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A Morphological Study of the Parotid Gland and the Peripheral Branches of the Facial Nerve in Koreans

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In this study, 45 parotid glands and 111 facial nerves were examined in adult Korean cadavers to determine the morphological relationship of the parotid gland and the peripheral facial nerve. The results are summarized below; (1) The average length of the parotid gland was 54.7 mm and the width averaged 32.9 mm, and the gland was slightly larger in males. (2) The shape of the parotid gland was classified into four types and the series contained 66.7% type A, 15.5% type B, 8.9% type C and 8.9% type D. Type A was the most common type. (3) The patterns of tributory ducts into Stenson's duct were divided into 5 types and the series showed 42.2% type a, 26.7% type b, 4.4% type c, 4.4% type d, 22.3% type e. The frequency of occurrence of accessory glands was 22%. (4) The average distance from the external angle of the mandible to the bifurcation of the facial nerve trunk was 28.8 mm. (5) A pattern of trifurcation of the main facial nerve trunk was discovered in 4.4% of the cases. (6) The pattern of anastomosis of the peripheral branches of the facial nerve was classified into six types, and the rate of occurrence of each type was type I 6.3%, type II 13.5 %, type III 33.4%, type IV 23.4%, type V 6.3%, type VI 17.1%.

The parotid gland shows great variety, in size and shape especially in its relationship with the facial nerve, and this variety is of great importance in the field of otorhinolaryngology and head and neck surgery when parotidectomy is undertaken.

In the clinic, many surgeons have attempted to remove the diseased parotid gland completely without injury to the facial nerve, but this has proved very difficult because of the great variation in the anatomical structure of both the parotid gland and the facial nerve. (Bailey (1941), McCormack(1945), Davis(1956), Nesci (1671), Hollinshead(1968), Adson and Ott (1923) Coleman(1944) and McKenzie(1968)).

Many authors have reported on the variety of the running course of the facial nerve in the parotid gland in Caucasians, and have reported on incidence of about 4.4~18.5% of postoperative facial nerve palsy.(Benedict and

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Meigs(1930), Stein and Geschickter(1934), McFarland(1942) and McCune(1951)).

However, the study of this important part of head and neck surgery has not been done on Koreans.

In order to reduce the postoperative morbidity due to facial nerve paralysis during surgery, the authors have studied 45 parotid glands and 111 facial nerve specimens from Korean adult cadavers.

MATERIALS AND METHODS

A. Materials

The material for this study was a collection of 45 parotid glands and 111 facial nerve specimens from Korean adult cadavers in the Yonsei University Medical College, Department of Anatomy.

B. Methods

1. Parotid gland

The parotid gland was exposed surgically and the shape, width, length, course of parotid duct and occurrence of accessory parotid lobes were observed.

2. Facial nerve

Whenever possible, the peripheral branches of the facial nerve were located and traced back to their origin in the facial nerve trunks, but the peripheral branches were traced outward from the main trunk in some cases. The pattern of anastomosis of peripheral branches of facial nerve in the parotid grand and length of the facial nerve from the external angle of the mandible to the bifurcation of the facial nerve were observed.

RESULTS

A. Length of the parotid gland

The length of the parotid gland (vertical distance between the tip of the superficial lobe and the base of the parotid gland) was measured as 39.5~69.0 mm.

Although there was a wide range of values, 18 out of the 45 cases were between 51~60 mm in length(Table 1).

Table 1. Length and Width of the Parotid Gland

Length and Width in mm	Number	
	Length	Width
21~30	—	15 (33.3%)
31~40	2 (4.4%)	26 (57.8%)
41~50	12 (26.7%)	4 (8.9%)
51~60	18 (40.0%)	—
61~70	13 (28.9%)	—
Total	45(100.0%)	45(100.0%)
	Mean; 54.7 mm S.D.: 0.79	Mean: 32.9 mm S.D.: 0.61

B. Width of the parotid gland

The width of the parotid gland from the portion which was in contact with the sternocleidomastoid muscle posteriorly to the portion in contact with the masseter muscle anteriorly was measured.

