

# SUBLAMINAR OSTEOTOMY FOR LUMBAR SPINAL STENOSIS: SURGICAL TECHNIQUE

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## SUMMARY

**Background:** Lumbar spinal stenosis (LSS) is the primary indication for spinal surgery in patients aged 65 and older. The condition is characterized by neurovascular compression resulting from degenerative hypertrophy of the ligamentum flavum and facet joints. While surgical intervention is required when conservative management fails, standard procedures such as total laminectomy are associated with risks of iatrogenic instability, whereas instrumented fusion increases surgical morbidity, blood loss, and healthcare costs.

**Objective:** This article details a surgical technique for lumbar recalibration utilizing a sublaminar osteotomy to achieve effective decompression of the spinal canal while preserving the structural integrity of the posterior arch and facet joints.

**Key Points:** The procedure involves a medial sagittal incision followed by the detachment of the erector spinae muscles. After performing a transverse osteotomy of the inferior facet joint process and a medial facetectomy, a sublaminar osteotomy is executed through the enlarged interlaminar space. An osteotome is used to divide the lamina through the cancellous bone, allowing for the en bloc extraction of a bone fragment containing the ligamentum flavum insertion. This intraosseous approach facilitates complete decompression of the dural sac and nerve roots while maintaining the caudal portion of the posterior arch for muscle reinsertion. Clinical application of this technique in over 1,500 patients demonstrated no instances of postoperative iatrogenic instability.

**Conclusion:** Lumbar recalibration combined with sublaminar osteotomy offers a reproducible method for treating symptomatic LSS. By preserving the posterior elements and facet joints, the technique minimizes the risk of mechanical instability and avoids the complications associated with more extensive decompressive or instrumented procedures.

## KEYWORDS

Spinal Stenosis; Laminectomy; Osteotomy; Lumbar Vertebrae; Ligamentum Flavum

Lumbar spinal stenosis (LSS) is the most common indication for spinal surgery in patients aged 65 and over. The ligamentum flavum contributes to the narrowing of the spinal canal. The challenge of surgical treatment for LSS is how to effectively and lastingly remove the causes of the compression whilst avoiding complications such as iatrogenic instability. We describe a technique involving lumbar recalibration followed by a sublaminar osteotomy performed through enlarged interlaminar space. This technique is simple, effective, long-lasting and reproducible.

## INTRODUCTION

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Lumbar spinal stenosis (LSS) is the most common indication for spinal surgery in patients aged 65 and over [1] and the impact of a narrow spinal canal is increasing due to the ageing of the population [2]. LSS is a common degenerative condition characterized by a narrowing of the space containing the neurovascular structures of the spine and can affect both the spinal canal and foramina. It causes leg pain and intermittent neurological claudication and affects patient quality of life.

Constant mechanical stress results in degeneration and hypertrophy of the ligamentum flavum [3–5] which, combined with facet joint hypertrophy, contributes to the narrowing of the spinal canal [8] and compression of the nerve roots inside. This article describes a technique for surgical lumbar recalibration incorporating sublaminar osteotomy which has several benefits as described below.

## DIAGNOSIS

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All patients described intermittent neurological claudication and reduced walking distances combined with a greater or lesser degree of nerve root pain on both sides. Dynamic x-rays were used to identify and subsequently treat any cases of clinical instability (spondylolisthesis).

The diagnosis of LSS was then confirmed with imaging studies, either CT or MRI (Fig. 1). Dynamic myelography was useful to search for any compression not detected on the static images.

