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Laminoplasty is better of laminectomy in cervical stenotic myelopathy: myth or truth?

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Abstract. – INTRODUCTION: Laminoplasty has been proposed as a treatment for cervical stenotic myelopathy (CSM) as an alternative to standard laminectomy as this has been considered directly associated with an increased risk of postoperative deformity.

METHODS: We retrospective reviewed postoperative results of open door laminoplasty (unilateral approach technique) compared with laminectomy in terms of clinical/electophysiological results (somatosensory evoked potentials – SSEP, and motor evoked potentials – MEP); in addition the rate of subsequent spinal deformities was analyzed in both techniques.

RESULTS: Postoperative results in terms of late follow up neurological assessment and neurophysiological improvement was substantially comparable in both groups. Postoperative dynamic cervical X-rays showed a kyphotic deformity in (12.5%) in patients undergoing laminectomy; none was unstable. No case of kypothic deformity occurred in patients undergoing open door laminoplasty. Complication rate was similar in both groups.

DISCUSSION AND CONCLUSIONS: Standard laminectomy seems to be associated to late cervical spine deformities in a more relevant percentage of patients, possibly leading to severe forms of kyphosis and segmental instability over time compared with open-door expansive laminoplasty. The unilateral approach represents an evolution to standard open door technique that further spares posterior elements, may decrease the incidence of progressive spinal deformity and prevent the need for subsequent spinal stabilization.

Key Words:
Cervical stenotic myelopathy, Laminectomy, Laminoplasty, Evoked potentials.

Introduction

CSM is a progressive and invalidating syndrome that can determine major irreversible neurological damage. Four basic surgical procedures have been established in the treatment of compressive CSM: anterior discectomy, anterior corpectomy, posterior laminectomy and posterior laminoplasty[1]. The length and the extent of laminectomy, has been considered to be directly associated with an increased risk of postoperative deformity[2]. To overcome the shortcoming of conventional laminectomy in multilevel stenosis, Gui in 1965 and, later, the Japanese school, developed new techniques to treat posterior compressive disorders termed expansive laminoplasty, performed to enlarge the spinal canal, either sparing or remolding the posterior laminar arch[3]. The so called 'open-door laminoplasty' is likely the most common expansive laminoplasty technique[3].

Nowadays, as a matter of fact, increasing attention has been given to sparing muscular and ligamentous posterior elements in order to guarantee as much as possible posterior support[1,2].

However, in a 2003 metaanalysis, investigators found that the rate of deformity following osteoplastic laminotomy was comparable to the rate of postlaminectomy deformity in patients undergoing intramedullary spinal cord tumors[4].

Several studies have been published dealing with postoperative deformities after laminoplasty or laminectomy, however, most of the studies focus on patients undergoing surgery for intramedullary tumors, while few for CSM[4,5]. In addition the literature is definitely limited with specific concern of expansive laminoplasty techniques. Yet there is still no conclusive position.

In this retrospective review we set out to determine whether open door laminoplasty compared with laminectomy has reduced the incidence of secondary spinal deformities.

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Figure 1. Representative postoperative imaging studies. *Left:* An X-ray film showing the an open-door laminoplasty with laminae stabilization with titanium miniplates; the spinal canal is significantly enlarged. *Right:* Early postsurgical CT scan demonstrating a good spinal canal expansion.

Methods

We retrospectively analyzed surgeries for CSM performed in a time range of three years. Among 57 patients 24 (9 males, 15 females, age range 32 to 79, mean age 67,8) underwent cervical laminectomy and 33 (25 men and 8 women, age range 45 to 78 years, mean age 62.2 years) underwent expansive open-door laminoplasty. In all the patients of both groups clinical signs or symptoms of cervical myelopathy were found. Generally, no more than four levels of cervical laminectomy were performed, while open door laminoplasty was performed in a standard fashion from C2 to C7 in all cases.

Neurophysiological assessment was performed in all the patients before and after surgery. Spinal functions were evaluated by SSEP and MEP monitoring before and after surgery (before the discharge). At the maximum follow up the clinical status was compared with the preoperative. Operative results were evaluated in terms of activity recovery rate, and daily living criteria. The recovery rate was established according the JOA (Japanese Ortopedic Association Scale) criteria[6]. A score greater than 75% indicates an excellent recovery, from 50 to 74% indicates a good recovery, from 25 to 49% indicates a fair recovery, less than 25% indicates unchanged status. Preoperative neuroimaging assessment of the cervical spine included X-Ray standard and dynamic (anterior/posterior and lateral at rest and flexion/extension), CT scanning and MR imaging. The the anteroposterior canal diameter and the spinal canal/vertebral body ratio was evaluated by obtaining preoperative X-ray films and CT scans at the level where the more severe compression was found. The anteroposterior diameter of the cervical spine, as well as the signal intensity changes in the spinal cord, were measured on sagittal T2-weighted images. After surgery all the patients wore a Philadelphia cervical collar for 1 month; X-ray films and CT scans were obtained in all the cases within 1 week and repeated at 6-months and at the latest follow up. The minimum follow-up update was considered at 12 months. According to the literature the cervical spinal canal was considered stenotic when the anteroposterior diameter was less than 13 mm on MRI[7].

