Nerve root canal decompression

Lumbar perineural venous dilatation as an indicator of its efficacy

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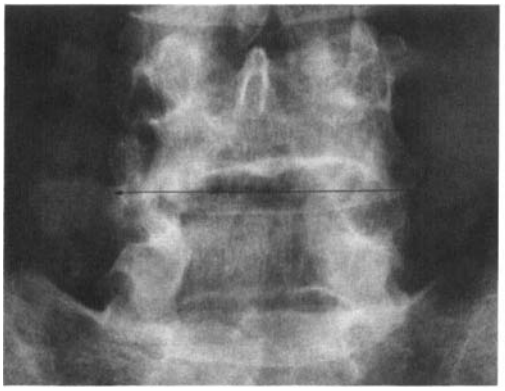
When surgeons perform operations for stenoses of lumbar nerve root canals and intervertebral foramina they pose the question: "Can one be sure that the decompression is adequate?" (Figure 1). The answer is often: "Yes, when a probe can be passed easily along the nerve root or into the intervertebral foramen, when the laminectomy is wide enough, when the nerve root is free". In fact, there is a further indicator of the adequacy of the decompression procedure—changes in the venous drainage of the nerve root which can be observed during operation. The importance of venous obstruction in the nerve root canal and intervertebral foramina as a fundamental cause of referred leg pain has gained acceptance only in recent years. Clinical, radiographic and experimental studies have confirmed its relevance (Olmarker 1990, Gallinaro et al. 1992, Castro and Assheuer 1993).

I want to present visual evidence of the refilling of the lumbar perineural veins which occurs when nerve root canal and foraminal decompressions have been adequately performed. Dilatation of the internal vertebral venous plexus around the affected nerve roots which occurs during operation is the most reliable objective indicator of the adequacy of the decompression (Figures 2–4).

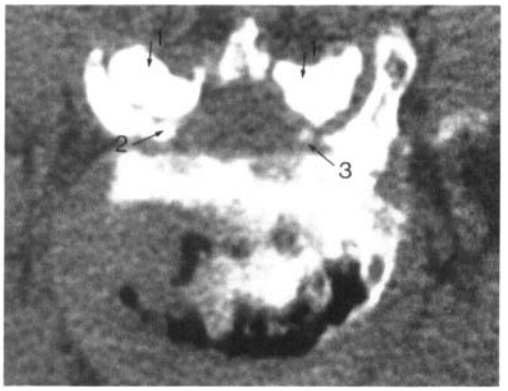
Surgical technique for lumbar nerve root canal and foraminal decompression

The essential steps in nerve root canal and foraminal decompression involve excision of the ligamentum flavum and identification of the medial margin of the pedicle on the lower vertebra at the level of the affected disc space. The medial and apical margins of the superior facet at that level should then be defined,

Figure 1. The black marker in the AP radiograph (left) of the lumbar spine indicates the level of a postoperative axial CT image (right).

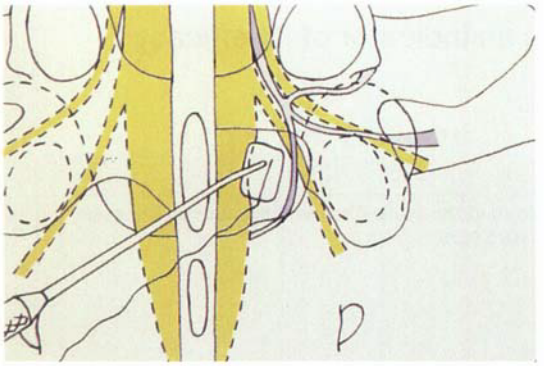


Question: Has the decompression been adequate?