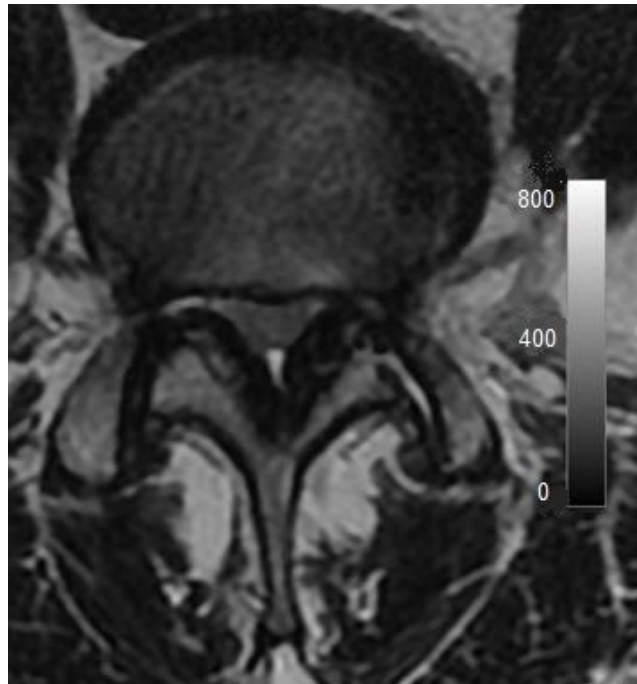


Figure 1: Axial MRI of the lumbar spine: lumbar spinal stenosis with hypertrophy of the joint and ligamentum flavum.

Patients eligible for this lumbar release technique therefore had symptomatic LSS without radiological instability.

## SURGICAL TECHNIQUE

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The patient is placed in prone position on a Hall frame. A medial sagittal incision is made over the spinous processes at the level of the spinal stenosis. The erector spinae muscles are detached from both sides of the spinous processes and laminae, down to the facet joints laterally which are disengaged (Fig. 2).

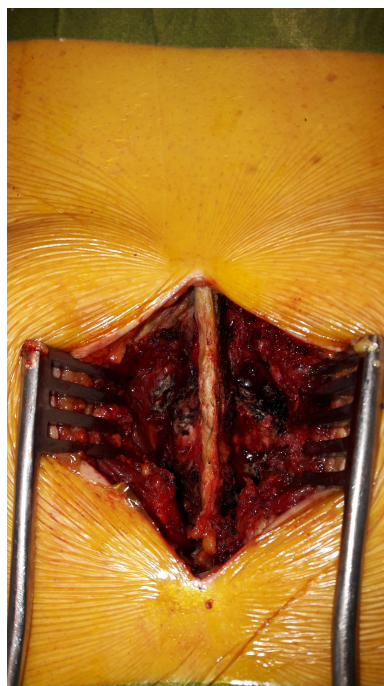


Figure 2: The erector spinae muscles are detached from both sides of the spinous processes and laminae, down to the facet joints laterally which are disengaged.

The inferior quarter of the inferior facet joint processes subjacent to the compressed level is resected using an osteotome using a strictly transverse osteotomy cut (Fig. 3).

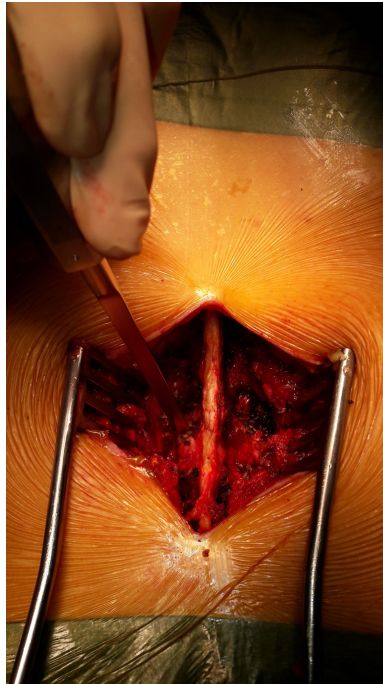


Figure 3: Osteotomy of the inferior quarter of the inferior facet joint process of the vertebra subjacent to the stenosis. The cut line is transverse to allow the subsequent sublaminar osteotomy.

The lumbar canal is recalibrated using a technique similar to the one described by S negas [9], with a cephalic hemilaminectomy of the inferior vertebra, and a medial facetectomy using a 4 or 5mm Kerrison rongeur. The bone cut extends directly above the pedicle to allow unroofing of the recess. Downwards and outwards, the resection must be completed to allow the hook to pass freely into the foramen without damaging the nerve root. Upwards and outwards, the cut extends directly above the inferior edge of the lamina of the superior vertebra.

