間に 0.2cc 以下の ピークが存在するものをここで仮りに名付けることにした。形成術Ⅲ型に認められた。

結論

Wullstein によれば形成術後の治癒過程が聴力回復度に影響すると。耳管による換気が行われると粘膜炎の治癒と新鼓室内の完全な上皮化が起る。この内部の上皮化が完全でない場合にはその欠損部に肉芽組織増生と分泌が起り、中耳伝音障害を起し最終的には癒着に陥ると。形成術における耳管機能は内耳機能に次ぐ要因であり、前に耳管炎を治癒できない場合には形成術をあきらめるか、あるいは手術によって耳管炎も治癒するであろうの期待の許に手術を行うか、どちらかの選択しかない。

以上の Wullstein の見解に添って演者らの術例の TG 所見を検討すると A 型や W 型は耳管障害を残さず鼓室内が完全に上皮化し、従って連鎖の癒着を残さなかった例でその聴力回復が正常レベルかそれに近かったことを裏書している。C 型は耳管障害の存続を示し癒着が連鎖に及ぶ傾向が大で従ってその聴力回復は A と W 型に比して悪い。B 型と BC 型は新鼓膜および連鎖の癒着過程が著しい所見と思われる。

文献

Wullstein H.L.: 聴力改善手術。日本語訳、医学書院 1979。

Northern J.L.: Selected Readings in Impedance Audiometry. American Electromedics Corporation, 1976.

質問 熊沢 (関西医大)。術後のチンパノメトリーで B, C タイプを示しても、これは鼓膜の性状による影響が、必ずしも耳管の通気性を示していないと思う。

応答 恩地 豊 B 型は C 型のように耳管障害が検出されないが C 型が進んだものあるいは新鼓膜が癒着したものと Wullstein の見解に添って鼓室形成術の成績を批判したのに過ぎない。耳管障害については熊沢教授は素晴らしい研究をしておられる。その見解からすると私の結論も変えねばならないと思っている。耳管障害と帆張筋ならびにチンパノグラムの関係について御高説を承りたい。

(B 82—1009—22182)

53. Impedance bridge studies on the ears of school children

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Early detection of ear diseases has been the main focus of study in the audiological field, and it is true that many children still have never had their hearing defected and treated.

Audiometric test is applied to diagnose middle ear diseases generally, as it thought that middle ear diseases cause hearing impairment and it is easily found by the pure tone audiometric screening method. However, Eagles, Whishik and Doeffler (1967), Fay, et al (1970), Osborn (1970) reported that only 64 % of all conductive pathology cases were detected by pure tone audiometric examination. Considering mild hearing loss in conductive type, ambient noise and troublesome test for infants, it has been considered to develop a more accurate and objective device to test.

On 1940 Metz first described electroacoustic impedance device to test, Thomsen, Anderson, and

Terkildsen learned objective testing method with impedance ten years later, and Onchi emphasized the mechanism of middle ear in the era of 1960. These principles have become widely utilized since 1970, when Jerger and Liden reported their study with impedance audiometry.

McCandles & Thomas (1974) reported that impedance bridge was 2.8 times accurate than pure tone audiometry. Brooks (1973) stated that impedance audiometry picked 14% more of middle ear pathology cases which passed by pure tone audiometry.

Since our country applied the device for clinical examination, we screened school children for the purpose of establishing the standard value of it.

Subjects:

We had two groups to test. Group I, 1,035 primary and middle school students, aged 7 to 16, performed the test during July to September 1976. Group II,

Table 1 Age and Sex Distribution

Sex \ Age	7	8	9	10	11	12	13	14	15	16	Total	Ears
Male	18	68	78	72	70	69	64	42	51	5	537	1074
Female	19	69	77	59	61	65	39	69	36	4	498	996
Total	37	137	155	131	131	134	103	111	87	9	1035	2070

Table 2 Tympanogram on Clinical Finding

	Type A	Type B	Type C
Normal	1840 (88.9%)	13 (0.63%)	46 (2.22%)
Abnormal			
Need Tx	47 (2.27%)	54 (2.61%)	22 (1.06%)
Not Need Tx	43 (2.77%)	3 (0.14%)	2 (0.10%)

Fig. 1 **Fig. 2**

100 patients, aged 7 to 16, visited ENT clinic during Feb. 1978 through March 1979 with complaints of hard of hearing and nasal obstruction.

Method:

The first otoscopic examination was performed to observe middle ear pathology and to remove ear wax to carry on the audiometric test. Teledyne Impedance Audiometer was used to test pure tone screening as well as impedance test.

