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REVIEW ARTICLE

Lumbar degenerative spondylolisthesis epidemiology: A systematic review with a focus on gender-specific and age-specific prevalence

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Summary The epidemiology of lumbar degenerative spondylolisthesis (DS) remains controversial. We performed a systematic review with the aim of gaining a better understanding of the prevalence of DS in the general population. The results showed that the prevalence of DS is very gender- and age-specific. Few women and men develop DS before they are 50 years old. After 50 years of age, both women and men begin to develop DS, with women having a faster rate of development than men. For elderly Chinese (≥ 65 years, mean age: 72.5 years), large population-based studies MsOS (Hong Kong, females: $n = 2000$) and MrOS (Hong Kong, males: $n = 2000$) showed DS prevalence was 25.0% in women and 19.1% in men. The female:male (F:M) prevalence ratio was 1.3:1. The published data for MsOS (USA) and MrOS (USA) studies seem to show that elderly Caucasian Americans have a higher DS prevalence, being approximately 60–70% higher than elderly Chinese; however, the F:M prevalence ratio was similar to the elderly Chinese population. Patient data showed that female patients more often received surgical treatment than male and preliminary data showed the ratio of female to male patients receiving surgical treatment did not differ between Northeast Asians (Chinese, Japanese, and Korean), Europeans, and American Caucasians, being around 2:1 in the elderly population. The existing data also suggest that menopause may be a contributing factor for the accelerated development of DS in postmenopausal women.

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The translational potential of this article is that a better understanding of the epidemiology of lumbar degenerative spondylolisthesis can support patient consultation and treatment planning.

Introduction and basic concepts

Degenerative spondylolisthesis (DS) is a disorder that causes the slip of one vertebral body over the one below due to degenerative changes. It differs from spondylolytic spondylolisthesis by the absence of a pars interarticularis defect (spondylolysis), i.e., in DS, the whole upper vertebra (vertebral body and posterior part of the vertebra including neural arch and processes) slips relative to the lower vertebra. Both DS and spondylolytic spondylolisthesis are commonly seen as incidental findings in asymptomatic patients. A good understanding of the natural history of these conditions is important to counsel patients and determine a course of action. The plain radiographic features include the essential finding of spondylolisthesis on a lateral view of forward (or backward) displacement of L4 on L5 or, less commonly, L5 on S1 or L3 on L4 in the presence of an intact neural arch. The "listhesis" is a rotary deformity and not a simple forward (or backward) displacement [1]. Radiograph can also show small compensating curves in the upper lumbar and lower thoracic spine [1]. The major local reasons of DS that probably lead to the development of degenerative vertebral slippage are: (1) arthritis of the facet joints with loss of their normal structural support; (2) malfunction of the ligamentous stabilizing component, probably due to hyperlaxity; and (3) ineffectual muscular stabilization [2–7]. Disc degeneration leads to segmental instability in the sagittal plane and may also result in DS [8]. Pregnancy and sports activities are also associated with DS [9–14].

Separation of the pars interarticularis can occur when spondylolysis is present (Figure 1). Spondylolysis can be congenital or caused by a stress fracture of the bone and is especially common in adolescents who overtrain in sports activities [2, 12–14]. The pars interarticularis is vulnerable to fracture during spinal hyperextension, especially when combined with rotation or when experiencing a force during landing. This stress fracture most commonly occurs where the concave lumbar spine transitions to the convex sacrum (L5–S1). A significant number of individuals with spondylolysis will develop spondylolisthesis, accounting for 50–81% of this particular population. It is believed that both repetitive trauma and an inherent genetic weakness can make an individual more susceptible to spondylolysis [15,16].

After degenerative changes unlocked the intervertebral joint, the vertebral body slipping occurs along a direction that roughly depends on two factors: (1) the symmetry of facet joint lesions, and (2) the distribution of weight-bearing forces. When facet joint subluxation is symmetric, slipping is mainly sagittal, but with asymmetric subluxation, a rotatory displacement also occurs. Defects of the pars interarticularis seen on lateral or bilateral oblique views help to distinguish between DS and isthmic spondylolisthesis. Additional findings include disc space narrowing, endplate sclerosis, peridiscal osteophytes, facet sclerosis, and hypertrophy. In the last stage, osteophytes and advanced disc space narrowing lead to restabilization of the intervertebral level with decrease or disappearance of the range of movement [17,18].

The natural course of spondylolysis and spondylolisthesis has been studied [19–21]. A prospective study was initiated in 1955 with a radiographic and clinical study of 500 first-grade children. A total of 22 individuals of 6 years of age were found to have a lytic defect of the pars interarticularis, giving a rate of 4.4%. Thirty adult individuals consisting of 10 females and 20 males (F:M ratio 1:2) were found to have pars lesions with a prevalence rate of 6%. Of the 30 individuals, 22 had bilateral L5 pars defects and 8 individuals had unilateral defects. All bilateral pars defects were at L5. Over the course of the study, spondylolisthesis developed in 18 of the 22 individuals with bilateral L5 lesions (spondylolisthesis prevalence = 18/500 = 3.6%). The average slip was 11% for all individuals with initial spondylolisthesis. The average slip in the 1999 studies for this group was 18%. There appeared to be a marked slowing of

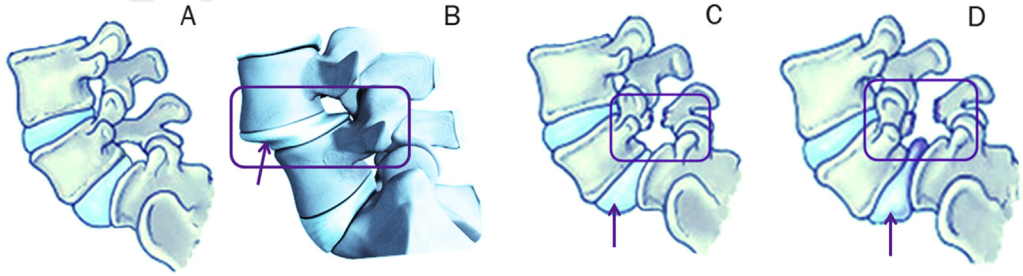

Figure 1 (A) Normal anatomy L5/S1; (B) degenerative spondylolisthesis of L4/L5; and (C,D) different extents of spondylolytic spondylolisthesis of L5/S1.

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