**Sublaminar osteotomy (Figs. 4a & 4b):**

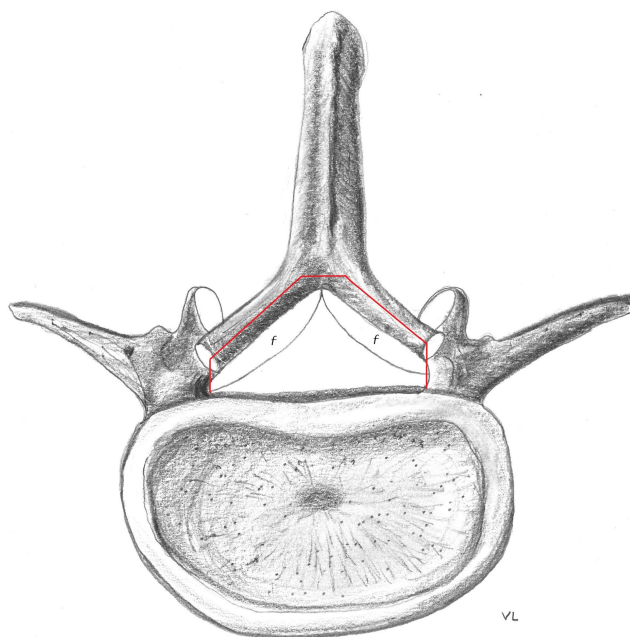


Figure 4. a) Inferior view of a lumbar vertebra showing the osteotomy line (in red). f = Hypertrophied flavum. b) Position of the osteotome into the middle of the lamina and parallel to it.

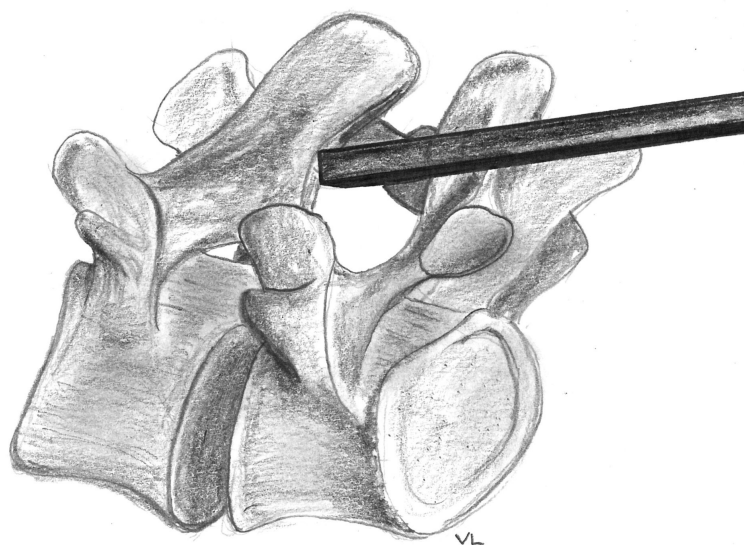


Figure 4. a) Inferior view of a lumbar vertebra showing the osteotomy line (in red). f = Hypertrophied flavum. b) Position of the osteotome into the middle of the lamina and parallel to it.

We perform the sublaminar osteotomy by passing the osteotome through the enlarged interlaminar space.

The first cut is paramedian and parallel to the target lamina. The chisel is directed into the cancellous bone of the lamina, between its lateral and medial (intraspinal) cortex, keeping the blade edge horizontal. The lamina is thus cut into two halves through its middle (Figs. 5 & 6).