The range of values for the width was 22~49 mm and 26 of the 45 cases(57.8%) studied fell within the range of 31~40 mm, while the average width was 32.9 mm(Table 1).

C. Sexual differences in size of the parotid gland

The average length of the parotid gland in males was 59.2 mm and the width averaged 34.7 mm.

Table 2. Sex Difference of Size of the Parotid Gland

Size	Male(25 cases)	Female(20 cases)
Length in mm	59.2	51.7
Width in mm	34.7	30.2

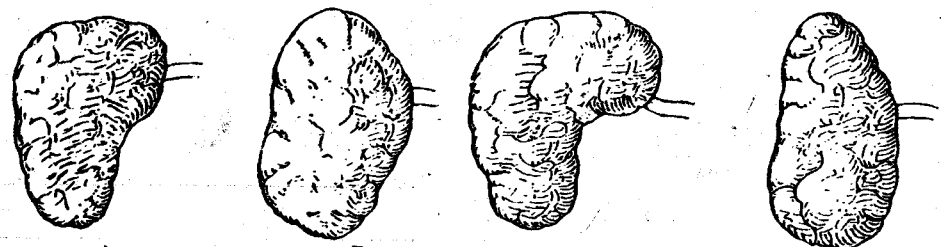

Fig. 1. Four Basic Types of the Parotid Gland.

In females, the corresponding values were 51.7 mm and 30.2 mm. The average values indicate that the male parotid gland is larger than the female gland(Table 2).

D. Shape of the parotid gland

In 1945 McCormack et. al. classified the shape of the parotid gland into four basic types: type A, inverted triangular shape; type B, oval shape; type C, inverted L shape and type D, roughly triangular shape.

In our study, type A was most common(66.7 %) and we also found accessory glands in 22 % (10cases) of our series(Fig. 1 and Table 3).

Table 3. Shape of the Parotid Gland

Shape	Number
A	30 (66.7%)
B	7 (15.5%)
C	4 (8.9%)
D	4 (8.9%)
Total	45(100.0%)

E. Types of tributory duct patterns of the parotid duct

Davis et. al. (1956) classified the tributory duct patterns of the parotid duct into five

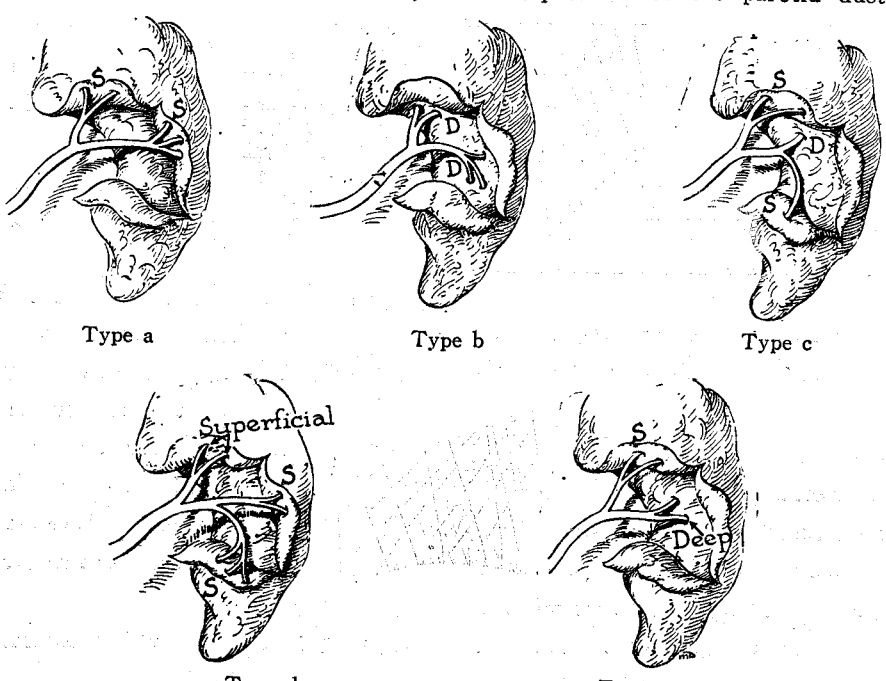

Fig. 2. Five Basic Patterns of the Parotid Duct.

