

Flat Back Syndrome

A patient guide

In brief: Flat back syndrome is the loss of the spine's natural lower curve, the lumbar lordosis, so that the trunk is pitched permanently forward and cannot be held fully upright. It is best understood not as a vague stooping but as a specific, sagittal-plane flattening of the lower back, and it is classically the long-term consequence of earlier spinal surgery: the straight distraction rods, such as the old Harrington rods, once used to correct scoliosis, or a lumbar fusion set in too little curve. The body compensates with a chain of adjustments at the pelvis, hips and knees, and as those adjustments tire, the forward stoop and fatigue that characterise the syndrome emerge, sometimes many years after the original operation.

What flat back syndrome is (and why the lower curve matters)

A healthy spine, viewed from the side, is not straight. It carries a series of gentle curves: a forward curve in the neck, a backward curve in the chest, and, most importantly here, a forward curve in the lower back known as the lumbar lordosis. This lordosis is what allows a person to stand upright with the head, chest and pelvis stacked economically over the feet, holding the body's centre of gravity in a position that costs very little muscular effort to maintain.

Flat back syndrome is, quite literally, the flattening of that lower curve. When the lumbar lordosis is lost or reduced, the upper body is no longer balanced over the pelvis but is carried forward of it. The trunk tips ahead of the hips, the gaze is drawn towards the floor, and standing fully erect becomes difficult or impossible. The essential abnormality is therefore one of the side-on profile of the spine, the sagittal plane, rather than the side-to-side profile that defines scoliosis.

This sagittal emphasis is the single most important idea in understanding flat back syndrome. The problem is not that the spine is bent to one side, nor that any one vertebra is crumbled, but that the smooth forward curve of the lower back has been straightened out, taking the body's balance forward with it. Everything that follows, the compensations, the symptoms and the corrective surgery, flows from this loss of the lower curve.

The term also carries a specific historical and mechanical meaning. In its classic sense, flat back syndrome is iatrogenic, meaning it arises as an unintended consequence of earlier treatment. It describes the loss of lumbar lordosis that follows certain types of spinal surgery, and the forward-leaning, fatiguing posture that develops as the body's attempts to compensate gradually fail. Understanding it well means understanding both how the lower curve is lost and why its loss is so demanding to live with.

How flat back syndrome differs from its neighbours

Flat back syndrome is frequently confused with several related conditions, and distinguishing it from them is central to understanding it correctly. It sits within a wider family of problems grouped under the heading of sagittal imbalance, or positive sagittal balance, in which the trunk is carried forward of the pelvis. Flat back syndrome is one specific cause within that family, not a synonym for the whole group.

The first distinction is from ****general adult degenerative sagittal imbalance****. Here the lower curve is also lost and the trunk also pitches forward, but the cause is wear and degeneration: discs collapse, vertebrae wedge, and the lower curve flattens with age. Flat back syndrome in its classic sense is different in origin, arising from earlier surgery rather than from degeneration, although the final side-on picture and the compensations the body makes can look very similar. The mechanism by which the curve was lost is what separates them.

The second distinction is from ****proximal junctional kyphosis****. This is a focal forward angulation that develops at the very top of a previous spinal fusion, where the instrumented spine meets the mobile spine above it. It is a

junctional failure, occurring at a specific boundary, whereas flat back syndrome is a regional flattening within the lumbar spine itself. The two can occur in the same person, but they are mechanically and geographically distinct problems.

The third, and perhaps most important, distinction is from **camptocormia**, sometimes called bent spine syndrome. Camptocormia is a forward bending of the trunk caused not by a fixed change in the bones but by a disorder of the muscles that hold the spine erect, or by a movement disorder such as Parkinson's disease. The defining difference is reducibility. Camptocormia typically eases or disappears when the person lies down, because the underlying spine is structurally normal and can be straightened passively. Flat back syndrome, by contrast, is a fixed structural deformity that persists whether the person is standing or lying flat. This single observation, whether the forward bend corrects on lying down, is one of the most useful ways of telling the two apart, and it is supported by examination and, where needed, by scans of the spinal muscles.

The historical cause: Harrington rods and distraction

No account of flat back syndrome is complete without the story of the Harrington rod, because it is the origin of the term and the clearest illustration of how the lower curve can be lost.

From the early 1960s until the early 1980s, the Harrington rod was the standard surgical treatment for scoliosis, the sideways curvature of the spine that often arises in adolescence. The instrument worked by distraction: a straight metal rod was anchored to the spine and used to pull the curved vertebrae apart and straighter, correcting the side-to-side deformity that was the focus of attention at the time. In the coronal plane, the plane of the scoliosis, it worked well.