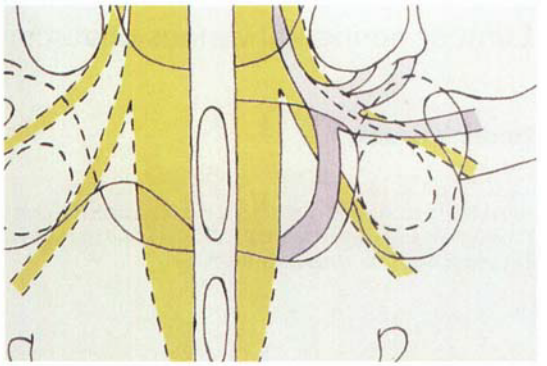


Answer: No. The explanation for failure can be found by examining the CT: 1) hypertrophic inferior facets of L4 lamina; 2) and 3) ossified remnants of ligamentum flavum attached to the superior facets of L5 with persistent nerve root canal stenosis on both sides.

Figure 2. The findings at L5/S1 during foraminal and nerve root canal decompressions.



Note the sucker and patty retracting the dural sac to expose the S1 nerve root across which a thin blue vein is running.



A view of the same area following adequate decompression of the intervertebral foramen and nerve root canal. Note the engorged perineural veins. The superior facet of S1 has been trimmed until its medial margin is flush with the inner border of the S1 pedicle. The ligamentum flavum has been excised in toto. The spinous process of L5 and S1 are intact along with the supraspinous and interspinous ligaments.

using a sucker and patty to retract the epidural fat and underlying dura. The smooth flat end of a dissector is manipulated gently between the soft tissues covering the nerve root and the anterior margin of the superior facet.

This superior facet can then be trimmed under direct vision until its medial margin is flush with the medial margin of the pedicle. This is most safely accomplished by using 45-degree forward-angled punches with cup sizes ranging from 1 to 4 mm. Some authors have recommended the use of thin osteotomes for this procedure, erroneously cautioning against the use of oblique-angled punches (Getty et al. 1981).

At this stage, the nerve root may be visible from its point of take-off from the dural sac to the level of the medial border of the exposed pedicle. Lateral to the nerve root, the anterior margin of the superior facet will be found abutting against the bulging disc margin, at which point the veins draining the nerve root are obstructed. Further dissection of the medial margin of the facet is required, using either an angled curette or a 1 mm cup size oblique-angled punch to trim the edge of the facet by a further few millimeters, until the veins around the nerve root can be seen to refill. Some venous hemorrhage usually occurs during these manœuvres but with the use of a sucker and patty attached, as described above, the refilling of the large venous trunks can always be seen. Decompression of the stenotic canal can be confidently predicted to have been adequate once the perineural veins have been seen to have refilled and distended. Any persistent venous hemorrhage can be controlled by placing a small fragment of gelfoam at the site. The use of diathermy or even of bipolar coagulation should be avoided. The manœuvres required may also involve excision of the tip of the apex of the superior facet and removal of the upper attachment of the ligamentum flavum from the undersurface of the lamina on the superior side of the disc space.

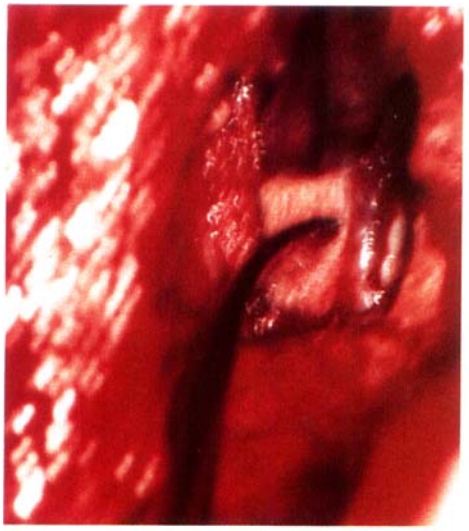
In most cases, bilateral foraminal and nerve root canal decompressions need to be performed and these should be done, ideally, with the preservation of the central portions of the laminae and the spinous processes, together with the interspinous ligaments. At the end of the procedure, the lumbo-dorsal fascia should be reattached to the midline ligaments, thereby bringing the paraspinal muscles back into a normal relationship with the roof of the canal. This prevents bowstringing of the muscles across the level of the decompression and avoids creation of a large dead space in which dense scar tissue is likely to develop.

