

Intradural Spinal Tumours

A patient guide

In brief: Intradural spinal tumours are growths that arise inside the dura, the tough waterproof membrane that wraps the spinal cord and nerve roots. They are uncommon, and the great majority are benign and slow-growing. They are divided according to where they sit relative to the spinal cord itself. Tumours that lie inside the dura but outside the substance of the cord — the intradural-extramedullary group — are the more common, and include meningiomas, schwannomas and neurofibromas (nerve sheath tumours), and the myxopapillary ependymoma of the filum terminale at the very bottom of the canal. Tumours that grow within the substance of the spinal cord — the intramedullary group — are rarer, and are mostly ependymomas, astrocytomas and haemangioblastomas. Some are found because they cause symptoms; a proportion are discovered incidentally on a scan performed for another reason. Magnetic resonance imaging is the key investigation, and the central principle running through the whole subject is that assessment and management are specialist-led, undertaken within a neurosurgical or spinal-oncology multidisciplinary team, with options ranging from watchful surveillance to microsurgical excision depending on the tumour and the individual.

What "intradural" means, and why the compartment matters

The spinal cord and the nerve roots that stream off it are enclosed within the dura, a strong membrane that contains the cerebrospinal fluid in which the cord floats. The word *intradural* simply means "inside the dura". When a tumour is described as intradural, it is located within this sac, in close company with the cord or the nerve roots, rather than in the surrounding bone of the spinal column.

Naming the compartment precisely is more than a technicality, because it largely determines what type of tumour is likely, how it tends to behave, and how it is approached. Two compartments are distinguished within the intradural space. The first, the ****intradural-extramedullary**** compartment, lies inside the dura but outside the spinal cord — the tumour sits alongside the cord or wrapped around a nerve root, pressing on the cord from the outside. The second, the ****intramedullary**** compartment, lies within the very substance of the spinal cord, so that the tumour grows among the delicate nerve fibres of the cord itself.

This distinction shapes everything that follows. Intradural-extramedullary tumours, because they sit outside the cord, often have a plane of separation from it that a surgeon can develop, and they are more often amenable to complete removal. Intramedullary tumours, being embedded in the cord, demand a different and more delicate approach. The literature consistently divides the subject along this line, and so does this guide.

How common these tumours are, and how they break down

Primary tumours of the spinal cord and its coverings are uncommon. Across populations, primary intraspinal tumours are described with an incidence in the region of one per hundred thousand people per year, with broader estimates spanning a few per hundred thousand depending on what is counted. They are, in short, a small minority of all spinal problems, and most spinal symptoms have nothing to do with a tumour.

Within the intradural space, the extramedullary compartment is the busier of the two. Intradural-extramedullary tumours make up roughly four-fifths of intradural tumours in adults, and around two-thirds in children. The most common members of this group are the nerve sheath tumours — schwannomas and neurofibromas — and the meningiomas; in many series schwannomas and meningiomas together account for over half of all intradural-extramedullary lesions, with schwannomas around a quarter to a third and meningiomas a similar share.

Intramedullary tumours, growing inside the cord, are rarer, comprising roughly a fifth to a third of primary spinal cord tumours. Within this group the gliomas predominate, chiefly ependymomas and astrocytomas, which between them account for the large majority of intramedullary lesions; haemangioblastomas form most of the remainder. A notable pattern is that ependymomas are relatively more common in adults and astrocytomas relatively more common in children, a difference that colours how each group is typically encountered.

The intradural-extramedullary group: meningiomas

Meningiomas arise from the arachnoid cap cells, specialised cells embedded in the lining membranes of the cord near where the nerve roots leave. They are typically slow-growing and, in the spine, almost always benign. They show a strong predilection for the thoracic spine and a marked female predominance, and they are encountered most often in middle and later life.

Because a spinal meningioma grows inside the dura but outside the cord, its effect is one of gradual compression from the outside. As it slowly enlarges it presses upon the cord or the adjacent nerve roots, and any symptoms tend to build up insidiously over months. On imaging a meningioma typically sits broadly against the dura, often with a so-called dural tail, and enhances after contrast. Its slow tempo means that a meningioma can reach a considerable size before it declares itself, and it also means that some are found incidentally before they have caused any trouble at all.

The intradural-extramedullary group: nerve sheath tumours

The nerve sheath tumours — schwannomas and neurofibromas — arise from the cells that insulate the nerve roots. Schwannomas grow from Schwann cells and are typically well-defined, encapsulated tumours attached to a single nerve root; neurofibromas are more intimately bound up with the nerve fibres. Together they are among the commonest intradural-extramedullary tumours and, like meningiomas, are usually benign and slow-growing.

