

An anatomical study on the facial nerve trunk in fetus cadavers

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Background/aim: Facial nerve paralysis is the most worrying parotid surgery complication. Little attention has been paid to the facial nerve trunk, especially in children. Pathological variations, tumors, and anatomic variations of the facial nerve may cause parotid and facial nerve surgery difficulties. This study describes the facial nerve trunk.

Materials and methods: We measured the facial nerve trunk from 8 female and 8 male fetus cadavers aged 21.0 to 35.5 gestational weeks. The locations and positions of the trunks were described. The length of the facial nerve trunk (K) was measured and bifurcation and trifurcation of the trunk was examined. Values were analyzed separately for right and left sides and for male and female fetuses.

Results: The most common facial nerve trunk type was bifurcation (81.25%), followed by trifurcation (18.75%). K was 11.59 ± 2.80 mm in the total fetuses. There was no significant difference between K measurements.

Conclusion: Facial nerve injury during parotid surgery is a main cause of pediatric facial paralysis. There are few previous descriptions of the facial trunk in children. K must be accurately known in any surgical procedure planned for the area. The main furcation of the facial nerve should also receive special attention.

Key words: Facial nerve, fetus, morphometry, anatomy

1. Introduction

Facial nerve paralysis is a common complication of parotid surgery and one that causes particular anxiety. The facial nerve is a particularly important structure encountered during surgical extraction of parotid gland tumors, not least since these approximate the nerve very closely.

The facial nerve emerges from the facial canal via the stylomastoid foramen. It then passes anteriorly to enter the parenchyma of the parotid gland. After crossing the styloid process, retromandibular vein, and external carotid artery, it divides into 5 terminal branches behind the neck of the mandible (1–3). The segment of the facial nerve between its point of emergence from the skull through the stylomastoid foramen and its furcation into upper and lower branches at the parotid area is known as the main trunk of the facial nerve (2,4).

Holt referred to the difficult problem of dissecting the facial nerve trunk through the surrounding soft tissues (5). The dissection of this segment becomes more difficult and risky when the normal anatomy is deformed by a tumor, a scar from previous surgery, or other pathological processes (4). In infants, the facial nerve trunk is located in a more

superficial plane and is liable to injury during surgical incision and trauma to the retromandibular area (6). The processus mastoideus is not yet developed in infants, and the facial nerve arising from the stylomastoid foramen is very close to the surface. The facial nerve trunk may therefore be vulnerable when using the forceps during difficult births (7). Accurate knowledge of the anatomy of the facial nerve trunk is therefore essential for performing various surgical procedures on the mastoid process and parotid gland, for approaches to the cranial base, and for surgery aimed at facial nerve repair (4,8).

Preservation of the facial nerve during parotid gland surgery depends upon its being exposed and located without suffering damage. An accurate knowledge of the anatomy of the nerve and considerable perioperative care are essential if trauma is to be avoided. The surgeon must be acquainted with a range of techniques, since anatomical variations may make any specific approach difficult (9,10).

The facial nerve trunk being dissected and manipulated between the exit from the cranial base through the stylomastoid foramen and its furcation is a crucial stage in a number of otological, plastic, and neurosurgical

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procedures (4). Understanding the anatomy of the facial nerve trunk is essential for performing any surgical procedure in the region.

This study was intended to describe the furcation types of the facial nerve trunk and to measure K values in infants and premature babies, whose facial trunks can be easily injured since these lie close to the surface. We also aimed to compare the morphometric measurements obtained.

2. Materials and methods

The study was performed at the Karadeniz Technical University (KTU) Department of Anatomy, Trabzon, Turkey. Sixteen fetus cadavers (8 females, 8 males) aged between 21.0 and 35.5 gestational weeks (gw) by foot length with no visible external abnormalities and preserved in 10% formaldehyde were used (11).

Measurements were performed in 32 sides of faces (males: 8 right, 8 left; females: 8 right, 8 left). Fetuses with no external pathologies or abnormalities were obtained from the Trabzon Maternity and Children's Hospital between 1992 and 1998. Written consent from the families and the approval of the Ethics Committee of the KTU Faculty of Medicine were obtained prior to the start of the study.