basic patterns as follows;

Type a: tributory branches from the upper and middle superficial lobes only

Type b: tributory branches from the upper and middle deep lobes only

Type c: tributory branches from the superior and inferior part of the superficial lobe and from the middle part of the deep lobe

Type d: tributory branches from the upper, middle and inferior part of the superficial lobe

Type e: tributory branches from the superior part of the superficial lobe and the middle part of the deep lobe

In our series, we found 19 cases(42.2%) of type a, 26.7% type b, 22.3% type e and type c and d were each 4.4%(Fig. 2 and Table 4)

Table 4. Types of Tributory Duct Patterns of the Parotid Duct

Type	Number
a	19 (42.2%)
b	12 (26.7%)
c	2 (4.4%)
d	2 (4.4%)
e	10 (22.3%)
Total	45(100.0%)

F. Distance from the external angle of the mandible to the bifurcation of the facial nerve

The method of McCormack *et. al.* (1945) was used to measure the distance from the angle of the mandible to the point of bifurcation of the superior and inferior divisions of the facial nerve. The range of values was 12.1 ~39.8 mm with an average value of 28.8 mm.

The modal value range was 26~30 mm (18 cases, 40%) followed by the 31~35 mm range with 14 cases and 31.1% of the series(Table 5).

Table 5. Distance from Bifurcation of Facial Nerve to External Angle of Mandible

Distance in mm	Number
11~15	3 (6.7%)
16~20	1 (2.2%)
21~25	5 (11.1%)
26~30	18 (40.0%)
31~35	14 (31.1%)
36~40	4 (8.9%)
Total	45(100.0%)

Mean: 28.8 mm

G. Frequency of trifurcation

In the majority of the cases in our series, the facial nerve divided into two divisions (bifurcation), but in 2 cases (4.4%) trifurcation (splitting into three divisions) occurred.

H. Types of branching and anastomosis of the facial nerve

The divisions of the facial nerve were classified according to method of Davis *et al.* (1956) which is as follows;

Type Ⅰ: abscence of anastomosis between the temporofacial division and cervicofacial division.

Type Ⅱ: anastomosis among the branches of the temporofacial division only.

Type Ⅲ: single anastomosis among the branches of the temporofacial division and cervicofacial division

Type Ⅳ: combination of type Ⅱ and type Ⅲ.

Type Ⅴ: double anastomosis between the temporofacial division and cervicofacial division.

Type Ⅵ: complex multiple anastomosis between two divisions.

