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Short Communication
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Thorax Flexibility can be Increased by Standing Pole Exercise

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Abstract

Background: Discussion has been continued about the stability of the spine, and relationship with physical flexibility and exercise function. We have continued physical rehabilitation for various subjects, and proposed clinical application for pole exercise. In this study, we investigated the efficacy of standing pole exercise.

Study protocol: The subjects were 9 healthy adults, 26.9 ± 5.9 years old. Method included standing pole exercise and 2 tests before and after the exercise. The exercise has 6 movements, including lateral bending, axis rotation, wave motion, backward spiral, forward spiral and warp and rounding. The pole was 160 cm in length, 610 g in weight. Two tests were percentage vital capacity (%VC) and weight bearing index (WBI), which showed significant differences between before and after the exercise ($p<0.01$).

Discussion and conclusion: Theoretical mode of spinal stability has relationship with inner/outer core stability, flexibility, expandability, curved angles in spinal alignment, and so on. In current study, standing pole exercise would be effective for increased %VC and WBI, which may be from increased flexibility and expandability. These data would be basal data for clinical application and research development in the future.

Keywords: Pole exercise; Vital capacity (VC); Weight bearing index (WBI); Physical flexibility; Exercise function

Abbreviation:

VC: Vital Capacity; WBI: Weight Bearing Index; DFL: Deep Front Lines

Introduction

Discussion has been continued about the stability of the spine. It is the fundamental requirement to protect nervous structures and prevent the early deterioration of some spinal components [1]. During human various postures and movements, three subsystem would be necessary which are a passive, an active and a neural control subsystem [2]. An active subsystem is controlled by muscle function, which has inner unit and outer unit including lots of trunk muscles, leading to the concept for core stability [3]. Recent studies include core instability, functional spine unit, segmental motion and radiographic variables using kinetic MR imaging [4-6].

From these backgrounds, the thorax unit tends to be in decreased flexibility due to various factors. It may induce impaired function of the rib cage, which gives rise to various influences to dysfunction of respiratory system, inner muscle collapse of the center of gravity line/ posture, and so on.

We have continued physical rehabilitation for the patients with various orthopaedic diseases and for sports conditioning in athletes. Previously, we presented the trial of clinical application for pole exercise [7]. Based on the above, we investigated the influence of standing pole exercise against the changes in thoracic expandability and physical function before and after the exercise.

Study Protocol

Subjects were 9 healthy adults, who are 26.9 ± 5.9 years old in average, including 7 men and 2 female. Methods included thoracic/ spinal column complex exercise and 2 tests before and after the exercise.

The intervention exercise has been 'pole exercise' originated by Moriyasu, which includes 6 kinds of movement. It is performed at the standing position and its detail is shown in Figure 1 and summarized in Table 1.

Lateral binding	Axis rotation	Wave motion
Do not put your strength on both shoulders	Do not use force on shoulders without recoil.	Do not use force on shoulders without recoil.
Do not make force yourself to fall down.	Rotate with conscious for the front of chest.	Be conscious on the epigastrium and wave.
Bend with your conscious on side chest.	Recognize back bone/thorax with soft stretch.	Do not tilt your head, but always upright.
At most bent point, breathe in and out.	Be conscious for rotating form the chest.	Move rib cage, backbone, and pelvis separately.
Three round trips to the right and left slowly.	Three round trips to the right and left slowly.	Take 10 times round trips slowly.
Back spiral	**Forward spiral**	**Wrap and rounding**
Open both legs around shoulder width	Do not use force on shoulders without recoil.	The rod height is the level of nipple.
Do not use force on shoulders without recoil.	Be conscious on the epigastrium and wave.	Do not force to shoulders during move.
Be conscious, as if your epigastrium is center	Do not tilt your head, but always upright.	Face facing forward, conscious of rib cage.
Move rib cage, backbone, and pelvis separately.	Move rib cage, backbone, and pelvis separately.	At most bent points breathe in and breathe out.
Take 10 times round trips slowly and relax.	Take 10 times round trips slowly and relax.	3 round trips slowly with relax

Table 1: General procedure of pole exercise with 6 steps.

Six movements include, lateral bending, axis rotation, wave motion, backward spiral, forward spiral and warp and rounding. During this exercise, we advised subjects for opening the legs to the shoulder width, weakening the shoulders, and breathing freely without pain.

