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Branching Pattern of the Facial Nerve in the Parotid Gland

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이하선 내 안면신경의 분지양상

김영순 · 서영진 · 김 욱 · 전정수

Iatrogenic injury of the facial nerve branch is the main complication during a parotidectomy, leading to functional damage in the patient. An exact and thorough understanding of the anatomy of the branching pattern of the facial nerve in the parotid gland is prerequisite for surgeons performing a parotidectomy. The aim of this study was to elucidate the branching pattern of the facial nerve inside the parotid gland. The relationships between the branches of the facial nerve were investigated in 23 adult faces during parotidectomies for various etiologies. The branches of the facial nerve were divided into six types according to their branching patterns and their communication. Straight branching with two subtrunks was seen in 12 (52%) out of the 23 cases (Type I), two buccal branches from the lower and upper subtrunks was seen in 4 (17%) cases (Type II), and anastomosis between the buccal and zygomatic branches in 4 (17%) cases (Type III). There were multiple anastomoses among the temporal, zygomatic and buccal branches in 2 (9%) cases (Type IV). Only one (4%) case had buccal branch stemming from the marginal mandibular branch (Type VI). In most cases, the buccal branch was the thinnest. We think that many of the patients having a parotid tumor would possibly show a Type I branching pattern during a parotidectomy. Although the marginal mandibular branch was known to have a long course, almost no anastomosis with other branches, and the most devastating functional damage after iatrogenic injury. Surgeons should be especially careful during the dissection along the course of buccal branch, which may be the thinnest, and prone to damage, transiently or permanently, following the procedure. **(J Korean Surg Soc 2002; 62:453-455)**

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INTRODUCTION

Branches of a facial nerve have many variations. And the familiarity with the branching patterns of the facial nerve is the crucial factor for the safe and complication-free parotidectomy. After entering the parotid gland, facial nerve is divided into two subtrunks, the temporofacial (superior-upper) and the cervicofacial (inferior-lower) portions. (*1*) These two subtrunks, in turn, give off branches and form five branches: temporal, zygomatic, buccal, marginal mandibular and cervical, (*1*) which communicate with one another, forming multiple complex anastomoses in parotid gland. Many studies have been performed on the facial nerve features from on the clinical ground and revealed that many solid connections are formed between the branches of the facial nerve in parotid gland. (*2*) This study was carried out in order to determine frequency of the each type of branching pattern of the facial nerve inside the parotid gland intraoperatively and to compare the prevalence of the branching types previously reported.

MATERIALS AND METHODS

In this series, twenty-three patients (12 male and 11 female) were investigated during the parotidectomy for various etiologies from December 1997 to April 2001 at the Department of Surgery, St. Vincent's Hospital, The Catholic University of Korea. The patients' age was between 23 and 81 (average: 43). Benign adenoma was 19 cases and malignant cases were 4. The dissection of the facial nerve was done under naked eye without use of nerve stimulator to avoid any minor nerve injury that may eventually cause temporary or permanent functional loss. After dissection and removal of the lobe, the length of the

principal trunk of the facial nerve from the stylomastoid foramen to the point where two subtrunks begin to divide was measured. The ways of the division and branching of the facial nerve were determined according to previous report. (*3*)

RESULTS

In twenty-three faces, the facial nerve branched out two subtrunks, upper and lower, in the parotid gland, (Fig. 1. Type I and VI), whereas in ten of the faces the facial nerve was divided into three trunks, upper, lower and middle buccal trunk. (Fig. 1. Type II, III, IV, V)

The straight branching (Type I) was observed in 12 (52%) of all cases. The buccal branch was arising from the upper and lower subtrunks in 12 (52%) (Type I) and one (4%) (Type VI) of the cases, respectively. Four cases (17%) had dual buccal branches, one from upper and the other from middle subtrunk. (Type II). There was anastomosis between the buccal and zygomatic branches in 4 cases (17%) (Type III). In two cases (9%), there were multiple anastomoses among temporal, zygomatic and buccal branches (Type IV). Out of the eight cases, there were anastomoses in two (9%) and six (26%) between the buccal and the marginal mandibular branch and buccal and zygomatic branch, respectively. The buccal branch was arising from the main trunk (Type I and VI) in 13 cases (57%), but in four (17%) of the cases from both lower and upper subtrunks (Type II, III and IV).