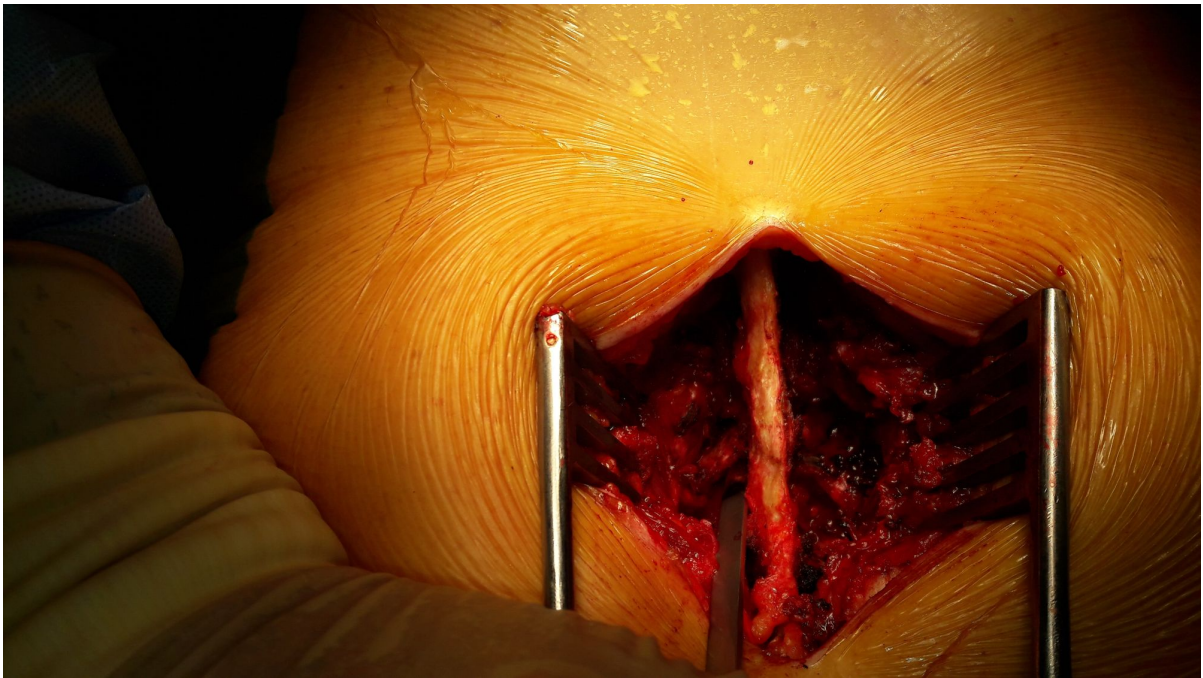


Figure 5. a) The lamina is divided into two halves through its middle by cutting into the cancellous bone; the first cut is paramedian. b) The osteotome exits at the cranial aspect of the target lamina because the subjacent level has also been recalibrated, allowing good exposure.

