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COMMENTARY

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Pole exercise would be clinically effective through increasing thoracic spinal mobility

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Low back pain (LBP) has been a common and costly problem for long years. Surveillance study was made of about 2000 workers from the National Institute for Occupational Safety and Health (NIOSH). The results were that 1-year prevalence of LBP lasting 7 days, seeking medical care, and lost time due to LBP were 25%, 14% and 10%, respectively [1].

Generally speaking, a person has more than 75% lifetime rate of prevalence [2]. LBP continuing more than 3 months has been evaluated as chronic situation, and adequate evaluation and treatment have been anticipated. In these cases, the flexibility or mobility of thoracic cage and vertebrae have been limited or restricted [3]. Further, several factors have been involved in the diseased states such as unstable lumbar spine with pain, less mobility of adjacent spinal joints and other influences from respiration and various body movements.

Further evaluation among LBP, spinal posture and mobility can be assessed by using Spinal Mouse [4]. The Spinal Mouse is an external non-invasive device, which can measure the spinal shape and mobility of the spine in several planes [5]. It can provide surface-based measures of the curvature of the spine in the frontal and sagittal plane. This device has been proven to be feasible, reliable and non-invasive [6]. Furthermore, it can be useful for the evaluation of spine function linked to gait characteristics and trunk posture adaptation related to the decline in gait speed and frailty [7].

Investigation of the relationship among LBP, LBP history and spinal alignment stiffness by Spinal Mouse showed that the stiffness of the lumbar multifidus (LM) muscle would be significant and independent factor [8]. These results suggest that LBP history and LBP would be related with LM stiffness in the prone position and decreased lumbar lordosis in the standing position [8]. In addition, the study by Spinal Mouse could clarify the difference between thoracic-lumbar-sacral spine inclination and craniofacial morphology [9].

Concerning LM muscle, its action has been stronger than lumbar extension [10]. Furthermore, the LM activity for lumbar facet joint adaptation and lumbar flexion have been stronger, which can lead to lumbar stability [10]. As mentioned above, the evaluation by Spinal Mouse can contribute to several aspects. They include to examine the detail function of thorax and lumbar regions, to give exercise interventions, to maintain various mechanism, and others [7].

Concerning the research using spinal mouse, authors have continued the study of thoracic cage and vertebrae. Our previous research showed that there was dysfunction of LM in asymmetry/muscle thickness reduction associated with LBP and thoracic flexibility/stability in patients with LBP [11]. Thus, the exercise efficacy of the lower thorax was observed on the LM and spinal flexion mobility [11].

The range of motion (ROM) of thoracic upper/lower (U/L groups) thoracic cage was analyzed before and after the intervention exercise [12]. It was daily continuation of pole exercise method proposed by Moriyasu [13].The results included that total ROM in main effect showed a significant difference in U/L groups, and that ROM (total, flexion, extension) in alternating effect showed significant difference, associated with larger ROM tendency in U group.

For the spinal stability, there are important interconnected functions of three elements, which are active (muscles), passive (bones) and neural systems [14]. Among them, body muscles can regulate global and local mechanism [15]. The former includes rectus abdominis (RA), external oblique (EO), and internal oblique (IO), and the latter includes transverse abdominis (TrA), multifidus (MF) and interspinal is situated in deeper trunk. Smaller muscles seem to be related with the stiffness of the spinal segment for maintaining the posture [14].

For evaluation of the efficacy of core stability training and dynamic stretching, patients with chronic LBP were investigated [16]. The biomarkers were chosen as three factors, which are pain degree, functional disability and thoracolumbar range of motion (ROM). The protocol included the classified to three groups from performances, which were with core stability (CS), dynamic stretching (DS) and control (Cont). The results showed that core stability training and dynamic stretching showed efficacy on these three groups [16].

There has been various training for trunk stabilization so far. They include Pilates exercise [17], core exercises [18], ball exercises on the unstable surface [19] and others. In contrast, comparison study was held for trunk muscle activity between flexi-bar and non-flexi-bar exercises [20]. There were successive studies for increasing coordination and balance skills [21].

As for pole exercise training, authors and colleagues have continued clinical rehabilitation and research using Moriyasu pole exercise method [13,22]. It includes basically 6 main

Figure 1. *Presentation of pole exercise by the author, Workshop is always performed with impressive flexibility.*

movements, which are lateral bending, axis rotation, wave motion, backward spiral, forward spiral and warp/rounding. Further, it includes basically 11 evaluation methods for physical flexibility and exercise function [13,23]. They are Wing test, Thomas test, shoulder extension test (SET), straight leg raise (SLR), body warp prone position, heel buttock distance (HBD), finger floor distance (FFD), back muscle strength (BMS), weight bearing index (WBI), functional reach test (FRT) and closed eye leg standing time [13,23]. These tests are summarized as physical flexibility tests, which evaluate three changes of vertebrae function, physical flexibility and exercise function.

Taking most advantages of these exercise, we have broadened the useful knowledge and practice through various workshops and opportunities [24]. The subjects include patients with metabolic syndrome, locomotive syndrome, flail, elderly people with mild cognitive impairment (MCI) in nursing home, sportsman with masters' athletes, professional soccer and baseball players, and others [25]. When giving lectures, the authors can always teach a variety kinds of pole exercises, presenting the flexibility and mobility of the body (Figure 1). Such performance would be necessary for leading people make up their mind to practice every day.

In summary, we have continued various rehabilitation practices and lectures with the slogan "Be healthy by pole exercise". Authors expect that this article would become the reference data for developing adequate exercise training and research in the future.

Keywords: *pole exercise; low back pain (LBP); spinal mouse; lumbar multifidus (LM); thoracic spinal mobility.*

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