

Research on Spinal Column from Three-Dimension Viewpoints with Spinal Mouse and Pole Exercise

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Abstract

In the orthopedic and rehabilitation medicine, low back pain (LBP) is a prevalent problem. For the evaluation of LBP and spinal posture and mobility, Spinal Mouse has been used for sagittal and frontal planes. It is reliable, feasible and non-invasive device, and can obtain the detail data of the surface-based measurements of the curvature in the spine. As to clinical practice and research, authors have developed pole exercise and reported several articles with fundamental six main movements. They show the movements of three dimensions with lateral bending, axis rotation, wave motion, backward spiral, forward spiral and warp & rounding.

Keywords: *low back pain (LBP), pole exercise, Spinal Mouse, lumbar stabilization (LSE), Rotation Dance.*

COMMENTARY

In the specialty of orthopedic and rehabilitation departments, clinical problem of low back pain (LBP) has been prevalent. Several research for lumbar stabilization (LSE) and also thoracic flexibility exercise (TFE) have been in discussion [1]. There was a surveillance study for LBP by National Institute for Occupational Safety and Health (NIOSH). Results from approximately 2000 cases showed that about 14% had necessary medical care and 25% had LBP for 7 days [2]. As a whole, 75% people have experiences of LBP for the lifetime [3].

For clinically persisting LBP, authors and co-workers have continued further evaluation and research in the rehabilitation and sports region [4]. The subjects and patients included elderly people, patients with LBP and other disorders, Masters' athletes, professional team athletes of football and baseball, and high school and college students [5]. LBP patients tend to have limited thoracic spinal mobility [6]. We have given a variety of reports on LBP, running, spinal flexibility,

running, sports and so on [7].

For the evaluation of LBP and spinal posture and mobility, we can assess them by the useful device, Spinal Mouse [8]. It is a non-invasive apparatus, and can investigate the shape of the vertebrae and the spinal mobility in several planes [9]. By using Spinal Mouse, we can obtain the detail data of the surface-based measurements of the curvature in the spine. A sagittal plane and a frontal plane can be investigated [10]. For reference, human body can be analyzed from three dimensions, which are sagittal, frontal and horizontal planes (Figure 1). When applying in sagittal plane, it includes three postures of upright, forward bending and backward bending (Figure 2). Consequently, it shows the results of the angle between adjacent vertebral bodies, thoracic kyphosis, lumbar lordosis, range of motion, overall tilt angle, and overall length. In contrast, when applying in frontal plane, it includes three postures of upright, lateral bending to the right and left [10].

