An Anatomic Study of the Facial Nerve Trunk and Branching Pattern in an African Population

Francis Mutahi Thuku, BDS, MDS-OMFS1 Fawzia Butt, BDS, FDSRCS (ENG)E, FICD, MDS-OMFS2 Symon W. Guthua, MMEDSc, DOMS, FIAOMS, FCS, FICD1 Mark Chindia, BDS, MSc, FFDRCS1

1 Department of Oral and Maxillofacial Surgery, University of Nairobi, Nairobi, Kenya
2 Department of Human Anatomy, University of Nairobi College of Health Sciences, Nairobi, Kenya

Craniomaxillofac Trauma Reconstruction Open 2018;2:e31–e37.

Address for correspondence Fawzia Butt, BDS, FDSRCS (ENG)E, FICD, MDS-OMFS, Department of Human Anatomy, University of Nairobi College of Health Sciences, P.O Box 25361, Nairobi 00603, Kenya (e-mail: fawziamaxfax@gmail.com).

Abstract
There are known racial variations in the branching and furcation pattern and the length of the facial nerve (FN) trunk and hardly any studies from the black African population. Surgeries around the FN predispose it to trauma and warrant a detailed anatomy of its branching pattern. Using a descriptive cross-sectional study, a total of 40 FN (20 fresh cadavers) were dissected to record the pattern and length of the FN. The frequency of various patterns of FN using the Davis et al classification was as follows: type I: 10 (25%), type II: 9 (22.5%), type III: 7 (17.5%), type IV: 6 (15%), type V: 2 (5%), and type VI: 6 (15%). The nerve bifurcated in 32(80%) and trifurcated in 8(20%) of the cadavers. There was no statistical difference in the branching patterns (p = 0.509) and furcation types (p = 0.414) between the sides and gender. The length of the trunk of the FN measured from the stylomastoid foramen to the bifurcation point was 16.14(–/ + 3.28 mm). The results from this data established a variation in the anatomical branching pattern of the FN in a black Kenyan population.

Keywords
► facial nerve
► branching and furcation pattern
► length
► African population

The arborization of the extratemporal facial nerve (FN) typically begins within the substance of the parotid gland and ultimately branches off the main trunk as the cervical, marginal mandibular, buccal, zygomatic, and frontal (or temporal) nerve. It emerges from the stylomastoid foramen in the base of the skull and immediately branches off the main trunk to the auricular muscles, the posterior belly of the digastric, and the stylohyoid muscles. The nerve then courses ventrally, and at the posterior edge of the parotid gland it splits into the upper and lower divisions. Within the gland, there is further branching with multiple individual variations. The upper (temporofacial) division of the FN gives off the temporal, zygomatic, and buccal branches, whereas the lower (cervicofacial) division gives off the marginal mandibular and cervical branches.

Several studies have demonstrated variations in the branching patterns of the FN, bifurcation and trifurcation of the main trunk, reanastomosis, looping patterns, and morphometric variations in relation to surgical landmarks. Various classification systems of the FN have been used by different authors dating from 1945 by McCormack et al, Dargent and Duroux (1946), Davis et al (1946), Baker and Conley (1979), Katz and Catalano (1987), Kopuz et al (1994), Tsai et al (2002), and Kwak et al (2004) to mention a few. Racial differences have been noted regarding the branching in FN in some studies. Davis et al in 1946 dissected 350 cadaveric facial halves and categorized the branching pattern of the FN into six distinct types. The FN trunk typically gave rise to superior/upper (temporofacial) and inferior/lower (cervicofacial) divisions. They noted that the marginal mandibular and cervical branches of the FN were exclusively derived from the inferior division, whereas the buccal branch always received some contribution from the inferior division and either none or a variable contribution from the superior division. There is a difference in the frequencies of branching patterns of FN using the Davis et al classification in studies from different countries.

