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Tracing the Course of the Cervical Branch of the Facial Nerve

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Abstract

Backgorund: Concern has been raised that some facial palsy may be due to damage to branches of the cervicofacial nerve during routine operations. This study examines the anatomy of the cervicofacial nerve in relation to readily identifiable mandibular landmarks in order to provide a safer operative outcome.

Materials and Methods: Eleven fresh, adult cadaver hemi-neck dissections were performed under loupe magnification, identifying the perimandibular branch of the cervicofacial nerve. The distances between the gonion and the antegonial notch, and the antegonial notch and the pgonion were measured. Measurements were then taken of the cervical branch's distance below the mandible at 25%, 50%, 75%, and 100% of the distances between these points.

Results: The average gonion to antegonial notch distance was 3.1 cm. The branch's distance below the mandible at 25%, 50%, 75%, and 100% of the distance from the gonion to the ante-gonial notch was 1.1 cm, 1.3 cm, 1.6 cm and 1.8 cm, respectively. The average distance from antegonial notch to pogonion was 7.8 cm. The branch's distance below the mandible at 25%, 50%, and 75% of that distance was 2 cm, 2.2 cm, and 2.2 cm, respectively. The cervical nerve could not be reliably dissected anterior to 75% of this distance.

Conclusion: The peri-mandibular branch of the cervical branch of the facial nerver a progressively caudal course from the gonion to the pogonion, within 2.5 cm below the mandible. The course of the cervical branch, and it's fine arborizations became imperceptible under loupe magnification as it approached the pogonion.

Keywords: *Facial nerve; Cervical branch; Mandibular anatomy; Rhytidectomy; Cervicoplasty; Aesthetic surgery.*

Introduction

Interest in aesthetic procedures which a rejuvenate appearance has been well documented. In this capacity, few parts of the body receive as much attention as the face. Aesthetic surgeons perform a wide range of dissection planes from subcutaneous facelifts to the deeper superficial muscle aponeurotic system (SMAS) in the lower face [1-4]. In 2016, there were more than 131, 000 rhytidectomies done in the US alone, making it one of the top five cosmetic surgical procedures performed [5]. This statistic does not account for other surgical procedures that involve this region of the body, including: neck dissections for oncologic purposes, hyperkinetic platysmal motility disorders, and cervical motor branch transfers for brachial plexus injuries [6, 7].

However, previous cadaveric anatomical studies with modified Sihler staining have demonstrated that in some patients, co-innervation of the depressor angulioris muscle (DAO) by the cervical and mandibular branches exists. This may be a plausible explanation for lower lip deformities following facial surgeries [8]. Furthermore, platysmal contributions to lower lip depression have been demonstrated in electromyographical studies in 1964 by de Sousa [14]. Ellenbogen was the first to suggest in 1979 that damage to the cervical branch of the facial nerve causes a pseudo-paralysis, mimicking true paralysis of the marginal mandibular branch of the facial nerve [15]. While there have been a handful of studies [9, 10] attempting to delineate the course of the cervical branch of the facial nerve, the purpose of this study is to provide the surgeon with readily identifiable, superficial anatomical landmarks with readily available tools, which may accu- rately predict its course, offering a safer operative outcome.

Materials and Methods

A total of 11 hemi-neck dissections were performed on decapitated, cadaveric heads under loupe magnification (3.5x) at the Yale University School of Medicine anatomy lab. Fresh cadaveric heads were secured and positioned on a table using block supports to the side, to facilitate dissection. A pre-auricular incision was made at the level of the zygomatic arch and extended poster inferiorly to the anterior border of the mastoid process, then caudally for approximately 7 centimeters. A skin only flap was elevated utilizing a combination of blunt and sharp dissection in a plane superficial to the platysma from the mastoid to the pogonion. The facial nerve was then identified exiting the mastoid process and the branches of the facial nerve were identified, including the marginal mandibular and cervical branches.

Loupe magnification was used to dissect out only the course of the peri-mandibular branch of the cervical nerve to its termination [Figure 1]. It was dissected from its division from the main trunk of the facial nerve to its fine terminal branches. A simple ruler was used to measure the distance between the gonion and the ante-gonial notch, then the distance between the ante-gonial notch and the pogonion.

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Measurements were recorded with a ruler from the cervical branch's distance inferior to the gonion, and from the branch's distance inferior to the border of the mandible at 25%, 50%, 75%, and 100% of the distance between the gonion and ante-gonial notch. Afterwards, the branch's distance from the inferior border of the mandible at 25%, 50%, 75%, and 100% of the distance between the ante-gonial notch and the pogonion was recorded [Figure 2]. All measurements were repeated three times.