Because they arise on a nerve root, nerve sheath tumours classically announce themselves through that root. Radicular pain — pain that radiates along the territory of the affected nerve — is the characteristic early feature, sometimes with altered sensation in the same distribution. A schwannoma can sometimes grow partly inside the canal and partly outside it through a nerve exit foramen, taking on a dumbbell shape. On MRI these tumours typically enhance with contrast and often show particular signal characteristics, including cystic change, that help distinguish them from meningiomas, although imaging alone does not always separate the two with certainty.

The intradural-extramedullary group: myxopapillary ependymoma of the filum

At the very bottom of the spinal canal, below where the cord ends, the nerve roots of the cauda equina descend around a fine thread called the filum terminale. A particular tumour, the **myxopapillary ependymoma**, arises characteristically here, from the filum and the region of the conus medullaris and cauda equina. Although ependymomas elsewhere grow within the cord, this variant typically presents as an intradural-extramedullary mass in the lower lumbar region.

Under the 2021 World Health Organization classification of central nervous system tumours, the myxopapillary ependymoma is graded as a grade 2 tumour, reflecting a recognised tendency to recur, a change from its earlier designation. Clinically it most often produces lower back or coccygeal pain, sometimes with radiation down a leg, and can be associated with disturbance of sensation or of bladder and bowel function when the lower nerve roots are involved. Its location among the cauda equina nerve roots makes the surgical relationship to those roots a central consideration.

The intramedullary group: ependymomas, astrocytomas and haemangioblastomas

Within the substance of the cord, three tumour types account for most intramedullary lesions. **Ependymomas** arise from the ependymal cells lining the central canal of the cord and are the most common intramedullary

tumour in adults. They are typically slow-growing, tend to sit centrally within the cord, and characteristically have a relatively well-defined edge, so that a plane of separation from the surrounding cord can often be developed. Cysts within or around the tumour, and sometimes a cap of old blood at its margins on MRI, are recognised features.

Astrocytomas arise from the astrocytes, the supporting glial cells of the cord, and are the most common intramedullary tumour in children. They differ importantly from ependymomas in being infiltrative, growing among the cord's nerve fibres without a clear boundary, which makes the interface between tumour and healthy cord far less distinct. Their behaviour and outlook are strongly governed by their grade under the WHO classification, with low-grade astrocytomas behaving far more indolently than the uncommon higher-grade forms.

Haemangioblastomas are the third common intramedullary tumour. They are benign, highly vascular tumours that tend to lie towards the back of the cord and are often accompanied by a sizeable cyst or by swelling of the cord. On MRI their rich blood supply is a distinguishing feature, and they classically present with slowly progressive sensory disturbance, particularly affecting the sense of position and balance.

Associations: NF1, NF2, schwannomatosis and von Hippel-Lindau

Most intradural tumours occur sporadically, as isolated events with no inherited cause. A minority, however, arise in the context of recognised genetic conditions, and these associations matter because they can mean multiple tumours and a different pattern of surveillance.

Neurofibromatosis type 1 (NF1) is the most common of these conditions and is associated particularly with neurofibromas of the peripheral and spinal nerves. **Neurofibromatosis type 2 (NF2)**, now often termed NF2-related schwannomatosis, is characterised by schwannomas — classically of the hearing nerves — together with meningiomas and, notably, spinal ependymomas; affected individuals may harbour several tumours across the nervous system. **Schwannomatosis** describes the development of multiple schwannomas without the hallmark hearing-nerve tumours of NF2, and often presents in adulthood with chronic pain. **Von Hippel-Lindau disease (VHL)** is the condition associated with haemangioblastomas, which in this setting are frequently multiple and may arise throughout the cord and elsewhere in the nervous system.

The presence of one of these conditions changes the picture from a single lesion to a tendency to form tumours over time, which is why their recognition sits firmly within specialist, multidisciplinary care.

How these tumours may present, and why some are found incidentally

The symptoms that intradural tumours can produce reflect their slow growth and their location. Because most enlarge gradually, the typical history is one of features evolving over months rather than suddenly. Pain is among the earliest and commonest features — localised back or neck pain, or pain radiating in the distribution of a nerve root, sometimes worse at night. As a tumour presses on or grows within the cord, it may give rise to altered sensation, weakness, unsteadiness of gait, or disturbance of bladder and bowel control, in patterns that depend on the level and the compartment involved. Haemangioblastomas, sitting at the back of the cord, are noted for early disturbance of the sense of position; intramedullary tumours generally tend to produce signs referable to the cord itself.