Dissections were performed with cadavers in a semilateral position. A skin incision was made starting in front of the ear and extending downward behind the lobulus auriculæ and further down to the neck along the anterior border of the sternocleidomastoid muscle. The facial skin and subcutaneous tissue were removed

and the platysma muscle was divided and retracted. The sternocleidomastoid muscle was identified and retracted posterolaterally.

The entire trunk of the facial nerve through the dense soft tissue was identified and traced back to the stylomastoid foramen. The facial nerve trunk was identified at its emergence from the stylomastoid foramen and was followed caudally to its furcation. In every dissection, the entire trunk of the facial nerve was exposed from its emergence at the stylomastoid foramen and distally as far as the main furcation (Figures 1 and 2). K was measured between its emergence from the skull through the stylomastoid foramen and its furcation in the parotid area. The main trunk of the facial nerve was then traced forward to its furcation and examined in order to determine bi- and trifurcation of the facial nerve trunk. K measurement values were recorded as male/female and right/left, and averages were calculated. Following dissections, the facial nerves were photographed and patterns were drawn.

Measurements were performed using digital calipers, sensitive to 0.05 mm. Because the facial nerve trunk has a small arc, it could not be measured directly with the digital calipers. Measurement was performed 5 times with surgical silk thread, and these threads were measured 5 times with digital calipers. K was thus measured 25 times. Means and standard deviations were calculated using SPSS 10.0. Normally distributed data were analyzed using the independent t-test; data that were not normally distributed were analyzed using the Mann-Whitney U test (12). $P < 0.05$ was considered statistically significant.

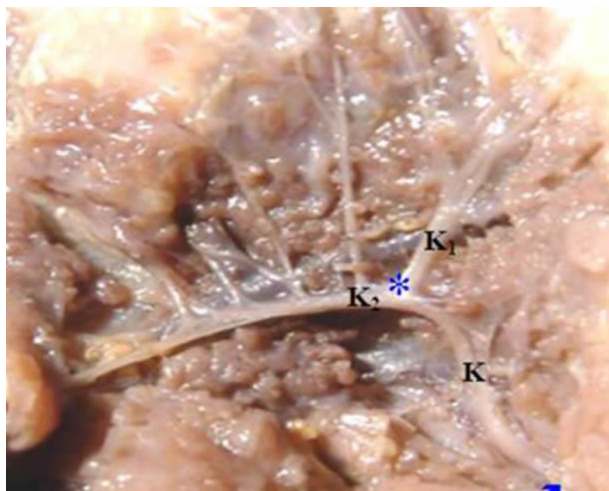


Figure 1. Photograph showing pattern of bifurcation of the facial nerve trunk. K: Facial nerve trunk, K_1 : upper division of the facial nerve trunk (truncus temporofacialis), K_2 : lower division of the facial nerve trunk (truncus cervicofacialis). *: Bifurcation point of the facial nerve trunk. ↗: The stylomastoid foramen.

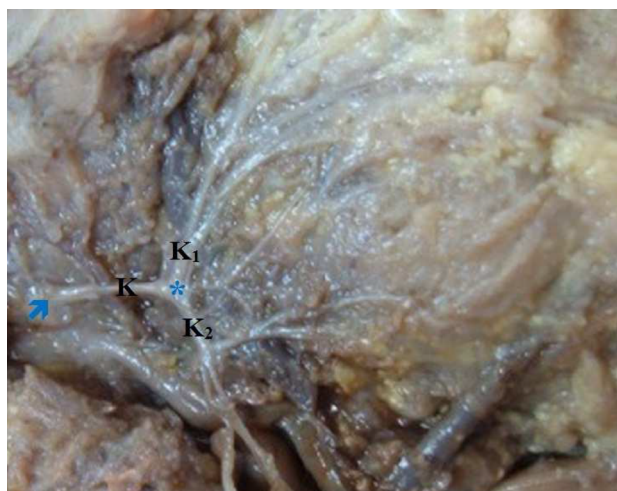


Figure 2. Pattern of bifurcation of the facial nerve trunk. K: Facial nerve trunk, K_1 : upper division of the facial nerve trunk (truncus temporofacialis), K_2 : lower division of the facial nerve trunk (truncus cervicofacialis). *: Bifurcation point of the facial nerve trunk. ↗: Stylomastoid foramen.

