Distribution of Facial Nerve in Parotid Gland: Analysis of 50 Cases

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Summary: The purpose of the present study is to reduce the postoperative morbidity related to facial paralysis during parotid surgery and to layout the different characteristics related to intraparotideal distribution and anatomoses of the facial nerve in our community. We also report new variations in the facial nerve branchings that have not been previously published.

In this paper, facial nerves from 48 cadavers and 2 patients of which 45(90%) were males and 5(10%) were females; 26(52%) being right and 24(48%) being left facial nerves were put forward. Their photographs were taken and the diagrams of intraparotideal distributions of each facial nerve were drawn. The intraparotideal configuration of the facial nerve was evaluated in 5 types. Twenty-four% of the facial nerves had no anastomoses (Type I); 12% had a ring-like shape anastomosis between the buccal and the zygomatic branches (Type II); 14% anastomoses were between the buccal and the other branches in a ring-like shape (Type III); 38% of the facial nerves had multiple complex anastomoses and were named as multiple loops (Type IV); 12% had two main trunks (Type V).

Of the bilateral cadaver dissections, the facial nerve distribution in 9(47.3%) were bilaterally the same and in 10(52.7%) main trunks were different. A facial nerve trifurcation composed of two main trunks were also established. There were no statistical differences between branching of the facial nerves in the right and left side of the faces. It was shown that there were primary nerve anastomoses between the main trunk and the lower trunk in 4 cadavers (8%); also in 1(2%) cadaver they were between the main and lower trunk and between the upper and lower trunk.

This study shows that there are racial differences in the branching of the facial nerve, and it is important to remind the surgeon of the surprises related to the topographic anatomy during the facial surgery.

Superficial or total parotidectomy with preservation of the facial nerve has been commonly used for many years in the surgical treatment of parotid gland tumors.[7]

Variability of the facial nerve branching in the parotid gland may add difficulty to the surgery. In the parotid gland surgery, particularly during removal of deep lobe tumors, facial nerve can be injured because of many variations and anomalies. The knowledge of all possibilities about the facial nerve branchings becomes vital concern to the surgeon.[6,8,14,15,16]

The terminal nerve branching of the facial nerve in the parotid gland is divided into subgroups according to possible anastomotic connections between upper and lower branches. Injury to some branches of the nerve during surgery is less likely to result in permanent paralysis if anastomotic branches are present.[14]

For preservation of the facial nerve during surgery, first of all, good exposure of the nerve is essential. It depends on a thorough knowledge of extratemporal anatomy of the nerve and reliability of the surgical dissection method used.[1,7,8,11,12,13,16,17]

There are many studies about the variations of the facial nerve branching in parotid gland in different communities.[8,14] However, hitherto no relevant Turkish study was done. The aim of the present study is to clarify whether different features of the facial nerve branching occured in our population and also to provide a better guidance to the surgeon. Meanwhile we present variations in the facial nerve branchings that have not previously reported.

This study was performed in Anatomy Departments of Hacettepe University of Ankara and Ondokuzmayis University of Samsun and ENT Department of Numune Hospital in Ankara

Material and Methods

Our material consisted of 48 cadavers (19 bilateral, 12 unilateral dissections) and 2 patients. Of all cases 5 were female, 45 were male. Their ages ranged from 5 to 80 years (average 47.7 years).

Prior to dissection, glycerine solution was injected into the parotid region in order to render the formalin fixated cadevers softer. Hereafter, a classic parotidectomy incision was made (Hellman, 1965) and the main truncus of the facial nerve was identified at stylomostoid foramen. Dissection of the peripheral branches of the facial nerve was achieved bluntly by using different sizes of clamps and scissors. When the main truncus was thin, dissection was performed in a retrograde manner. Peripheral branches were identified at different regions such as, around the stenon duct over the masseter muscle, along the course of retromandibular vein or where anterior facial vein and facial artery cross the mandible. Surgical dissection of the thin branches of the facial nerve was achieved under microscope (Carl Zeiss Opmi 99).

Following the dissection, branches of the facial nerve were photographed and schemaetic illustrations were drawn. Hereafter branching types were classified into groups (Katz and Catalano, 1987). Histopathologic examinations of the anastomotic branches of the trunks were performed to determine whether they were nerve fibers or fibrous tissues.

Findings of our study were evaluated statistically using Student-t test.