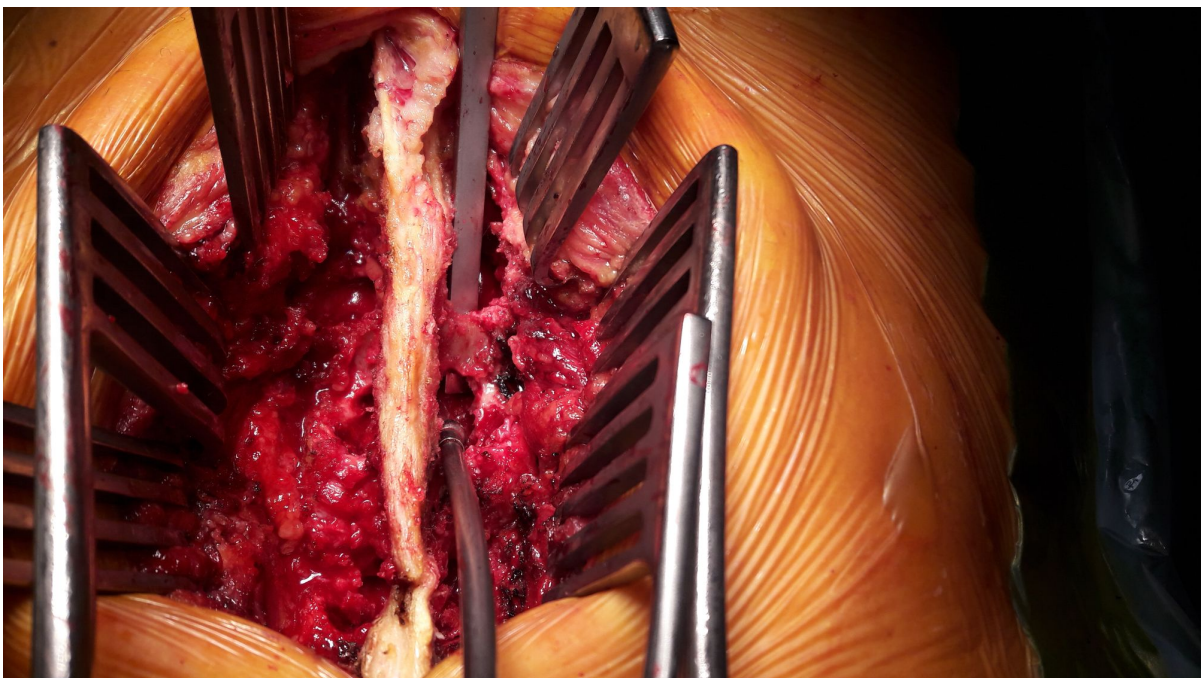


Figure 5. a) The lamina is divided into two halves through its middle by cutting into the cancellous bone; the first cut is paramedian. b) The osteotome exits at the cranial aspect of the target lamina because the subjacent level has also been recalibrated, allowing good exposure.

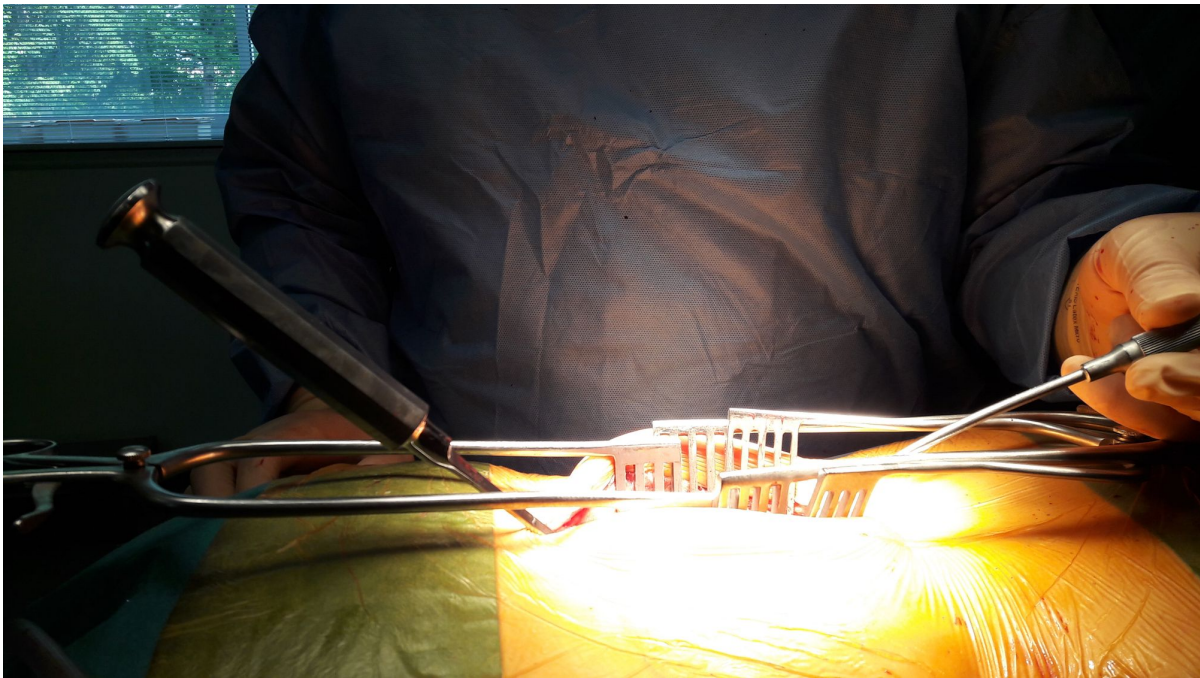


Figure 6: Osteotomy in progress, with the blade edge horizontal and the chisel axis parallel to the target lamina.

The osteotomy is complete when the surgeon feels a lack of resistance to the hand holding the chisel and the noise suddenly becomes duller and muffled. A second cut is then made, outside the first, with the blade edge slightly inclined along the plane of the lamina, and the axis of the chisel lying outside the sagittal axis.

