

‘Lumbar Degenerative Kyphosis’ Is Not Byword for Degenerative Sagittal Imbalance : Time to Replace a Misconception

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Lumbar degenerative kyphosis (LDK) is a subgroup of the flat-back syndrome and is most commonly caused by unique life styles, such as a prolonged crouched posture during agricultural work and performing activities of daily living on the floor. Unfortunately, LDK has been used as a byword for degenerative sagittal imbalance, and this sometimes causes confusion. The aim of this review was to evaluate the exact territory of LDK, and to introduce another appropriate term for degenerative sagittal deformity. Unlike what its name suggests, LDK does not only include sagittal balance disorder of the lumbar spine and kyphosis, but also sagittal balance disorder of the whole spine and little lordosis of the lumbar spine. Moreover, this disease is closely related to the occupation of female farmers and an outdated Asian life style. These reasons necessitate a change in the nomenclature of this disorder to prevent misunderstanding. We suggest the name “primary degenerative sagittal imbalance” (PDSI), which encompasses degenerative sagittal misalignments of unknown origin in the whole spine in older-age patients, and is associated with back muscle wasting. LDK may be regarded as a subgroup of PDSI related to an occupation in agriculture. Conservative treatments such as exercise and physiotherapy are recommended as first-line treatments for patients with PDSI, and surgical treatment is considered only if conservative treatments failed. The measurement of spinopelvic parameters for sagittal balance is important prior to deformity corrective surgery. LDK can be considered a subtype of PDSI that is more likely to occur in female farmers, and hence the use of LDK as a global term for all degenerative sagittal imbalance disorders is better avoided. To avoid confusion, we recommend PDSI as a newer, more accurate diagnostic term instead of LDK.

Key Words : Sagittal · Imbalance · Lumbar · Degenerative · Kyphosis · Flat-back.

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INTRODUCTION

Lumbar lordosis is unique to the human spine and develops as an adaptation that facilitates the upright posture. Sagittal spinal alignment with intact sagittal balance enables humans to walk in an upright posture with minimum power¹⁹. However, decreased lumbar lordosis and increased thoracic kyphosis are hallmarks of an aging human spinal column²¹. Loss of lordosis causes irregular weight distribution on the spine. The resulting increased energy expenditure required to maintain the erect position aggravates back pain and loss of lordosis¹¹. The impact of sagittal plane alignment on the treatment of spinal disorders is of critical importance. Failure to recognize malalignment in this plane can have significant consequences for the patient, not only in terms of pain and deformity, but also in terms of decreased social interaction due to deficient forward gaze²⁰. Awareness of sagittal balance, even when addressing problems in the coronal plane, is necessary to avoid future complications²⁰.

With an aging society, adult degenerative deformity has become one of the most notable topics of spinal disorders owing to its significant impact on health related quality of life²⁴. Lumbar degenerative kyphosis (LDK), a sagittal plane malalignment disease, was first described by Takemitsu et al.²³, and is caused by unique life styles such as the prolonged crouched posture during agricultural work and performing activities of daily living on the floor, as shown in Fig. 1¹⁶. Previous papers reported that LDK was frequent only in the farming districts of ‘oriental’ countries such as Korea and Japan^{14,16,23}. Patients with LDK usually show extensive degenerative changes of the lower lumbosacral discs and facet joints from L2 to S1 levels, and atrophy and fatty changes of the lumbar extensor muscles¹⁶. LDK has been the subject of numerous publications in Korea and Japan; however, meaningful progress toward understanding the pathogenesis of this disease has been limited^{14,16,23}.

Although the life style of these countries has changed to be similar to that of western countries, the number of patients with LDK in Korea and Japan has not decreased. In fact, the incidence of diseases mimicking LDK has recently been increasing in western countries^{1,3,8,12}. With a rising prevalence, adult degenerative sagittal deformity is emerging as a major health care issue of the 21st century³. This increase cannot be directly attributed to the long hours spent in the crouched



Fig. 1. A photograph showing female farmers working in a crouched posture on the ground in a farming district in Korea. This photograph is courtesy of Korea Agency of education, promotion and information service in food, agriculture, forestry and fisheries.

posture while performing agricultural work, but rather to the increase in the number of elderly patients and other sagittal imbalance diseases. Unfortunately, LDK has been used as synonym for degenerative sagittal imbalance, sometimes resulting in confusion. The aim of this review was to evaluate the exact territory of LDK and to introduce another appropriate term for degenerative sagittal deformity.

