Cysts of the ligamentum flavum are unusual causes of spinal compression. Their etiology and histopathologic classification have yet to be fully elucidated. We report our experience of four cases of ligamentum flavum cysts occurring in the lumbar spine and discuss some of the possible etiologies and pathophysiologic mechanisms according to the available literature. **Conclusion:** This entity is clearly different from the synovial facet-joints or ganglion cysts.

**CASE REPORTS**

An outline of the cases is contained in the Table, and imaging examples are shown in Figure 1.

**Case 1**

The patient was an 82-year-old woman referred for recent onset of right-sided sciatica involving mostly the S1 distribution and causing major incapacitation because of severe pain. There was no pain on coughing; however, she had increased urinary frequency at night. On examination, motor function was normal and there was no sensory disturbance on examination of the legs. Reflexes were hypoactive in the right leg with plantar reflexes downgoing.

Computerized tomography (CT) imaging of the lumbo-sacral spine showed significant degenerative disease in the lumbar spine, as well as an epidural mass occupying the L5-S1 region, with a small postero-central subligamentous hernia, possibly representing a synovial or arachnoid cyst but also compatible with a benign cystic tumour such as a schwannoma. Subsequent magnetic resonance imaging (MRI) demonstrated a voluminous epidural cystic lesion compressing the cauda equina to the right of the sac at L5-S1, compatible with a synovial cyst of the ligamentum flavum. In light of the acuity and degree of incapacitation of the disease, the patient was hospitalized for urgent laminectomy with microsurgical removal of the cyst.

The patient was placed under general endotracheal anaesthesia in knee-chest position. Longitudinal midline incision from L4 to S2 with exposure of the L5-S1 junction was performed as well as incision of the lumbosacral fascia and dissection of the paraspinal muscles. The lesion, thought to be originating from the right facet joint, was fragmented and extensively removed as well as the affected portion of ligamentum flavum.

Both the excised portion of ligamentum flavum and the cystic lesion were sent for pathological examination. The ligamentum flavum specimen consisted of an irregular fragment of beige, rubbery tissue measuring 2.2 x 1 x 0.6 cm. It was composed largely of fibroadipose tissue and portions of dense, fibrocollagenous material. The cyst measured approximately 1.5 cm in greatest dimension, and the wall up to 0.3 cm in thickness. The lumen contained beige, friable, spongy material. Microscopically the specimen consisted of a pseudocyst, physically contiguous with a fragment of ligamentum flavum. The cyst wall was composed of dense fibrocollagenous tissue with a few areas of granulation tissue and chronic inflammation. There was no synovial lining. The lumen was filled with necrotic tissue, and in some areas the intraluminal material was viable with a distinct chondroid appearance. The lesion was, therefore, diagnosed as a nonsynovial cyst of the ligamentum flavum.

**ABSTRACT:** Background: Cysts of the ligamentum flavum are rare and unusual causes of spinal compression. Methods: We report our experience of four cases of ligamentum flavum cysts occurring in the lumbar spine and discuss some of the possible etiologies and pathophysiologic mechanisms according to the available literature. Conclusion: This entity is clearly different from the synovial facet-joints or ganglion cysts.

**RÉSUMÉ:** Sténose spinale lombaire incapacitante causée par un kyste du ligament jaune. Introduction: Les kystes du ligament jaune sont rares et causent très rarement une compression spinale. Méthodes: Nous rapportons notre expérience au sujet de quatre cas de kystes du ligament jaune au niveau lombaire et nous discutons de l’étiologie et de la physiopathologie de cette entité à la lumière de la littérature actuelle. Conclusion: Cette pathologie est nettement différente des kystes synoviaux des articulations facettaires ou des kystes ganglionnaires.
The postoperative course was uneventful and after 2.5 years of follow-up the patient continues to do very well, ambulating fully and her pain resolved.

Case 2
This 74-year-old male patient underwent placement of a ventriculoperitoneal shunt for normal pressure hydrocephalus eight months prior to his current presentation. He did relatively well with respect to cognitive function and had recuperated his walking ability. He remained, however, with some pain and during the recent weeks started complaining of major left-sided sciatica radiating into the L4 radicular territory. Sensory function was intact, as was motor function in the lower extremities although this was difficult to assess given the degree of pain. Reflexes were normal.