Results

Of 50 specimens, 26(52%) were left and 24(48%) were right sided. Sex distribution for statistical analysis was not performed, since the number of cases were insufficient. Regarding the intraparotidean branching of the facial nerve and the course of its trunci and terminal branching of the nerve, distribution of the facial nerve was classified into groups as Katz and Catalone described (1987). Type I, III and IV were further divided into subgroups regarding the origin of ramii buccales.

Of all specimens, 12(24%) were observed as straight branching (unbranched). Six of them were type IA, where the zygomatic division arises from the upper division. Type IB was noted in 6 cases with the zygomatic branch arising from the temporozygomatic branch and mandibular division gave branches back to itself. Type II, having major interconnections between the zygomatic and buccal divisions was found in 14% of the cases. Type III was noted in 7(14%) cases. Of 7 cases, 3 were type III A, 1 was type IIIB, 3 were type IIIC (Table 1) (Fig. 1).

The most common anatomic pattern termed multiple loops, were noted in 19(38%) cases. Of them, 1(2%) was type IVA having interconnections between ramus buccales and temporalis and zygomaticus, however 18(36%) were type IVB. The latter was the most common one of all types ($p < 0.01$). In this subtype, ramus buccalis originated from three different locations, the main trunk, the upper and lower divisions. Multiple interconnections among these various divisions were observed.

Type V which has two main trunks, one minor and one major, was noted in 6 (12%) cases. We found different subgroups in this type, apart from those of Katz and Catalano. The cases in this group, classified as type VA, had upper and lower divisions originating from major trunk and rami buccales originating from both upper and lower trunks and showing multiple anastomosis between various divisions (Fig. 1).

In type VB, the upper division originated from major trunk and the lower division originated from minor trunk and rami buccales originated from both upper and lower divisions. There were interconnections between major and minor main trunci via rami buccales. In type VC, the upper and lower division originated from the major main trunk, minor main trunk entered the upper division as a separate branch. One case in this type had accesory branch which followed a course parallel to the major trunk (Fig. 2).

There were no statistically significant differences between the right and left sides of the facial nerve configuration ($p > 0.05$) (Table 1). Of the 19 cases undergoing bilateral dissection, 9(47.3%) had bilaterally the same type; 10(52.7%) had different branching on either sides.

In 9 (18%) cases, trifurcation of the facial nerve was found. One case had two main trunks and trifurcation of the facial nerve.

Regression analysis, which was applied in order to determine whether there was a relation between age and branching of the facial nerve, was significant ($r = 1.64$, $p > 0.05$). Six (12%) cases were children cadavers. Of 6 cases, 4 had type I branching. In adults the most common anatomic pattern was type IV (43.2%).

The features displayed by the branching of the facial nerve in our study is illustrated in Fig. 1.

Histopathologic Survey

Primary nerve anastomosis also confirmed histopathologically, was found between main trunk and

