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Editorial

Clinical Lumbar Instability: Part I

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Low Back Pain (LBP) continues to be a major health problem and economic burden worldwide [1]. The heterogeneous condition of LBP is categorized into subgroup. One significant subgroup of LBP is clinical lumbar instability [2-4]. It has been reported abnormal increase in intersegmental motion of the lumbar spine during movements on patients with clinical lumbar instability [2,5,6]. Increased movement of motion segment could provoke pain, functional disability and alter trunk muscle activations [7]. However, clinical lumbar instability is often in the absence of radiological findings [8]. Consequently, clinical criteria using the common signs or symptoms are useful for diagnosing clinical lumbar instability [9-12].

This letter serves to describe concept of stability of lumbar spine, overview of lumbar instability, and definition of clinical lumbar instability.

Concept of Stability of Lumbar Spine

Panjabi (1992a) [4] proposed a model of a spinal stabilization system representing by three stabilizing subsystems. These subsystems comprise of the passive subsystem, active subsystem and neural control subsystem. Spinal stability is provided by the proper functioning and interaction of all subsystems. The passive stabilizing subsystem is comprised of vertebral bodies, intervertebral discs, facet joints, facet joint capsules, vertebral ligaments (anterior longitudinal ligament, posterior longitudinal ligament, ligamentumflavum, interspinous ligaments, supraspinous ligaments and passive mechanical tension from the spinal muscles [4]. The passive stabilizing subsystem plays an important stabilizing role that provides passive resistance toward the end range of movement in order to resist spinal excessive movement [4].

The active stabilizing subsystem is comprised of the spinal muscles surrounding the spinal column and their tendons [4]. This subsystem provides mechanical stability for loads exceeding 1,500 Newton (N) [13]. It is a major dynamic stabilization to generate forces to support the spinal segments [14]. The global muscle system consists of rectus abdominis, external abdominal oblique and iliocostalislumborum pars thoracis muscles. As these muscles do not directly attach to the lumbar spine, they are not capable of having an influence on the lumbar spinal segments. These muscles act as mobilizing muscles which demonstrate non-continuous activation to produce general gross trunk stabilization and generate large torque for trunk movement as well as spinal compression [15]. They are also important for shock absorption of the loads [16] and balancing external loads [17]. However, these muscles control spinal orientation and movement by their activations in a directional specific response [14]. On the other hand, the local muscle system consists of transversusabdominis, lumbar multifidus, posterior fibers of internal oblique, quadratuslumborum and diaphragm muscles. These muscles directly attach to the lumbar vertebrae that provide the lumbar segmental stability and directly control each segment of the lumbar spinal column. They act as the local stabilizing muscles that control intersegmental motion, and maintain mechanical stiffness of the spine by increasing stiffness. Moreover, the local muscle system activity is independent of directional movement and continuously actives through the movement [16]. Therefore, it plays an important role in providing dynamic stability to the lumbar spinal segments.

The neural control subsystem has the complex task of receiving the proprioceptive afferences from mechanoreceptors that present in the passive stabilizing subsystem (vertebral ligaments, intervertebral discs and facet joint capsules) and active stabilizing subsystem (muscle spindles and Golgi tendon organs) to determine the specific requirements for maintaining spinal stability and lastly, adjusting and generating the coordination and activation of the stabilizing muscles depending on the mechanical spinal stability needed [18,19,4].

Overview of Lumbar Instability

In 1951, Barr was the first author who raised the concept of lumbar instability. He stated that the genesis of LBP is often related to mechanical lumbar instability of the degenerative intervertebral disc condition. The loss of intervertebral disc height was described to increase vertebral segmental movement resulting from decreased passive stabilizing system restraints [20]. The concept of [20] was supported by Kirkaldy-Willis and [3] who proposed the degenerative cascade of spinal structures, especially facet joints and intervertebral discs in terms of laxity of ligaments and facet joint capsules, and decreased intervertebral disc contents. It also involves the muscle system which

is described later. Many years later, the basic concept of lumbar instability is defined by [4] as abnormal or excessive movement beyond the normal movement of the lumbar motion segment. It may present this response due to damage to the constrained structures including ligaments and/or muscles that establish the spinal stability [21]. This state causes a painful sensation and progressive deformity. In addition, neural structures may be at risk [22].

Lumbar instability can be classified into two types: radiological and clinical [23]. Radiological lumbar instability is typically diagnosed by using flexion-extension radiographs of the lumbar spine [2,24,25]. Although the etiology of radiological lumbar instability is controversy, several authors proposed the association between intervertebral disc degeneration and radiological lumbar instability, supporting Kirkaldy-Willis and Farfan' s concept [26-29] described that intervertebral disc degeneration results in laxity of the ligament responsibility for binding the adjacent vertebrae together and leads to superoinferior partial subluxation of the facet joints, which may be asymmetric form side to side. Frequently subsequent stresses on the facet joints cause osteoarthritis with traction osteophyte and produce abnormal hypermobility of the affected motion segment. Besides, collision of the apex of superior articular process with pars interarticularis and pedicle causes by partial subluxation of the facet joint. Hence, flexion-extension radiographs can show slippage of the affected vertebrae on the adjacent one [25].