A CT scan of the spine showed multilevel degenerative changes with severe spinal stenosis at L3-L4 with a left lateralisering soft tissue density lesion not seen in the previous scan, which was contributing to the stenosis. The MRI examination revealed a moderate to severe spinal stenosis at L3-L4 secondary to a prominent, posteriorly located synovial cyst with a moderate global disc bulge and facet osteoarthritis at this level.

The patient underwent laminectomy of L3-L4 with microsurgical removal of the epidural mass as described in Case 1. The extremely thick ligamentum flavum was gradually removed at L3-L4 and as expected from the MRI a voluminous cystic formation resulting from a diverticular extension of this synovial lining of the left facet joint was found and the content was sent to pathology, which confirmed the presence of normal synovial tissue as well as ligamentum flavum. Consequently this roundish cystic formation was gradually removed and the nerve roots completely decompressed.

The cyst specimen consisted of multiple fragments of pink, reddish, rubbery tissue measuring in aggregate 1.5 x 1.5 x 0.4 cm. Histopathologic examination revealed ligamentum flavum with extensive neovascularisation and dystrophic calcifications with fragments of hyperplastic synovium, compatible with portions of a synovial cyst with some secondary degenerative or possibly reparative changes in the adjacent tissues.

The postoperative course was uneventful and satisfying, and by the two year follow-up the patient was doing very well.

Case 3
The third patient was a 76-year-old female with a one-week history of right-sided sciatica with progressive weakness in the right leg. She eventually became incapacitated in the right leg and presented to the emergency department. An urgent MRI was done, which revealed a posterior lesion causing significant compression of the L3-L4 thecal sac. The patient underwent partial bilateral L3 and L4 laminectomy with resection of the lesion on the same day.

Following laminectomy, a thickened ligamentum flavum could be seen as well as a right-sided cystic formation. The cyst and involved portion of ligamentum flavum were removed in total with complete decompression of the nerve roots and thecal sac.

The excised specimen consisted of multiple fragments of beige rubbery tissue measuring in aggregate 2 x 2 x 0.5 cm. Histopathologic examination revealed fragments of ligamentum flavum with portions of eosinophilic, homogenous, necrotic debris probably representing necrotic ligamentum flavum. In viable segments intense neovascularization could be seen with proliferation of reactive fibroblasts. No synovium was seen.

The patient tolerated the procedure well and there were no complications postoperatively. She continues to do well after approximately one and a half years.

Case 4
This 57-year-old woman presented complaining of lower back pain with left-sided sciatica, having failed multiple conservative therapies and was completely debilitated on presentation, requiring admission for satisfactory pain control. An MRI was performed which demonstrated an extradural lesion that appeared to be cystic starting from the facet joint at the L5-S1 level. The patient electively underwent partial bilateral

The Table: Clinical, operative, radiological and pathological characteristics of patient series