Patients with preoperative cervical spine deformity detected at X-ray were not included in the study and addressed to our cervical spine stabilization surgical protocol.

Surgical Procedure

Open door laminoplasty (Figure 1): after a midline skin incision, unilateral left-sided exposition of the laminae and spinous processes is achieved through subperiosteal detachment of the muscles, sparing the inter- and supraspinous liga-

ments. A minimal lateral laminotomy is performed just medial to the facets by using a high-speed drill on one side only. Thereafter, each lamina is lifted and the spinous process is pushed sideways to achieve a contralateral laminar fracture. Further elevation is performed "en bloc" since the inter- and supraspinous ligaments and ligamenta flava are preserved. The open position of the posterior elements was stabilized using titanium miniplates that were appropriately shaped. Usually two plates are enough to hold the en bloc elevated elements in an open position.

Laminectomy: after midline incision, the laminae are exposed bilaterally and the spinous processes are then removed. A limited medial facet joints exposure is performed in all the cases. A special effort is made to preserve the facet joint capsules in all cases. Laminae are then removed by means of Kerrison's roenger. Facetectomy is never performed.

Results

Main results and patients characteristics are summarized in Table I.

Open Door Laminoplasty

Postoperatively cervical spinal canal varied from 15 to 21 mm, with a mean of 18.4 ± 1.3 mm. Postoperative imaging studies demonstrated an adequate and stable enlargement of the spinal canal in all the patients. Screw loosening did not occur. No instability and/or kyphotic deformity were observed on standard and dynamic X-ray films at the maximum follow up after surgery. However in six patients (18%) a minimal reduction in lordotic alignment was observed. Wound dehiscence without deep infection was observed in one patient undergoing laminoplasty. Late follow up neurological assessment showed that 9 patients had excellent, 15 good, 3 fair, and 6 poor results according the JOA score recovery rate.

Neurophysiological improvement was observed in 60% of patient at SSEP and in 50% at MEP at maximum follow up.

Laminectomy

Postoperative cervical spinal canal changes were not measured since the entire posterior complex was removed; however expansion of perimedullary CSF film width was observed in all patients in T2w MRI.

Postoperative standard and dynamic cervical X-rays showed a kyphotic deformity in 3 patients (12.5%) without instability (Figure 2). All cases were asymptomatic.

Late follow up neurological assessment showed that 8 patients had excellent, 11 good, 2 fair, and 3 poor results according the JOA scale recovery rate. Neurophysiological improvement was observed in 60% of patient at SSEP and in 52% at MEP at maximum follow up.

No dural tears or cerebrospinal fluid leaks occurred in both groups. Mean follow up was 36,6 months (minimum 12 months and maximum 46 months).

Table I. Summary of patients characteristics and main results at maximum follow-up.

Open door laminoplasty (33 patients)	Laminectomy (24 patients)
25 males, 8 females	9 males, 15 females,
age range 45 to 78 years, mean age 62.2 years	age range 32 to 79, mean age 67.8 years
Postoperative clinical recovery (according JOA score recovery rate): 9 (27.3%) excellent, 15 (45.5%) good, 3 (9.1%) fair, and 6 (18.2%) poor.	Postoperative clinical recovery (according JOA score recovery rate): 8 (33.3%) excellent, 11 (45.8%) good, 2 (8.3%) fair, and 3 (12.5%) poor.
Postoperative neurphysiological recovery: 60% at SSEP and 50% at MEP	Postoperative neurphysiological recovery: 60% at SSEP and 52% at MEP
0 dural tears	0 dural tears
1 Wound dehiscence	0 Wound dehiscence
0 infections	0 infections
Cervical canal enlargement: 15 to 21 mm, mean of 18.4 ± 1.3 mm	-
0 postoperative kyphotic deformity (18% of minimal reduction in lordotic alignment)	3 patients (12.5%) postoperative kyphotic deformity
0 instability	0 instability