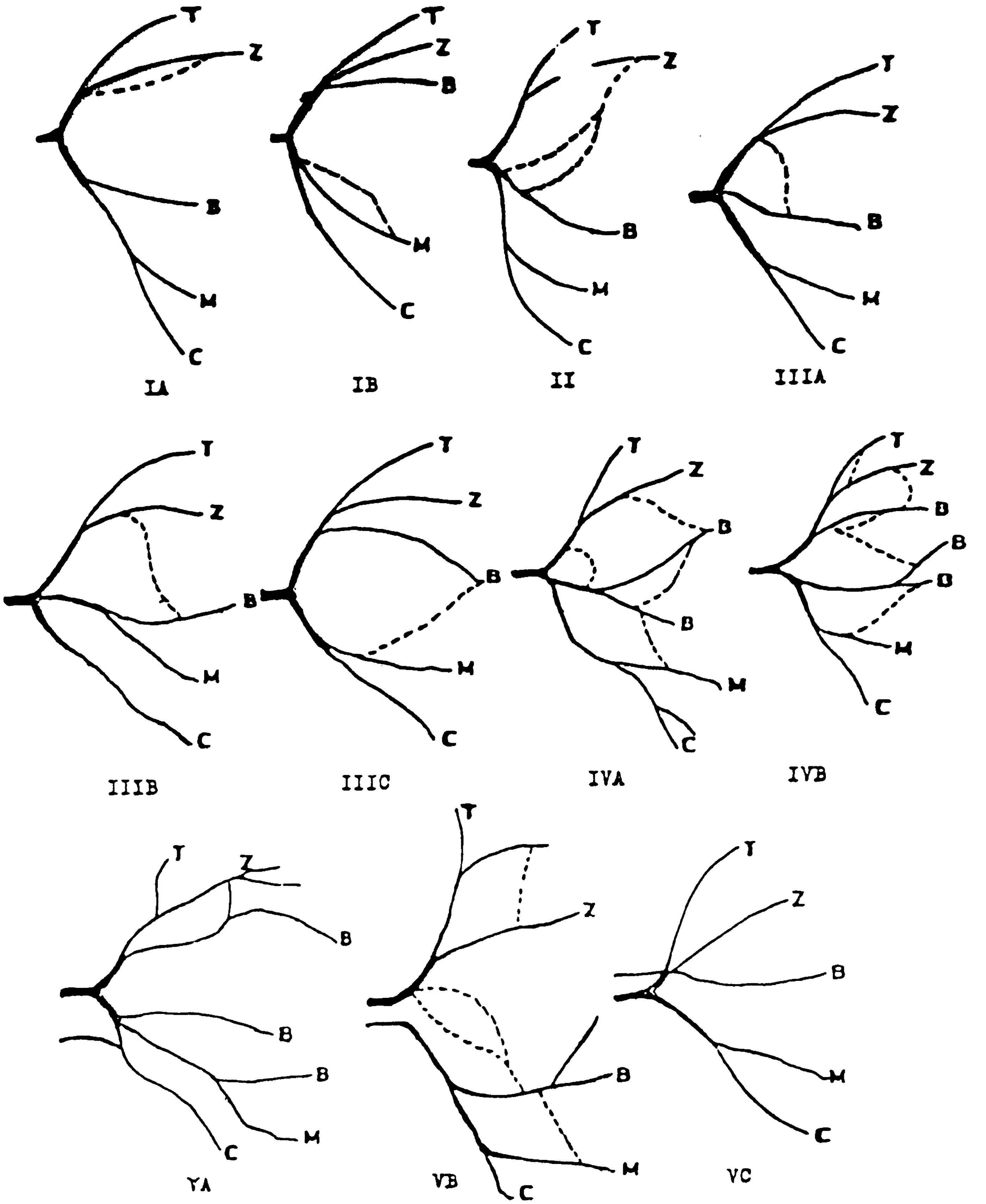

Fig. 1. Intraparotideal branching types of the facial nerve.
T: Rami temporales, Z: Rami zygomatici,
B: Rami buccales, M: Ramus marginalis mandibulae,
C: Ramus colli.

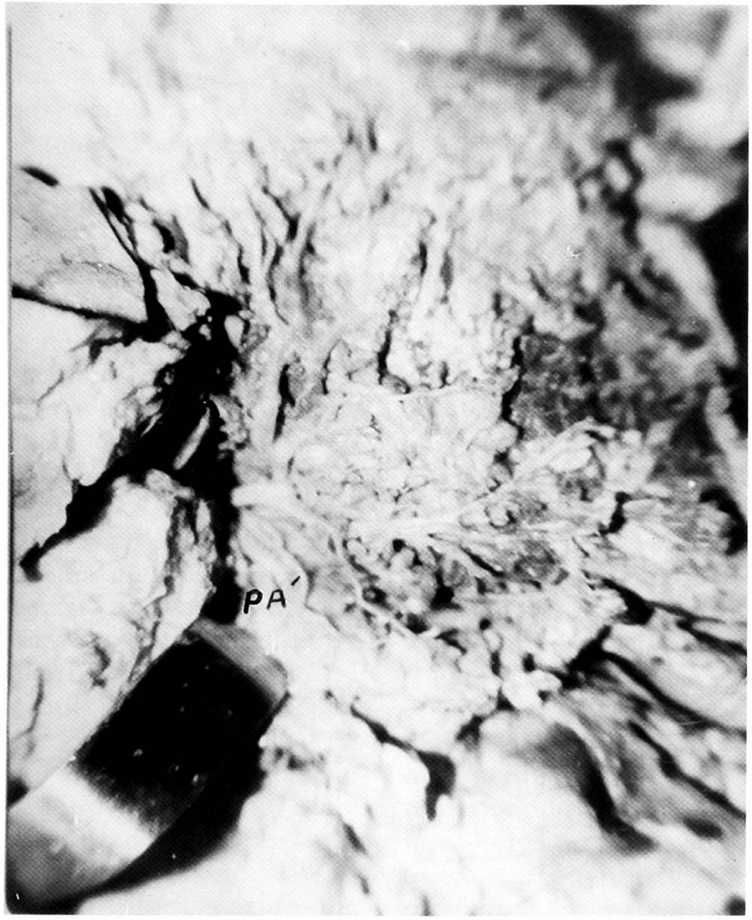

Fig. 2. The parallel course of the accessory branch to the major trunk (PA).