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (yr); Sex</th>
<th>Clinical</th>
<th>Imaging</th>
<th>Level</th>
<th>Intra-operative findings</th>
<th>Pathology</th>
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<tr>
<td>1</td>
<td>82; F</td>
<td>Sciatica</td>
<td>Voluminous epidural cyst of ligamentum flavum</td>
<td>L5-S1</td>
<td>Thickened ligamentum flavum; contiguous to facet joint</td>
<td>Nonsynovial pseudocyst continuous with ligamentum flavum</td>
<td>2.5 years Good</td>
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<tr>
<td>2</td>
<td>74; M</td>
<td>Sciatica</td>
<td>Synovial cyst with moderate disc bulge</td>
<td>L3-L4</td>
<td>Thickened ligamentum flavum; contiguous to facet joint</td>
<td>Portions of a synovial cyst as well as abnormal ligamentum flavum</td>
<td>2 years Good</td>
</tr>
<tr>
<td>3</td>
<td>76; F</td>
<td>Sciatica, leg weakness</td>
<td>Posterior cystic lesion</td>
<td>L3-L4</td>
<td>Thickened ligamentum flavum</td>
<td>Nonsynovial cyst with necrotic ligamentum flavum</td>
<td>1.5 years Good</td>
</tr>
<tr>
<td>4</td>
<td>57; F</td>
<td>Sciatica, back pain</td>
<td>Extradural lesion adjacent to facet joint</td>
<td>L5-S1</td>
<td>Scarred ligamentum flavum with adherence to dura</td>
<td>Nonsynovial cyst with extensive necrosis in cyst and ligamentum flavum</td>
<td>13 months Good</td>
</tr>
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</table>
laminectomy at L5 and S1. Intraoperatively the ligamentum flavum was noted to be scarred and adherent to the dura. The extradural cystic lesion was eventually identified and was noted to cause significant compression of the thecal sac at the level of S1. The lesion was removed in its entirety as well as additional scar tissue from the nerve root with satisfactory decompression. Histopathological examination demonstrated areas of necrosis in both the ligamentum flavum and cartilage surrounded by intense granulation tissue with multinucleated giant cells. No definite synovial tissue was identified. In the postoperative course the patient did well and there were no complications. The patient continues to do extremely well after approximately 13 months follow-up.

**DISCUSSION**

The term “juxta-facet” cyst was first implemented by Kao et al.\(^1\) and Rhoto n et al.\(^2\) to describe cysts arising from the synovial joints of spinal facets, and encompasses both the synovial and ganglion sub-types commonly encountered in this area. Synovial cysts, characteristically, are continuous with the joint space and hence are lined by a pseudostratified columnar epithelium. They are filled with clear and serous fluid. Ganglion cysts have no such communication with the joint and do not possess a synovial cell lining. Their intraluminal contents are more gelatinous and viscous.\(^3\) Not all ligamentum flavum cysts can be described

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**Figure 1:** Magnetic resonance imaging appearance of ligamentum flavum cysts from our case series. T2 sagittal (A), T1 axial (B), T1 with gadolinium in sagittal section (C), and T2 axial (D).
solely as a synovial or ganglion sub-type based on pathological findings, however, nor are they all associated with spinal facets, hence suggesting that they represent unique lesions.

Contrary to juxta-facet cysts, there have been only a few cases of ligamentum flavum cysts described in the literature. The majority of published cases involved the lower lumbar spine, and corroborate the notion that ligamentum flavum cysts may be associated with microtrauma in the form of increased mobility at this level, with associated spinal degeneration. The majority of patient series in the literature regarding juxta-facet cysts demonstrate that facet joint degeneration is virtually always co-present, and the incidence of degenerative spondylolisthesis varies between 42 and 65%. Hypertrophy of the ligamentum flavum, along with ligamentous degeneration and fibrosis, are also frequently present and likely to be sequelae of localized spinal trauma. Cyst formation may thus be part of a spectrum of more advanced ligamentous degeneration, which includes necrosis, fibrosis and calcification. In the present study, all four cases involved the lower lumbar spine, and histopathologic examination of the excised specimens (Figure 2) demonstrated evidence of degenerative changes within the ligamentum flavum, with scar remodelling and neovascularisation, supporting the theory that ligamentum flavum cysts occur within the context of longstanding deterioration at the implicated joint level.

Most ligamentum flavum cysts reported in the literature were also located laterally within the spinal canal. While possibly a consequence of chronic bony degenerative disease, this phenomenon may be further elucidated in certain cases by the observation that the yellow ligaments are not as thick laterally as they are medially. Furthermore, they form posterior recesses bilaterally to the vertebral bodies. These recesses are filled with epidural fat, offer an area of decreased resistance and may, as a result, tolerate cyst formation.