received
April 1, 2018
accepted after revision
June 11, 2018

License terms

Copyright © 2018 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA.
Tel: +1(212) 584-4662.
In addition to variations in studies from the same country in populations groups. Three studies from the USA among Caucasian done by Davis et al, Bernstein and Nelson, and Katz and Catalano and found type III to be most frequent. Among the Caucasians, the second most common was type IV according to Davis et al and type V according to Bernstein and Nelson, while, Katz and Catalano found type I to be the second frequent. Types V and VI were the least according to Davis et al and Bernstein and Nelson, respectively, and Katz and Catalano did not report any type VI and the type V was the least in occurrence in his study population. Similarly, studies from India and Pakistan, by Malik et al and Khaliq et al, had higher percentages of types I and III, while types V and VI were rare. Rana et al, from Pakistan, observed type IIs and IV to be the most common and type VI was the least in occurrence in his study population. The differences in the frequencies are probably due to population from various racial background which renders comparisons between different studies with populations complex.

Salame et al emphasized the importance of the length of the FN trunk, since a segment needs to be sufficiently long to permit anastomosis with the fewest possible manipulations and neither too tense nor too loose. The FN trunk being dissected and manipulated between the exit from the cranial base through the stylomastoid foramen and its furcation is a crucial stage in several craniofacial, otological, plastic, and bone surgery among others. Correct surgical approaches and identification of the FN trunk and its branches are critical in the avoidance of any iatrogenic injuries. Variant anatomy of the FN in different individuals and populations has been described in the literature, as well as racial differences, the aim of this study was to document the different anatomic variations with relation to the branching pattern and length of the FN trunk in a black African population in Kenya.

### Materials and Methods

This was a descriptive cross-sectional study design, conducted at the Kenyatta National Hospital mortuary. The hospital is the largest public referral hospital serving the whole country of an African population which is predominantly of the black racial background. It is also a teaching hospital in collaboration with the University of Nairobi. Ethical approval was obtained from the Kenyatta National Hospital/University of Nairobi Ethics and Research Committee (P112/03/2014). Informed consent was sought from the next of kin prior to the autopsy.

Convenient sampling of cadavers presented for postmortem in the mortuary was selected; they were all well preserved and refrigerated fresh with no tissue fixation or embalming. All cadavers that met the inclusion criteria were selected. Sample size was calculated using the following formula proposed by Varkevisser et al using variance and a sample size of 40 (20 cadavers) was calculated. The inclusion criteria were all well processed and preserved fresh adult cadavers. The exclusion criteria were any cadaver with facial malformations, pathologies, and traumatic injuries of the head and neck region in addition to those whose relatives did not consent.

Facial dissection of cadavers using a standard dissection kit was done during postmortem. The FN was exposed using a standard coronal incision during autopsy. These are incisions used for neck dissection and craniotomies to expose the skull and brain during autopsies. A mastoid to mastoid incision for craniotomy which joins the U-shaped cervical