Among the forgoing types, the most common

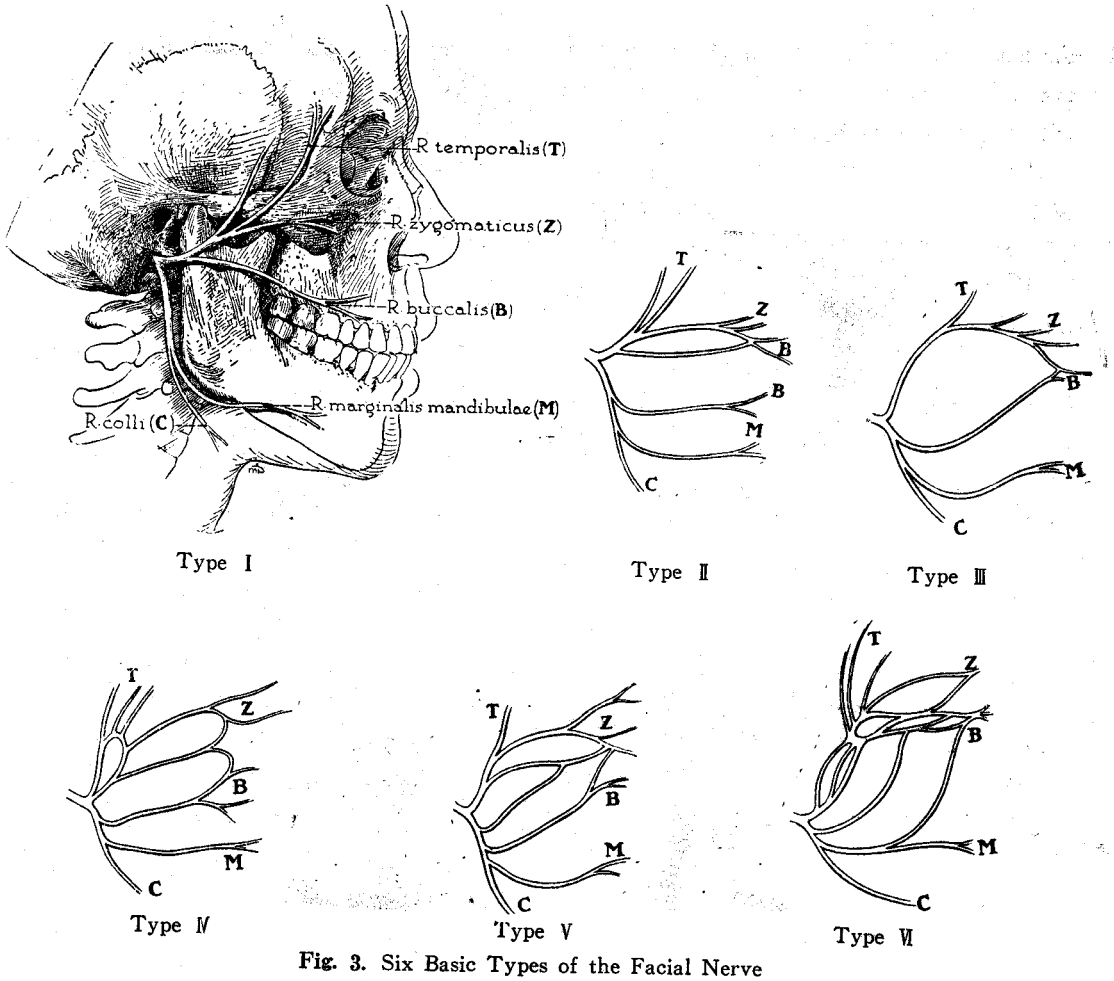

Fig. 3. Six Basic Types of the Facial Nerve

T: temporal branch Z: zygomatic branch B: buccal branch M: mandibular branch C: cervical branch

Table 6. Types of Branching and Anastomosis of the Facial Nerve

Type	Number
I	7 (6.3%)
II	15 (13.5%)
III	37 (33.4%)
IV	26 (23.4%)
V	7 (6.3%)
VI	19 (17.1%)
Total	111(100.0%)

was type III with 33.4% (37 cases) followed by type IV with 23.4% (26 cases) and in descending order type VI with 17.1% (19 cases) and type II with 13.5% (15 cases)(Fig. 3 and Table 6).

DISCUSSION

Of all the serous glands, the parotid gland is the largest of the salivary glands, and it opens into the oral cavity through Stenson's duct which appears in the mucosa of the cheek opposite the upper second molar tooth.

McCormack *et. al.* (1945) studied the size of the parotid gland and found the length ranged from 45~92 mm with an average of 60 mm and the width ranged from 20~54 mm with an average of 33 mm.

In another study, Davis *et. al.* (1956) found

the length to fall between 40~77 mm with an average 58 mm and width to be 20~65 mm with an average of 34 mm.

Our studies showed the average length to be 54.7 mm and the average width to be 32.9 mm.

Thus it can be seen that the parotid glands in Koreans are somewhat smaller than in Caucasians.