The difficulty lay in the side-on plane. A straight rod, placed under distraction, tends to flatten the natural forward curve of the lower back, particularly when the rod was extended down into the low lumbar spine, as was common practice. Many patients emerged from surgery with a well-corrected scoliosis but a lower back that had been straightened, its lordosis reduced or lost. Crucially, most felt well at first, and the consequences took years or even decades to declare themselves.

Over that long interval, two things happened. The spine below the old fusion continued to age and degenerate, and the hips gradually lost some of their range of movement. Both processes eroded the body's ability to compensate for the missing lower curve, and the forward stoop, the fatigue and the difficulty standing upright slowly emerged. This is why flat back syndrome characteristically appears long after the original operation, sometimes between ten and fifty years later, in a person who had done well in the meantime.

The lesson reshaped the surgery of scoliosis. Modern systems use multiple anchor points and contoured rods that preserve and restore the lower curve rather than flattening it, and surgeons take care to avoid distraction across the lumbar spine and to avoid extending fusions into the low lumbar levels where they can be avoided. Flat back syndrome is consequently far less common as a result of scoliosis surgery today, although it can still arise when a lumbar fusion, performed for other reasons, is set in too little lordosis.

Why the body's compensations cause fatigue and stoop

When the lower curve is lost and the trunk falls forward of the pelvis, the body does not simply give up. It deploys a chain of compensations designed to bring the head and trunk back over the feet, and understanding this chain explains almost every symptom of the syndrome.

The concept that underlies it is sometimes called the cone of economy: the idea that there is a narrow, energy-efficient envelope within which a person can stand and balance with very little effort. Lose the lower curve, and the trunk is pushed towards the edge of that cone, so that standing upright now demands continuous muscular work.

The compensations occur in a predictable order. First, the **pelvis rotates backwards**, a movement called pelvic retroversion, which swings the trunk back over the hips and is measured as a rise in pelvic tilt. Second, the **hips are extended** to their limit, drawing the body upright; over time, stiffness and loss of hip extension reduce how much this can achieve. Third, when the pelvis and hips can do no more, the **knees bend**, lowering and retracting the trunk to keep the head over the feet. Higher up, the chest may flatten and the neck extend to keep the eyes level with the horizon.

The trouble with all of this is that it is muscularly expensive. Holding the pelvis retroverted, the hips extended and the knees flexed requires the sustained contraction of the large muscles of the buttocks, the back of the thighs and the front of the thighs. These muscles tire, and as they tire the characteristic pattern appears: aching and fatigue in the back, buttocks and legs; a stoop that worsens as the day goes on; relief on sitting or lying down; and, in time, the inability to compensate at all, so that the forward-leaning posture becomes the resting state. This is also why ageing matters so much. As muscle strength and hip movement decline with the years, the reserve that once kept a person upright is exhausted, and a deformity that had been silently present for decades finally becomes symptomatic.

How it is measured: spinopelvic parameters

Because flat back syndrome is fundamentally a problem of the side-on balance of the spine and pelvis, it is assessed through a set of measurements known as spinopelvic parameters. These are taken from standing X-rays and provide the language in which the condition is described and surgery is planned.

The foundation of the system is **pelvic incidence**. This is a fixed, individual characteristic of a person's pelvis, set once growth is complete and unchanging thereafter. It determines how much lower curve that particular spine ought to have: a person with a high pelvic incidence needs a deeper lordosis, and one with a low pelvic incidence needs less. It is, in effect, each person's own target.

Against this target is set the **lumbar lordosis**, the actual amount of lower curve present. The relationship between the two, the **pelvic incidence to lumbar lordosis mismatch**, is the cornerstone of the assessment. In a well-balanced spine the two are closely matched, within about ten degrees of each other. A large mismatch, where the lordosis falls well short of what the pelvis requires, is the hallmark of flat back syndrome and correlates with greater disability.

Two further measurements complete the picture. **Pelvic tilt** records how far the pelvis has rotated backwards to compensate, and rises as the body works harder to stay upright. The **sagittal vertical axis** measures how far forward the trunk has fallen, by dropping a plumb line from the base of the neck and recording its distance from the back of the sacrum; a value beyond about fifty millimetres signifies positive sagittal imbalance, and larger values are associated with worse pain and function. These parameters are drawn together in the widely used SRS-Schwab classification, which grades pelvic tilt, sagittal vertical axis and the pelvic incidence to lumbar lordosis mismatch, and has been shown to correlate with patients' reported quality of life.

