INTRODUCTION

In previous studies, it was reported that the incidence of postoperative axial pain was lower in C3-C6 laminoplasty than in C3-C7 laminoplasty, emphasizing the effectiveness of the former procedure where dissection of the nuchal muscles that are attached to the C7 spinous process is avoided.1-3 However, there have been no detailed anatomic studies of the attachment of the nuchal muscles to the spinous process at the cervicothoracic junction. Further, it is known in the morphology of the cervical spinal spinous process that there is individual difference in the length of the C6 spinous process.

The current study was conducted on cadavers to investigate the anatomical details of the attachment of the nuchal muscles to the spinous process, and the relationship between the length of the C6 spinous process and anatomy of the nuchal muscles.

MATERIALS AND METHODS

In the current study, 25 Japanese adult cadavers (11 males and 14 females) with no history of cervical spine surgery were used for anatomical study. The mean age was 78.2 years (range, 49-92 years).

Observations included: the anatomy of the splenius rhomboideum of the trapezius, as well as the manner of attachment of the rhomboideus minor, rhomboideus major, serratus posterior superior, splenius capitus and splenius cervicis to the spinous processes of the cervical spine. The cephalocaudal ends of the rhomboideus major, serratus posterior superior, splenius capitus and splenius cervicis were sequentially identified and their attachments to the spinous processes were marked with thread. Then the nuchal muscles at the cervicothoracic junction were excised while they were attached to the C3-T12 spinous processes and the morphology of the attachment of each muscle to the spinous processes was observed at each side. Further, we measured the length of the spinous process of C6 and C7, and found the ratio of the C6 spinous process length to the C7 spinous process length (C6/C7 ratio).

RESULTS

The attachment of the cephalic end of the splenius rhomboideum to the spinous process was found to be at the level of C3 to C6, and at C3 in 16%, C4 in 40%, C5 in 36%, and C6 in 8%. The caudal end attachment was found to be at the level of C6 to T3, and at C6 in 4%, C7 in 12%, T1 in 28%, T2 in 52%, and T3 in 4%. The position of the center of the speculum rhomboideum was found at the spinous process at C5 in 12%, C6 in 16%, C7 in 60%, and T1 in 12%.

The rhomboideus minor was attached to the spinous process between C5 and C7. The cephalic end attachment was found at C5 in 66%, C6 in 30%, and C7 in 4%. The caudal end attachment was found at C5 in 6%, C6 in 58%, and C7 in 36%.

The rhomboideus major was attached to the spinous process between C5 and T6. The attachment of its cephalic end was at C5 in 20%, C6 in 18%, C7 in 46%, and T1 in 16%. The caudal end attachment was found at C7 in 8%, T1 in 4%, T2 in 16%, T3 in 28%, T4 in 24%, T5 in 16%, and T6 in 4%.

The serratus posterior superior was attached to the spinous process between C3 and T2. Its cephalic end was attached at C3 in 8%, C4 in 28%, C5 in 58%, and C6 in 6%. Its caudal end was attached at C5 in 2%, C6 in 2%, C7 in 44%, T1 in 44% and T2 in 8%.

The splenius capitis was attached to the spinous process between C3 and T3. Its cephalic end was attached at C3 in 74%, C4 in 22%, and C5 in 4%. Its caudal end attachment was C5 in 12%, C6 in 18%, C7 in 24%, T1 in 14%, T2 in 12% and T3 in 20%.

The splenius cervicis was attached to the spinous process between C5 and T6. Its cephalic end was attached at C5 in 8%, C6 in 16%, C7 in 14% T1 in 30%, T2 in 12%, and T3 in 20%. Its caudal end attachment was C7 in 8%, T2 in 10%, T3 in 26%, T5 in 8%, and T6 in 48%.

As for the C6 / C7 ratio, more than 0.9 was seen in 10 cases, more than 0.8 under 0.9 in 9, more than 0.7 under 0.8 in 3, more than 0.6 under 0.7 in 2, and more than 0.5 under 0.6 in 1. In the C6/C7 ratio of less than 0.8, the position of the center of the speculum rhomboideum was found at C7 in all cases, and the cephalic end attachment of the rhomboideus minor was found at C5 in all cases. The caudal end attachment of the rhomboideus minor was found at C6 in 83.3%, and the cephalic end attachment of the serratus posterior superior was found at C5 in 83.3%.

In the C6/C7 ratio of less than 0.8, the attachment to the spinous process level maintained the same and there was little individual difference in the speculum rhomboideum, rhomboideus minor, and serratus posterior superior. However, in the C6/C7 ratio of more than 0.8, there was a lot of individual difference in all muscles.

DISCUSSION

To reduce the surgical invasion of the nuchal muscles and prevent postoperative axial pain, a method to limit the area of decompression from “C3 to C7” to “C3 to C6” and to preserve the C7 spinous process has been performed. However, it is not known how much of which muscle is spared when the C7 spinous process is preserved. Based on the results of this study, the possibility of total discission of the speculum rhomboideum of the trapezius was 4% with C3-C6 laminoplasty and 16% with C3-C7 laminoplasty. More than 50% preservation was possible in 72% in C3-C6 laminoplasty and 12% in C3-C7 laminoplasty. Furthermore, instead of total discission of the muscular attachment, these findings indicated that in C3-C7 laminoplasty, the possibility of preservation of the muscular attachment at the spinous process of C6 was 0%, and the splenius capitis and splenius cervicis at the spinous process was 0%, and the possibility of completely preserving the muscular attachment was 20% in C3-C6 laminoplasty and 12% in C3-C7 laminoplasty.

In the current study, it was suggested that there is difference in the surgical area of the muscular attachment. The current study confirmed that C3-C6 laminoplasty in which the C7 spinous process is preserved reduces invasion of the nuchal muscles.

In the attachment of the nuchal muscles to the spinous process at the cervicothoracic junction, there were a lot of individual differences. However, in the C6/C7 ratio of less than 0.8, there was little individual difference in the surface nuchal muscles such as the speculum rhomboideum, rhomboideus minor, and serratus posterior superior. On the other hand, in the C6/C7 ratio of more than 0.8, there were a lot of individual differences. Based on the results of this study, it was suggested that there is difference in the surgical invasion of the nuchal muscles depending on the length of the C6 spinous process. In future, it may be necessary to consider the ratio of the C6/C7 spinous process length preoperatively in cervical laminoplasty.

REFERENCES