‘Lumbar degenerative kyphosis’: Is it a misnomer?

In 1988, Takemitsu et al. introduced the name “lumbar degenerative kyphosis” which included kyphosis or a marked loss of lordosis in the lumbar spine caused by degenerative changes in the middle-aged and elderly²³. Unlike what its name suggests, “lumbar” of LDK does not clearly explain the disease entity because the sagittal balance of the thoracic spine is also included in the diagnostic criteria. Takemitsu and colleagues divided LDK into four types by spinal curvatures as shown in Table 1. The detailed description of each type of LDK does not encompass the lumbar spine only, but also the thoracic spine. Moreover, the illustration of LDK types by Takemitsu et al. showed sagittal alignment of the whole spine as depicted in Fig. 2²³. The sagittal balance of the thoracic spine is very important in the pathophysiology of degenerative sagittal imbalance because the loss of normal lordosis in the lumbar spine is compensated by the thoracic curve and sacral slope⁹. “Kyphosis” of LDK gives the impression that LDK in-

Table 1. Types of ‘lumbar degenerative kyphosis’ by Takemitsu et al.²³⁾

Type	Lumbar spine	Thoracic spine
1	Little lumbar lordosis	Marked loss of thoracic kyphosis
2	Slight lumbar kyphosis	Slight lordosis in the thoracic region
3	Increased lumbar kyphosis	Varying degree of thoracic lordosis
4	Lumbar kyphosis	Enlarged thoracic kyphosis

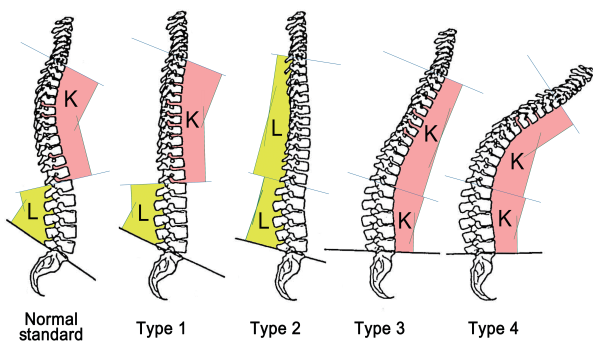


Fig. 2. Classification of the 4 types of ‘LDK’ with illustration of each type. These images were quoted from Takemitsu et al.²³⁾. LDK : lumbar degenerative kyphosis. L : lordosis, K : kyphosis.

cludes only kyphosis in the spine. However, type 1 LDK includes “little lumbar lordosis”. Moreover, keywords of the disease such as a female predilection, work in crouched posture, and extensor muscle atrophy are not included in the diagnostic criteria. Strictly speaking, the ‘LDK’ as named by Takemitsu et al.²³⁾ is an agriculture-related disease of elderly Asian females, and this nomenclature needs to be changed to a more comprehensive term to prevent misunderstanding.

New appropriate name of degenerative spinal disease with sagittal imbalance

Adult sagittal plane spinal deformity is diagnosed in adult patients when it occurs or becomes relevant after skeletal maturity with loss of lumbar lordosis, and is divided into sagittal deformity unknown cause and secondary sagittal imbalance depending on the cause, as noted in Table 2²⁾. The sagittal deformity unknown cause is also divided into late onset (≥ 60 years of age) and adolescent onset deformities depending on age of onset²⁴⁾. Instead of LDK, we suggest the name “primary degenerative sagittal imbalance” (PDSI), which includes degenerative sagittal misalignments of the whole spine of un-

