

High-Grade Spondylolisthesis (Meyerding Grades III-IV)

A patient guide

In brief: High-grade spondylolisthesis describes the forward slippage of one vertebra over the one below it by more than half of the width of the underlying vertebral body, corresponding to Meyerding grades III and IV. It is a distinct entity from the far more common low-grade disease (grades I and II), and it is the deformity and the disturbance of sacro-pelvic balance, rather than the percentage of slip alone, that come to dominate the clinical picture. In the overwhelming majority of cases the slip occurs at the junction between the fifth lumbar vertebra and the sacrum (L5-S1). High-grade slips carry a materially higher neurological risk than low-grade ones, both from the deformity itself and from any attempt to correct it surgically, and the questions that surround management are categorically different from those that apply to low-grade disease. This page describes high-grade spondylolisthesis and the evidence that surrounds its assessment and treatment. It is intended as general information and not as medical advice. Spondyloptosis (Meyerding grade V, a slip exceeding one hundred per cent in which the fifth lumbar vertebra has descended completely off the front of the sacrum) is a separate problem and is covered on its own page.

What separates high-grade from low-grade disease

The Meyerding system grades spondylolisthesis by dividing the top of the sacrum into quarters and recording how far forward the vertebra above has translated. A slip of up to a quarter is grade I, up to a half is grade II, up to three-quarters is grade III, and up to the full width is grade IV. Grades I and II are described as low-grade and grades III and IV as high-grade. A slip exceeding one hundred per cent, in which the vertebral body has slipped entirely off the sacrum, is grade V or spondyloptosis.

The grading number is a useful shorthand, but on its own it captures only part of what matters in high-grade disease. In low-grade spondylolisthesis the spine above the slip generally sits in a reasonable position over the pelvis, and where surgery is considered the central task is typically relief of nerve compression with a simple fusion to stabilise the segment. In high-grade disease the slip is accompanied by an angular deformity at the lumbosacral junction and by a reorganisation of the way the spine sits on the pelvis. It is this deformity and the resulting balance of the trunk over the pelvis, far more than the bare percentage of translation, that characterise high-grade spondylolisthesis and that shape the discussion of its management. The surgical questions that follow, such as whether to attempt to reduce the slip or to fuse it where it lies, how much of any reduction to attempt, whether to fuse from the back alone or to add support across the front of the disc, and how to protect the fifth lumbar nerve root, simply do not arise in the same way in low-grade disease.

Lumbosacral kyphosis and the slip angle

As a vertebra slips forward it also tends to tip forward, so that the lower lumbar spine rolls into a forward bend, or kyphosis, at the very point where it should normally curve gently backward into the natural lumbar lordosis. This angular component is measured as the slip angle, sometimes described as the lumbosacral kyphosis, and it expresses the relationship between the slipped vertebra and the sacrum.

The importance of this angle was set out by Boxall and colleagues, who reported that the slip angle was at least as important as the percentage of slip in describing the deformity and its behaviour. They observed that an uncorrected lumbosacral kyphosis was associated with progression of the deformity, and that this could continue even across a fusion that had gone on to unite solidly. The observation that a slip can appear to advance despite an apparently sound fusion has been an influential one, and it is part of the reason that contemporary descriptions of high-grade disease place the angular deformity at the centre rather than the translation alone.

The pelvis and spinopelvic balance

High-grade spondylolisthesis is closely bound up with the shape and orientation of the pelvis. Pelvic incidence is a fixed anatomical measurement that describes the relationship between the sacrum and the hip joints, and it tends to be high in people who develop high-grade slips. A high pelvic incidence is associated with high shear forces across the lumbosacral junction and is one of the anatomical features that recur in this population.

How the pelvis is positioned in response to the deformity has become central to the way high-grade disease is understood. Hresko and colleagues described two patterns among patients with high-grade slips. In one, the pelvis remains balanced, with a high sacral slope and a low pelvic tilt, so that the sacrum is relatively upright and the pelvis is not rotated backward. In the other, the pelvis is unbalanced or retroverted, rolling backward with a low sacral slope and a high pelvic tilt, as the body attempts to bring the trunk back over the hips. This distinction has been put forward as part of the rationale for considering whether realignment of the deformity is mechanically justified, the reasoning being that a retroverted, unbalanced pelvis reflects a spine that the body is struggling to keep upright, whereas a balanced pelvis does not carry the same implication. The Spinal Deformity Study Group classification draws these threads together, combining the grade, the pelvic incidence and the pattern of sacro-pelvic balance into a single framework. The position of the trunk as a whole, judged from the line dropped from the seventh cervical vertebra (the C7 plumbline) relative to the pelvis, is part of the same assessment of global balance.

