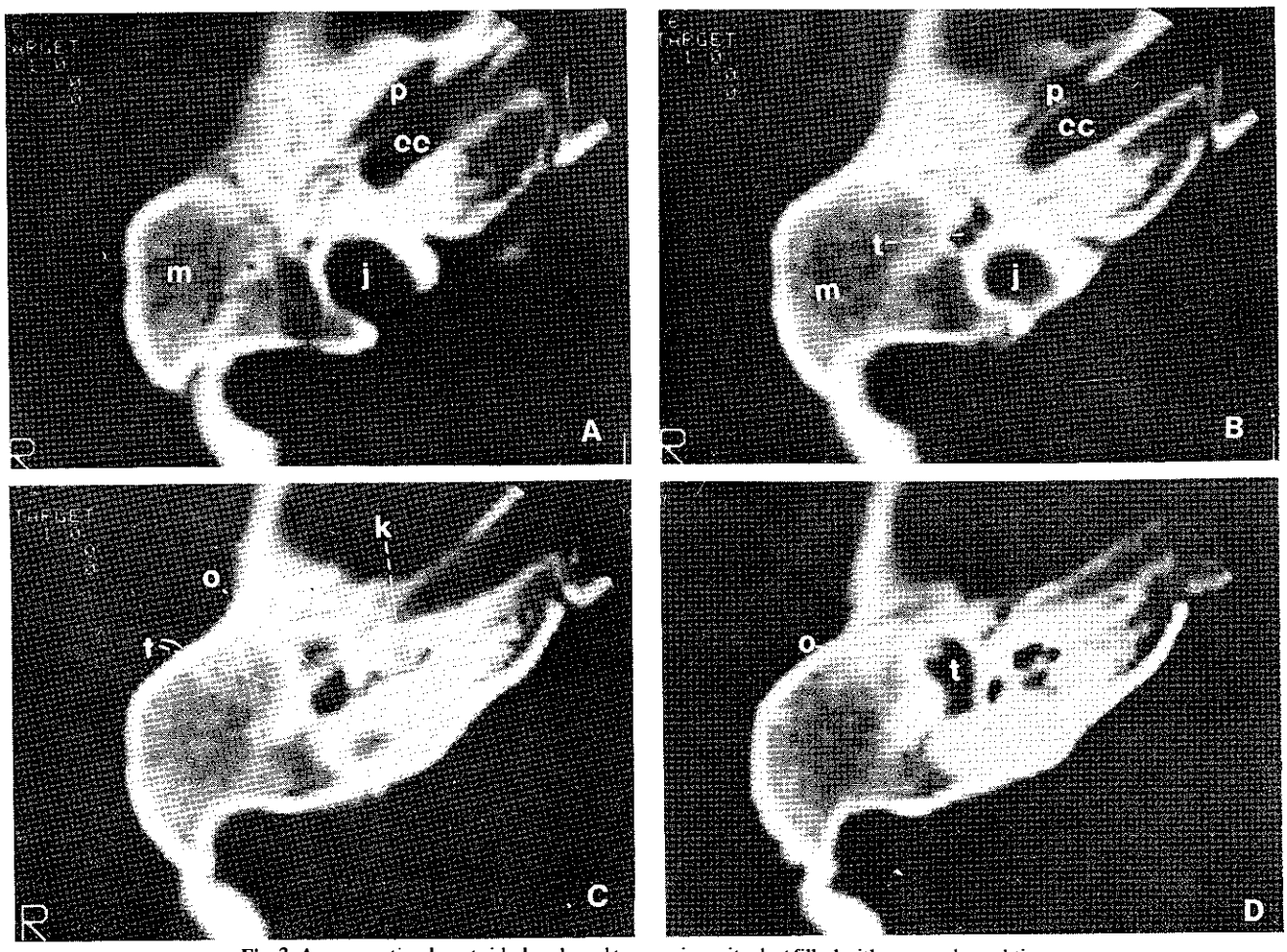

Fig. 3. A pneumatized mastoid. developed tympanic cavity, but filled with mesenchymal tissue.
A. Section at the level of the jugular fossa and carotid canal.
B. A higher section of the same temporal bone where the lower part of the cavum tympani (hypotympanum).
C. A higher section visualizing deformed auditory ossicles fixated for the cavity walls.
D. Even higher section visualizing a part of a deformed bone fixated for the anterior wall of the cavity.
CC- carotid canal, p- protympanum, J- jugular fossa,
m- mastoid, t- tympanic cavity, O- auditory bones.

malformed auricles and bone and atretic external auditory canal. The children were between six and 10 years old.