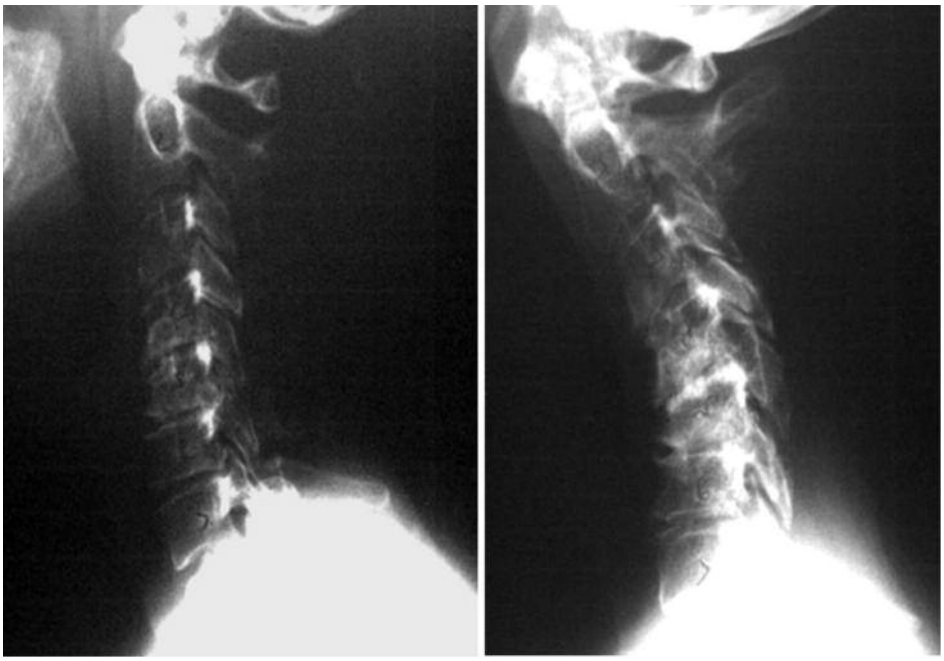

Figure 2. Representative case of postoperative kyphotic deformity after laminectomy: *left:* immediate postoperative X ray control. *Right:* X ray control after 2 years from surgery showing a severe kyphotic deformity.

Discussion

Until recently, laminectomy was performed as a common surgical procedure for multilevel CSM; however, complications such as postsurgical instability, kyphotic deformity, and re-stenosis by epidural scar affects the postoperative result[2-5].

So far most of published studies focuses on paediatric population undergoing surgery for intramedullary tumors and few of them discuss on adults harbouring CSM[5,8].

Several alternative techniques for laminoplasty have been described[4,9,10]. The most difficult surgical challenge dealing with laminoplasty is to maintain the posterior elements in open position[3,9,10]. Some authors have stressed the role of normal or lordotic alignment of the cervical spine to obtain good neurological improvement. Among the various techniques for laminoplasty, the one we have described offers two main advantages: preservation of biomechanical function of the posterior muscular-ligamentous complex and prevention of laminar collapse. By sparing the midline posterior structures and performing an unilateral left-sided exposition, the cervical motion loss was prevented along with the postsurgical malalignment. In addition, the techinique described in the present paper, provides the prevention of the collapse of the hinged side of the lamina, due to the preservation of the omolateral muscular-ligamentous complex; moreover, by avoiding periosteal dissection and muscle denervation in the hinged side as well as sparing the zygapophyseal joint, axial symptoms are prevented. Although the cervical cord decompression was comparable between the two groups of surgeries in our study, a safe decompressing effect, resulting from posterior shift of the spinal cord, without complications, was to achieved only by laminoplasty group.

Furthermore, we believe this technique to be a simple, reliable and time sparing procedure with minimal blood loss. Concerning the CSF fistula, no difference observed in our study although a theoretical benefit in reducing CSF leakage or pseudomeningocele formation was claimed for laminoplasty since the laminar barrier preserved in this surgery may help to contain CSF within the spinal canal[8].

Biomechanical and clinical studies have provided inconclusive data supporting the use of laminoplasty over laminectomy in terms of postoperative deformity and instability reduction[3-5]. Nowinski et al[11] using cadaveric specimens, found that spinal instability was increased after laminectomy when at least 25% of the facet joints were removed, compared with laminoplasty. Yeh et al[12] retrospectively found that laminoplasty was associated with decreased spinal deformity. However, in 2003 a metaanalysis by

Ratliff JK et al[4], found high rates of deformity following osteoplastic laminotomy comparable to the reported rates of laminectomy. In our small series we observed a kyphotic deformity in 3 patients (12.5%) undergoing laminectomy, while none in those undergoing open door laminoplasty. This data seems to be even more relevant if we consider that cervical laminectomy was always perfomed in no more than four levels whiles open door laminoplasty was always extented from C2 to C7.

Moreover we can assume that kyphotic postoperative deformities were detected at a very initial phase in laminectomy group and presumably could evolve to more severe symptomatic forms leading to segmental instability. Finally, the true incidence of postoperative deformity may be thus underestimated.

Conclusions

Several published studies have not yet established a conclusive efficacy of laminoplasty over laminectomy in preventing spinal deformity.

In our opinion, open-door expansive laminoplasty represents the evolution of the posterior surgical approach to CSM. The recent technical improvements in unilateral exposure and fixation by miniplates make this operation a more reliable, standard procedure.

Standard laminectomy seems to be associated to late cervical spine deformities in a more relevant percentage of patients, possibly leading to severe forms of kyphosis and segmental instability over time.

Open door laminoplasty via the unilateral approach is a feasible technique that may decrease the incidence of progressive spinal deformity and prevent the need for subsequent spinal stabilization.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

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