Table 1. Intraparotideal branching types of the facial nerve in right and left hemifaces.

	Right		Left		Total	
	n	%	n	%	n	%
IA	4	15.4	2	8.4	6	12
IB	1	3.8	5	20.8	6	12
II	2	7.8	4	16.6	6	12
IIIA	1	3.8	2	8.4	3	6
IIIB	1	3.8	—	—	1	2
IIIC	1	3.8	2	8.4	3	6
IVA	1	3.8	—	—	1	2
IVB	11	42.4	7	29.0	18	36
VA	1	3.8	2	8.4	3	6
VB	1	3.8	—	—	1	2
VC	2	7.8	—	—	2	4
Total	26	100.0	24	100.0	50	100.0

lower division in 4(8%) cases, main trunk and upper division in 3(6%) cases, upper division and lower division in 2(4%) cases. One case had multiple nerve anastomosis of the main trunk and lower division, and also of the upper and lower divisions, which was confirmed histopathologically as well.

Discussion

The success of the surgical intervention to the parotid gland for its pathologic conditions depends on the total removal of pathologic tissue with the gland as well as definitive exposure and preservation of the facial nerve. For this reason different types of anastomosis between the facial nerve branches were presented to warn the surgeon against the variations.

Ramus buccalis originating from the upper division had an incidence of 20% in Davis *et al.*'s series, and 12% in Katz and Catalano's series. This rate was found as 18% in our study. While ramus buccalis originating from both upper and lower divisions was found in 4% of cases in Katz and Catalano's series, it was 36% in our cases.

The types of the facial nerve from I to IV in our study resemble those of cadaver materials of Bernstein and Nelson (1984), Park and Lee (1977), David *et al.* and those of living dissection material of Katz and Catalano (1987). The six reports and our findings are included in Table 2. Type I which has straight branching was found 24% of cases by Katz and Catalano, 9% by Bernstein and Nelson, 13% by Davis *et al.*, 6.3% by Park and Lee. It was also noted in 24% of the cases in our series.

Type I was divided into two subgroups; type IA and type IB. They were found to be as frequent as 18% to 26%, 6% to 24% in the literature, respectively[2,8,9]. We found them 12% for type IA and 12% for type IB.

The findings in relation with type III in our series are different from those of other reports (Table 2).

The most common anatomic pattern in our cases was type IV (38%).

We have subdivided type V nerves into groups A, B, C based on the nature of the main trunk and rami buccales. These groups have not been reported previously by other authors. Type V A, B, C were found in a frequency of 6%, 2%, 4% respectively.

There is no report to compare the branching of the facial nerve on either sides of the face. The most common branching type of either sides, in our series, was type IV B (42.4% on the right side, 29% on the left side of the face).

The types of branching of the facial nerve on either sides of the same case have usually not shown similarity. There was no statistically significant difference between the right and the left side, in view of the type of nerve branching regarding all the cases ($p > 0.05$) (Table 1).

Trifurcation of the main trunk of the facial nerve, which is reported to be as frequent as 5 to 15% in the literature[3,5], was found in 9(18%) cases in our study.

We found anastomotic connections between the main trunk and upper and lower divisions, which has not been reported previously. These interconnections have been confirmed histopathologically as true nerves. In such cases, even if one of the trunks is injured during the surgery, loss of the nerve function will be less likely to result in paralysis.

Our results indicated that the branching of the facial nerve is not altered by age, however race may be an important factor in the branching of the facial nerve.

In parotid gland surgery if the branching variations of the facial nerve is kept in mind, the surgeon will be safe from unpleasant surprises.

Table 2. Branching types of the facial nerve according to various authors.

Author	Type I %	Type II %	Type III %	Type IV %	Type V %
Davis	13	20	28	39	–
Callander	24	–	60	16	–
Kitamura	43	17	10	30	–
Park	6	14	33	47	–
Bernstein	9	9	25	57	–
Katz	24	14	44	15	3
Our Study	24	12	14	38	12

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