The sections were used for analysis of:

-the mastoid process: antrum, central mastoid tract and peripheral mastoid fields,

-the cavum tympani: epitympanum, mesotympanum, retrotympanum and protympanum,

-the auditory ossicles (malleus and incus): shape and size, incudomaleollar joint and fixation of the auditory ossicles for the atretic plate.

we also studied the presence of mesenchymal tissue in the tympanomastoid cavities.

Stapes was not examined because it is very difficult to identify it on axial sections.

RESULTS AND DISCUSSION

In the major congenital malformations, the auditory bones (malleus and incus) are rarely normal (3.9%) where no surgical correction in the chain of the ossicles is needed. They are rarely completely missing (4.8%). In the majority of cases (88.3%) the malleus and incus are more or less deformed and the surgeon during surgery, after releasing them from the atretic plate or from the walls of the cavum tympani, should estimate whether they would be able to perform normal transmission function, or should be replaced.

Outcome of surgery is greatly determined by the condition of auditory ossicles and the tympanic cavity (Table I).

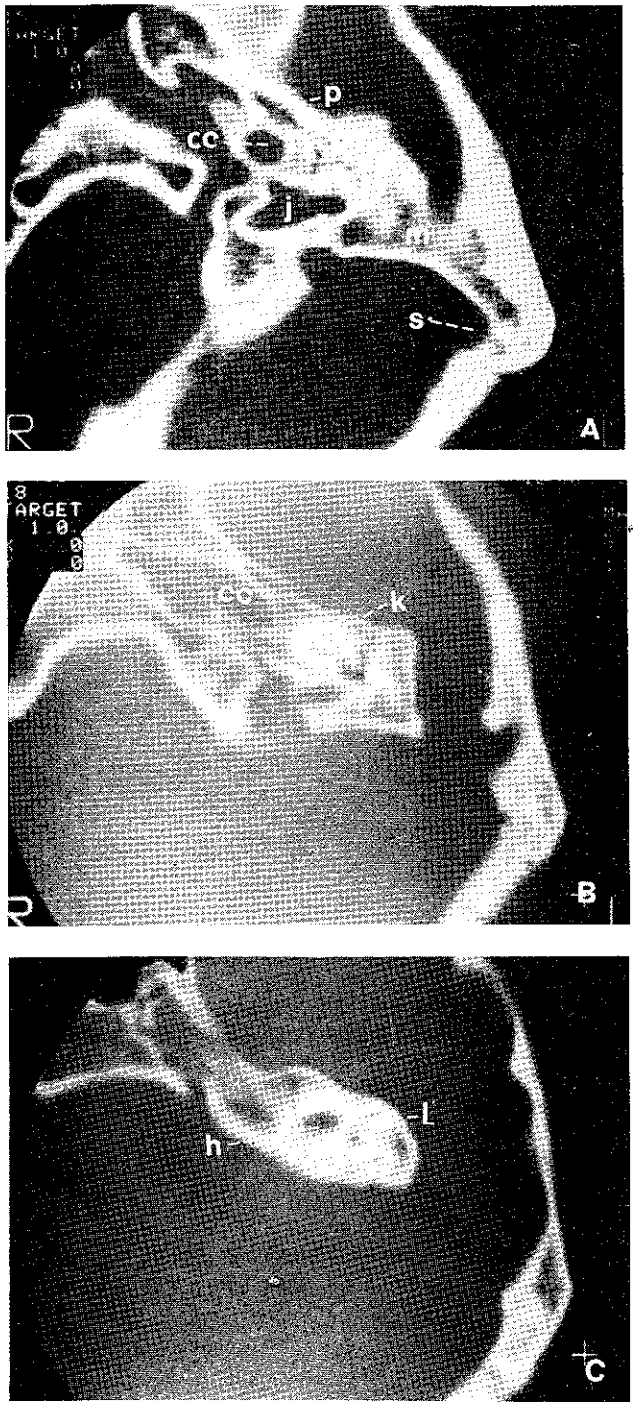

Fig. 4. Apneumatization of the mastoid process and complete absence of the tympanic cavity.
A. Section at the level of the jugular fossa and carotid canal.
B. A higher section at the level of the cochlea of the same temporal bone. Between the pyramid top and the temporal bone squama there is a wide groove instead of the middle ear structures, filled with temporal lobe of the cerebrum.
C. Even a higher section at the level of the inner auditory canal.
CC- carotid canal, p- protympanum, J- jugular fossa,
m- mastoid, s- sulcus of the sygmoid sinus,
K- cochlea, H- inner auditory canal, L- semicircular canals.