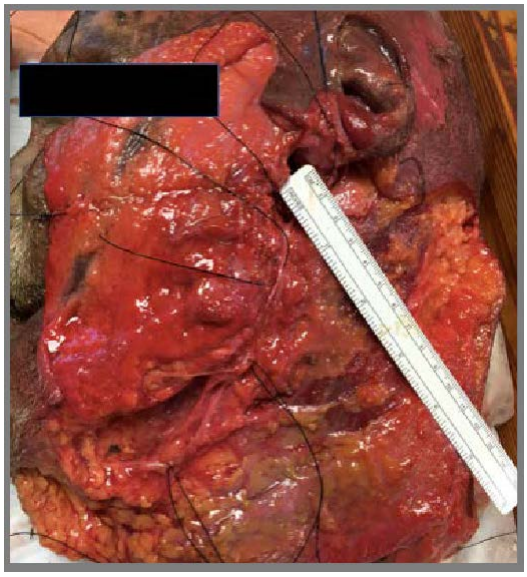

Figure 1: Lines of measurements used in the study

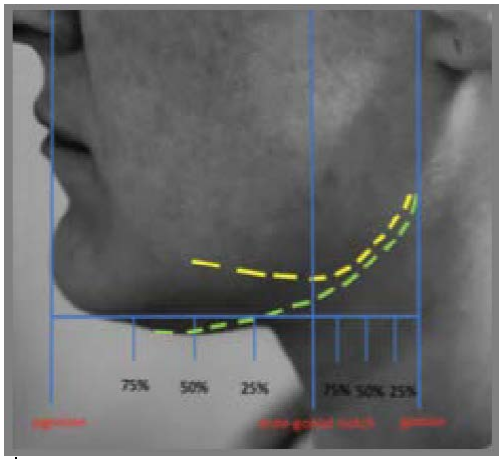

Figure 1: Lines of measurements used in the study.

Results

The peri-mandibular branch of the cervical nerve passed posterior to the angle of the mandible, running a progressively inferior course from the gonion to the pogonion, terminating into fine terminal branches that were unable to be dissected even with loupe magnification. As described in previous studies [10], we found the nerve to run deep to the platysma but superficial to the investing layer of the deep cervical fascia.

The average gonion to ante-gonial notch distance was 3.1 cm. The average distance of the cervical branch below the gonion was 0.2 cm. The branch's distance from the inferior border of the mandible at 25%, 50%, 75%, and 100% of the distance between the gonion and ante-gonial notch was 1.1 cm, 1.3 cm, 1.6 cm, and 1.8 cm, respectively. The average distance from ante-gonial notch to pogonion was 7.8 cm. The branch's distance from the inferior border of the mandible at 25%, 50%, and 75% of the distance between the ante-gonial notch and the pogonion was 2 cm, 2.2 cm, and 2.2 cm, respectively. The cervical branch of the facial nerve could not be reliably dissected past 75% of the distance to the pogonion, as the cervical branch terminated into fine plexuses [Table 1].

Discussion

Definition of the anatomic positioning of the facial nerve and its branches presents a challenge for the surgeon. The course of the major branches of the facial nerve are well-described, aiding safe dissection in most aesthetic and maxillofacial operations. However, the anatomical course of the cervical branch, particularly in its relation to the mandible, is less completely described. As evolving understanding continues to delineate normal lip and plastysmal functioning, surgeons require a detailed description of its location. Our study elucidates the course of the cervical the cervical branch in relation to clinically relevant mandibular anatomy. We describe easy to find, superficial cephalometric landmarks by which a surgeon in the operating room could readily identify prior to making incisions below the mandible.

In our study, we found the peri-mandibular branch the cervical nerve to run along the posterior surface of the platysma, but superficial to the investing layer of the deep cervical fascia. The nerve consistently ran posterior to the gonion, before taking a progressively caudal angulation inferior to the border of the mandible. The nerve then arborizes into its terminal branches approximately 75% of the distance between the ante-gonial notch and the pgonion. Anterior to this point could not be dissected reliably under loupe magnification.

Table 1: Cervical Branch Anatomical Measurements – all measurements in centimeters.