3. Results

Measurements were performed on 32 sides of faces (males: 8 right, 8 left; females: 8 right, 8 left) of 16 fetuses (8 males, 8 females) calculated at 21.0 to 35.5 gw according to foot length.

Fetuses had a mean age of 29.80 ± 4.29 gw, with 30.78 ± 3.59 gw for females and 28.33 ± 5.16 gw for males. No difference was determined between fetus ages by sex ($P = 0.30$). Male and female fetus groups were similar in terms of intrauterine age.

Average K in all fetuses irrespective of sex was 11.59 ± 2.80 mm. K values measured in this and earlier studies are presented in Table 1.

Average K was 12.38 ± 3.05 mm for female fetuses and 10.80 ± 2.37 mm for males. There was no difference between female and male fetus K values ($P = 0.11$, Table 2). K was 11.70 ± 2.93 mm for the right and $11.48 \pm$

2.76 mm for the left in all fetuses, irrespective of sex. No difference was determined between right and left K values ($P = 0.83$, Table 2). Furthermore, K values were similar in comparisons of female fetus right and left sides, male fetus right and left sides, and right and left sides of different sexes ($P = 0.75$, $P = 0.79$, $P = 0.38$, $P = 0.24$, respectively, Table 3).

Examination of facial nerve trunk furcation types in all fetuses, irrespective of sex, revealed that 81.25% of fetuses were of the bifurcation type (2 subtrunks: upper and lower) and 18.75 % of the trifurcation type (3 subtrunks: upper, lower, and middle). These were also analyzed according to sex and side (Table 4). Bifurcation type was the most common in all individuals. The bifurcation and trifurcation types of the facial nerve trunks examined in this and previous studies are presented in Table 5.

Table 1. Length of the facial nerve trunk according to various authors.

Author	Length (mm)
Dargent and Duroux, 1946 (14)	13
Kempe, 1970 (21)	14–26
Proctor, 1984 (22)	15
May, 1986 (23)	20
Holt, 1996 (5)	21
Ekinci, 1999 (15)	9
Salame et al., 2002 (4)	16.44
Cannon et al., 2004 (16)	9.38
Kwak et al., 2004 (1)	13
Present study	11.59

Table 2. Measurement of K performed for facial nerve means, standard deviations, and statistical comparison of right and left sides, females, and males in total subjects.

Measurement n = 16 (Mean \pm SD)	Right sides	Left sides	P 1	Female	Male	P 2
K	11.70 ± 2.93	11.48 ± 2.76	0.840	12.38 ± 3.05	10.80 ± 2.37	0.110

P 1: for total right vs. total left; P 2: for total female vs. total male.

Table 3. Measurement of K performed for facial nerve means, standard deviations, and statistical comparison of right side and left sides in females and males.

	Right sides n = 8 (mean \pm SD)	Left sides n = 8 (mean \pm SD)	P-values
Female n = 8 (mean \pm SD)	12.42 ± 3.20	12.34 ± 3.10	P 3 = 0.753
Male n = 8 (mean \pm SD)	10.98 ± 2.63	10.62 ± 2.23	P 4 = 0.793
P-values	P 5 = 0.382	P 6 = 0.248	

P 3: for female right vs. left; P 4: for male right vs. left; P 5: female right vs. male right; P 6: female left vs. male left.

Table 4. Incidence of furcation types of the facial nerve trunk.

Type	Total %			Female %			Male %		
	Total	Right	Left	Total	Right	Left	Total	Right	Left
Bifurcation	81.25	37.50	43.75	50.00	25.00	25.00	31.25	12.50	18.75
Trifurcation	18.75	12.50	6.25	0	0	0	18.75	12.50	6.25

Table 5. Bifurcation and trifurcation of the facial nerve trunk according to various authors.

Author	Bifurcation	Trifurcation
	%	%
Davis et al., 1956 (18)	100	-
Park and Lee, 1977 (19)	95.6	4.4
Katz and Catalano, 1987 (24)	100	-
Kopuz et al., 1994 (20)	82	18
Ekinci, 1999 (15)	81.4	18.6
Salame et al., 2002 (4)	97.8	2.2
Tsai and Hsu, 2002 (25)	100	-
Kwak et al., 2004 (1)	86.7	13.3
Present study	81.3	18.8

4. Discussion

The facial nerve trunk is the part of the facial nerve between where it emerges from the skull through the stylomastoid foramen and the point of furcation at the parotid area (4). This segment of the facial nerve is located in an area of complex anatomy that must be fully understood to prevent iatrogenic damage to the facial nerve. Therefore, understanding the anatomy of the facial nerve trunk is essential for performing any surgical procedure in this region.