### Table 1 Frequency and branching pattern (according to Davis et al classification) among different population

| AUTHOR         | Davis et al | Bernstein and Nelson | Katz and Catalano | Park and Lee | Myint et al | Weerapant et al | Thuku et al (current study) | Malik et al | Rana et al | Khaliq et al | Gataa and Faris |
|----------------|-------------|----------------------|-------------------|-------------|------------|----------------|-------------------------------|-------------|-----------|-------------|----------------|
| YEAR           | 1956        | 1984                 | 1987              | 1977        | 1991       | 2010          | 2015                          | 2016        | 2017      | 2017        | 2018           | 2016          |
| USA            | USA         | USA                  | Korea             | Malaysia    | Thailand   | Kenya          | India                         | India       | Pakistan  | Iraq        | USA            | USA           |
| Populations    | Caucasian   | Caucasian            | Caucasian         | Korean      | Malaysian  | Thai           | Africans (Blacks)              | Indian      | Indian    | Pakistani  | Arab           |               |
| Branch patterns|             |                      |                   |             |            |                |                               |             |           |             |                |
| I              | 13          | 9                    | 24                | 6.3         | 11.39      | 1              | 25                            | 40          | 9         | 34.2        | 16.2           |               |
| II             | 20          | 9                    | 14                | 13.5        | 15.19      | 10             | 22.5                          | 15          | 39        | 14.2        | 23.2           |               |
| III            | 28          | 25                   | 44                | 33.4        | 34.18      | 20             | 17.5                          | 25          | 20        | 25.7        | 30.2           |               |
| IV             | 24          | 19                   | 14                | 23.4        | 18.98      | 18             | 15                            | 10          | 25        | 11.4        | 18.6           |               |
| V              | 9           | 22                   | 3                 | 6.3         | 7.59       | 29             | 5                             | 5           | 6         | 8.5         | 4.6            |               |
| VI             | 6           | 16                   | 0                 | 17.1        | 12.67      | 21             | 15                            | 5           | 1         | 5.7         | 6.9            |               |
incision along the lateral aspect of the neck beginning from behind the ears and beyond the hairline to conceal the scar and avoid facial disfigurement was made. A flap was raised with an incision through the external auditory meatus with advancement anteriorly. The mastoid was identified and dissection proceeded to identify the FN using the surgical landmarks. The nerve was followed from its exit at the stylomastoid foramen to its furcation. The length of the FN trunk from the stylomastoid foramen to its furcation was measured using a caliper in millimeters. A superficial parotidectomy was done to expose its branches up to the anterior border of the masseter. Branching patterns were recorded in terms of the number of branches from the main trunk and final divisions pattern based on the classification by Davis et al. Identification of fine microscopic branches and their anastomosis was quite challenging. To assess intraobserver variability, every fifth specimen was measured twice and repeat measurement was done by the resident pathologist conducting the autopsies as well as the second co-author (F.M.B.). Meticulous closure of the incisions was done. Data was coded and analyzed using the SPSS version 18.0 software (IBM Inc.). Descriptive analysis was done and presented using frequency diagrams, tables, and figures. Statistical tests (Students t-test, Wilcoxon signed-rank, and Mann-Whitney U test) were done to determine if the difference was significant between males and females, right and left FNs. Differences between dependent and independent variables were analyzed using the Spearman rank order correlation and Pearson’s product moment correlation. The significance level was set at \( p < 0.05 \).

Results

Twenty fresh cadavers were dissected (40 FNs) among which 12 (60%) were male and 8 (40%) were females (M:F = 3:2). All the various patterns according to Davis et al. were present in the study population\(^5\) (\(\text{Fig. 1A-D}\)). The frequency of the pattern was type I (25%), type II (22.5%), type III (17.5%), type IV and VI (15%), and type V (5%). Eleven (55%) of the cadavers had similar branching patterns between the right and the left sides, while 9 (45%) had dissimilar patterns. Comparison of the branching pattern was done between the genders and Kruskal–Wallis H test showed that there was a no statistically significant difference in the branching patterns between the genders (\(\chi^2(1) = 1.127, p = 0.288\)). Type I had no anastomosis between the branches, while type VI had the most intricate pattern with anastomosis among all the branches except the cervical. On comparison between the branching patterns on the right with the left sides, a Wilcoxon signed-rank test did not elicit any statistically significant change between the left- and right-side branching pattern (\(Z = -0.660, p = 0.509\)); however, the Spearman’s rank-order correlation showed a positive correlation between the left- and right-side branching pattern which was statistically significant (\(r_s = 0.643, p = 0.002\)).

The FN trunk was found to branch into two (bifurcation) in 32 (80%) of the cases and three (trifurcation) in 8 (20%) of the cases. No case of quadrifurcation was noted in this study. In males, 19 (79%) of the FNs bifurcated, while 5 (20.8%) trifurcated (\(n = 24\)). In females, 13 (81.25%) FNs bifurcated, while 3 (18.75%) trifurcated (\(n = 16\)). One case of a minor trunk emerging from the stylomastoid foramen was observed which anastomosed with the temporal branch of the FN. (\(\text{Fig. 2}\)).