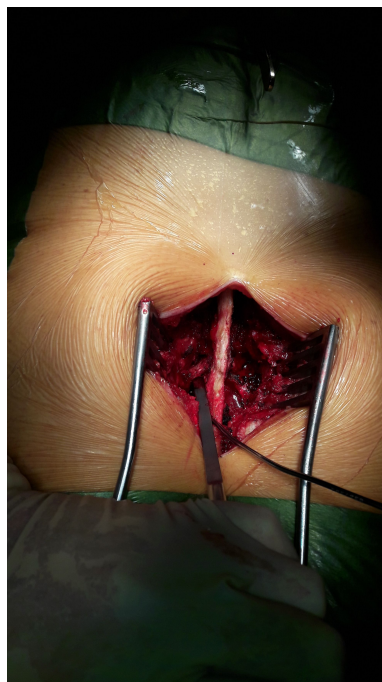


Figure 7: A second cut is then made, outside the first, with the blade edge slightly inclined along the plane of the lamina, and the axis of the chisel lying outside the sagittal axis.

A third cut is sometimes needed, vertically directly above the medial edge of the inferior facet joint process of the vertebra, in order to complete the osteotomy so that a single fragment of sublamina tissue can be extracted. The instrument should be rotated slightly on its axis to complete the laminar osteoclasia (Fig. 8).

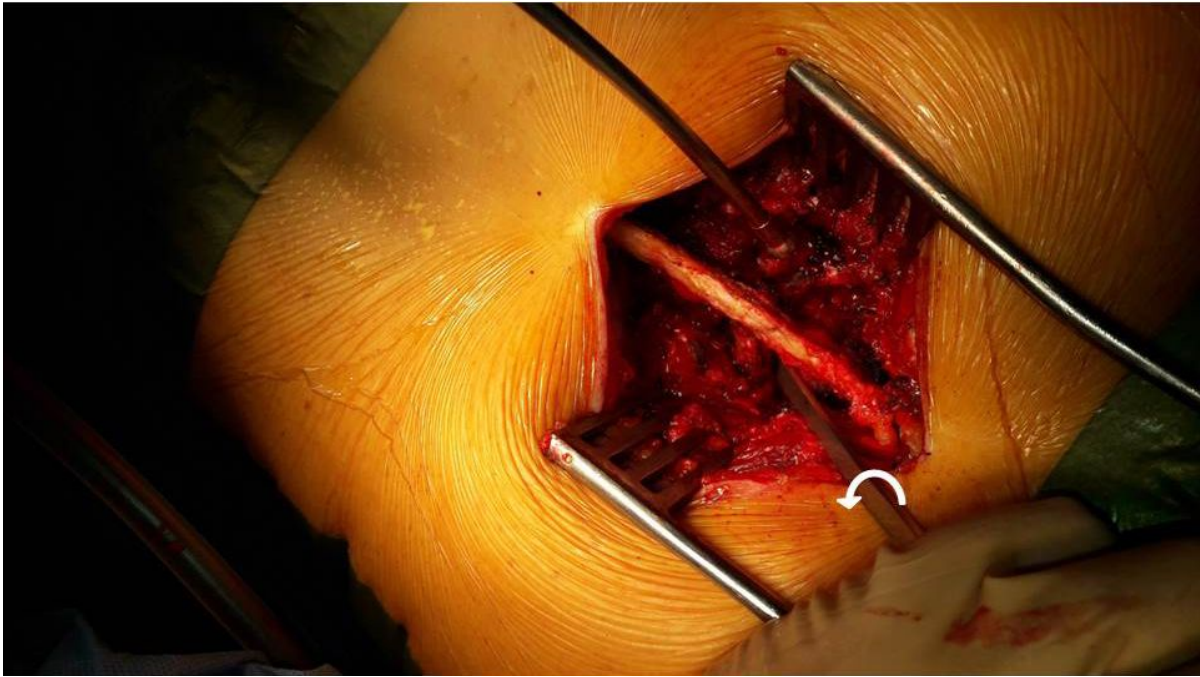


Figure 8: Gentle rotation of the osteotome on its axis to complete the laminar osteoclasia.

The osteotomy fragment can then be removed using angulated forceps, extracting it slowly downwards then outwards (Fig. 9).