How it is assessed in practice

The assessment of flat back syndrome depends above all on imaging the spine in the position in which the problem appears, which is standing.

The essential investigation is a **full-length standing X-ray** of the whole spine, taken from the side and from the front, with the hips and knees included in the picture and the arms held in a standardised position so that the natural posture is not disguised. Sitting or lying-down films are misleading here, because they allow the trunk to fall back into balance and hide the very deformity that is being sought. From these standing films the spinopelvic parameters described above are measured.

Alongside the films, the **flexibility of the deformity** is assessed. Films taken lying down, or with the back extended over a bolster, show how much of the forward lean can be reduced and how much is fixed by previous

fusion. This distinction between the mobile and the rigid parts of the spine is central to planning, and it is also one of the ways camptocormia is excluded, since a deformity that corrects fully on lying down points away from a fixed structural flat back. The **range of movement at the hips** is examined too, since loss of hip extension is both a cause of decompensation and a factor in planning correction.

Cross-sectional imaging has its place. **Magnetic resonance imaging** or **computed tomography** may be used to look for narrowing of the spinal canal, for failure of an old fusion to heal, and to assess previous metalwork, and where a muscle-based cause such as camptocormia is being considered, scans of the spinal muscles can be informative. Throughout, questionnaires that record pain and function are used to capture the impact of the deformity on daily life, since the radiographic picture and the lived experience are both part of the assessment.

What the evidence shows about management — impersonal

It should be stated plainly that the evidence base for treating flat back syndrome rests largely on retrospective series, on studies of measurement and classification, and on the experience accumulated in specialist centres, rather than on large randomised trials. The descriptions that follow summarise what the literature reports about the options; they are not guidance for any individual, and decisions in practice are made on a case-by-case basis.

Non-surgical measures are described as having a limited capacity to alter the structural problem, because no exercise or appliance can restore a lower curve that has been lost within fused or flattened segments.

Physiotherapy, conditioning of the muscles of the hips and trunk, pacing of activity and walking aids are reported to help some people manage symptoms, and they may form part of supportive care, but the literature is clear that they do not correct the underlying deformity.

The definitive treatments described in the literature are **corrective osteotomies**, operations that re-create the lost lower curve by reshaping the spine. The governing principle is to restore the lordosis and bring the trunk back over the pelvis, returning the spinopelvic parameters towards their targets. Several techniques are reported. The **pedicle subtraction osteotomy** removes a wedge of bone through a single vertebra and closes it down, generating a substantial amount of new curve, of the order of thirty degrees, at one level; it is the technique most often described for the fixed deformity that follows previous fusion, and published series report marked improvements in the forward position of the trunk and in quality of life. The **Smith-Petersen, or Ponte, osteotomy** removes bone at the back of the spine across a mobile segment, contributing roughly ten degrees per level, and several can be combined where the spine retains some flexibility. For the most severe and rigid deformities, more extensive procedures such as **vertebral column resection** are described, and techniques that restore curve through the front of the spine, such as the placement of specially shaped interbody implants, are also reported.

These are major operations. The literature documents a meaningful burden of complications, including substantial blood loss, risks to the nerves, failure of the bone to heal, breakage of the metalwork and the later development of junctional problems at the ends of the construct, and revision surgery is sometimes required. The reported outcomes, where the deformity is well corrected and the spinopelvic targets are achieved, are generally favourable in terms of posture, pain and function, but the decision to undertake such surgery is described throughout the literature as an individualised one, weighed carefully and shared between patient and surgeon.

Outlook

The outlook in flat back syndrome is shaped by the fact that it is a structural, mechanical problem rather than a progressive disease in the usual sense. Left unaddressed, the natural history described in the literature is one of gradual worsening, as the body's compensations are steadily eroded by ageing muscles, stiffening hips and continuing degeneration below an old fusion, so that the forward stoop and fatigue tend to increase rather than settle.

Where corrective surgery is undertaken and the lower curve is successfully restored, the reported results are generally encouraging in terms of standing posture, the ability to look ahead, the reduction of fatigue and the improvement in pain and daily function, because the operation addresses the root of the problem by rebuilding the balance of the spine over the pelvis. These gains are set against the considerable demands and risks of the surgery, and against the possibility of complications and further procedures, all of which the literature documents in detail.

Across the field, the consistent themes are that flat back syndrome is a specific, sagittal-plane loss of the lower curve rather than a general stoop, that its assessment rests on standing imaging and the spinopelvic parameters, and that its definitive treatment is reconstructive surgery to restore the lost lordosis. The variation between individuals is wide, and any particular outlook is a matter for assessment by the treating team rather than something that can be read from the diagnosis alone.