Table 2. Subtypes of adult sagittal spinal deformities

Type	Description
Type I	Primary (de novo) degenerative sagittal imbalance
Type II	Adolescent idiopathic sagittal imbalance
Type III	Secondary sagittal imbalance
IIIA	Due to bone metabolism abnormalities
IIIB	Due to trauma
IIIC	Due to iatrogenic causes or post-fusion
IIID	Due to dysplasia and neuromuscular

known origin, and is associated with back muscle wasting. We propose the following diagnostic criteria for PDSI : 1) C7 sagittal vertical axis ≥ 5 cm, 2) pelvic incidence – lumbar lordosis $\geq 15^\circ$, and 3) pelvic tilt $\geq 25^\circ$. Evaluation of the paraspinal musculature is also considered when assessing magnetic resonance images of the lumbar spine. Measurement of the cross-sectional area, visual grading of fatty atrophy, and assessment of the fascia may help the physician and radiologist reach a more confident diagnosis for the patients with clinically suspected PDSI¹⁰⁾.

Previous studies called this syndrome of loss of lumbar lordosis or flat back “fixed sagittal imbalance (FSI)”^{1,4,5,26)}, degenerative sagittal imbalance⁴⁾, LDK²³⁾, or “primary sagittal deformity”²⁵⁾. FSI as defined by Bridwell and colleagues was a syndrome in which the patient is unable to stand up erect without flexing the knees and hips, characterized by degenerative changes, and may refer to only a severe form of PDSI^{5,6)}. Those classified as degenerative sagittal imbalance defined by Bridwell and colleagues were patients with previous surgeries for spinal stenosis and degenerative disc disease without any coexistent scoliosis or traumatic kyphosis⁴⁾. With regard to iatrogenic sagittal imbalance, Doherty⁷⁾ first described a symptomatic fixed and forward inclination of the trunk due to loss of normal lumbar lordosis following posterior instrumented fusion surgery in 1973, and Moe and Denis⁸⁾ referred to this condition with the term “flat-back syndrome”, as a variant clinical manifestation due to fixed sagittal imbalance resulting from iatrogenic loss of lumbar lordosis. We suggest the term degenerative sagittal imbalance subtype IIIC, to highlight the cause of sagittal imbalance.

Treatment of PDSI

Patients diagnosed with PDSI are usually elderly females

showing lower lumbar multi-level disc and facet degeneration, poor bony quality, and atrophy and fatty degeneration of the psoas and paraspinal extensor muscles²⁴. Therefore, conservative treatments such as exercise and physiotherapy including backpack wearing are recommended as first line treatment¹⁷. Surgical treatment of PDSI is considered in patients who complain of walking difficulty or have intractable pain in the lower back and both legs with severe sagittal imbalance (kyphotic deformity) not responding to conservative management^{14,16,17}. Other surgical indications described in previous studies were 1) marked atrophy of the back musculature on radiographic examination, 2) no severe osteoporosis, and 3) a strong will to undergo surgical treatment^{14,15,22,23}.

Some authors described other surgical indications of PDSI which were quoted by Lee et al.¹⁴ These include notable clinical features referred to as the “four cardinal signs”, such as difficulty in walking due to forward stooping of trunk, inability to hold things in front of themselves, support with elbows in order to wash dishes or faces, and difficulty in climbing slopes^{15,16}. However, the original paper¹⁴ that they quoted reported that these were common cardinal symptoms rather than surgical indications, and the surgical indications described were age ≤ 65 years, ability to work, no response to conservative management, no severe osteoporosis, and a strong desire to undergo surgical treatment.

There is a growing interest in the use of spinopelvic parameters to predict outcomes in patients with degenerative spinal diseases¹³. The measurement of radiographic pelvic and spinal parameters for sagittal balance analysis has gained importance in reconstructive surgery of the spine, particularly in degenerative spinal diseases¹³. A clear understanding of the principles of sagittal balance is vital to achieve optimum outcomes when treating spinal disorders²⁰.

CONCLUSION

The LDK named by Takemitsu et al.²³ is likely a female farmers' (occupational) spinal disease with sagittal imbalance. Using LDK as a synonym for all degenerative spinal diseases with sagittal imbalances had better be avoided. To avoid confusion, we recommend using PDSI as a new name with an accurate conception instead of LDK. Surgical treatment of PDSI is considered in patients with walking difficulty and intractable pain.

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