Set against this is the important reality that a proportion of intradural tumours are discovered incidentally — found on a scan carried out for an unrelated reason, before they have caused any symptoms at all. The literature notes that a substantial share of incidentally detected meningiomas and schwannomas may never require treatment within a person's lifetime, particularly in older individuals or where the tumour grows minimally or not at all. An incidental finding is therefore a description of something seen on imaging, not in itself a statement that anything must be done; it is the kind of finding that warrants specialist assessment so that its significance can be judged properly.

The role of MRI and specialist assessment

Magnetic resonance imaging is the key investigation for intradural spinal tumours. It is uniquely able to show the position of a tumour relative to the cord and nerve roots, to define which compartment it occupies, to demonstrate its size, length and margins, to reveal associated cysts, swelling or syringomyelia within the cord, and — with contrast — to characterise the way it enhances. These features together allow a tumour to be located in the intradural-extramedullary or intramedullary compartment and a likely type to be suggested.

MRI cannot, however, give a definitive tissue diagnosis. Meningiomas and schwannomas share overlapping appearances, and the three common intramedullary tumours can be difficult to separate on imaging alone; the definitive diagnosis rests on examination of tissue. The interpretation of these scans, and the decision about what if anything follows, belongs to a specialist multidisciplinary setting in which neuroradiologists, neurosurgeons or spinal surgeons and neuro-oncologists consider the imaging alongside the clinical picture. This guide describes that process in general terms; it does not assess any individual scan or person.

What the evidence shows about management — observation versus microsurgery

The management of intradural spinal tumours is, throughout the literature, specialist-led and individualised, and it spans a spectrum from watchful surveillance at one end to microsurgical excision at the other. What follows describes the approaches reported in the literature, not guidance for any person; decisions in practice are made by the treating multidisciplinary team with the individual concerned.

****Surveillance**** is described for tumours that are small, asymptomatic and stable, particularly when found incidentally. Here the literature reports serial MRI — often performed after an initial interval of several months to a year, and then at lengthening intervals if the tumour proves stable — to watch for growth or for the emergence of symptoms, with intervention considered only if the picture changes. Many of these lesions are reported to grow extremely slowly or to remain stable over long periods, and a meaningful proportion never come to require treatment.

****Microsurgical excision**** is the principal active treatment described for symptomatic tumours and for those that grow or threaten the cord. For the benign intradural-extramedullary tumours — meningiomas and nerve sheath tumours — complete removal is the goal where it can be achieved safely, and the literature reports good neurological outcomes and low recurrence after such surgery, with the degree of removal and the relationship to the cord or nerve root shaping what is feasible. For intramedullary tumours the picture is shaped by tumour type: ependymomas, with their relatively defined edge, are often amenable to complete microsurgical removal with favourable reported outcomes; haemangioblastomas, though highly vascular, are benign and are reported to do well with complete excision, with early surgery before neurological decline associated with better recovery; astrocytomas, being infiltrative, lack a clear plane, so the surgical approach reported in the literature is more conservative and is strongly influenced by grade, with biopsy or limited removal described where the tumour is diffuse, and additional therapies such as radiotherapy or chemotherapy considered in selected higher-grade or recurrent cases.

Throughout, the consistent themes in the literature are that intramedullary surgery is undertaken with the aid of microsurgical technique and intraoperative monitoring of the cord, that the extent of removal is balanced against the preservation of neurological function, and that the whole process — surveillance, surgery and any further treatment — is conducted within a multidisciplinary framework. These are descriptions of reported practice and associations across groups of patients, not predictions or recommendations for any individual.

Outlook

For most intradural spinal tumours the outlook is, broadly, reassuring, and it tracks closely with the type of tumour and the compartment it occupies. The benign intradural-extramedullary tumours — meningiomas and nerve sheath

tumours — are slow-growing, and where they are treated the literature reports that complete removal is often achievable with good preservation or recovery of neurological function and low rates of recurrence. The myxopapillary ependymoma of the filum, though graded for its tendency to recur, is reported to carry a favourable survival.

Among the intramedullary tumours, the well-defined ependymomas and the benign haemangioblastomas are reported to do well after complete excision, with outcome closely tied to neurological function at the time of treatment, which is one reason the literature emphasises recognising and acting on these lesions before significant deterioration. The infiltrative astrocytomas are the more variable group, their outlook governed above all by their grade, with low-grade tumours behaving far more indolently than the uncommon higher-grade forms.

Across the whole field the recurring messages are that these tumours are uncommon and mostly benign, that the compartment and the tissue type drive both behaviour and management, that MRI is central but does not replace tissue diagnosis, that a sizeable share of incidental tumours are simply watched, and that any individual outlook is a matter for assessment by a specialist multidisciplinary team rather than something that can be read from a category alone.