Assembling Facial Muscles in a Skull Model for Plastic Surgery Trainees

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Abstract: The aim of this study was to report the results of a training workshop on assembling facial muscles in a skull model, with a focus on the depth and intermingling of the muscles.

A commercially available model with facial and masticatory muscles was used and this has 33 muscle pieces removable and attachable by magnets. Seven participants were recruited for workshop. At first stage, they were asked to assemble 33 detached pieces. Atlases of facial anatomy and Google searches except scientific articles were available. The time required to complete the assembly was measured. At second stage, a review article on facial anatomy was provided and they were again asked to assemble the pieces and the time was also measured. They were asked to rate their satisfaction with the outcomes on a Likert scale.

In the second stage, the time was significantly shortened (from 66.9 ± 22.2 to 27.9 ± 15.0 minutes, $P = 0.002$). The reasons for this improvement we think are: first, repeating an activity itself shortens time, and second, reading a review article about the anatomy of the face, especially the depth and relationship of each muscle, provided participants with deeper anatomical knowledge. Upon finishing the 2-stage workshop, the participants' knowledge of the name ($P = 0.019$), origin and insertion of each muscle ($P = 0.017$), as well as the relationships of all neighboring muscles (including their depth) increased significantly ($P = 0.002$).

This model would be useful for anatomy classes at the undergraduate level in medical schools or developing a station as part of the objective structured clinical examination for board certification.

Key Words: Anatomy, education, facial muscles, medical, regional

(*J Craniofac Surg* 2022;33: 939–941)

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Received December 3, 2020.
Accepted for publication July 4, 2021.

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This study was supported by a grant from Inha University Hospital.
The authors report no conflict of interest.
Supplemental digital contents are available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's web site (www.jcraniofacialsurgery.com).

ISSN: 1049-2275
DOI: 10.1097/SCS.0000000000008014

An individual's appearance and facial expression are based on the musculoskeletal system of the face. The facial muscles or skin muscles generally originate from underlying bone surfaces and insert to the skin of the face or intermingle with other facial muscles. This complex musculature orchestrates the functions of the eye, nose, ear, and mouth, as well as the facial expressions of emotional and affective states.[1]

In facelift surgery, the facial muscles are important landmarks in the dissection of the superficial fascia in different planes for avoiding injuries of the facial nerve. Since the facial nerve branches are not all present in the same plane, a three-dimensional anatomical knowledge of the facial musculature is essential for young plastic surgeons, especially trainees.

There have been several computer models of facial soft tissues,[2,3] as well as a body painting model.[4] However, these models were made available through a computer interface. We thought that assembling facial muscles in a physical skull model could help plastic surgery trainees to learn the facial muscles and their relationships.

The aim of this study was to report the results of a training workshop on assembling facial muscles in a skull model, with a focus on the depth and intermingling of the muscles.

MATERIALS AND METHODS

Model

We used a commercially available model with facial and masticatory muscles (J-01, Bikin Lab/Iyashikuukan-fuu, MMI Co, Niigata, Japan). This model has 33 muscle pieces that are removable and attachable by magnets (Figs. 1–2).

Participants

Seven participants (4 plastic surgery residents and 3 graduate students enrolled in the PhD program in plastic surgery) were recruited for the facial muscle assembly workshop.

Selection of an Article to Read Between Stage 1 and Stage 2

In PubMed, a search was made using the terms (facial muscles) AND (anatomy) AND (superficial) AND (deep), resulting in 124 titles. Among the 124 abstracts, 2 full papers were reviewed,[1,5] and finally 1 review paper was selected.[1]

First stage: The participants were asked to assemble 33 muscle pieces, which were all detached. Atlases of facial anatomy and Google searches were made available to the participants, whereas they assembled the models; however, scientific articles were prohibited during the workshop. The time required to complete the assembly was measured.

Second stage: A selected review article on facial anatomy was provided.[1] At least 1 week later, the participants were again asked to assemble the 33 muscle pieces, which were all detached as before. The time required to complete the assembly was measured.

The participants were asked to rate their satisfaction with the outcomes on a Likert scale (5: definitely satisfied, 4: satisfied, 3:

FIGURE 1. Model with facial and masticatory muscles, with 33 muscle pieces removed.

neutral, 2: not satisfied, 1: definitely not satisfied) (Supplementary Digital Content, Assessment Form 1, http://links.lww.com/SCS/D27, Supplementary Digital Content, Assessment Form 2, http://links.lww.com/SCS/D28).

RESULTS

The time required to complete the assembly was 66.9 ± 22.2 minminutes in the first stage and 27.9 ± 15.0 minutes in the second stage. The required time was significantly shorter in the second stage ($P = 0.002$ [independent 2-samples t test]) (Supplementary Digital Content, Table 1, http://links.lww.com/SCS/D29).