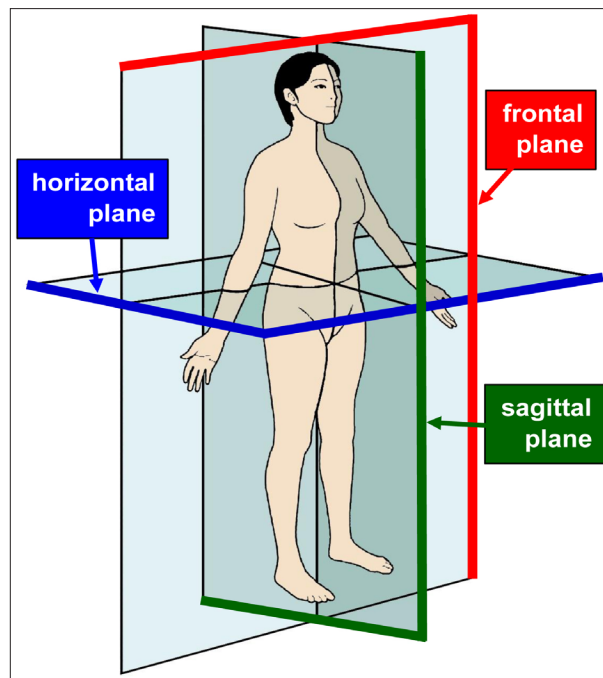


Fig1. Three planes of sagittal, frontal and horizontal views

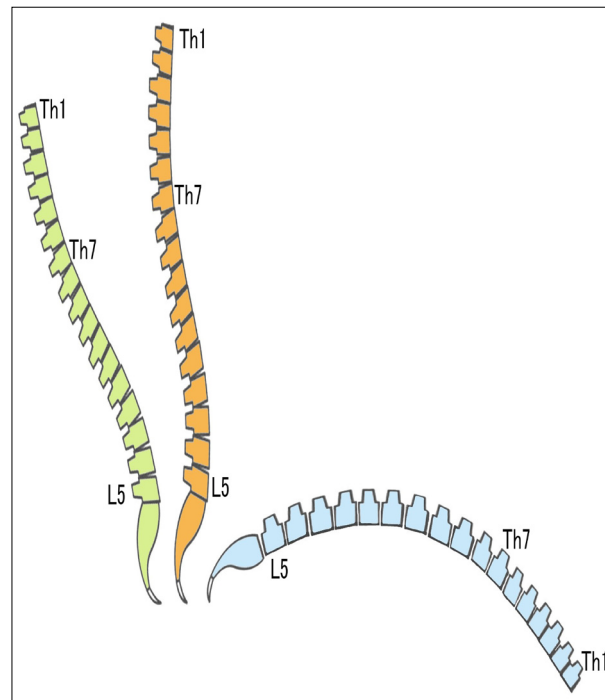


Fig2. Results of measurement of three postures.

Fig 2a. Extension posture (green), **Fig 2b.** upright posture (orange), **Fig 3b.** Flexion posture (light blue)

This apparatus is evaluated to be reliable and feasible [11]. In addition, it has been useful for spinal function associated with trunk posture and gait characteristics in frailty and speed evaluation [12]. Concerning the fundamental data, subjects of young generation were examined by using Spinal Mouse [13]. In the previous reports, sagittal spine curvature beyond normal range

could reduce functional capacity and perceived QOL. For the improvement of the posture, Pilates method can contribute to some degree [14].

As regards to the research on spinal mouse, authors had reported the investigation for the function of the thorax and spinal column [15]. Among them, some dysfunction was observed for the lumbar multifidus

(LM) in asymmetry/muscle thickness reduction which are associated with LBP and thoracic flexibility/stability in LBP patients. Consequently, the exercise effect for the lower thoracic cage was found on the LM and spinal flexibility and mobility [15]. In the upper and lower (U/L) thoracic cage, range of motion (ROM) was measured before and after the intervention exercise [16]. The intervention method for the protocol was the continuous daily pole exercise proposed by the author Moriyasu [17]. As the results, total ROM in the main effect revealed that there was a significant difference in U/L groups. Thus, Spinal Mouse has been useful device for clinical research on thoracic flexibility and stability with important data [18].

Our standard pole exercise training has its fundamental six main movements. They are 1) lateral bending, 2) axis rotation, 3) wave motion, 4) backward spiral, 5) forward spiral and 6) warp & rounding [17]. Anyone can arrange these movements, and revised motion can be added as one like. The pole can be set from 60 cm to 160 cm. The movement 1) can be performed using 60 cm, and the movements 4) and 5) can be performed using 160 cm.

Pole exercise would contribute to relatively smoother movement of ribs, cervical, thoracic and lumbar spinal column related to the thorax. In particular, the movement of the costotransverse joint and the costovertebral joint seem to be important in the case of rotating the thoracic spinal column. When there is left rotation, left costotransverse joint can be rotated backward and the right costovertebral joint can be rotated forward. These movement of the ribs associated with these thoracic spinal rotations are called the Rotation Dance [19]. There was a report of pole exercise of flexible bar and non-flexible bar associated with muscle activity of four muscles. They include internal oblique (IO), external oblique (EO), rectus abdominis (RA) and erector spinae (ES) [20]. As a result, flexible bar seemed to be a little more useful for the activation of several trunk muscles.

In summary, LBP is one of the most prevalent problems. Spinal Mouse has been applied for clinical research and pole exercise has been recommended for various practice in orthopedic and rehabilitation region. This article will hopefully become a reference for future research development.

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Research on Spinal Column from Three-Dimension Viewpoints with Spinal Mouse and Pole Exercise

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