Some studies suggested that a gold standard for diagnosing radiological lumbar instability includes the stiffness assessment of vertebral column during surgery or external fixation that is not applicable in real clinical situation. [30,31]. Consequently, the clinical relevance of radiographic evidences, including Magnetic Resonance Imaging (MRI) and X-rays, for diagnosing radiological lumbar instability has been proposed [25,27,28]. MRI is generally considered to be the most accurate imaging method for diagnosing lumbar degeneration except for the vacuum phenomenon of intervertebral disc [29]. However, MRI is very costly and may be not available in general hospitals. X-ray including neutral and flexion-extension radiographs are commonly used in the imaging diagnosis for lumbar instability [2,3] because of its simplicity, low expense and wide availability. Furthermore, a radiography showed significant correlation with MRI for assessment of intervertebral disc degeneration ($R^2 = 0.642$) [32]. A neutral radiograph of radiological lumbar instability can show vacuum phenomenon [24] and traction osteophyte [26]. For flexion-extension radiograph, many orthopedic surgeons using it investigate disclose abnormal intersegmental motion before diagnosis and deciding on spinal fusion [29].

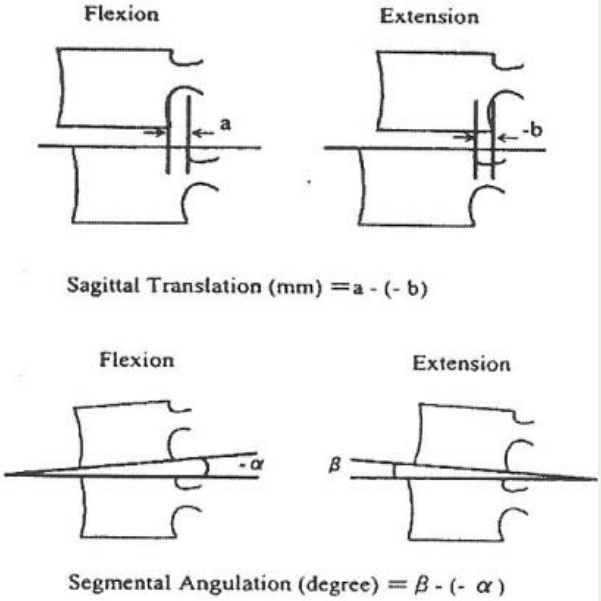

Figure 1: Method for measurement of sagittal translation and sagittal rotation of the spine.

White and Panjabi [25] defined threshold of radiological lumbar instability as cases of sagittal translation larger than 4.5 mm or larger than 15% of the vertebral body width when comparing with other, or sagittal rotation of larger than 15° at L1-L2, L2-L3 or L3-L4, 20° at L4-L5 or 25° at L5-S1. The measurement method is shown in (Figure 1). It is an obvious radiological displacement of vertebral segment which may cause mechanical deformation of intraspinal nerve tissues and thereby is often associated with neurological deficit and major deformity [33,9]. Some authors might call radiological lumbar instability as spondylolisthesis [34,29]. Radiological lumbar instability can be addressed via spinal fusion [35,36] however, instability of above a fusion level is reported that the incidence was 6.5 after spinal fusion [37] and it is a high cost method. On the other hand, clinical lumbar instability should be distinguished [38].

Definition of Clinical Lumbar Instability

Several authors have attempted to propose definitions of clinical lumbar instability based on the background of individuals [25,26]. Nevertheless, the definition of clinical lumbar instability by [25] has been commonly used. It is the inability of the spine to maintain its normal patterns of displacement under physiologic loads so there is, at rest, no initial or additional neurologic deficit, no major deformity, and no incapacitating pain [25]. But, these deficits or symptoms may occur during movement or provocation tests. During flexion and extension of the lumbar spine, sagittal translation demonstrates by excessive displacement of one vertebra on the below one and sagittal rotation demonstrates by a change of the angle when measured between the adjacent vertebral end plates at each intervertebral disc [22]. It is more challenging to diagnose and may involve discrepancies in radiological findings [4]. Because of traditional radiographs concentrate on end range of movement while clinical lumbar instability may present abnormally excessive movement in mid-range or through range of movement where is observed the specific clinical symptoms of clinical lumbar instability [2,5,6]. Negative findings using traditional radiographs are often observed in patients with clinical lumbar instability [39,40]. Recently, radiography in mid-range of motion has been believed as a method for differentiating between radiological lumbar instability and healthy.

Several tests have been used to identify clinical lumbar instability however clinical tools that are specific and sensitive still need to be develop in order to assist therapists' ability to diagnose clinical lumbar instability.

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