After completing the 2-stage workshop, the participants' knowledge of the name of each muscle (3.1 ± 0.7 to 4.1 ± 0.7) and their origin and insertion (2.6 ± 0.8 to 3.6 ± 0.5) increased significantly ($P = 0.019$ and $P = 0.017$, respectively [independent 2-samples t test]). The participants' knowledge of the relationships of all neighboring muscles, including their depth (2.0 ± 0.6 to 3.7 ± 1.0), increased significantly ($P = 0.002$ [independent 2-samples t test]). However, there was no significant difference in the participants' knowledge of the function of each muscle (3.3 ± 0.8 to 3.7 ± 1.0) ($P = 0.369$ [independent 2-samples t test]) (Supplementary Digital Content, Table 1, http://links.lww.com/SCS/D29).

The satisfaction score for whether the participants found the workshop interesting or boring was 4.7 ± 0.5. The satisfaction score for whether the workshop was helpful practically was 4.7 ± 0.5. A high satisfaction score (4.9 ± 0.4) was also found for whether the technical process was helpful from a practical standpoint as a doctor or anatomist. The satisfaction score for whether the workshop improved the participants' knowledge of the configuration of the facial muscles was 4.4 ± 1.0. The satisfaction score for participation in the workshop was 4.7 ± 0.5, whereas that for whether the workshop should be included in the objective structured clinical examination for board certification was 4.4 ± 0.8. The satisfaction score for whether the participants would recommend the workshop

FIGURE 2. Assembled model in which the muscles are attached by magnets.

to others was 4.9 ± 0.4 (Supplementary Digital Content, Table 2, http://links.lww.com/SCS/D30).

DISCUSSION

The muscles of the face include all the mimetic muscles innervated by the facial nerve (VII). Two masticatory muscles (the masseter and temporalis) supplied by the motor portion of the trigeminal nerve (V3) also contribute to the facial contour.[1]

Mazza developed a computer model of the face that included the superficial layers of the face (skin, superficial musculoaponeurotic system, and fat), and most facial muscles.[2] Nowinski created a three-dimensional interactive, stereotactic atlas, which provided spatial relationships among the head muscles, glands, and cranial nerves.[3] Boggio used the body painting technique to represent the major muscle groups of botulinum toxin A targets.[4] These models showed the anatomy of the face well, but were only accessible on flat computer monitors.

On the contrary, our model was composed of a plastic skull model that had 33 pieces of muscles that were removable and attachable by a magnet. When the participants were assembling the pieces, they engaged in a trial-and-error process because the pieces could not be assembled if the deeper muscle had not been attached first.

In the second stage, the time required to complete the assembly was significantly shortened (from 66.9 to 27.9 minutes). We think that the reasons for this improvement were as follows: first, repeating an activity itself shortens the required time, and second, reading a review article about the anatomy of the face, especially

the depth and relationship of each muscle, provided participants with deeper anatomical knowledge. Upon finishing the 2-stage workshop, the participants' knowledge of the name, origin, and insertion of each muscle, as well as the relationships of all neighboring muscles (including their depth) increased significantly.

The difference between the groups was significant and showed an improving trend between the first and second activity and this is more likely due to repeated action on the same model. The fact that the second attempt was after reading relevant articles cannot sorely indicate an improvement in knowledge and this cannot be proven by this experimental method. Further study, which compare control group with experimental group who received academic articles before the first attempt might be followed.

This model would be useful for anatomy classes at the undergraduate level in medical schools. It is suggested to hold workshops for larger groups in plastic surgery residency programs or to develop a station using this model as part of the objective structured clinical examination for board certification.

ACKNOWLEDGMENTS

The authors thank to Hun Kim, PhD, Department of Plastic Surgery, Inha University College of Medicine, for making figures.

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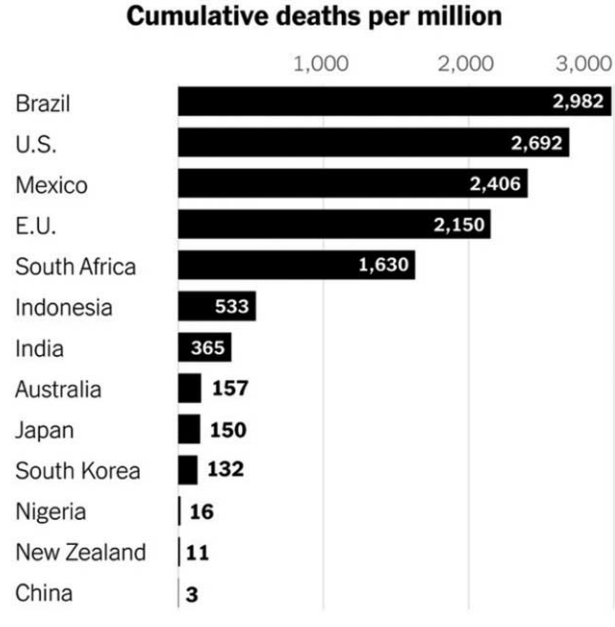

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