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Degenerative Spondylolisthesis: A Narrative Review

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Abstract. Degenerative spondylolisthesis (DS) is a condition leading to the slippage of one vertebral body over the one below due to degenerative changes resulting in spinal stenosis and producing neurogenic claudication, with or without low back pain. DS prevalence is age and gender specific. Other risk factors mainly include a history of occupational driving, intense manual activity and sedentary work. Diagnosis for patients with DS include detailed history, physical examination and imaging through standing lateral radiographs and MRI. Most patients with symptomatic DS and absence of neurological deficits should perform better with conservative treatment, whereas, patients with neurological symptoms, are more prone to undergo progressive functional deterioration without surgery. There is a lack of agreement on the best surgical management in patients with DS and symptomatic stenosis. There is a contradictory data that does not permit for a recommendation for or against the addition of fusion to decompression. There is also controversy on which fusion technique is best. Spinal minimally invasive surgery is a promising approach for DS promoting early recovery and enhanced quality of life by reducing skin incision, muscular damage and perioperative pain with significant improvements in clinical results and high satisfaction rates. (www.actabiomedica.it)

Key words: Degenerative spondylolisthesis, decompression, fusion, spinal stenosis, pedicle screw

Introduction

Spondylolisthesis derives from the Greek words spondylos which means vertebra and olisthesis which means slipping forward (1). There are many mechanisms that can cause spondylolisthesis, and Marchetti and Bartlozzi has been described a classification system (2). The aim of the present narrative review is to focus on degenerative spondylolisthesis (DS). DS is a condition leading to the slippage of one vertebral body over the one below due to degenerative changes, with an intact neural arch, resulting in spinal stenosis and a typical manifestation of neurogenic claudication, with or without low back pain (2).

DS prevalence has been shown in a systematic analysis as being very age and gender specific (3). The ratio between women and men is 6:1, which appears to be common among people over 50 years of age (3). Kobayashi et al. (4) reported a prevalence of DS of 2.1% in males and 8.1% in females and Wang et al. (3) showed a prevalence of 19.1% in males and 25.0% in females. Most DS cases are L4-L5 or less usually L5-S1 or L3-L4 (1, 3). DS rarely exceeds Grade II (5).

The main local causes likely contribute to the formation of DS are: disc degeneration causing segmental instability; arthritis of the facet joints; ligamentous stabilizing component failure, and inadequate muscular stabilization (3).

Many studies in the literature demonstrated that surgical management improves pain and quality of life in patients affected by DS with persistent pain, radicular symptoms, cauda equina syndrome and high functional demands that are refractory to conservative management (6, 7). Recently, there has been a growing interest in minimally invasive surgery (MIS), owing to its many benefits over the traditional open approach such as shortened length of operation and reduced perioperative complications, thus facilitating early recovery, quicker return to work and enhanced quality of life (8-10). Unlike the traditional posterior midline approach,

this technique avoids damaging the posterior midline muscle-ligament structures, which play a role in spine stability, leading to improved clinical outcomes (9, 11).

Risk factors

Many risk factors leading to the development of DS has been reported in the literature. In both sexes, the incidence of DS increases with age (7). Studies, in fact, shown that the feature alterations are uncommon below 50 years of age but the prevalence grows rapidly with age affecting up to 15% of men and 50% of women aged 66–70 years (12). Owing to ligamentous hyperlaxity and hormonal influences it is more often observed in females (2). Wang et al. (3) reported that menopause can lead to increased development of DS.

In a cross-sectional population analysis (12) it has been found that a history of occupational driving (>4h/day) and intense manual activity in the agricultural/fishing sector were correlated with radiographic spondylolisthesis. There is a likely increased risk of developing DS from sedentary work and decreased risk from work requiring walking or climbing slopes or steps.

In a prospective study Aono et al. (13) followed 142 women without baseline deformity and found that high pelvic incidence (PI), L4 inclination angle (IA), modified vertebral size and facet joint (FJ) orientation in the sagittal plane were all indicators of the development of DS. Similarly, Guo et al. (14) demonstrated that greater L4 IA (>11.15°) , more sagittal FJ (>60.19°) , and more severe degeneration of FJ were significant indicators of DS. Also Nakamae et al. (15) reported that high PI (>45°) and lumbar lordosis (51.3°) are significant indicators for DS.

Diagnosis

Diagnostic strategy for patients with DS starts with thorough history and physical assessment (16). Symptom of DS may be associated either with spinal stenosis causing leg symptoms or with mechanical low back pain (2). Extension positions of the spine are problematic for patients with spinal stenosis, while symptoms are quickly improved by spinal flexion (2). Any combination of low back pain, hamstring spasm, neurogenic claudication, and radiculopathy can be encountered in patients suffering DS (3).

Imaging is used to confirm a clinical diagnosis and provide evidence for assessing the extent of DS (16). The standing lateral radiograph is the most reliable, non-invasive test for diagnosing DS (17). Moreover, many surgeons determine the degree of lumbar instability in DS using flexion-extension radiographs (3). MRI is indicated when neurological symptoms and signs are present for detecting the presence of spinal stenosis accompanying DS (16), while CT is a useful noninvasive test in patients with MRI contraindication, when MRI findings are inconclusive or there is a poor association between symptoms and MRI findings (17).

Classification

The most used radiographic classification for DS was proposed by Meyerding. In this classification: Grade I defines a slippage of 0-25% of the vertebral body, grade II defines a slippage of between 25% and 50%, grade III defines a slippage of between 50% and 75%, grade IV defines a slippage of between 75% and 100% and grade V defines slippage of the entire vertebral or spondyloptosis. The majority of DS cases will represent grade I or II (1, 2).