Fourteen 14(70%) cadavers had similar furcation type of the trunk between the right and left sides, while 6 (30%) had different types. A Spearman’s rank-order correlation was used to determine the relationship between the left-side bifurcation of the main trunk and the right-side bifurcation of the main trunk. There was a positive correlation between the left- and right-side bifurcation of the main trunk which was not statistically significant (\(r_s = 0.081, p = 0.735\)). The Pearson correlation test between the left- and right-side variables showed that there was a positive correlation which was statistically significant in the length of the trunk (\(p = 0.414\)). The Wilcoxon signed-rank test found no statistical significance between the left- and right-side bifurcation of the main trunk (\(Z = 0.816, p = 0.414\)) (\(\text{Table 2}\)).

The mean lengths of the trunk were closely related between the two sides with a mean on the right of having been 16.15 mm compared with 16.13 mm on the left side. Independent samples t-test was used to analyze the difference of the various measurements across the genders. The results showed no statistically significant differences in the length of the trunk and between the genders.

Discussion

Branching Patterns

Earlier studies by Davis et al in 1946 showed the highest frequency of mainly the type III (28%) pattern which is similar to other studies done in Caucasians, Arabs, Malaysians, and Koreans.\(^5,7,9,16,22,23\) Our study found type I (25%) as the most frequent type documented by other studies done in India and Pakistan.\(^17,18\) In other reports from Thailand and India, types II and V were the highest, respectively.\(^19,24\) Type I, the classical textbook pattern, was found to have been one of the least common patterns, which was not the case in this population.\(^23\) The second most frequent in our population was type II (22.5%), like in Iraqi study.\(^22\) Other studies from USA, Korea, Malaysia, and India had types I, IV, and V as the second common.\(^5,7,9,16–18\) The third in place were types II, III, IV, and VI as was the observation in our population.\(^5,7,9,12,16–18,23,24\) The branching pattern types VI, I, II, and V were the least frequent among Caucasians Indians, Pakistanii, Thai, Koreans, Malaysians, and Arab similar to our study.\(^5,7,9,17,19,22,24\) Types IV and VI occurred at the same frequency (15%) with the least being type V (5%) (\(\text{Table 1}\)). Most studies did not find a significant difference between the right and left branching pattern of the FN. Type V, although showing extensive anastomosis in the upper part of the face, has no additional contribution to the mandibular branch. Thus, surgeons should take precaution in surgery of the mandibular region. Type VI has the most complicated pattern with anastomosis between every branch, except the cervical one. This complex anastomatic pattern would lead to less...
incidences of facial paralysis in case of iatrogenic injury to any of the branches; however, this being not a frequent pattern in our cadavers, caution is, therefore, exercised during parotid surgery when exposing the FN. Very few studies have attempted to compare the incidence of FN paralysis following damage to the branches and branching types. Temporal and mandibular branches of the FN are most prone to injury because they rarely have any anastomosis with other branches of the nerve. Racial differences have been demonstrated in frequencies of various types between Asians and Caucasians. Bilateral comparison for the FN branching pattern did not elicit any significant difference between the right and left sides.

Racial differences have been noted in some studies. In a Korean population, the results indicated that the communicating branches between the buccal and marginal
mandibular branches occurred more frequently in Koreans than Caucasians. In addition, Wang et al reported a 60% prevalence of these communicating branches in the Chinese, while Niccoli and Varandas reported 9% prevalence in Spanish cases. Myint et al in a Malaysian study found no significant difference in the percentage of each type between the Malaysian population and that of the Koreans, though some differences with Caucasians were noted in three uncommon types. When compared with the studies done in different races, the present study from a black African population shows that types I and II were the most frequent pattern while, Caucasian and Asian studies reported a higher frequency of type III. And type V was the least common similar to as reported by others. Kopuz et al in a study in a Turkish population also suggested that race may be an important factor in the branching of the nerve. Previous studies had not attempted to correlate the bilateral configuration. This could be of surgical relevance in case of bilateral surgical procedures to predict the opposite side configurations. However, on furcation types, there was positive correlation which was not statistically significant ($r_s = 0.081, p = 0.735$). In an attempt to demonstrate the significance of these differences, an Iranian study suggested that variability in the branching patterns of the nerve creates variability in facial animation, both between patients and ethnic groups and between the sides of the face.