The distinction of ligamentum flavum cysts from intraspinal synovial and ganglion cysts has been suggested to be solely an exercise in nomenclature, in consideration of the high frequency of these lesions at the L4-L5 level, the coexistence of

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**Figure 2:** Histopathological sections from a sample patient in our series demonstrating ligamentum flavum (LF) and associated cystic degeneration. The sections were stained with the elastic van Gieson stain: elastic fibers are dark brown to black, while collagen stains red. Slide (A) shows a high power view of normal LF contained in the specimen. Slide (B) is a high-power view of an area of collagenous scarring in the LF while slide (C) reveals organising granulation tissue (upper two thirds of the image) replacing part of the LF. Slide (D) is a low power view demonstrating cystic degeneration of the LF.
spinal degenerative disease, and overlapping histopathological features. In other case reports, these lesions are similarly classified together as juxta-facet cysts.5,6 While it is plausible that the etiologies of ligamentum flavum cysts described above are similar to those cysts implicating the spinal facet, the distinction is useful as surgical treatment of ligamentum flavum cysts does not require exploration of the facet joint.4 Various other pathologies involving the ligamentum flavum—distinct from the facet joint—have also been described in cases of spinal stenosis and compression, typically within the context of chronic degenerative changes or trauma at the implicated spinal level. These include other cystic lesions such as ligamentum flavum granulomas,23 as well as intraligamentous amyloid deposition,24 ossification of the ligamentum flavum,25 myxomatous degeneration of the lumbar ligamentum flavum,26 and ligamentum flavum hematoma.27

The CT appearance of juxta-facet cysts is often diagnostic and correlates well with pathologic findings. They typically consist of a cystic formation whose walls show calcification, and are located adjacent to facet joints that frequently show signs of degeneration.28 Ligamentum flavum cysts, conversely, have not been observed to cause rim calcification.29 On MRI (Figure 1), juxta-facet cysts appear as well-delineated cystic masses; the rim of synovial cysts are typically isointense to slightly hyperintense compared to cerebrospinal fluid in T1,30 and hypointense in T2. The rim contents have variable intensities and several classifications have been proposed.19 In the case of ligamentum flavum cysts, they are seen adjacent to the ligamentum flavum and there is no observable communication with the spinal facet joint. When intraluminal hemorrhage occurs in a minority of cases, they are easier to distinguish from herniated disk fragments and most neoplasms.3 In addition to other cystic lesions that may affect the lumbar spine, calcium pyrophosphate dihydrate deposits have been observed in the ligamentum flavum among patients presenting with lumbar pain and/or radiculopathy, and typically are hypointense on MRI and show calcifications on CT imaging.31 They have also been noted to occur in conjunction with synovial cysts of the lumbar spine.32

The majority of symptomatic juxta-facet cysts usually present with radiculopathy, such as sciatica in the case of lumbar cysts, and can mimic symptoms related to intervertebral disk herniation.33 The progression can be both acute and sub-acute. Not all juxta-facet cysts are symptomatic, and can be discovered incidentally.34 In the four cases described, however, the juxta-facet cysts were the source of incapacitating pain.

Most conservative therapies are temporary and have varying success in the short term. Percutaneous steroid injection of facet and juxta-facet synovial cysts has achieved variable but generally good short-term outcomes.35,36 Evidence-based information on the surgical management of ligamentum flavum cysts is limited. The goal of surgery in juxta-facet cysts is spinal decompression via laminectomy and resection of the cyst and affected ligamentum flavum. Complete excision at the base of the ligamentous insertion of the cyst assures a minimal rate of recurrence.37 While nearly 95% of all operated synovial cysts can be removed in their entirety,38,39 a major reported intraoperative difficulty lies in the presence of adhesions to the dural wall, which is the main causative factor of incomplete resections. Literature series regarding synovial cysts have reported excellent levels of recuperation of neurologic function in 87-98% of cases.40,41 Likewise, improvement in both pain and neurologic function in the majority of patients with both ligamentum flavum and juxta-facet cysts has been reported.42 In our present series, surgical removal of the cyst and affected ligamentum flavum resulted in marked improvement of pain and reversal of neurologic symptoms in all four patients.

In conclusion, ligamentum flavum cysts represent a rare cause of lumbar spinal stenosis. Several features of these lesions suggest that they represent entities distinct from classical juxta-facet cysts. We have presented four cases from our own experience, and discussed their imaging features as well as possible mechanisms for their development.

REFERENCES