

Low-Lying Conus Medullaris

A patient guide

In brief: The conus medullaris is the tapering, cone-shaped lower end of the spinal cord, where the cord narrows and gives way to the fanned-out bundle of nerve roots known as the cauda equina. In the great majority of adults this tapering tip sits at around the level of the first lumbar vertebra, with a normal range that runs from the lower part of the twelfth thoracic vertebra to the upper or mid part of the second lumbar vertebra. A "low-lying conus medullaris" is a description used on an imaging report when this tip is seen to sit lower than that normal range, most often defined as below the middle of the second lumbar vertebra. The single most important idea is that a low-lying conus is a finding on a scan, not a diagnosis in itself. In some people it is a borderline anatomical variant of no consequence; in others it is a marker of an underlying condition that fixes the cord in place, known as tethered cord syndrome, often with associated findings such as a thickened or fatty filum terminale or a form of occult spinal dysraphism. Whether a low-lying conus carries significance depends on the wider picture on the scan and, above all, on whether there are symptoms.

What the conus medullaris is and where it normally sits

The spinal cord does not run the full length of the spinal canal. It narrows towards its lower end into a cone-shaped tip called the conus medullaris, or medullary cone. Below this tip the nerve roots that supply the legs, bladder, bowel and pelvic floor continue downwards on their own as a loose bundle, the cauda equina, floating within the cerebrospinal fluid of the lower spinal canal before they exit at their respective levels. From the very tip of the conus, a fine thread of fibrous tissue called the filum terminale runs down to anchor gently to the back of the tailbone, helping to stabilise the cord within the canal.

In the average adult, the tip of the conus medullaris lies at around the level of the first lumbar vertebra, often described as opposite the lower border of the first lumbar vertebra or close to the first–second lumbar disc. Large imaging studies of healthy people confirm both this average and the spread around it. In a study of more than six hundred healthy adults, the conus was found most commonly at the first lumbar vertebra, with the levels distributed across the lower twelfth thoracic vertebra, the twelfth thoracic to first lumbar junction, the first lumbar vertebra itself, the first–second lumbar junction and, less often, the second lumbar vertebra. Taken together, the literature describes a normal range that stretches from roughly the lower third of the twelfth thoracic vertebra to the upper or mid second lumbar vertebra, with the great majority of healthy people falling at or above the second lumbar level.

This matters because it shows there is no single point at which a normal conus must sit, but rather a band of normal positions. A conus at the first lumbar vertebra is squarely normal. A conus sitting a little lower, towards the top of the second lumbar vertebra, is still generally regarded as within or at the edge of the normal range. It is only when the tip drops below this band that the term low-lying is applied.

How the conus reaches its adult level: development

The position of the conus is best understood through how the spine develops. Early in life the spinal cord fills almost the entire length of the bony canal. As the fetus grows, the bony spine lengthens faster than the spinal cord, so the cord appears to "ascend" relative to the vertebrae, and its lower tip comes to lie progressively higher up. In early fetal life the tip sits very low, around the sacrum, and through the second half of pregnancy it rises steadily. Studies of fetuses and newborns describe the tip reaching the third lumbar region around the middle of pregnancy and continuing to ascend so that, by the time a baby is born at term, it has usually reached close to its adult level.

A key point established by modern imaging is that this ascent is largely complete by birth, or within the first weeks to couple of months of life, rather than continuing throughout childhood as was once thought. By infancy the conus generally lies at or above the first–second lumbar disc, much as it will in adulthood. This developmental background explains why a low-lying conus in an older child or adult is interpreted as the cord having failed to reach its expected height, which in turn can raise the question of whether something has held it down.

What "low-lying" means and where the cut-off is drawn

"Low-lying conus medullaris" is a radiological description applied when the tip of the conus is seen to lie below the normal range. The most widely used threshold places the boundary at the middle of the second lumbar vertebra: a conus tip ending below the mid-body of the second lumbar vertebra is generally reported as low-lying. Some descriptions use the lower border of the second lumbar vertebra or the second–third lumbar disc as the reference point, particularly in the context of tethered cord syndrome, where the cord is classically described as ending below the first–second lumbar level.

It helps to set this against the distribution in healthy people. Because around ninety-five per cent of healthy adults have a conus that ends at the second lumbar vertebra or above, a tip that sits clearly below this is statistically uncommon and is the reason the finding is flagged. The cut-off, though, is a line drawn across a continuous range of normal anatomy, and a tip sitting just at or marginally below the boundary is a borderline finding rather than an abnormality in its own right. This is precisely why the term describes a measurement and not a disease, and why its meaning depends on the rest of the picture.