A study of the morphological types of the parotid glands in 57 cases (McCormack *et. al.*) showed 21 cases to be type A, and 24 cases which were type B.

Davis *et. al.* (1956) found 52.6% of the cases were type A and 31.5% were type B, demonstrating that type A and B were the most prevalent types. In our study, 66.7% were type A and 15.5% were type B, showing a predominance of type A.

The frequency of occurence of accessory glands shows a high degree of variability dependent upon the method which is used for their detection.

In 1948, Bailey discovered approximately 1% of his cases had an accessory gland as revealed by observation during surgery. The highest rate of discovery of accessory glands was recorded by Blady and Hocker (1938) who found up to 50% using sialography, and cadaver dissection yields a 19.7% rate of occurrence of accessory glands.

Our study, using cadaver dissection, showed an occurrence rate of 22% which was not significantly different from studies on Caucasians.

Davis *et. al.* (1956) reported that the morphological arrangement of Stenson's duct within the parotid gland could be divided into 5 major types and reported the incidence of each type among their 34 cases as being 17 cases of type a, 7 cases of type b, 2 cases of type c, 3 cases of type d and 5 cases of type e.

Our study also showed a similar distribution with 42.2% type a, 26.7% type b and 22.3% type c.

Turnning to the course of the facial nerve within the substance of the parotid gland, the nerve leaves the stylomastoid foramen and enters the parotid gland on the posterior deep surface.

Inside the gland, the facial nerve trunk first divides into a superior temporofacial division and an inferior cervicofacial division.

The divisions then further divide and anastomosis to form a temporal branch, a zygomatic branch, a buccal branch, and a cervical branch. Each of these branches is then distributed to the appropriate facial muscles.

The division of the facial nerve trunk within the parotid gland is extremely variable and actually forms a plexus-like arrangement which may be termed the "parotid plexus".

This plexus may be divided into general types depending on whether or not there is anastomosis between the upper and lower divisions.

In the type in which anastomosis occurs, even if there is damage to some branches of the nerve during surgical manupulation, the resultant palsy of facial musculature is minimal or may not occur.

In order to minimize facial palsy when performing parotidectomy, it is extremely important to be cognizant of the many possible variations in the division of the facial nerve within the parotid gland and the ramifications.

One anatomical landmark which is of importance in avoiding injury to the facial nerve during surgery is the distance between the angle of the mandible and the bifurcation of the facial nerve.

McCormack *et. al.* (1945) found this distance to range from 14~46.9 mm and to average 34

mm; Davis *et. al.* (1956) found the range to be 25~45 mm and the average to be 32 mm.

In our study, the range was 12.1~39.8 mm and the average was 28.8 mm, which was somewhat shorter than in Causasians.

Trifurcation of the facial nerve trunk occurred in 15% of Pilheu's series (1955) and in 5% of Gaughran's series (1961). However it was abscent in the reports of Davis *et. al.* (1956).

In our series, a trifurcation rate of 4.4% was found, approximating the results of Gaughran.

The classification of the peripheral distribution of the facial nerve is based on the type and number of anastomosis between the peripheral branches.

McCormack *et. al.* (1945) proposed a classification with eight types and found that 13% were type Ⅰ, 11% were type Ⅱ, 22% were type Ⅲ, 21% were type Ⅳ, 12% were type Ⅴ, 9% were type Ⅵ, 5% were type Ⅶ, and 7% were type Ⅷ, and that type Ⅲ and Ⅳ were most common.

In 1956, Davis *et. al.* proposed a classification with only 6 types and found that their series contained 18% type Ⅰ, 20% type Ⅱ, 28% type Ⅲ, 24% type Ⅳ, 9% type Ⅴ, 6% type Ⅵ, and also found that type Ⅲ and Ⅳ were most common.

In our study, we followed the classification of Davis and also found that type Ⅲ and Ⅳ were most prvalent with 33.3% and 23.4% incidence rates respectively.

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