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Case Study

Immediate effects of scapular stabilizing exercise in chronic stroke patient with winging and elevated scapula: a case study

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Abstract. [Purpose] The purpose of this study was to investigate the effect of scapular stabilizing exercise in a stroke patient with winging and elevated scapula. [Subject and Methods] The subject was a 46-year-old female with a history of stroke. She had right side hemiplegia with winging and elevated scapula on the right side, and had compensatory motions of the neck and shoulder when using the paretic upper extremity. The subject participated in scapular stabilizing exercises for four days. This exercise program consisted of scapular protraction-retraction in an upright seated position. Scapular position was measured as distance between scapular medial border and thoracic vertebrae 3, 4. Upper extremity function was measured as time required for lifting and lowering a cup with the affected arm. [Results] After intervention, distance between scapular medial border and spinouse process of T3, 4 decreased. Time required for lifting and lowering a cup with the affected arm decreased. Compensatory motions of the neck and shoulder joint decreased. [Conclusion] Despite the short period, scapular stabilizing exercises had a positive effect on scapular position and upper extremity function.

Key words: Scapular stabilizing exercise, Winging and elevated scapula, Chronic stroke

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INTRODUCTION

Stroke patients have muscle weakness and imbalance and poor voluntary control and body malalignment. These problems may diminish the ability of the affected arm[1)]. A paretic arm can change scapular orientation, as scapular stabilizers are often impaired by muscle weakness. Such weakness increases motor impairment in upper extremities[2)]. The ability to maintain scapular position and control movement is essential for optimal upper limb function[3)].

The scapula provides dynamic stability with controlled mobility at the glenohumeral joint[4)]. It plays a significant role in facilitating shoulder joint function, as anatomy and biomechanics of the scapula allow for controlled movement of shoulder joints. Given its significance, recent studies have focused on the need to design upper extremity exercises[4, 5)]. Scapular stabilization exercise may be effective in increasing muscle strength, and decreasing scapular dyskinesis[5)].

Muscles are providing stability. The serratus anterior and rhomboid muscles, attached to the scapula, have the crucial function of scapular stabilization[6)]. The serratus anterior attached from the first 9 ribs to the medial border of the scapula[7)]. The serratus anterior is to stabilize the scapula during elevation and pulls the scapular forward[6)]. Weakness in the serratus anterior can impair scapular orientation and stability, thereby contributing to pathologic kinematics. Rhomboids, active in scapular retraction or adduction, are positioned deep under the trapezius, working together to retract, elevate, and downward rotate the scapula[7)]. The rhomboid minor is attached from the ligamentum nuche, and C7 to T1 vertebrae to the medial border

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Table 1. Active ROM of the right upper extremity

	Active ROM
Shoulder flexion	75.5°
Shoulder abduction	53.0°
Elbow flexion	90.0°
Elbow extension	0.0°
Elbow pronation	90.0°
Elbow supination	0.0°
Wrist flexion	0.0°
Wrist extension	0.0°

ROM: range of motion.

Fig. 1. Compensatory motions of the neck and shoulder. Left: pre, Right: post.

of the scapula. The rhomboid major is attached from T2–T5 vertebrae to the medial border of the scapula. They descend laterally, attaching on the scapular medial border at an inferior angle[3].

The purpose of this study is to determine effectiveness of strengthening exercises for the serratus anterior and rhomboids in a stroke patient with winging and elevated scapula. Though many studies have noted the significance of scapula stabilization exercises, few have investigated scapular alignment[5]. Assessment of postural alignment is a key orthopedic element of treatment. Impaired postural alignment causes excessive compression and stress, that, in turn, causes pain in muscles and joints[9]. In this study, we assess scapular alignment and upper extremity function in a stroke patient with winging and elevated scapula.

SUBJECT AND METHODS

This case study was conducted in S rehabilitation center (Seoul, Korea). The subject was a 46-year-old female with a history of stroke. In 1999, the subject was diagnosed with middle cerebral artery (MCA) infarction. She had right side hemiplegia with winging and elevated scapula. She could ambulate independently, and had no orthopedic disease in upper or lower extremities. Cognitive function of the subject was intact. She was undergoing treatment two times a week (treadmill and arm-ergometer). After receiving an explanation of the purpose and methods of this study, the subject signed a statement of informed consent. The study's protocol was approved by Anyang Sam Hospital (IRB No. 2017004).

The subject complained of discomfort especially in the right arm (the paretic upper limb). She used her left hand for all daily activities. The subject's elbow flexor spasticity was assessed using the Modified Ashworth Scale (MAS). This measurement was satisfactory for inter- and intra-rater agreement. For upper extremities and inter-rater agreement: ICC+=0.748 (95% CI), and for intra-rater agreement: ICC+=0.748 (95% CI)[10]. In this study, the MAS grade for subject's right hand was 2. The subject had poor sensation in the right upper extremity. Table 1 reveals the active range of motion (ROM) of the right upper extremity measured in sitting position. The subject had moderate kyphosis on thoracic vertebrae and scapular winging and abduction on the right side. She had compensatory motions of the neck and shoulder when using the paretic upper extremity in daily activity, in which the subject was holding a cup of the right upper extremity measured in sitting position (Fig. 1).