**Table 2** Distribution of branching patterns (Davis et al) by side

| Branching pattern | Right | Left |
|-------------------|-------|------|
| I                 | 5     | 5    |
| II                | 4     | 5    |
| III               | 3     | 4    |
| IV                | 4     | 2    |
| V                 | 1     | 1    |
| VI                | 3     | 3    |

**Facial Trunk Bifurcation**

Several authors have reported the possibilities of trifurcation, quadrifurcation, or even a plexiform branching pattern of the FN trunk, and type III.9,15,20,28 Most of these studies have been done on adult cadavers. Reports from Davis et al, Park and Lee, Katz and Catalano, Kopuz et al, Ekinci, Salame et al, Tsai et al, Kwak et al, and Rana et al 2012 from various racial groups including Caucasians, Koreans, Malaysians, Turkish, Thai, and Indians reported percentage of bifurcation ranging from 100 to 81.3%, similar to our finding of FN trunk bifurcation at 80%.2,5,7,9,15,19,20,30 Trifurcation in the present study was observed in 20% of the population like other studies from Turkey reporting trifurcation of 18.6, 18.8, and 18%, respectively.6,31,32 Khaliq et al in another study from Indian reported single trunk of FN in 95 and 8.57% of bifurcation, while Rana et al reported single trunk (2%) and trifurcation (3%).18,19 With regard to furcation of the main trunk, 14 were similar, while 6 were not. There was no significant difference between the left- and right-side furcation types. The results from this study tally with Kopuz et al and Kalaycioğlu et al on bilateral configurations.6,31

**Table 3** Wilcoxon signed rank test for branching patterns (Davis et al classification I to VI and bifurcation of the main trunk

| Side                     | Left  | Right | −Ranks | +Ranks | Ties | Z    | p     |
|--------------------------|-------|-------|--------|--------|------|------|-------|
| Davis branching pattern  | 2.80  | 1.82  | 3.0    | 1.81   | 6    | 3    | −0.660| 0.509 |
| Bifurcation of main trunk| 2.15  | .37   | 2.25   | .44    | 2    | 4    | −0.816| 0.414 |

Abbreviation: SD, standard deviation.
There are very few studies showing significant racial differences in FN trunk length. The length of the FN trunk in this population was found to have been 16.15 (± 3.28) mm and there was no statistical difference between the right and left sides. Different authors have found varied lengths of the FN reported ranging from the shortest (13 mm) reported by Dargent and Duroux in 1946 (Switzerland) and Kwak et al in 2004 (Korea) to the longest (21 mm) reported by Holt in 1996 (USA). The average length from the literature reviewed was 15.34 mm (see Table 5). There were no statistical differences between the genders in keeping with previous studies.

The longer length of the trunk probably makes it more suitable for anastomosis during nerve grafting.

**Limitations**

As parts of the FN trunk formed curves, the caliper measurements may not be absolutely accurate; in addition, using a larger size probably provides better extrapolation of parameters to the African population.

**Conflict of Interest**

None.

**References**

1. Moore K, Dalley AF, Agur A. Clinically Oriented Anatomy. 6th ed. Baltimore, MD: Lippincott Williams and Wilkins; 2010:945–947
2. Kwak HH, Park HD, Youn KH, et al. Branching patterns of the facial nerve and its communication with the auriculotemporal nerve. Surg Radiol Anat 2004;26(06):494–500
3. Rodriguez GM, Valdés IL, Sibat F. Facial nerve: anatomical revision. Internet J Neurol 2009;27:183–186
4. Solares CA, Chan J, Koltai PJ. Anatomical variations of the facial nerve in first branchial cleft anomalies. Arch Otolaryngol Head Neck Surg 2003;129(03):351–355
5. Davis RA, Anson BJ, Budinger JM, Kurth LR. Surgical anatomy of the facial nerve and parotid gland based upon a study of 350 cervicofacial halves. Surg Gynecol Obstet 1956;102(04):385–412