Natural history

Most patients with symptomatic DS and a lack of neurological deficits should perform better with conservative treatment, whereas, patients with sensory changes, muscular weakness, or syndrome of cauda equina, are more prone to undergo progressive functional deterioration without surgery (17). Slippage progression becomes less possible when the disc has lost more than 80% of its initial height and when intervertebral osteophytes have developed (17). Finally, There is no association between clinical symptom changes and DS radiographic progression (3).

Treatment

Nonoperative treatment for patients with no neurogenic claudication or radiculopathy and stable low grade DS is usually recommended as first-line therapy (18). Conservative procedures involve activity modification, bracing, physiotherapy, nonsteroidal antiinflammatory medications, epidural steroid injections, strength/postural training, and core training to regain range of motion and stabilize the spine (7, 18). There is data suggesting, in contrast to extension-based exercises, that flexion exercises provides better pain reduction and functional improvement (1).

Surgical intervention can be recommended for managing symptomatic spinal stenosis combined with low-grade DS in patients that have been refractory to conservative therapy for at least 3 to 6 months (1). Data suggests the surgical management of DS and spinal stenosis leads to better clinical outcomes compared to nonsurgical management (10). Indeed, randomized controlled trials, including the Spine Patient Outcomes Research Trial, have found that surgical management enhances pain and function in patients with symptomatic DS relative to nonoperative management (19). Weinstein et al. (7) observed that patients with DS and spinal stenosis treated surgically demonstrated considerably higher pain and function improvement over a span of 2 years compared to non surgically treated patients.

Surgical procedures for DS include decompression alone and decompression with non instrumented or instrumented fusion (20). There is, however, a lack of agreement on optimal surgical management in patients with DS and symptomatic stenosis (21).

Adding fusion to decompression for DS can lead to higher clinical outcomes and lower reoperation rates, though this is not consistent with all available evidence (10). Martin et al. (22) carried out a systematic review to determine if adding fusion to decompression is an advantage over decompression alone for patients with DS and found that fusion is much more likely to produce a satisfactory clinical outcome than decompression alone. Whereas, Försth et al. (23) found in a randomized controlled trial, that in patients with spinal stenosis, with or without DS, decompression and fusion did not yield improved clinical outcomes at 2 years and 5 years compared with decompression alone. Thus, there is a contradictory data that does not permit for a recommendation for or against the addition of fusion (10). Some clinicians therefore favor decompression alone especially for elderly patients with stable low grade DS and prevalent leg pain due to the lower morbidity and mortality related to the treatment (1). But, not every case of DS can be treated with decompression alone. Patients with low-grade DS and foraminal stenosis or vertebral instability can benefit from concomitant fusion (21). In addition, low back pain may be induced by spinal segment instability, hence fusion is needed to stabilize the affected segment. Finally, iatrogenic instability may happen if extended decompression is done needing an instrumented fusion of the segment (24).

There is also controversy on which fusion technique is best. Martin et al. (22) found that adding instrumented fusion to decompression in patients affected by DS and stenosis significantly improved the probability of achieving solid fusion, however there was no substantial difference in the clinical outcome relative to non instrumented fusion. Chan et al. (10) found that supplementing fusions with pedicle screw fixation contribute to a substantial variation in successful fusion rates in favor of instrumentation, although this is not correlated to better clinical outcomes.

Long-term benefits of adding instrumented posterior fusion with interbody to posterolateral lumbar fusion (PLF) with pedicle screws are also inconclusive (25). Kelly et al. (26) performed a retrospective study to assess the results of patients with DS treated by decompression and PLF with pedicle screw fixation versus decompression and PLF with transforaminal lumbar interbody fusion (PLF + TLIF) finding that adding a TLIF to a PLF did not yield to a functional improvement in the treatment of DS. Similarly in a retrospective review, Gottschalk et al. (27), compared the clinical, radiographical, and cost of adding an interbody fusion (IBF) to a PLF in the treatment of L4–L5 DS and found that adding IBF to PLF added expense while achieving comparable results in fusion rates and clinical scores when compared with PLF alone.

Spinal minimally invasive surgery (MIS) is widely utilized, because it promotes early recovery

and enhanced quality of life by reducing skin incision, muscular damage and perioperative pain (28), and it has been shown that MIS has similar clinical results with open fusion, at a reduced price, shorter surgical duration, decreased blood loss, and shorter hospital stay (10). Lateral access surgery (LAS) for DS is a minimally invasive fusion technique that has become increasingly popular. Xu et al. (29) conducted a study to identify the clinical outcome following LAS and posterior pedicle screws fixation in 52 patients with DS. They observed that back and leg pain decreased by 80.3% and 83.0%, respectively and Oswestry Disability Index and North American Spine Society score increased by 76.2% and 75.9%, respectively. Excellent/good satisfaction was reported by 90% of patients. They concluded that LAS is a successful therapy for DS with significant improvements in clinical results and high satisfaction rates. MIS, although, is not appropriate for all patients because anatomic factors such as morbid obesity and surgical requirements such as the necessity for extended bilateral decompression can prevent the use of MIS (10).

Conclusions

DS is defined as the slippage of one vertebral body over the one below due to degenerative changes. It's more common in women over the age of 50 years. The slippage is best seen on standing lateral radiographs while the degenerative changes are best seen on MRI. Evidence suggests that surgical management of DS and spinal stenosis leads to better clinical outcomes compared to non surgical management but there is a lack of agreement on optimal surgical approach.

Conflict of interest: The author declares that he has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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