Cadaveric Hemi-Neck Dissection												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Average (in cm)**
Gonion to Ante-Gonial Notch Distance (in cm)	3	4	3	2.5	3.5	3	2.6	2	4	3.5	3	**3.1**
Gonion	0.5	0	0	0	0.5	0.4	0.2	0	0	0.3	0.5	**0.2**
25%	1.2	1.5	0.1	0.5	1.5	1.1	1.2	0.6	2	1.4	1	**1.1**
50%	1	2	0.1	1	2	1	1.5	1	1.7	1.5	1.2	**1.3**
75%	1.5	2.5	0.1	1.4	3	1.4	1.6	1.5	1.6	1.7	1.5	**1.6**
(Ante-gonial notch) 100%	1.8	1.5	0.2	1.8	3	2	2	2	1	2.1	2	**1.8**
Ante-Gonial Notch to Pgonion Distance (in cm)	8	7.5	8	7.5	7	8	7.5	8	8	8	8	**7.8**
25%	1.9	2	0.2	2	4	1.8	2	2.5	1.7	2.1	2	**2.0**
50%	1.9	3.5	0.2	1.5	3.5	1.8	2.5	2.7	2	2	2.3	**2.2**
75%	2	4	0.2	1	3	2.1	3	N/A	N/A	2.4	2.7	**2.2**
(Pgonion) 100%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**N/A**

Limitations to this study are as follows; this study was limited by sex bias. All of the heads that were dissected were male. Female anatomy could differ when compared to male counterparts. However, these authors postulate that it would likely not yield significantly different measurements. Furthermore, there were decapitated cadaveric heads. It is also possible that this distortion of the anatomy could cause retraction of neck tissue, which would alter the accuracy of our measurements, when compared in vivo. However, our results are consistent with other descriptive anatomic studies of the course of the cervical branch of the facial nerve [11,15]. Another limitation of the study was that the fine plexuses of the peri-mandibular branch could not be teased out reliably under loupe magnification. It is unclear if these branches contributed to depressor angulior is function, however, prior histologic studies suggest this is indeed probable [15]. This study is limited to the peri-mandibular branch of the cervical branch of the facial nerve, described as the branch which runs directly inferior to the mandible. There are often other branches of the cervical nerve that track caudally that were not dissected in this study. These branches may also have relevance in other surgical procedures, like thyroid surgery. Lastly, measurements were made by these authors, and while repeated individually to minimize intra-rater error, inter-rater error was not addressed formally in this study.

Damage to the cervical branch of the facial has been shown to result in lower lip dysfunction, which may result in deformity and dysfunction. Clinically, our study aimed to provide the surgeon with clinically relevant, readily identifiable landmarks with which to guide surgical incisions around the mandible. All these relationships can be assessed intraoperatively in a timely fashion using a simple ruler at the time of surgery and palpation of the gonion, ante-gonial notch and the pgonion. Submandibular incisions designed within 2 cm of the inferior border of the mandible, and deep to the platysma, should be done so with extreme caution. While a safer dissection could take place greater than2.5 cm distance inferior to the mandible border, the great variation in anatomic location of the cervical nerve and its branches portends the possibility of injury even outside this zone, even as much as 3.5 cm in one dissection. Incisions anterior to 75% of the distance between the ante-gonial notch and the pgonion should also be done with caution, as iatrogenic injury to one of these fine branches could result in lower lip dysfunction. Fine branches of this nerve do arc towards the marginal mandibular nerve, suggesting anastomoses that may be important for achieving both a normal lower lip appearance and preservation of function.

Conclusion

The cervical branch of the facial nerve is often given less consideration during craniofacial or aesthetic surgeries, relative to its counterparts. This is because of the perception that the cervical branch is less important to facial musculature function, as well as a consensus that the nerve is out of harm's way. However, previous histologic studies have demonstrated the cervical branches potential for contributions to lower lip competency in some patients. Our anatomical study demonstrates that the nerve more frequently runs within 2.5 cm to the inferior border of the mandible, however surgical approaches even within a few centimeters of the inferior border of the mandible should be done so with judicious dissection to avoid a potential nerve injury to their patient.

Declaration

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No products, devices, or drugs were used in this article.

Authorship Role/Participation

John A Persing

- ☒ I participated in designing the study.
- ☒ I participated in generating the data for the study.
- ☒ I participated in gathering the data for the study.
- ☒ I participated in the analysis of the data.
- ☒ I wrote the majority of the original draft of the paper.
- ☒ I participated in writing the paper.
- ☒ I have had access to all the raw data of the study.
- ☒ I have reviewed the pertinent raw data on which the results/ conclusions are based.
- ☒ I have approved the final version of this paper.
- ☐ I have performed the statistical analysis of the data.

Scott Persing

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- ☒ I participated in generating the data for the study.
- ☒ I participated in gathering the data for the study.
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