Table II. Classification of Middle and External Ear Malformations

GROUP I. (25 ears, 48%)
-external auditory canal atresia
-fixation and deformation of auditory ossicles (in two ears ossicles were normal)
-pneumatisation of mastoid tract is normal
-normal antrum
-normal cavum tympani

GROUP II. (13 ears, 15%)
-external auditory canal atresia
-fixation and deformation of auditory ossicles
-apneumatisation of mastoid tract (in two ears mastoid tract is filled with mesenchyme)
-normal antrum
-normal cavum tympani

GROUP III. (14 ears, 27%)
-external auditory canal atresia
-fixation and deformation of auditory ossicles or absence of the ossicles
-apneumatisation of mastoid tract
-absence of the antrum
-possible deformation of cavum tympani (in four ears cavum was filled with mesenchyme)

All malformed ears (52) were divided into three groups on the basis of malformed ossicles, changes of cavum tympani, antrum and mastoid processes.

In the first group, 25 ears, ossicles were deformed and attached to the atretic plate in almost all cases, dimensions and shape of the cavum tympani and antrum were normal and the mastoids had normal pneumatisation in all cases.

In the second group, 13 ears, ossicles were deformed and attached to atretic plate in all cases. Cavum tympani and antrum are normal in all cases. Mastoid is apneumatised in almost all cases. These two groups are favourable for reconstruction of the transmission apparatus.

In the third group, 14 ears, ossicles were deformed and attached to atretic plate in all cases and in some cases malleus and incus were absent. In more than half of cases cavum tympani is deformed and filled with mesenchyme. Also, antrum is absent and mastoid is apneumatised. In this group reconstruction of the transmission apparatus is hardly feasible or absolutely impossible (Table II).

Our studies indicate that HRCT has great value for giving detailed insight into the condition of the tympanic cavity, malleus and incus and mastoid tract, and to estimate whether the reconstruction of the transmission apparatus is feasible.

REFERENCES

1- Belluci J: Congenital malformations. Diagnosis and Treatment. Otolaryngol Clin North Am 14:95-124, 1981.

2- Chakers W, Weider J: Computed tomography of the ossicles. Neuroradiology 27:99-108, 1985.
3- Funaska S: Congenital ossicular anomalies without malformations of the external ear. Arch Otorhinolaryngo1224:231-240, 1979.
4- Gerhardt J, Otto D,: The intratemporal course of the facial nerve and its influence on the development ot the ossicular chain. Acta Otolaryngol (Stockh), 91:567-573, 1981.
5- Holmes E: The microtic ear. Arch Otolaryngol 45:243-248, 1949.
6- Hough D, Curtin C: Congenital malformations of the ear. In: Diagnosticimagingin otolaryngology- I. Otolaryngol Clin North Am 21:317-337, 1988.
7- Jahrsdoerfer A: Congenital atresia of the ear. Laryngoscope 88 Suppl 13:1-48, 1978.
8- Jahrsdoerfer A: Congenital malformations of the ear. Analysis of 94 operations. Ann Otol 89:348-352, 1980.
9- Jahrsdoerfer A: The facial nerve in congenital middle ear malformations. Laryngoscope 91:1217-1224, 1981.
10- Ombérdanne M: Chirurgie de la surdité: Fénestration dans les aplasies de l'oreille avec imperforation du conduit: Resultates. Otol Rhinol Laryngol Internat 31:229-235, 1947.
11- Savić D, Radulović R, Djerić D: Kongenitalne malformacije srednjeg uva i spoljašnjeg slušnoghodnika. Symp Otorhinol Yug 15, 1980.
12- Savić D, Djerić D, Radojković Z, Janošević S, Djukić V: Urodjene malformacije otorinolaringološkog područja u novorodjene dece. Srp arh celk lek 112:273-286, 1984.
13- Savić D, Jašović A, Djerić D: The relations of the mastoid segment of the facial canal to surrounding structures in congenital middle ear malformations. J Pediatric Oto Rhino Laryngol 18:13-19, 1989.
14- Swartz D, Glazer AU, Faerber N,: Congenital middle ear deafness: CT study. Radiology 159:187-190, 1986.