---

**Table 4** The percentage of bifurcation and trifurcation FN trunk by various studies

| Author               | Racial Group | Single % | Bifurcation % | Trifurcation % |
|----------------------|--------------|----------|---------------|----------------|
| Davis et al, 1956    | Caucasians   | 100      | –             | –              |
| Park and Lee, 1976   | Korean       | 95.6     | 4.4           | –              |
| Katz and Catalano, 1987 | Caucasian | 100      | –             | –              |
| Myint et al, 1991    | Malaysian    | 96.2     | 3.8           | –              |
| Kopuz et al, 1994    | Turkey       | 82       | 18            | –              |
| Ekinci, 1999         | Turkey       | 81.4     | 18.6          | –              |
| Salame et al, 2002   | Korea        | 97.8     | 2.2           | –              |
| Tsai et al, 2002     | Thailand     | 100      | –             | –              |
| Kwak et al, 2004     | Korea        | 86.7     | 13.3          | –              |
| Kalaycioglu et al, 2013 | Turkey  | 81.3     | 18.8          | –              |
| Thuku et al, 2015    | Kenya        | 80       | 20            | –              |
| Rana et al, 2017     | Indian       | 2        | 95            | 3              |
| Khaliq et al, 2016   | Indian       | 91.4     | 8.57          | –              |

**Abbreviation:** FN, facial nerve.

**Table 5** Length of the FN trunk in different studies

| Author               | Country | Length (mm) |
|----------------------|---------|-------------|
| Dargent and Duroux, 1946 | Switzerland | 13         |
| Holt, 1996           | USA     | 21          |
| Salame et al, 2002   | Israel  | 16.44       |
| Cannon et al, 2004   | USA     | 9.38        |
| Kwak et al, 2004     | Korea   | 13          |
| Pather and Osman, 2006 | Korea  | 14          |
| Nishanthi et al, 2006 | India   | 18.51       |
| Thuku et al, 2015    | Kenya   | 16.15       |
| Malik et al, 2016    | India   | 16.45       |
| **Average**          |         | **15.34**   |