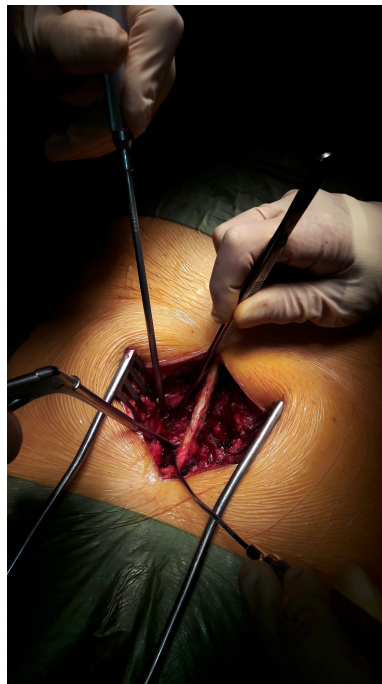


Figure 9. a) The osteotomy fragment is gripped using angulated forceps. b) It is then extracted slowly downwards then outwards.

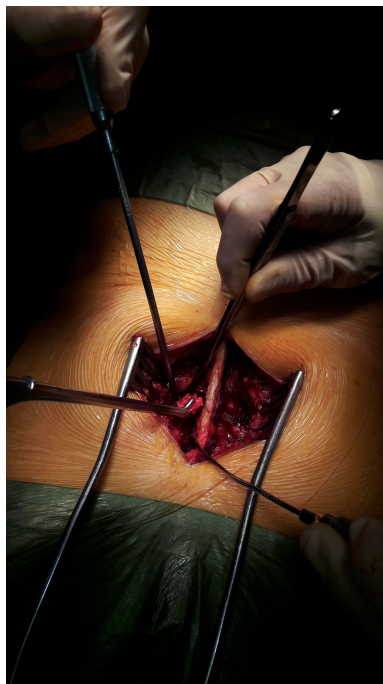


Figure 9. a) The osteotomy fragment is gripped using angulated forceps. b) It is then extracted slowly downwards then outwards.

Examination of the single extracted fragment reveals the resected bone surface on one side, and on the other side the hypertrophied ligamentum flavum and its attachment site (Fig. 10).

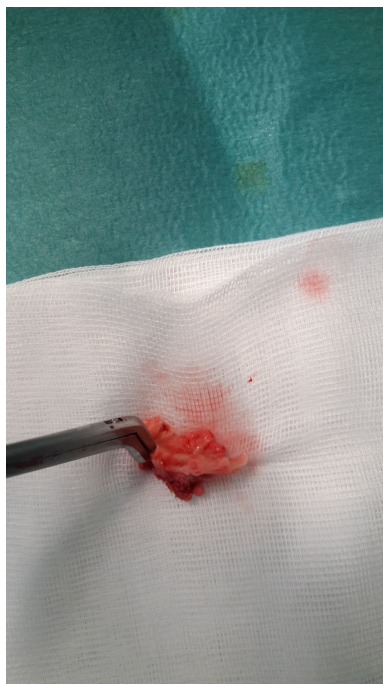


Figure 10: The single extracted fragment has a resected bone surface (on the right) and the ligamentum flavum with its attachment site (on the left).

At each level, the dura mater and roots are therefore decompressed whilst preserving the caudal part of the posterior arch and major part of the facet joints (Figs. 11 & 12).

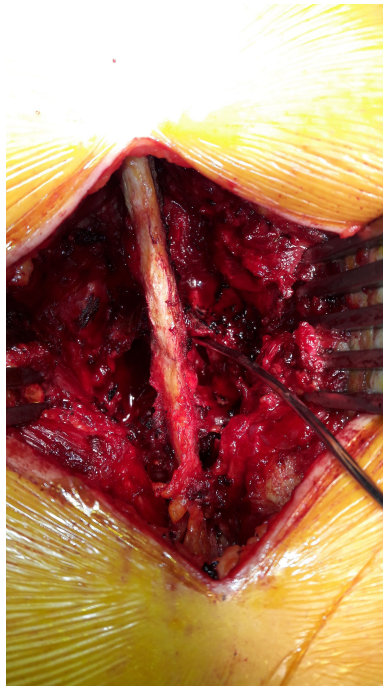


Figure 11: The osteotomy creates a comfortable space for the dural sheath, whilst preserving the caudal part of the posterior arch, which is needed for the muscle reinsertion.