Parotidectomy is the standard operation for parotid tumors. The main trunk of the facial nerve is frequently dissected and exposed during parotidectomy and other surgical procedures. Injury to the facial nerve causes considerable fear and anxiety. Such injury during parotid surgery is also one of the most widespread causes of facial paralysis in children (6). The key to safe parotidectomy therefore lies in correct identification and safeguarding of the facial nerve trunk (13).

Our scan of the literature showed that the facial nerve trunk between the stylomastoid foramen and the main furcation of the nerve has attracted little attention to date. Salame et al. emphasized the importance of the length of the facial nerve trunk, since a segment needs to be sufficiently long to permit anastomosis with the fewest

possible manipulations, and neither too tense nor too loose (4).

In a study published in 1946, Dargent and Duroux examined 27 specimens and determined a K value of 1.3 cm (14). Ekinci investigated the facial nerves on 27 sides of 14 cadavers aged 0 to 5 and determined a mean K value of 0.9 cm (0.6–1.2 cm) (15).

In a study published in 2002, Salame et al. examined the facial nerve trunk in 46 specimens from its emergence through the stylomastoid foramen to its furcation and reported a K value of 16.44 ± 3.20 mm (12.20–18.68 mm) (4). Kwak et al. investigated the facial nerve trunk in 30 subjects, with K measured at 13.0 ± 2.8 mm (1). These 2 studies examined adult cadavers.

In a study published in 2004, Cannon et al. investigated the facial nerve trunk in 79 patients, reporting a K value of 9.38 mm (16).

We also measured K between where the facial nerve emerges from the skull through the stylomastoid foramen and its furcation at the parotid area. Our groups were identical in measurements made, irrespective of sex, among all fetuses. Our results were in agreement with those of other studies. All measured values were compatible with those of previous research (Tables 1–3).

Comparison of female and male fetuses, right and left sides, female fetus right and left sides, male fetus right and left sides, and right and left sides of different sexes revealed similar K values. No statistically significant difference was determined among any of these pairs ($P = 0.11$, $P = 0.83$, $P = 0.75$, $P = 0.79$, $P = 0.38$, and $P = 0.24$, respectively).

After emerging through the stylomastoid foramen, the main trunk of the facial nerve passes through the parotid gland, where it branches to form the parotid plexus. The most common branching pattern is a bifurcation of the trunk (17).

A study published in 1956 investigated 350 specimens and reported on the bifurcation of the main facial nerve trunk (18). Park and Lee examined 111 facial nerves and determined a pattern of trifurcation of the main facial nerve trunk in 4.4% of cases (19). Kopuz et al. investigated the facial nerve in the parotid gland in 50 specimens and reported a trifurcation of the main facial nerve trunk in 9 (18%) cases (20). Salame et al. identified 1 case of trifurcation out of 46 cases (4). Kwak et al. reported 4 cases (13.3%) of trifurcation of the facial nerve trunk (1). These studies all examined adult subjects. In 1999, Ekinci examined the facial nerves on 27 sides of 14 cadavers aged

0 to 5 and reported bifurcation in 22 cases and trifurcation in 5 (15).

We examined the facial nerve trunk by bilaterally dissecting the sides and investigated trunk bifurcation and trifurcation. We observed bifurcation in 26 out of 32 dissections (81.25%) and trifurcation in the other 6 (18.75%). In addition, in the trifurcation cases, the middle divisions originated from somewhere between the upper and lower divisions and connected in various patterns with the other 2 main divisions.

In conclusion, understanding the anatomy of the facial nerve trunk is essential for performing any surgical procedure in the region. We are firmly of the opinion that understanding the morphometric measurements of the facial nerve trunk will shed light on all kinds of surgical and clinical evaluation concerning the facial nerve and prevent injury of the facial nerve, especially in children.

The implications of a more detailed facial nerve anatomy are applicable to complex approaches to facial nerve surgery. Therefore, a detailed knowledge of all aspects of the anatomy of the facial nerve trunk is essential for careful dissection and preservation of the facial nerve.

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