Results:

Table 3 Age Distribution of Tympanogram

Age	A	B	C	Total
7	66(89.2%)	3	5	74
8	258(94.2%)	7	11	274
9	289(93.2%)	7	14	310
10	247(94.3%)	9	6	262
11	244(93.1%)	11	7	262
12	249(92.9%)	8	11	268
13	193(93.7%)	11	2	206
14	205(92.3%)	9	8	222
15	162(93.1%)	7	5	174
16	17(94.4%)	0	1	18

Total 1930(93.2%) 70(3.4%) 70(3.4%) 2070(100%)

Table 4 Static Compliance of Tympanogram Type A

Static Compliance	No. of Ears
0.10 ↓	121(6.27%)
0.11 ~ 0.20	451(23.37%)
0.21 ~ 0.30	513(26.58%)
0.31 ~ 0.40	325(16.84%)
0.41 ~ 0.50	204(10.57%)
0.51 ~ 0.60	117(6.06%)
0.61 ~ 0.70	56(2.90%)
0.71 ~ 0.80	42(2.18%)
0.81 ~ 0.90	26(1.35%)
0.91 ~ 1.00	13(0.67%)
1.01 ~ 1.10	15(0.78%)
1.11 ~ 1.20	11(0.57%)
1.21 ~ 1.30	9(0.47%)
1.31 ~ 1.40	7(0.36%)
1.41 ~ 1.50	1(0.05%)
1.51 ~ 1.60	5(0.27%)
1.61 ~ 1.70	4(0.21%)
1.71 ~ 1.80	10(0.52%)

A. Group I

By otoscopic examination, 1899 ears were shown normal, 123 ears were abnormal, and 48 were found to need treatment. Among normal ears, 88.9% was shown tympanogram type A. Tympanogram type A is 1,930 ears (93.2%), type B and C is 70 ears each (3.4%). Age distribution of tympanogram shows on Table 3-A. Maximum compliance and initial compliance are increasing in value as the age is growing gradually. At the age of 7, maximum compliance is 0.98 cc and 2.08 cc at the age of 16. The initial compliance is 0.69 cc to 1.57 cc. Static compliance does not show much increase in volume and yet still it shows slight increase as the age is getting old. Mean value of the compliance of all children; maxi-

Table 5 Static Compliance of Tympanogram Type A (1930 Cases)

0.05	0.07.....0.34.....1.09	1.71
<div style="text-align: center;"> </div>		

Table 6 Mean Value of Compliance on Age

Age	Comp.	Maximum Comp.	Initial Comp.	Static Comp.
7		0.98	0.69	0.29
8		1.04	0.72	0.32
9		1.08	0.77	0.31
10		1.20	0.84	0.36
11		1.19	0.85	0.34
12		1.18	0.83	0.35
13		1.30	0.97	0.33
14		1.45	1.11	0.34
15		1.80	1.41	0.39
16		2.08	1.57	0.51
Total		1.24	0.90	0.34

Table 7 (dB) Stapedial Reflex Threshold

Hz \ Age	7~9	10~11	12~13	14~16	Ave.
500	97.7	98.8	95.4	89.4	95.6
1000	98.9	98.6	96.2	96.9	96.2
2000	98.1	98.5	96.6	90.5	96.2
4000	98.5	98.5	96.7	90.8	96.4
					96.1

Table 12 Static Compliance of Type A in Nasal Obstruction

Age	7	8	9	10	11	12	13	14	15	16	Mean value
Max. compliance	1.70	1.66	1.81	none	1.49	1.05	1.73	none	2.27	1.53	1.66
Ini. compliance	1.20	1.0	1.44		1.18	0.76	1.12		1.66	1.18	1.19
Static compliance	0.50	0.66	0.38		0.31	0.29	0.61		0.62	0.35	0.47

Table 13 Static Compliance of Type A in Hard of Hearing

Age	7	8	9	10	11	12	13	14	15	16	Mean value
Max. compliance	1.39	1.75	1.43	1.62	1.64	1.52	2.04	2.24	3.27	1.76	1.87
Ini-compliance	1.06	1.36	1.04	1.20	1.22	0.96	1.51	1.63	2.33	1.36	1.37
Static compliance	0.33	0.39	0.39	0.42	0.42	0.56	0.53	0.61	0.94	0.40	0.50

Table 8 Classification by Chief Complaints

Nasal obstruction:	25 cases
Hard of Hearing:	75 cases

Table 9 Sex and Age Distribution

Sex \ Age	7	8	9	10	11	12	13	14	15	16	Total
Male	17	10	8	3	2	7	3	6	2	6	64
Female	7	3	6	6	5	1	3	1	1	3	36
Total	24	13	14	9	7	8	6	7	3	9	100

Table 10 Tympanogram and Otoscopic Ex. on the Nasal Obstruction Patients

	Drum intact	Not intact
Type A	25(51.02%)	3(6.12%)
B	4(8.16%)	13(26.53%)
C	2(4.08%)	2(4.08%)

Table 11 Tympanogram and Otoscopic Ex. on the Hard of Hearing Patients

	Drum intact	Not intact
Type A	50(33.56%)	19(12.75%)
B	16(10.73%)	53(35.57%)
C	5(3.35%)	6(4.02%)

maximum compliance is 1.24cc, initial compliance is 0.90cc and static compliance shows 0.34cc.