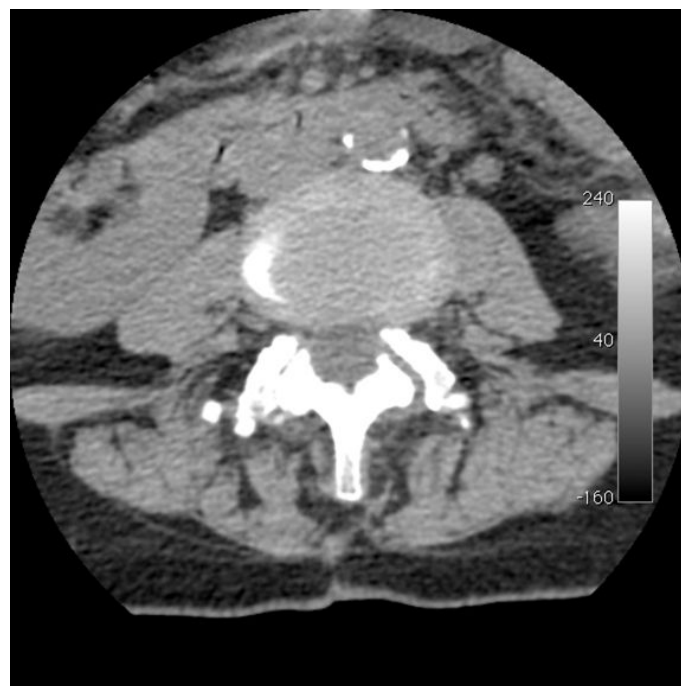


Figure 12: Post-operative axial scan showing the osteotomy cuts and spinal canal decompression.

## DISCUSSION

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LSS is one of the most common indications for spinal surgery and its incidence is expected to rise given the ageing of the population and advances in imaging capacity [2]. Once the neurological symptoms become disabling, conservative treatment is no longer appropriate, and the patient requires surgery.

The goal and challenge are to release the neurovascular structures inside the spinal canal effectively and lastingly, without destabilising the spine. However, simply creating an interlaminar window is not enough [10]. In 1988,

Sénégas insisted on the importance of completely dissecting the ligamentum flavum, including its insertion onto the caudal lamina [9]. Nevertheless, the method for performing this dissection was never sufficiently explained.

We propose an instrument-free lumbar recalibration technique, with an osteotomy through the middle of the lamina to restore a comfortable interspinal space and a smaller bone resection. By removing the bone fragment carrying the ligamentum flavum insertion, the entire sublaminar flavum can be removed in one single motion that is probably safer - being intraosseous - than 'blindly' introducing a Kerrison into the canal. The thickness of the remaining lamina can be used to hold the erector spinae, which could in theory both help restore their function and avoid any long-term fibrous growth directly in contact with the dura mater, which would obstruct any revision surgery. Finally, this method can also be used for the subjacent lamina when performing a posterior lumbar interbody fusion in order to prevent or delay the onset of decompensation at the subjacent level.

There are naturally numerous surgical strategies for treating LSS, from laminectomy or lamino-arthrectomy, which is reserved for elderly subjects with comorbidities, to lumbar fusion which is preferable in cases of dynamic instability. The use of instrumentation causes greater bleeding, longer hospital stays, decompensation of the adjacent segment and greater expense [11–13]. On the other hand, a laminectomy carries real complications in the more or less long term, such as adjacent stenosis, disc herniation and above all iatrogenic instability or even spondylolisthesis [11,12,14–16]. There is no real documented proof of the superiority of one surgical strategy over another in the treatment of LSS [17].

We believe our osteotomy technique has an accessible learning curve and is therefore simple, effective and reproducible for the treatment of LSS. Dr Lalouz used this technique for over 1,500 patients during his career, without any cases of iatrogenic instability.

## CONCLUSION

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Lumbar recalibration combining a cephalic laminectomy and sublaminar osteotomy appears to offer a simple, effective, long-lasting and reproducible method for treating symptomatic degenerative lumbar spinal stenosis.

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