It is worth being candid that these parameters describe associations and provide a mechanical rationale rather than a settled rule. They inform how surgeons think about the deformity, but they have not resolved the central controversies of treatment.

How common it is and in whom

The great majority of people with spondylolisthesis have low-grade disease, and most never progress beyond it. High-grade slips are the minority pathway. They are concentrated in particular anatomical settings, most notably in spines that carry dysplastic elements, meaning that the bony architecture of the lumbosacral junction is congenitally underdeveloped, with deficient facet joints, a rounded or domed top to the sacrum, and a poorly formed arch. They are also concentrated in skeletally immature individuals with a high pelvic incidence, in whom the deformity has the opportunity to advance during periods of growth. The dysplastic form shows a female preponderance. By contrast, the isthmic form, which arises from a stress fracture in the bony bridge known as the pars interarticularis, more often remains low-grade.

Natural history and progression

The most informative observations on the behaviour of spondylolisthesis over time come from long-term studies of largely unselected populations. Beutler and colleagues, continuing a cohort first described by Fredrickson, followed individuals from childhood into adult life. Several findings from this body of work are consistently cited. Defects affecting only one side of the arch did not go on to slip. The likelihood of further slippage diminished with each passing decade, so that progression became less rather than more probable with age. And the magnitude of the slip correlated poorly with the presence or severity of back pain.

These data are reassuring, but it is important to recognise that they are dominated by low-grade disease and may not transfer cleanly to the high-grade setting. The features that have been associated with progression to a high grade are a different matter and include young age, the presence of dysplastic elements, a high slip angle, a high pelvic incidence and a domed sacrum. Where surgery has been described for an asymptomatic person who already has a high-grade slip, the rationale rests largely on professional consensus rather than on high-quality evidence, and this uncertainty is openly acknowledged in the literature.

How it presents

High-grade spondylolisthesis can produce a visible alteration in the shape of the lower back. As the vertebra slides forward the buttocks may appear flattened, a step can sometimes be felt in the midline at the lower lumbar spine, and the trunk may appear shortened as the rib cage settles closer to the pelvis. The posture and the way a person walks may change, with a crouched stance and a characteristic rolling, pelvic-waddle gait that reflects both the deformity and tightness of the hamstring muscles at the back of the thighs. Hamstring tightness is a recognised and often prominent feature.

Symptoms within the legs commonly follow the distribution of the fifth lumbar nerve root, which is the nerve most exposed at this level, and may include pain, altered sensation or weakness. Compression of the whole bundle of nerves below the spinal cord, known as cauda equina syndrome, is uncommon but is a recognised risk of high-grade disease. It is worth noting that cauda equina syndrome has been documented even in the setting of a fusion performed without any attempt at correction; Schoenecker and colleagues reported it occurring after in-situ arthrodesis, a reminder that leaving the deformity undisturbed does not by itself remove neurological risk.

Imaging

The deformity is assessed on imaging taken with the patient standing, because the slip and the angular deformity are influenced by load and posture and may be understated on images taken lying down. A standing lateral radiograph allows the grade and the slip angle to be measured. Full-length standing imaging of the whole spine and pelvis, including low-dose EOS imaging where available, allows the pelvic incidence, pelvic tilt and sacral slope to be measured and the C7 plumbline to be assessed against the pelvis, so that the global balance of the trunk can be judged. Radiographs taken in bending forward and backward give information about how mobile the slip is. Magnetic resonance imaging shows the nerves and the soft tissues and demonstrates any compression. Computed tomography gives the most detailed picture of the bony anatomy, including the dysplastic features of the sacrum and the arch, and is also used in assessing whether a fusion has united. These descriptions reflect what each form of imaging can show rather than any recommendation as to what a given individual should undergo.

The evidence around management

The central controversy in high-grade spondylolisthesis is whether the deformity should be realigned, a procedure described as reduction, or fused where it lies, described as in-situ fusion. This question has not been resolved by high-level evidence. The single quasi-randomised comparison, reported by Poussa and colleagues, favoured fusion in situ over reduction. Longo and colleagues, reviewing the evidence base for reduction against in-situ fusion, likewise found no clear demonstration that one strategy is superior, underscoring how unsettled the matter remains.

It would be a mistake to regard fusion in situ as neurologically safe simply because it leaves the deformity untouched. As noted above, Schoenecker and colleagues documented cauda equina syndrome following in-situ arthrodesis, so the absence of a reduction does not equate to an absence of neurological risk.