Figure 2 depicts in diagrammatic form the venous obstruction which is found in the preliminary stages of the decompression procedure and shows the refilling of perineural veins at the completion. Four examples of operative photographs provide the visual evidence in support of my statements in this paper (Figures 3 and 4).

References

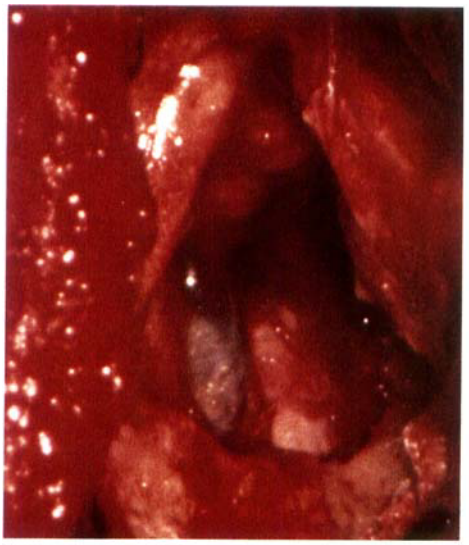
Castro W H M, Assheuer J. Haemodynamic changes in stenotic processes of the lumbar spinal canal. A magnetic resonance imaging study. Paper presented to the Intern Soc for the Study of the Lumbar Spine. Marseille 1993.

Figure 3. A Zeiss 300 mm lens operating microscope was used during the preliminary stages of nerve root canal and foraminal decompression at L5/S1, in a man aged 65 years.



The supraspinous ligament between the spinous processes of L5 and S1 is on the left margin. The medial border of the S1 facet is along the right-sided margin of the photograph. In the center of the field a small patty lies over the dural sac to expose the partially filled perineural vein coursing along the posterior surface of the S1 nerve root. The lateral edge of the S1 nerve root is lying medial to the inner margin of the S1 facet.

A detailed view of the same field at the conclusion of the operation. Note the distension of the perineural veins which only occurs after their obstructed tributaries, which lie lateral to the S1 nerve root, have been decompressed. Perineural venous distension of this order constitutes objective evidence of adequate foraminal and nerve root canal decompressions.



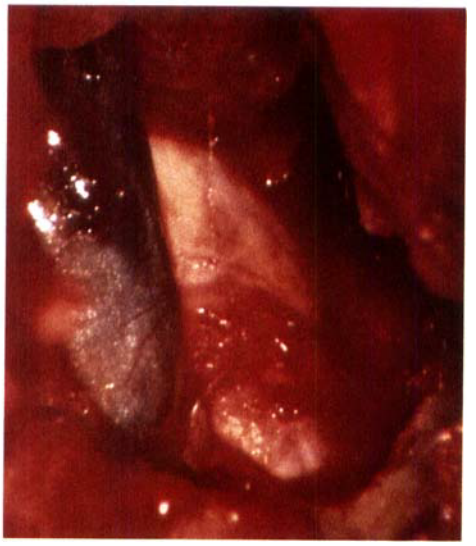


Figure 4. Operative photographs oriented in the same plane as those in Figure 3. These pictures were taken during (A) and at the completion (B) of foraminal and nerve root canal decompressions at L5/S1 in a woman aged 34 years. Note the marked distension of the perineural vein—now almost equal in size to the S1 nerve root which it accompanies.

Gallinaro P, Indemine E, Tabasso G, Massazza G. Stenosis of the nerve root canal caused by disc resorption. Chir Organi Nov 1992; 77 (1): 61–3.

Getty C J M, Johnson J R, Kirwan E O G, Sullivan M F. Partial undercutting facetectomy for bony entrapment of the lumbar nerve root. J Bone Joint Surg (Br) 1981; 63: 330–5.

Olmarker K. Spinal nerve root compression. Thesis, University of Gothenburg, Gothenburg, Sweden 1990.