

Anatomic Confirmation of the Motor Fibers in the Cervical Nerves Innervating to the Trapezius Muscle

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Abstract : This study aimed to confirm the presence of motor fibers in the cervical nerves distributing to the trapezius muscle.

Thirteen cases were examined. Motor fibers were present in C3 in 7 of 9 cases (77.8%) and were absent in 2 of 9 cases (22.3%); the other 4 cases were damaged during dissection. C4 exhibited motor fibers in 9 of 10 cases (90.0%), whereas motor fibers were absent in 1 of 10 cases (10.0%); and 3 cases were damaged.

The motor fibers in C3 were of medium size (57.1%; 4/7 cases), whereas those in C4 were large (44.4%; 4/9 cases). The average number of motor fibers in C3 and C4 were 114 ± 112 and 219 ± 167 , respectively.

These results show that C4 is more important in terms of the frequency and size of the cervical motor fibers distributing to the trapezius muscle.

Keywords : Motor fiber, Cervical nerve, Trapezius muscle

Introduction

The trapezius muscle receives dual innervations from the spinal accessory nerve and cervical nerves (C3, C4). The spinal accessory nerve conveys motor components, and the cervical nerves convey sensory components (Soo et al. 1993, Moore and Dalley 2006). However, the cervical nerves innervating the trapezius muscle have been shown to contain a few motor fibers by electrophysiological testing and immunohistochemical studies (Fahrer et al. 1974, Standring 2005, Pu et al. 2008, Tubbs et al. 2011).

This study aimed to confirm the presence of motor fibers in the cervical nerves distributing to the trapezius muscle using a nerve fiber separation method.

Materials and Methods

Thirteen Korean adults (male: 7, female: 6) were examined in this study. Of the 13 cases, 12 were bilateral (6 cadavers) and 1 was unilateral. The trapezius muscle, the distributing cervical nerves, and the spinal cord were detached *en bloc*. The detached specimens were immersed in guanidine-HCl (0.2 M) for 2 weeks and then treated several times with an ultrasonic cleaner to soften the connective tissue around the nerve bundles. Then, the specimens were carefully dissected under a surgical microscope at a magnification of $12.5 \times$ (Carl Zeiss OPMI-FC). Retrotracing of the nerve bundle was performed up to the root portion of the spinal cord. If some fibers of the cervical nerves were connected to the anterior root (motor root) of the spinal cord, it was estimated that the motor components were present. Each component was processed with osmium tetroxide and stained with hematoxylin and eosin (H & E) in order to count the nerve fibers. Imbroglia Modometer version 2.0 software was used to count the nerve fibers.

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Results

The cervical nerves C3 and C4 supply to the trapezius muscle (Fig. 1). Motor fibers were detected in C3 in 77.8% cases (7/9), and were absent in 22.3% cases (2/9); 4 cases were damaged during dissection. C4 had motor fibers in

90.0% cases (9/10), whereas motor fibers were absent in 10.0% cases (1/10); 3 cases were damaged. The C3 motor fibers were of medium size (57.1%; 4/7 cases). On the other hand, the C4 motor fibers were large in most cases (44.4%;

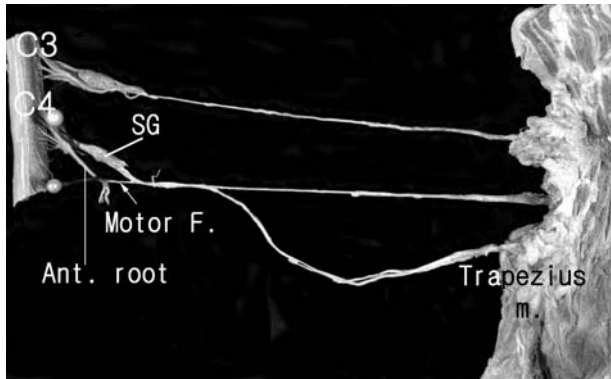


Fig. 1. Trapezius muscle received the C3 and C4. C4 contained the motor fibers that are seen as a large amount. Arrow indicates the motor fibers in cervical nerve. SG: spinal ganglion.

Table 1. The size of the motor fibers in the cervical nerves innervating to the trapezius muscle

No. Cases	C3	C4
1 F, R L	Medium Medium	Medium Damaged
2 M, R L	Absent Damaged	Large Large
3 M, R L	Damaged Small	Small Damaged
4 M, R L	Damaged Absent	Large Medium
5 F, R L	Medium Small	Small Absent
6 F, R L	Small Medium	Large Damaged
7 M, R	Damaged	Small
Total cases	9	10

C3, third cervical nerve; C4, fourth cervical nerve; F, female; M, male; R, right; L, left