It shows most cases of static compliance are be-

tween 0.10 cc to 1.00 cc, and 121 ears (9.27 %) are below 0.10cc, which are far below Brooks, Feldman, and Jerger's value. It is hard to conclude Korean

Table 14 Static Compliance

Static compliance	No. of Ear (%)
0.10↓	0(0 %)
0.11~0.20	3(3.09%)
0.21~0.30	22(22.68%)
0.31~0.40	18(18.56%)
0.41~0.50	18(18.56%)
0.51~0.60	16(16.49%)
0.61~0.70	7(7.22%)
0.71~0.80	5(5.15%)
0.81~0.90	4(4.12%)
0.91~1.00	2(2.06%)
1.01~1.10	1(1.03%)
1.11~1.20	0(0 %)
1.21~1.30	0(0 %)
1.31~1.40	0(0 %)
1.41~1.50	1(1.03%)
Total	97(100 %)

Table 15 Stapedius Reflex Threshold

frequency	500	1K	2K	4K
site				
Rt.	95.31	97.65	96.0	95.44
Lt.	95.44	96.62	96.0	96.42

Table 16

	Static Compliance	Reflex
Robertson, 1968		Cifference between 18 m + adult (65 dB SPL) 500 11.9 dB 1K 7.1 dB 2K 7 dB
Brooks, 1969	0.35~1.40 95% 0.28~1.72 99%	
Alberti & Kristensen, 1972	5~10 yrs 0.61 (mean value)	
Mc Candle, 1972	0.35~1.37	
Keith, 1973	0.25~1.65, infant	
Jerger, 1974	>6 yrs 0.55 cc	>3 yrs 95.5 5 yrs 89.5

children's static compliance is lower than Caucasians as they reported, and further investigation is advised. With the 99 percentile is 0.07cc to 1.09cc. STAPEDIAL REFLEX: Its value is accounted as shown on as by table 7. These are tested with 30dB pure tone on 500 Hz, 1,000 Hz, 2,000 Hz and 4,000 Hz on 1,267 ears the age of 7 to 9, 10 to 11,

12 to 13, and 14 to 16. Each value shows 95.6 dB, 96.2 dB, and 96.2 dB and 96.4 dB, average 96.1 dB.

B. Group II

25 children with complaints of nasal obstruction and 75 children with complaints of hard of hearing were analysed. Among the nasal obstruction patients, tympanogram type B was shown 17 ears, and type C is 4 ears. 69 ears with tympanogram type A are shown among the patients with the complaints of hard of hearing, 69 ears with type B and 11 ears with type C.

The static compliance of type A on the patients with nasal obstruction and hard of hearing was shown along the age group on table 12, 13. Their mean values are 0.47cc and 0.50cc. As a whole, the value is exhibited between 0.11cc to 1.10cc as 99 percentile.

The stapedial reflex threshold is represented as mean value 95.33dB on 500Hz, 97.14dB on 1,000Hz, 96.0dB on 2,000Hz, and 95.93dB on 4,000Hz.

Discussion

It has been well known that impedance audiometry has shown remarkable progress in the audiological field, and has stimulated much in research of hearing because of its handy and objective quality.

Brooks reported on the static compliance 0.35cc to 1.40cc on 95% and 0.28cc to 1.72cc on 99%. Alberti and Kristensen mean value of static compliance at the age between 5-10 yrs old 0.6cc. McCandle reported 0.35cc to 1.37cc, and Keith learned 0.25cc to 1.65cc in infant. Jerger stated 0.55cc in children aged less than 6 years old.

On the stapedial reflex threshold, Robertson learned the difference between age of 18 months to adult on the 65dB SPL, 11.9dB on 500Hz, 7.1dB on 1,000Hz, and 7dB on 2,000Hz. Jerger reported 95.5dB at the age less than 3 and 89.5dB at the age of 5.

Our data of static compliance is much smaller than their reports through reflex threshold is shown similar value.

Conclusion

1. Range of static compliance in school children is 0.09cc~1.7cc in 99%, 0.07cc~1.09cc in 95%, and hospital group show 0.11cc~1.10cc in 99%.
2. Stapedial Reflex threshold is;

	School group	Hospital group
500	95.6	95.4
1K	96.2	97.1
2K	96.2	96.0
4K	96.4	95.9

3. In school children, screening learns tympanogram type A is 93.2 %, type B is 3.4 %, and type C is 3.4 %.

(B 82—1010—22582)