

Original Article

## Effect of the application of local vibration in scaption on joint stability

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**Abstract.** [Purpose] The aim of this study was to determine the initial effect of local vibration on the stability of the shoulder joints by applying local vibration to the shoulder joints. [Subjects and Methods] For the test, the subjects held a FlexBar with one hand, at about 10 cm from one end, and performed the oscillation movement with the shoulder at 90° flexion and the elbow in the full-extension position in scaption; the vibration stimulus was set to 5 Hz. Then, the subjects underwent the Upper Quarter Y Balance Test to evaluate the stability of the shoulder joints. [Results] The moving distances in the left, right, and upper directions after the oscillation movement were increased significantly compared with the results before the oscillation movement. [Conclusion] A vibration stimulus is effective as an exercise method to increase the stability of the shoulder joints.

**Key words:** Local vibration, Shoulder joint, Stability

*(This article was submitted May 26, 2014, and was accepted Jul. 24, 2014)*

### INTRODUCTION

The stability of the shoulder joints is the result of the combination of static-dynamic balance and the interaction between various joints<sup>1,2)</sup>. In addition, coordination around the shoulder joints plays an important role in stabilization of the shoulder joints<sup>3)</sup>. Thus, strengthening exercise programs for these muscles can help with recovery from instability in the shoulder joints or help prevent instability from occurring<sup>4)</sup>. Moreover, vibration is regarded as an effective exercise method to improve muscle strength and endurance. According to Bosco et al., applying dynamic vibration to arm flexor muscles increased the muscle power significantly<sup>5,6)</sup>. In addition, it has been shown that vibration stimuli in the lower extremity improved balance ability<sup>7)</sup>. Furthermore, Han et al. reported that vibration stimuli decreased knee joint reposition error<sup>8)</sup>. In order to apply vibration more safely and effectively, low frequency vibration has been widely used. The FlexBar is a resistance tool that can be applied to the upper extremity. It has been used to apply a low frequency vibration stimulus to a local area while performing an oscillating movement<sup>9)</sup>. In addition, the Upper Quarter Y Balance Test is a method for examining shoulder stability by measuring the distance a fingertip can reach while in a closed-chain position, which is known to be highly reliable.

This method is a preprogram test through which the exercise limit and asymmetry can be tested<sup>10)</sup>. Nonetheless, few studies have been done on the acute and chronic effects of a vibration stimulus applied to the upper extremities. Therefore, the aim of this study was to determine the initial effect of local vibration on the stability of the shoulder joints by applying local vibration to the shoulder joints.

### SUBJECTS AND METHODS

Twenty-one male and female young adults voluntarily participated in this test. They were chosen because they had a suitable range of motion and muscle strength to perform the exercises required in this test and had no problems or diseases related to the shoulder joints in the past. The mean age, height, and weight of the subjects were 24.2±2.7 years, 165.4±7.9 cm, and 62.2±13.5 kg, respectively. The procedures of this study were harmless to the human body. All subjects read and signed a written consent form. Also, this study was approved by the Daegu University Faculty of Rehabilitation Sciences Human Ethics Committee. To apply the local vibration to the subjects, a FlexBar (Hygenic Corporation, Akron, OH, USA) was used<sup>11)</sup>. A FlexBar is an oscillating device that weighs 0.59 kg and is 0.3 m long. For the test, the subjects held a FlexBar with one hand, at about 10 cm from one end, and performed the oscillation movement with the shoulder at 90° flexion and the elbow in the full-extension position in scaption; the vibration stimulus was set to 5 Hz<sup>11, 12)</sup>. In total, three sets of the oscillation movement were completed, with each set consisting of three exercises lasting three minutes each. About 10 minutes of rest was provided to the subjects between the sets to minimize muscle fatigue. Once all exercise sets were complete,

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the subjects underwent the Upper Quarter Y Balance Test to evaluate the stability of the shoulder joints. The mean value of the three test results was used for the Upper Quarter Y Balance Test, and the distance a subject could reach with a fingertip was divided by the arm length of the subject to find the percentage value, as this removed the bias due to the physical structure differences between the subjects. For the data analysis, SPSS for Windows (ver. 18.0) was used, and a paired t-test was employed to compare the results before and after the oscillation movement. Significance was accepted for values of  $p < 0.05$ .

## RESULTS

The moving distances in the left, right, and upper directions after the oscillation movement were  $95.5 \pm 9.3$ ,  $85.1 \pm 11.9$ , and  $63.8 \pm 14.8$  cm, respectively; all increased significantly compared with the results before the oscillation movement ( $82.9 \pm 9.2$ ,  $75.7 \pm 11.4$ , and  $52.5 \pm 11.5$  cm, respectively) ( $p < 0.05$ ). The total moving distance also increased significantly after the oscillation movement, rising from  $211.1 \pm 26.8$  cm to  $244.3 \pm 30.1$  cm ( $p < 0.05$ ).

## DISCUSSION

The objective of this study was to determine the initial effect of the vibration stimulus on the stability of the shoulder joint. The results showed that the vibration stimulus improved the shoulder joint's stability.

Scaption is an ideal exercise plane that is used to strengthen various muscles around the shoulders, as these muscles are required to lift the arms in daily life<sup>13</sup>. Furthermore, the rotator cuff and deltoid are two dynamic stabilizers that surround the shoulder, and they press the humeral head toward the glenoid fossa or offset the superior gliding of the humeral head during shoulder movement, thereby preventing impingement<sup>14</sup>.

In the present study, the vibration stimulus in scaption effectively strengthened these muscles, thereby increasing the stability of the shoulder joints.

Vibration has normally been used in resistance exercises to improve muscle strength and power by strengthening the neuromuscular performance, but different effects have been identified depending on the vibration characteristics<sup>12</sup>. According to Bongiovanni, a suppression effect was displayed if the duration and strength of vibration continued to in-

crease gradually. The suppression effect was a reduction in motor output during maximum muscle contraction<sup>15</sup>. Therefore, if a vibration stimulus is applied using a suitable amplitude and frequency, highly effective resistance training will be achieved.

In conclusion, a vibration stimulus is effective as an exercise method to increase the stability of the shoulder joints. Furthermore, application of a vibration stimulus for patients with impaired shoulder joints can help support effective rehabilitation programs.

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