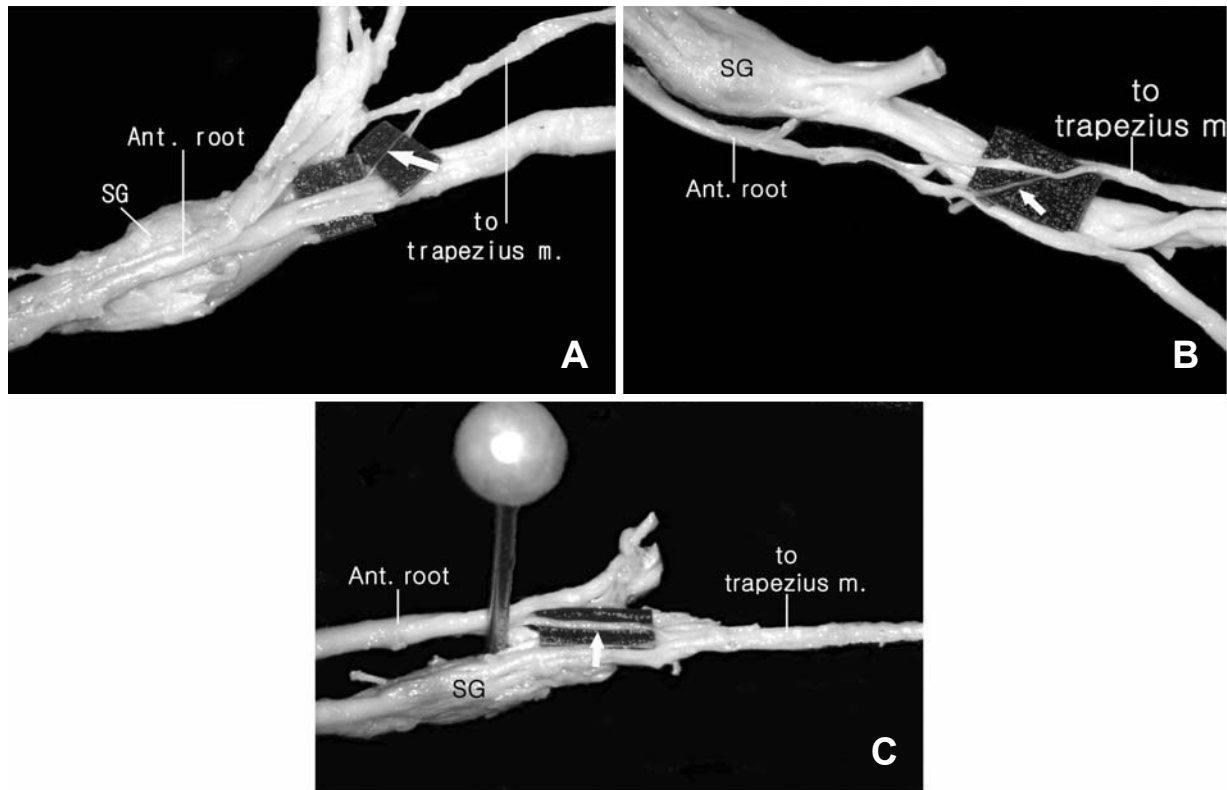


Fig. 2. The quantities of motor fibers varied with a small (A), medium (B) and large (C) amount. Arrows indicate the motor fibers in cervical nerve. SG: spinal ganglion.

4/9 cases) and situated deeper within the nerve bundle. The average number of motor fibers in C3 and C4 were 114 ± 112 and 219 ± 167 , respectively (Fig. 2) (Table 1).

These results show that C4 is more important in terms of the frequency and size of cervical motor fibers distributing to the trapezius muscle.

Discussion

Until recently, the presence of motor fibers in the cervical nerves innervating the trapezius muscle has been confirmed using electrophysiological and immunohistochemical studies. However, the use of a nerve fiber tracing method, which separates the nerve bundle, makes anatomic approach possible. The anatomic approach has a limitation in that it is impossible to find the distributing area of the cervical motor fibers within the trapezius muscle because the number of nerve fibers is small.

The cervical innervations of the trapezius muscle by the electroneurographic study was reported of 5.9% in C2, 88.2% in C3 and 55.9% in C4 (Pu et al. 2008). Tubbs et al. (2011) referred C2, C3 and C4 innervation in 10%, C2 and C3 innervation in 6.7%, C3 and C4 innervation in 83.3% by the immunohistochemical study. In present study, the motor fiber within the cervical innervations to the trapezius muscle was 77.8% in C3, 90.0% in C4. Unlike the previous studies (Weisberger 1987, Nori 1997), the distribution of C2 to the trapezius muscle was not observed in this study. The frequency and size of the motor fibers in C4 were higher and larger than in C3, suggesting that C4 may be more important for cervical motor distribution. Furthermore, the C4 motor fibers were located deeper within the bundle in all cases.

There is no standardized data describing the quantity of

the nerve fibers that can be detected by electrophysiological testing. However, if the quantities of nerve fiber are fewer, it may be hard to detect by electrophysiological and/or electroneurographic testing.

The present results may be helpful for a surgeon dealing with the head and neck surgery.

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등세모근에 분포하는 목신경에서 운동성분 확인

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간추림 : 등세모근에 분포하는 운동신경성분을 확인하기 위하여 목신경에서 등세모근으로 가는 신경성분을 조사하였다.

한국성인 시신 팔신경얼기 13쪽(남: 7, 여: 6)을 사용하였다. 13쪽 중 셋째 목신경에서는 4쪽에서 넷째 목신경에서는 3쪽에서 해부 도중 손상되었다.

셋째 목신경에서 운동성분은 9쪽 중 7쪽에서 관찰하였고(77.8%), 2예에서는 관찰하지 못하였다(22.3%). 넷째 목신경에서 10쪽 중 9쪽에서 운동성분을 확인하였고(90.0%), 1쪽에서는 확인하지 못하였다(10.0%). 셋째 목신경에 존재하는 운동성분의 양은 중간정도가 가장 많았고(57.1%; 7쪽 중 4쪽), 넷째 목신경의 양은 셋째 목신경에 비해 비교적 많았다(44.4%; 9쪽 중 4쪽). 셋째 목신경과 넷째 목신경에 포함된 운동성분의 양은 각각 114 ± 112 와 219 ± 167 개 였다.

이 연구의 결과 등세모근에 분포하는 목신경에 존재하는 운동성분은 넷째 목신경에 있어 출현빈도와 양에서 더 많았다.

찾아보기 낱말 : 운동성분, 목신경, 등세모근