Degenerative lumbar spinal stenosis—results of expansive laminoplasty

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Received: 1 April 2007 / Revised: 26 April 2007 / Accepted: 27 April 2007 / Published online: 18 July 2007
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Abstract Expansive laminoplasty, a procedure used more and more often for cervical myelopathy, was carried out in patients with lumbar spinal stenosis in the Department of Orthopaedics, Paraplegia, Physical Medicine and Rehabilitation of our institute. Twenty-five such clinico-radiologically proven cases were operated upon. For radiological evaluation, computed tomography (CT) was used. Expansive laminoplasty decompresses the nerve roots by osteoplastic enlargement of the lumbar spinal canal, with the maintenance of spinal stability. These advantages were confirmed during the follow-up of 3 to 5 years. Using CT, the spinal canal was found to be enlarged to a nearly rectangular shape and the average enlargement was 124%. The visual analogue scale (VAS) was used for subjective pain assessment before and after the surgery. The ultimate outcome was assessed by the Surin et al. criteria (Spine 17:1–8, 1992).

Résumé Nous réalisons habituellement, dans notre département de chirurgie orthopédique, de traitement des paraplégiques, de médecine physique et rééducation, dans les myélopathies cervicales une laminoplastie étendue. Dans ce contexte, nous avons opéré 25 patients qui ont été explorés sur le plan radiologique et scanographique. La laminoplastie étendue entraîne une décompression des racines nerveuses et un élargissement du canal tout en permettant un maintien de la stabilité rachidienne. Ces avantages ont été confirmés par le

suivi des patients sur une période de 3 à 5 ans. L'élargissement du canal a été en moyenne de 124%. Nous avons utilisé une échelle visuelle analogique pour analyser la douleur avant et après l'intervention chirurgicale. Le devenir de ces patients a été également étudié selon les critères de Surin et collaborateurs.

Introduction

Degenerative lumbar spinal stenosis is the most common cause of lower back and lower extremity discomfort and disability in elderly patients. It has been said to be the end processes in the pathogenesis of low back pain. With the increasing longevity of our population and a continually rising proportion of middle-aged and elderly patients, the problem of lumbo-sacral pain is a significant health care issue [14]. Extensive laminectomy has been used widely for the treatment of lumbar spinal stenosis [3, 6, 7, 10]. We performed expansive laminoplasty in patients with degenerative lumbar spinal stenosis with hypertrophy of ligamentum flavum, spinal stenosis with multiple ossification of intraspinal ligaments or herniated intervertebral disc. We followed up all patients for more than 3 years. The results have been quite satisfactory, with added advantages of the maintenance of spinal stability, along with enlargement of the spinal canal.

Patients

Twenty-five patients with degenerative lumbar spinal stenosis were surgically treated by expansive laminoplasty in the Department of Orthopaedics, Paraplegia, Physical Medicine and Rehabilitation between 2003 and 2006. There were 16 females and 9 males patients, with a mean age of 57.6 years

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(range 35 to 80 years). In 19 patients, we performed laminoplasty at two levels and in the rest at one level only. The clinical diagnosis was made from patient history and thorough general physical and neurological examination. It was correlated with plain radiography and computed tomography (CT) scanning. All patients had bilateral neurogenic claudication; however, 23 patients had low backache associated with it. Nine patients had motor weakness and six had sensory deficits. The majority of patients presented symptoms from central canal stenosis with or without lateral recess stenosis. All of the patients had ligamentum flavum hypertrophy, 13 had facet joint hypertrophy, six had thickening of laminae and 12 patients had disc herniation associated with it. Informed consent for the study was obtained from all of the patients.

The procedural approach was through the midline incision over the stenotic vertebrae in all cases. The surgical method of expansion of laminae is similar to open-door laminoplasty, as performed for cervical spinal stenosis [5]. The target laminae were cut using a high-speed air drill after the spinous processes has been removed at its base. On the side to be opened, interrupted perforations were made up to the inner cortex of laminae using a guarded/shouldered drill bit and then the laminae were detached completely with an osteotome to obtain sufficient rotation. The ligamentum flavum was dissected free on the same side with a knife. On the hinged side, an incomplete separation of laminae was created by means of an interrupted perforation of the outer cortex only by using the same drill bit, keeping the inner cortex intact. These holes were enlarged using a burr and a groove was made. The outer edge of the bilateral grooves were made to reach the lateral one third of the articular facets. The groove on the hinged side was made wider to allow the required expansion of the lateral recess. The open side was gently lifted up, enlarging the canal and, in doing so, the hinged side on the outer cortex of the laminae came into close apposition.

Before the laminae were mobilised, small holes were made in each lamina and in the articular process on the open side. The laminae were turned up at an angle of at least 45°. It was possible to lift and rotate the laminae from the open side and rotation was achieved sufficiently by closing the groove the on hinged side completely. A 0.3-mm braided steel wire was passed through the hole in the laminae. The spinous processes were cut into blocks measuring approximately 20×15 mm and a transverse hole was made through the graft. One end of the steel wire was just passed through the laminae, the bone graft and the articular process and tied after the graft was placed in the open side of the graft (Figs. 1 and 2). In patients with disc herniation, the disc was removed by fenestration through ligamentum flavum and then laminoplasty was performed. The wound was closed in layers without negative suction drain. Stitches were removed after two weeks.