A separate and better-defined point concerns the durability of the fusion itself. The rate of pseudarthrosis, meaning failure of the bone to unite, is considerably higher when the fusion is performed from the back alone, by posterolateral fusion, than when support is added across the front of the disc space by an interbody or circumferential technique. Molinari and colleagues, comparing approaches, reported pseudarthrosis rates that fell across the spectrum of techniques, with uninstrumented posterolateral fusion faring worst at around forty-five per cent, instrumented posterolateral fusion intermediate at around twenty-nine per cent, and circumferential fusion essentially abolishing the problem at zero per cent in their series. This is one of the clearer signals in the literature and is part of the reason circumferential or interbody support is so often discussed in high-grade disease.

Where reduction is undertaken, the neurological deficits that follow are most often temporary. Sailhan and colleagues, reporting on instrumented reduction, described transient neurological deficits in the region of nine per cent and persistent deficits in the region of two per cent. The mechanism is the stretching of the fifth lumbar nerve root as the vertebra is brought back into position. Petraco and colleagues studied this and found that the strain on the L5 nerve is not distributed evenly through the reduction; rather, around seventy per cent of the total strain occurred during the final half of the correction. This observation underpins the concept of partial reduction, in which the deformity is improved enough to restore acceptable balance and reduce the lumbosacral kyphosis without pushing the correction into the range where the nerve is at greatest risk. Techniques that provide support across the lumbosacral junction from front to back, including transsacral fixation and the fibular dowel graft described by Bohlman, are also part of the surgical vocabulary in this area.

Whichever route is taken, the available outcome data indicate that quality of life tends to improve after surgery. Bourassa-Moreau and colleagues, measuring health-related quality of life, reported improvement following surgical treatment of high-grade spondylolisthesis.

Outlook

The general message from the literature is that the outlook is good once a solid fusion has been achieved, and that this holds broadly true regardless of the particular technique used to reach it. The chief mechanical mode of failure is pseudarthrosis, which is concentrated in fusions performed from the back alone and is largely removed by the addition of circumferential or interbody support. A persistent neurological deficit is uncommon but is not entirely absent with either strategy, reduction or fusion in situ, and this residual risk is part of the reason the choice between the two remains a matter of careful, individual judgement rather than a settled rule.

Common questions

What does high-grade spondylolisthesis mean?

It refers to a forward slip of one vertebra over the one below it by more than half the width of the lower vertebral body, corresponding to Meyerding grades III and IV. The slip almost always occurs at the lowest level of the lumbar spine, where it meets the sacrum.

How is the grade actually measured?

The top surface of the sacrum is divided into four quarters, and the grade reflects how far forward the vertebra above has moved across them. A slip into the first quarter is grade I, the second is grade II, the third is grade III and the fourth is grade IV, with anything beyond the full width being grade V.

How does high-grade disease differ from low-grade spondylolisthesis?

In low-grade disease the spine generally remains reasonably balanced over the pelvis, and the focus tends to be on relieving nerve pressure and stabilising the segment. In high-grade disease an angular deformity and a disturbance of the way the spine sits on the pelvis come to dominate, and the surgical questions that arise are quite different.

How is it different from spondyloptosis?

Spondyloptosis is Meyerding grade V, a slip of more than one hundred per cent in which the vertebra has dropped completely off the front of the sacrum. It represents a further and more extreme stage and raises additional surgical considerations, and it is described on a separate page.

Why does the deformity matter more than the percentage of slip?

Because the percentage describes only how far the vertebra has translated forward, whereas the deformity captures how the spine is tipped and how the trunk is balanced over the pelvis. Boxall and colleagues showed that the slip angle was at least as important as the percentage, and that an uncorrected angular deformity was linked to progression.

What is lumbosacral kyphosis?

It is the forward tipping, or forward bend, that develops at the lumbosacral junction as the vertebra slips. The region that should curve gently backward instead rolls forward, and this angular deformity is measured as the slip angle.

What is the slip angle?

The slip angle is a measurement of the angular relationship between the slipped vertebra and the sacrum. It expresses the lumbosacral kyphosis and is regarded as one of the most important descriptors of high-grade deformity.

What does the pelvis have to do with it?

The shape of the pelvis, expressed as the pelvic incidence, tends to be high in high-grade disease, and the way the pelvis tilts in response to the deformity reflects how hard the body is working to stay balanced. Hresko and colleagues distinguished a balanced pelvis from an unbalanced, backward-rotated one, and this distinction informs thinking about whether realignment is mechanically justified.

The full set of questions and answers, with references, is available on the condition page.