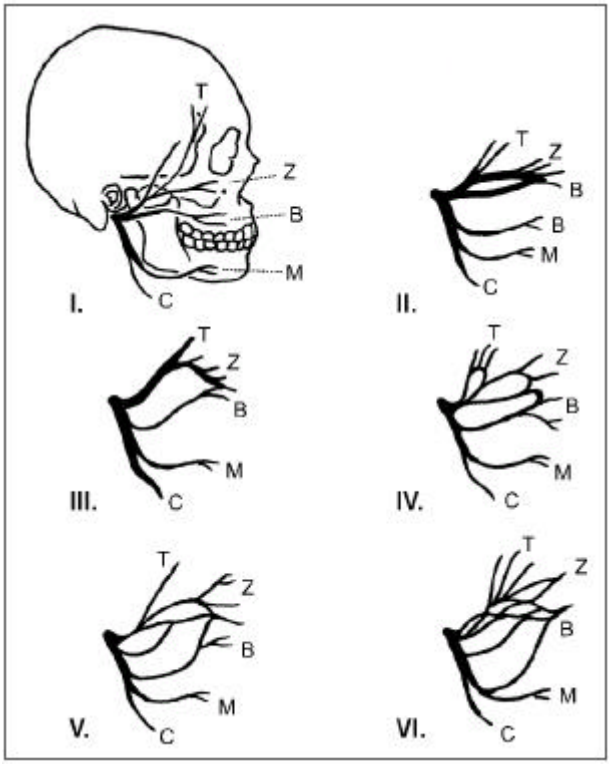

Fig. 1. Diagram of six types of facial nerve.

Type I pattern was observed over half of the cases studied, and Type II, III and IV comprised almost other half of studied cases (43%). The width of the branches varies from 1 to 1.8㎜, and most of the cases (20 cases, 87%) buccal branch was the thinnest and rest of them was marginal mandibular branch. The length of the main trunk from the stylomastoid foramen to first branching point varied 1.0 to 1.8 cm (average 1.5 cm).

DISCUSSION

While the straight branching (Type I) of the facial nerve has been reported to be 6 43% in the literature, (*4,5*) in our study it was found somewhat higher to be 52%. This high incidence of the straight branching might be related to age, as Kopuz et al. (*4*) reported in children. But, until recently, there has been not much report describing the discrepancy between adult and child branching pattern of the facial nerve and the exact cause of the difference. Some scientists have investigated subgroups of Type I. (*5*) We think that that kind of subclassification is none of use because minor interconnecting anastomosis could be found easily during the dissection and definitely all branches like that could not be saved while removing parotid gland tumor minimizing recurrence.

Type II, III, IV and V is categorized as having one more subtrunk from lower subtrunk and the so-called middle trunk radiating buccal branch. However we didn't see any of Type V that have multiple anastomoses between zygomatic and buccal branches. Type II has a straight middle buccal subtrunk. Type III has a middle buccal trunk but has one anastomosis with zygomatic branch. Type IV has multiple loop-like anastomoses between temporal and zygomatic branches from the upper subtrunk, and buccal branch from its own middle trunk. Type V has multiple communicating net between zygomatic branch from upper subtrunk and buccal branch from its middle trunk, but no gross web with temporal branch.

Type II facial nerve called zygomatic loop was found as frequent as 9 to 20% in the literature and so was ours. (*6*) The incidence of Type IV with multiple anastomoses has been reported between 14 and 57%. (*4*) In our study it was found to be only 9%. Kopuz et al. (*4*) also reported that there were 2% Type IVA and 30% Type IVB according to the presence of minor connection with marginal mandibular branch. But unfortunately we don't have that kind of information. Type V

with two main trunks was reported to be 3% by Katz and Catalano, (5) 12% by Kopuz et al. (4) but in our study it was none.

The parotid gland has clinical importance in the presence of tumor and other pathological lesions. It might be very important for surgeons to know facial nerve distribution in parotid gland during surgical operation in the parotid area. We think that most of the patients probably have Type I pattern mostly or minor percentage of other types. Functional loss after inadvertent nerve damage can be temporary or permanent, but the chance of recovery after immediate nerve anastomosis or medication is little. So the most safest and surest procedure is the prevention of the injury with complete and through anatomic knowledge. And many of the parotid tumors sit on or embrace buccal and/or marginal mandibular branches, which are liable to be hurt during the operation. Our experience also indicates that many of the patients having a tumor in the parotid gland showed displaced buccal and/or marginal mandibular branch. So either inadvertent approach or ignorance of facial nerve branching pattern can easily lead anyone to unrecoverable fatal functional damage of these branches after operation. Until now most reports on the iatrogenic functional damage after parotidectomy were due to injury of the marginal mandibular branch that carries nerve stimuli to the muscles of the lower lip and chin, because its course is longer than others, almost no anastomosis between other branches that can be seen in our series, and most drastic functional damage on the facial muscle. (7) And our report showed that probability of the type I branching pattern is higher and is almost 50%, so surgeon should be aware of the consequences after iatrogenic injury and take into consideration that preservation of the marginal mandibular branch is the utmost importance and the nearby buccal branch is the thinnest of all - according to our series that underscore the likelihood of having been injured, though many instances it may have communication from others, mostly from the zygomatic branch. (7) Unlike from the information by the western anatomy, buccal branch is the thinnest of all rather than largest. (7) Both marginal mandibular and buccal branch innervates the risorius muscle, one of the muscles around the mouth, so in case of injury on both nervi bring about failure of the retraction of the mouth angle permanently. (7) And buccinator muscle is innervated solely by buccal branch, so damage on this nerve may be serious for the musician blowing a musical instrument like trumpet. (7) In addition, we suggest prograde dissection instead of retrograde one, because branching pattern can be easily distinguished in the former procedure rather than later one. We think that the surgeon being equipped with that information might prevent many of the possible damage.

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