The link with tethered cord syndrome

The reason a low-lying conus attracts attention is its association with tethered cord syndrome. Tethered cord syndrome is a condition in which the lower end of the spinal cord is abnormally fixed, or "tethered", to the surrounding tissues, so that it cannot move freely as the spine bends and the body grows. This fixation is thought to place the lowest part of the cord under abnormal mechanical tension and to impair its blood supply, which can, over time, interfere with the nerve functions served by that region. Classically, tethered cord syndrome has been associated with a low-lying conus, because the very thing that holds the cord down also prevents it from ascending to its normal level.

It is essential, however, to separate the imaging finding from the clinical syndrome. A low-lying conus on its own is not the same as a tethered cord. Many people with a slightly low conus have no symptoms and no functional problem, and the abnormal anatomy on a scan does not, by itself, produce the syndrome. Tethered cord syndrome is fundamentally a clinical diagnosis, made when symptoms and signs of disturbed nerve function are present, supported by imaging, rather than a label applied purely on the basis of where the conus sits. Equally, the reverse can occur: a small group of people have the typical symptoms of a tethered cord while their conus sits at an entirely normal level, a situation sometimes called occult tethered cord syndrome, attributed to a tight or poorly elastic filum rather than a visibly malpositioned cord. The relationship between conus level and tethered cord is therefore real but loose, and neither one reliably predicts the other.

Associated findings: filum, fat, lipoma and dysraphism

A low-lying conus rarely sits in isolation. When it is meaningful, it is usually accompanied by other findings that help to explain why the cord has been held down, and these associated features are often more informative than the conus level itself.

The commonest associated finding is an abnormality of the filum terminale, the fine thread that anchors the cord. A normal filum is slender, generally measured at no more than around two millimetres across at the mid-lumbar level. A filum that is thicker than this, a thickened or "tight" filum, is recognised as one of the causes of tethering. Closely related is the fatty, or fibrofatty, filum, in which fat is deposited within the thread; on a scan this fat is bright on the standard sequences and follows the signal of fat elsewhere in the body. A small amount of fat in the filum is a frequent incidental finding of no significance in many people, but a markedly thickened, fatty filum occurring together with a low-lying conus is part of the picture of tethering.

Beyond the filum, a low-lying conus may be associated with a fatty lump, or lipoma, involving the filum, the conus itself, or the canal, and with the broader group of conditions known as occult, or closed, spinal dysraphism, in which the spine has not formed completely but the defect is hidden beneath intact skin. These include lipomyelomeningocele, the commonest of them, along with intradural and filar lipomas, dermal sinus tracts and split cord malformations. Other findings sometimes seen alongside a low conus include a fluid-filled cavity within the cord, a syrinx, a curvature of the spine, a scoliosis, and abnormalities of the vertebrae or sacrum. On the skin overlying the lower spine, certain markings, such as a tuft of hair, an unusual dimple, a fatty swelling, a skin tag or a patch of altered colour, are recognised as possible external pointers to an underlying closed dysraphism, although many simple midline dimples turn out to have nothing beneath them.

Why a low conus alone is not the same as a tethered cord

This distinction is worth stating in its own right because it is the heart of how the finding is interpreted. The conus level is a measurement on an anatomical scale. Tethered cord syndrome is a clinical entity defined by a disturbance of function. The two overlap but are not interchangeable.

On one side, a low-lying conus can exist with no symptoms whatsoever, discovered incidentally when a scan is performed for an unrelated reason such as ordinary back pain. In that situation the finding is descriptive: the cord ends a little lower than average, and that may be the whole story. On the other side, the syndrome can be present with a normally positioned conus, where the problem lies in a poorly elastic filum that holds the cord under tension without dragging its tip downwards. Between these extremes lies the common, meaningful pattern, in which a low conus, a thickened or fatty filum or other dysraphic features, and a set of symptoms all point in the same direction. It is the convergence of these elements, rather than any one of them alone, that gives the finding its weight.

Symptoms that can accompany a tethered cord

When a low-lying conus is part of a genuine tethered cord syndrome, the symptoms reflect disturbance of the nerves that arise from the lowest part of the cord, which serve the legs, the bladder, the bowel and the pelvic floor. In adults the picture is often gradual and can be easy to overlook, and the literature describes several recurring themes.