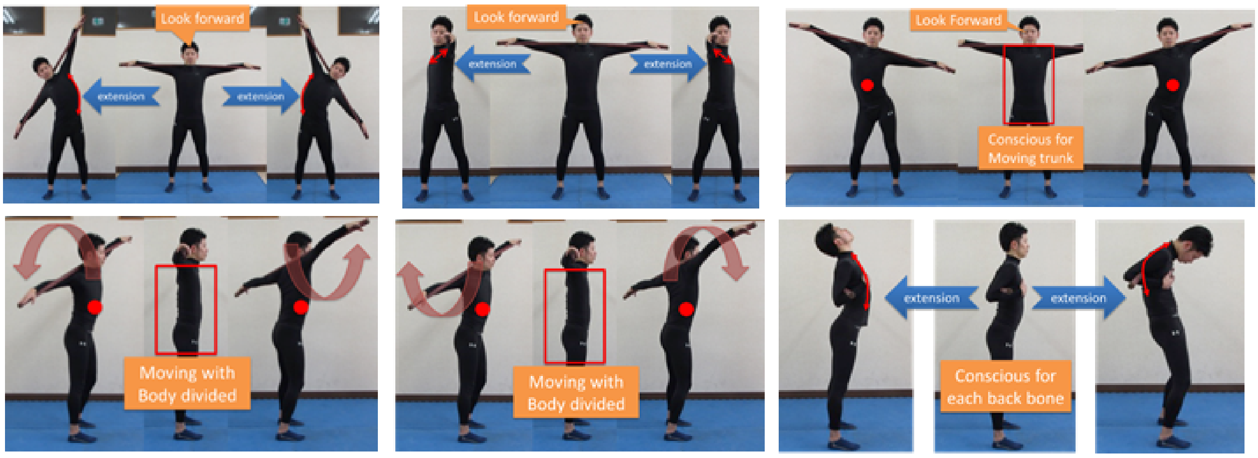

Figure 1: Method of standing pole exercise with 6 steps.

The exercise pole was originated by Moriyasu, and can be combined to different length. There are 4 types, which are 1600 mm, 1400 mm, 1000 mm and 800 mm in length, with 610 g, 540 g, 380 g and 315 g in weight, respectively (Figure 2). The diameter is 32 mm. Another similar wood pole is also prepared originated by Moriyasu, if needed, which is 1600 mm in length, 650 g in weight, 36 mm in diameter.

The examination included percentage vital capacity (%VC) and weight bearing index (WBI), which were performed before and after the pole exercise. To measure the value of %VC, electronic spirometer Chestgraph Jr.HL-101 (Chest Corporation) was used according to the Japan Respiratory Society Guidelines. WBI value was obtained using a handheld dynamometer (μ-TasF-1 manufactured by Anima Co., Ltd.), measuring maximum isometric contraction muscle force twice for 5 s per leg and converting the minimum value to the weight ratio (%).

In current study, obtained data was shown as the mean ± standard deviation (SD). For statistical analyses, correlation coefficients were calculated using a paired t test of the Microsoft Excel analytical tool [8]. A significance level of less than 5% obtained using a two-tailed test was considered to be statistically significant.

We explained the subjects about the detail of the examination sufficiently, and the informed consents were obtained from all subjects. Current study was conducted in compliance with the ethical principles of the Declaration of Helsinki and Japan's Act on the Protection of Personal Information along with the Ministerial Ordinance on Good Clinical Practice (GCP) for Drug.

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Figure 2: Useful pole with 4 different length (Four types are available, 1600 mm, 1400 mm, 1000 mm and 800 mm in length, when combined).

Examination	Before	After	Difference
%vital capacity	104 ± 8.3	111 ± 7.0	P<0.001
Weight Bearing Index	120 ± 13.0	130 ± 14.0	P<0.001

Table 2: Changes in data before and after pole exercise.

As a result, there were significant differences of both test which are %VC and WBI, between before and after the intervention pole exercise (p<0.01) (Table 2).

Discussion and Conclusion

From the point of the theoretical mode of spinal stability, potential cause would be altered motor control strategies concerning core stability and stabilization exercise [1,9,10]. Related to these, clinical investigation was developed WBI, and curved angles in spinal alignment [11-13]. Moreover, there is on-going debate concerning core stability and stabilization exercise in the clinical and research fields [14].

From current results, pole exercise seemed to show a significant immediate change for %VC and WBI. We have speculated this process on several stages as follows: 1) receiving pole exercise, 2) increased thorax expandability, 3) increased respiration volume (%VC), 4) stimulated the first axis (flexibility/rigidity), 5) coordinated second axis (fixed source/drive source), 6) increased motor function and 7) increased physical function (WBI). Consequently, as %VC increased, WBI also increased because both are related to fixed source function.

We have unpublished data for the similar protocol of sitting pole exercise test, in which significant positive changes are observed in shoulder extension test, finger floor distance, straight leg raise and body warp prone position. Those additional data would be supportive for the efficacy of pole exercise [15]. From these, pole exercise would be a movement that can be used to change thoracic flexibility and maintain or improve motor function.

From the results, we can consider the influence of thoracic unit for the motor function. Thoracic spine is surrounded by ribs so that it is called as rib cage. Then, mobility of the thoracic vertebra is easily restricted, and the fixation becomes stronger than the mobility, and the flexibility of the thorax is likely to be restricted.

As for the change in respiration, there is probable influence with shallow and deep front lines (DFL), which is the effect on anatomy train [16]. In DFL, the change in respiration may be affected by the connection between the diaphragm, the waist rectangular muscle, and the iliopsoas muscle. Moreover, DFL is a fascia that travels in the center of the body, and it can influence the formation of axes and also sensory nerve activation.

In this study, standing pole exercise would be effective for increased %VC and WBI, which may be from increased flexibility and expandability. These data would be basal data for clinical application and research development in the future.

Supplement

The outline of this article was presented at 9th and 10th Scientific Meeting of Integrative Medicine Japan, Shikoku division, Japan, 2016 and 2017. The authors appreciate subjects and staffs for their co-operation and support.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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