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Short Commentary

# Various Human Movements can be compared to the Concept of Three Spherical Surfaces as Head, Lung and Pelvis

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## Abstract

Authors and colleagues have continued research on flexibility of spinal vertebrae. For evaluation of spinal movement, an idea of three circles or spherical surfaces would be presented for head, chest and pelvis. Connection points are i) mastoid process of the head motion sphere, ii) the sternoclavicular joint of the chest motion sphere, and iii) the upper posterior iliac spine of the iliac bone. When each sphere rotates forward or backward, another sphere rotates in the opposite direction. They have mutual connecting relationships, which bring us delicate and minute movements. This article will be expected to be some reference.

## Text

Human beings had been evolved from animals for long time, and can perform complicated operation [1]. What kind of mechanism do we have for fine movements? The movement of the human body can be considered from an anatomical, physiological and orthopedic point of view.

One of the ideas for the movement would be described in this article. A variety of movements in human beings may be functionally related to the head, chest and pelvis (lower lumbar region) [2, 3]. It is considered that these three parts can be moved adequately, thereby enabling the whole body to move smoothly.

These three parts are shown in the Figure 1. Although it is revealed by three circles, each circle is not a plane but a solid or a ball [4]. In other words, there are ball motions in three directions, such as sagittal, frontal and transverse planes. It is assumed that there are three spherical surfaces, and each of them operates not in a plane but in three dimensions [5]. The spheres are connected with some points. They are mastoid process of the head motion sphere, the sternoclavicular joint of the chest motion sphere, and the upper posterior iliac spine of the iliac bone.

The authors and colleagues have continued research on the movements of the thoracic, lumbar vertebrae and pelvis [6, 7]. As a rehabilitation, treatment method using a pole has been recommended [8, 9]. Among them, various clinical effects due to the connection of the head, chest, and pelvis have been considered.

Using these links of the trunk, we can generally consider smooth movements for the head, chest, pelvis. Several related mechanisms have been speculated in the following.

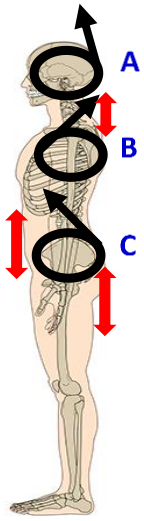


**Figure 1:** The concept of three spherical surfaces indicating head, chest and pelvis

Figure 1-A shows the mechanisms that affect the movement of head and neck. At first, the subject raises the back of the head upward and rotate the head forward [10]. Then, the muscles located at the back of the neck are stretched, with some tension at the posterior neck. Consequently, the unstable cervical spine would become fixed to some degree. This series of process can stabilize the heavy head at a position just above the cervical vertebrae.

Figure 1-B shows the mechanisms by which the rotation of the head affects the chest movement. The rotation of the head in the forward direction causes the chest to rotate in the backward direction [11]. Then, the front of the chest (sternum) has been pulled upward. At the same time, the abdomen is stretched with some tension at the anterior abdomen. This series of process can stabilize the chest fixed and stable condition.

Figure 1-C shows the mechanism by which the rotation of the chest affects the pelvis (lower lumbar). The slight rotation of the chest in the rearward direction causes the lower lumbar to rotate slightly in the forward direction. Then, the axis of the pelvis is slightly tilted forward. As a result, the hamstrings behind the thigh are stretched and tensioned. This allows bilateral legs to open smoothly back and forth, increasing running stride. For example, Japanese martial arts experts and some top athletes can recognize delicate movements of the body and can make loose of the sternocostal joints and sacroiliac joints [12]. Furthermore, they can make fine movements by moving the left or right pelvis slightly shifted [12].

On the other hand, the body can be bent in bilateral direction straightly to right or left. Then, the flank in one side receives expansion, and the opposite flank receives contraction. On the extended side, the distance between ribs and pelvis becomes wide. Simultaneously, the trunk muscles become softer and move larger [13].

As described above, the posture can be kept straight in the upright position by the connection of the trunk. The intra-abdominal pressure (IAP) can be increased by abdominal breathing, with possible awareness of the lower abdomen. Then, the lumbar spine and the pelvis are firmly fixed, and the trunk is tightly hold and strengthened. Consequently, the trunk has been connected with three spheres. When the femur and the tibia are located directly just below the rigid trunk, the body can be maintained in a well-balanced, upright position on the straight skeleton without exerting any force. This posture means a good and natural standing position [14]. At that time, the gravity center of the body is situated at the position directly below the tibia (UNA) [15].

The word UNA stands for U: uchi (medial) + NA: naka (inside) in Japanese [15]. UNA is situated just below the tibia [16]. When a man is standing upright with completely relaxed posture, the center of the gravity of the body is on the UNA [15-17]. UNA is situated in the center of the three arches in the foot [15-17]. Consequently, UNA has been important to discuss the posture of the man.

When the posture of the body is adjusted by these three chain movements, the head, chest, lower lumbar and pelvis are connected, and the body axis (gravity center) can be strengthened [17]. Consequently, the reaction force obtained from the ground has been transmitted to the whole body without loss. At this point, the subject feels some tension in the abdomen when the pelvis is at an upright position. Therefore, appropriate muscle tension has been present in the iliopsoas muscle and the hamstring. Successively, the legs can be smoothly bent and extended, and then the power is transmitted smoothly.

In summary, authors presented an idea of three circles or spherical surfaces, which means head, chest and pelvis. They show mutually connecting relationships, which bring us delicate and minute movements. As future tasks, it will be necessary to investigate the fluctuation in each sphere, the interacting movements in the three spheres three-dimensionally and the differences in movement in other sports. We hope that this article will become some reference for further research development.

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