Pain is frequently prominent: a back, buttock or leg discomfort that often does not follow the neat band-like pattern of a trapped nerve root and which may be aggravated by movements that bend or stretch the lower spine. Disturbances of the bladder and bowel are common and are among the most easily missed features, including urinary urgency or frequency, difficulty emptying, occasional leakage, or constipation and changes in bowel control. There may be weakness, numbness, altered sensation or, over time, wasting in the legs and feet, and sometimes changes in the way the legs and feet are shaped, such as a high arch. A scoliosis may be present, particularly one that behaves unusually. In children the picture can include progressive foot and spinal deformity and difficulties as the child grows, whereas in adults the deformities tend to be less of a feature and pain and bladder symptoms more so. None of these symptoms is unique to a tethered cord, which is one reason the diagnosis rests on the overall assessment rather than on any single complaint.

How a low-lying conus is identified and assessed on imaging

Magnetic resonance imaging, the MRI scan, is the principal means of identifying the conus, measuring where it ends and examining the structures around it. Because it shows the cord, the nerve roots, the filum, fat and fluid in fine detail without using radiation, it is well suited to defining both the level of the conus and any associated features. The position of the tip is judged against the vertebral bodies, the thickness of the filum is measured, and the scan is examined for fat within the filum, for lipomas, for a syrinx, for split cord and vertebral or sacral anomalies, and for any clumping of the nerve roots.

There are recognised limitations. A routine scan is performed lying on the back, and in the small group with an occult tethered cord and a normally placed conus the static, supine position may not reveal the underlying tension, so the scan can look unremarkable despite symptoms. Care is also needed in measuring fat in the filum, because the boundary between fat and surrounding fluid can create artefacts on the images. For these reasons the scan is interpreted alongside the clinical picture, and in selected situations additional assessments, such as tests of bladder function, are considered as part of a fuller evaluation. The descriptions here concern how the finding is characterised on imaging and do not constitute guidance for any individual.

How the finding is approached: from incidental note to specialist assessment

The way a low-lying conus is approached follows directly from the distinction between an imaging finding and a clinical syndrome, and the literature describes a graded picture rather than a single rule.

Where a low conus, or a borderline low conus, is found incidentally in a person who has no relevant symptoms and no associated abnormality, it is frequently regarded as a description rather than a problem to be treated, and the literature on asymptomatic findings emphasises monitoring for any new neurological, bladder, bowel or orthopaedic change rather than immediate intervention. Where the finding is accompanied by symptoms, by a thickened or fatty filum, by a lipoma or other dysraphic features, or by skin markings over the lower spine, it is the kind of finding that prompts assessment by a specialist team familiar with the cord and its anchoring structures, often a neurosurgical or spinal service, sometimes working alongside urology and other specialties.

The literature describing the surgical treatment of a genuinely symptomatic tethered cord centres on an operation to release the tether, most often by dividing the filum terminale or addressing the lesion holding the cord, performed with monitoring of the nerves during surgery, with series reporting that the procedure is generally well tolerated and that the aim is to relieve symptoms or to halt their progression. The decision to undertake any such surgery, and the choice between watching and intervening, is an individualised one made by the treating team in

the light of the whole picture, and these descriptions report what the literature observes rather than offering advice. The consistent themes are that the conus level is one piece of information among several, that symptoms and associated findings carry at least as much weight as the measurement, and that specialist assessment is the route by which the significance of the finding is established.

Outlook

The outlook attached to a low-lying conus medullaris is, for most people, reassuring, precisely because the finding spans such a wide spectrum. At one end, a borderline or mildly low conus found by chance in someone with no symptoms and no associated abnormality may carry no consequence at all and behave as a quiet anatomical variant. At the other end, when a low conus is part of a genuine tethered cord syndrome, with a thickened or fatty filum or other dysraphic features and a matching set of symptoms, it identifies a treatable condition for which specialist assessment can clarify the situation, and the literature on treating symptomatic cases describes outcomes that are, in the majority, favourable in relieving or stabilising symptoms.

What ties the whole subject together is that a low-lying conus is a finding to be interpreted, not a verdict. Its significance is read from the company it keeps: the level of the conus, the state of the filum, the presence or absence of associated abnormalities and skin markings, and, above all, whether there are symptoms of disturbed nerve function. Any individual outlook is therefore a matter for assessment by the treating team in the round, rather than something that can be inferred from the position of the conus alone.