**Abbreviation:** FN, facial nerve.
6 Kopuz C, Turgut S, Yavuz S, Ilgi S. Distribution of facial nerve in parotid gland: analysis of 50 cases. Okajimas Folia Anat Jpn 1994; 70(06):295–299
7 Park Y, Lee ME. A morphological study of the parotid gland and the peripheral branches of the facial nerve in Koreans. Yonsei Med J 1977;18(01):45–51
8 Hwang K, Cho HJ, Chung IH. Pattern of the temporal branch of the facial nerve in the upper orbicularis oculi muscle. J Craniofac Surg 2004;15(03):373–376
9 Katz AD, Catalano P. The clinical significance of the various anastomotic branches of the facial nerve. Report of 100 patients. Arch Otolaryngol Head Neck Surg 1987;113(09):959–962
10 Pather N, Osman M. Landmarks of the facial nerve: implications for parotidectomy. Surg Radiol Anat 2006;28(02):170–175
11 Upile T, Jerjes W, Nouraei SA, et al. The stylomastoid artery as an anatomical landmark to the facial nerve during parotid surgery: a clinico-anatomic study. World J Surg Oncol 2009;7:71
12 McCormack LJ, Cauldwell EW, Anson BJ. The surgical anatomy of the facial nerve with special reference to the parotid gland. Surg Gynecol Obstet 1945;80:523–524
13 Dargent M, Duroux PE. Gives anatomical about morphology and some reports of intraparotid facial nerve. Press Med 1946;37:523–524
14 Baker DC, Conley J. Avoiding facial nerve injuries in rhytidectomy. Anatomical variations and pitfalls. Plast Reconstr Surg 1979;64 (06):781–795
15 Tsai SC, Hsu HT. Parotid neoplasms: diagnosis, treatment, and intraparotid facial nerve anatomy. J Laryngol Otol 2002;116(05):359–362
16 Bernstein L, Nelson RH. Surgical anatomy of the extraparotid distribution of the facial nerve. Arch Otolaryngol 1984;110(03):177–183
17 Malik NU, Verma D, Varshney S, Shareef M, Shweta Gupta S. Facial nerve branching pattern as seen in parotidectomy in Indian population- a single center experience. Eur J Pharm Med Res 2016;3(03):359–361
18 Khaliq BA, Nisar J, Yousuf A, Maqbool T, Ahmed R. Facial nerve branching pattern as seen in parotidectomy in Kashmiri population: our experience. Int J Otorhinolaryngol Head Neck Surg 2017; 3(01):95–97
19 Rana S, Akhtar UB, Atif S, Javaid Z. Terminal branching pattern of facial nerve seen in adult cadavers: an anatomical study. APMC 2017;11(04):31–315
20 Salame K, Ouaknine GE, Arensburg B, Rockkind S. Microsurgical anatomy of the facial nerve trunk. Clin Anat 2002;15(02):93–99
21 Varkevisser CM, Pathmanathan I, Brownlee A. Designing and conducting health system research. IDRc WHO 2003;3:214
22 Gataa IS, Faris BJ. Patterns and surgical significance of facial nerve branching within the parotid gland in 43 cases. Oral Maxillofac Surg 2016;20(02):161–165
23 Myint K, Azian AL, Khairul FA. The clinical significance of the branching pattern of the facial nerve in Malaysian subjects. Med J Malaysia 1992;47(02):114–121
24 Weerapant E, Bunaprasert T, Chokrungvaranont P, Chentanez V. Anatomy of the facial nerve branching patterns, the marginal mandibular branch and its extraparotid ramification in relation to the lateral palpebral line. Asian Biomed 2010;4(04):603–608
25 Wong DS. Surface landmarks of the facial nerve trunk: a prospective measurement study. ANZ J Surg 2001;71(12):753–765
26 Wang TM, Lin CL, Kuo KJ, Shih C. Surgical anatomy of the mandibular ramus of the facial nerve in Chinese adults. Acta Anat (Basel) 1991;142(02):126–131
27 Niccoli Filho W, Varandas JT. Surgical anatomy of the facial nerve and the parotid gland. Rev Odontol Univ Sao Paulo 1988;2(01):48–50
28 Holt JJ. The stylomastoid area: anatomic-histologic study and surgical approach. Laryngoscope 1996;106(04):396–400
29 Standring S, Bolrey NR, Collins P, Crossman AR, Gatzoulis MA, Healy JC. Grays Anatomy; The Anatomical Basis of Clinical Practice. 40th ed. Philadelphia, PA: Churchill Livingstone Elsevier; 2008:561–562
30 Ekinci N. A study on the branching pattern of the facial nerve of children. Kaibogaku Zasshi 1999;74(04):447–450
31 Kalaycioglu A, Yeginoglu G, Ertemozuoglu Oksu C, Uzun Ö, Kalkışım ŞN. An anatomical study on the facial nerve trunk in fetus cadavers. Turk J Med Sci 2014;44(03):484–489
32 Shakuntala R, Gangadhara R, Manivannam K, Krishna HR. Identifying patterns of facial nerve branches with review of literature. J Evol Med Dent Sci 2014;3:4731–4735
33 Nishanthi TH, Hewapathirana IS, Nanayakkara CD. Surgical anatomy of the facial nerve trunk. Asian J Oral Maxillofac Surg 2006; 18:259–262
34 Cannon CR, Replogle WH, Schenk MP. Facial nerve in parotidectomy: a topographical analysis. Laryngoscope 2004;114(11): 2034–2037