Fig. 1 Line diagram showing the placement of graft and fixation with wire

All of the patients were taught active lower limb exercises, calf squeezing and active dorsiflexion-plantar flexion of the ankle, which was an important aspect to prevent deep vein thrombosis. None of our patients had deep vein thrombosis. There was no mortality.

Fig. 2 Computed tomography (CT) scan (axial section) showing enlarged canal with graft and wire in situ

Fig. 3 Postoperative X-ray showing the placement of wires after graft fixation

Results

A total of 25 patients consisting of 19 females and 6 males with an average age of 57.6 years (range 35–80 years) were included in the study. The average operation time per lamina was 49 min. There was minimal blood loss during the surgery and none of our patients required blood transfusion. The clinical and radiological average preoperative canal diameter was 8.63 mm and the average postoperative canal diameter was 19 mm. The average enlargement of the canal was 124% (Fig. 3). The average preoperative claudication distance was 85.2 ± 60.56 m and it improved to 632 ± 154.70 m after surgery. Subjective pain assessment was carried out on the visual analogue scale (VAS) and improvement in VAS score was highly significant by paired student's *t*-test ($p < 0.001$). Postoperatively, the average duration of hospital stay was 7.56 days. The average time taken to achieve bony fusion in the region of laminoplasty was 4 months.

Postoperatively, standing and walking were allowed after 2 weeks. A stainless steel jacket was applied for one month and then a soft brace was applied for another 3 months. There was no postoperative deformity and none of our cases suffered failed back syndrome during the follow-up.

The ultimate clinical outcome was assessed by the following criteria by Surin et al. [12].

Excellent	Patient is symptom-free and has resumed all previous activities.
Good	The patient has resumed normal activities but may occasionally have recurrent leg or back pain after heavy work.
Fair	The patient has to reduce his/her previous activities because of persistence of some pain symptoms but is non incapacitating.
Poor	The patient is virtually disabled and the symptoms have not been reduced at all by surgery.

As per the above criteria, we achieved excellent results in seven patients, good in 15 and fair in one patient. Two patients had poor results, who had recurrent claudication six months after the surgery. There were no other major complications of the procedure.

Discussion

Degenerative lumbar spinal stenosis is one of the most common spinal disorder affecting people older than 50 years of age. Degenerative lumbar spinal stenosis is the end stage of a long-standing disc disease, often at several lumbar segments. It leads to narrowing of the intervertebral disc space and causes secondary changes in the structures bordering the lateral recess and the intervertebral foramina. Also, the descent of pedicles and the subluxation of the facet joints, resulting in osteophyte formation, infolding of the ligamentum flavum, posterior spur formation, as well as the occasional bulging of the disc itself, cause entrapment of the spinal neural elements. The clinical complaints of the patients include, therefore, symptoms both in the low back region and the lower extremities [11].

Extensive laminectomy has been the main surgical procedure for lumbar spinal canal stenosis in past; however, it causes significant postoperative spinal instability [3, 6, 7, 11]. Gelalis et al. [2], in their study of 50 patients of lumbar spinal stenosis treated by extensive laminectomy, showed that extensive decompression is a must while preserving spinal stability. But to maintain stability, concomitant spinal fusion had to be considered, which was required in 10% of their patients.

Laminoplasty has become an established procedure and is being extensively performed for the treatment of cervical canal stenosis [1, 5, 8, 13]. An epoch-making laminoplasty, i.e. the expansive open-door laminoplasty, was used by Hirabayashi et al. [4] for cervical canal stenosis.

Recently, lumbar laminoplasty has been taking over laminectomy for lumbar spinal stenosis. There is a paucity of work and we could find less than ten studies in the English literature. We have our own experience of expansive laminoplasty for lumbar spinal canal stenosis. Our technique is a modification of the open-door laminoplasty used for cervical canal stenosis. The technique has been quite useful and its advantages are that it decompresses the nerve roots by expanding the cross-sectional area of the spinal canal without compromising the spinal stability, avoids delayed deformities of the spine and avoids laminectomy membrane formation postoperatively, so there is a lesser chance of recurrence and patients can be rehabilitated early.

In our series, we have measured the canal diameter by CT scanning as it is a better investigation for bony outline (canal diameter). The main outcome of our procedure was

the increase in anteroposterior canal diameter, along with the maintenance of spinal stability. We fixed the laminae and graft with 0.3-mm monofilament circlage wire and the rest of the stability was maintained by proper suturing of the musculoligamentous structures. There was no sinking or slipping of the graft in any of the cases. Using CT scanning for canal measurements before and after surgery, we had an average enlargement of 124% in the anteroposterior canal diameter. This great enlargement of canal diameter was quite sufficient for relieving pressure on the caudal equina. Similar results have been found in other studies [9].

We conclude that expansive laminoplasty has yielded encouraging results in relieving neurogenic claudication by increasing the canal diameter, with simultaneous excision of the disc and the maintenance of spinal stability. A downside of this investigation is that it is a short-term study and the results of many such studies, along with long-term follow-up, will be required to establish whether expansive laminoplasty is the procedure of choice for this condition.

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