During the intervention period, 4 days in June 2017, the subject participated in scapular stabilizing exercises with supervision to strengthen the serratus anterior and rhomboid muscles. This exercise program consisted of scapular protraction-retraction in an upright seated position, maintaining the shoulder at 90° flexion, the elbow extension, and the forearm in neutral position. In this position, the subject engaged in isometric contraction with scapular protraction and retraction. Each contraction was conducted for a 5-second interval. This intervention was conducted in 15 repetitions of 3 sets, with a 1-minute rest time between sets. This exercise program is based on Jung et al. literature[11].

The subject was assessed for scapular position and upper extremity function. Scapular position was measured as distance between scapular medial border and spinouse process of thoracic vertebrae 3, 4 using a tape measure[12]. The measurement was conducted twice, and the mean value was used. To assess upper extremity function, time required for lifting and lowering a cup with the affected arm was measured. Mean of two measurements was used. Measurement occurred before and immediately after each intervention (at the end of each session), for a total of 5 times.

RESULTS

Distance between the scapular medial border and the spinouse process of T3, 4 was observed from 8.2 cm (pre-test) to 6.5 cm (day 4). Decreased amount was greatest on day 1 (from 8.2 cm to 6.7 cm) (Table 2). Time required for lifting and lowering a cup with the affected arm decreased, from 9.9 sec (pre-test) to 6.6 sec (day 4), decreasing gradually throughout intervention (Table 3). Compensation in the neck and shoulder joint also decreased when performing this action (Fig. 1).

Table 2. Distance between the scapular medial border and the spinouse process of T3, 4

	Pre-test	Day 1	Day 2	Day 3	Day 4
Distance (cm)	8.2	6.7	7.4	7.0	6.5

Table 3. Time required for lifting and lowering a cup with the affected arm

	Pre-test	Day 1	Day 2	Day 3	Day 4
Time (sec)	9.9	8.4	7.6	6.8	6.6

DISCUSSION

This case study identified immediate effects of scapular stabilizing exercise on scapular position and upper extremity function in a stroke patient with winging and elevated scapula. The subject, a 46-year-old female, was 28 years old at disorder onset. Therefore, the subject was a chronic stroke patient. The subject had right-side hemiplegia with winging and elevated scapula. Scapular winging can lead to limited functional activity of the upper extremity[7]. In turn, upper extremity paresis in stroke patients often limits daily activities, and social roles[13]. Scapular winging can be caused by weakness of the serratus anterior and rhomboid muscles[14]. The serratus anterior plays an important role in scapular stability, causing upward rotation and protraction of the scapula[15]. Rhomboids provide scapular stability, causing retraction and adduction of the scapula[6]. Therefore, in this study, a scapular protraction-retraction exercise was conducted for scapular stability.

After intervention, distance between scapular medial border and spinouse process of T3, 4 decreased. Especially, on day 1, decreased amount was greatest (from 8.2 cm to 6.7 cm). As normal average distance between scapular medial border and T3, 4 is 6.9 cm[16], scapular position in this study approached the normal range after intervention.

Therefore, the position of the winging and elevated scapula improved. Rhomboids are attached from C7–T5 to the scapular medial border at inferior angle[3]. These muscles control medial-stabilizing of the scapula[17]. In this study, strengthening rhomboids through scapular retraction decreased distance between scapular medial border and the spinouse process of T3, 4. This had a positive effect on scapular position, reducing winging and scapular elevation. On day 2, distance between scapular medial border and spinouse process of T3, 4 had become shorter than that of pre-test while it had increased since Day 1. This may be due to lack of control over subject's activity outside this study. In this study, upper extremity function was assessed by time required for lifting and lowering a cup with the affected arm. After intervention, duration decreased gradually throughout intervention (from 9.9 sec to 6.6 sec), that can indicate improvement in the upper extremity. Compensatory motions of the neck and shoulder joint decreased. Compensatory motion is abnormal movements in the paretic side of stroke patients, and they are most often observed in the upper limbs[18]. These movements, which interfere with activities of daily living, reflect postural instability[18, 19]. Therefore, in this study, reduction of compensatory motion indicates improvement in postural stability of upper extremity.

Findings of this study are consistent with those of previous studies that found scapular stabilizer strengthening exercise improves function in the upper extremity in chronic stroke patients[8]. Scapular position improved, as did upper extremity function[20]. Scapula affects the shoulder joint, playing a critical role in adjusting its position. Therefore, improvement of scapular position can have a positive impact on the shoulder joint, resulting in improved upper extremity function

In this study, despite of a brief period (four days), scapular stabilizing exercises had a positive effect on scapular position, resulting in improved upper extremity function. Primary limitation of this study was that it comprised one subject. Future studies should include more subjects. Nonetheless, it is meaningful, as it suggests that chronic stroke patients can be treated with proper intervention.

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