NeuroQuantology | July 2020 | Volume 18 | Issue 7 | Page 16-25 | doi: 10.14704/nq.2020.18.7.NQ20187

Leonello Tacconi, Cervical Laminoplasty in the Elderly: Report of a Single Center Experience and Review of the Literature

Cervical Laminoplasty in the Elderly: Report of a Single Center Experience and Review of the Literature

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Abstract

Background: Cervical laminoplasty has become one of the most endorsed surgical techniques for the treatment of multilevel spondylotic myelopathy, especially in the elderly. It can avoid an extensive anterior neck surgery in any case where there is not a pre-existing kyphosis or evidence of abnormal spinal movement.

Methods: We report our retrospective single centre experience with open-door laminoplasty for multilevel cervical myelopathy in an elder population, focusing on both radiological and functional outcomes to compare our results with the recent literature.

Results: Among the 30 selected subjects, 2 (6, 7%) showed surgical complications that required re-intervention and were excluded from the study. All the others 28 patients (93,3%), with a minimum follow-up of 18 months, showed adequate decompression of the spinal canal at the post-operative MRI, no persistent axial pain nor persistent post-operative complications. The majority of patients showed an improvement of both the Nurick scale and the mJOA score during follow up, with an ultimate median value of the mJOA recovery rate of 69,7%.The median value of C2-C7LA of the 18 evaluated patients at 18 months after surgery was 17,4°, with a medium loss of lordosis of about 5,2 degrees.

Conclusions: Our study has the limitations of a retrospective review with a limited amount of patients; nevertheless the clinical and radiological outcomes of our patients confirm the good results of this surgical approach. Its effectiveness in improving cervical spinal cord compression mixed with its lower risk of developing or worsening kyphosis made it an undeniable resource in surgeons' armamentarium.

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Introduction

Cervical laminoplasty is the commonly and widely used term to denote that group of assorted surgical procedures that entail the reconstruction of vertebral lamina after opening the spinal canal. More specifically these operative approaches to the posterior cervical spine usually require creating hinges on which the lamina is lifted but not removed.

Since its introduction in 1973 by Oyama and colleagues, this approach has become, and is still today, one of the most endorsed surgical techniques for the treatment of multilevel spondylotic myelopathy and continuous type of posterior longitudinal ligament ossification (OPLL), especially in the elderly.

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Its effectiveness in improving cervical spinal cord compression applying both a straight posterior decompression and an indirect anterior decompression, resulting by posterior migration of the spinal cord, mixed with its lower risk of developing or worsening kyphosis (Urokawa et al, 2015; Wang et al, 2018), has made laminoplasty an undeniable resource in neurosurgeons' armamentarium. This topic is even more critical when related with elderly patients who suffer age-related degenerative diseases of the cervical spine and usually have more than three cervical levels affected by stenosis, which can concur to a major risk of post-operative complications such askyphosis and persistent neck pain after standard posterior laminectomy (Wang et al, 2004). Furthermore, these patients often present high comorbidities and an anterior multilevel decompressive cervical approach might not be indicated, because they are prone to major surgical and anesthesiologic risks. This is the reason why in this kind of population, usually we prefer an easier and faster surgical procedure. Several technical evolutions of the two standard procedures ("open-door" and "French-door" laminoplasty) have been suggested over the years in the literature to decrease post-operative axial pain, to achieve the maximum volumetric expansion to the spinal cord and to minimize post-operative complications.

In this paper we present our single center experience with cervical "open door" laminoplasty in an elderly population and offer an overview of the recent findings in literature.

Material and Methods

After the study had been approved by our Institutional Review Board to use clinical information for research purposes, we retrospectively collected all cases of cervical laminoplasty treated in our center between 2007 and 2017. The inclusion criteria were as follows: 1) 70 years of age and older, 2) cervical compressive myelopathy and spinal canal stenosis with three or more levels involved, 3) cervical stenosis due to both continuous type of ossification of posterior longitudinal ligaments (OPLL) and multiple spondylotic lesions, 4) failure of anterior cervical decompression (ACD), 5) absence of cervical instability and/or severe kyphosis observed during the pre-operative dynamic X-rays (lordosis angle >10°) (Choi et al, 2018; Lee et al, 2017).

The exclusion criteria were as follows: 1) post-traumatic cervical myelopathy or intrinsic spinal cord lesions, 2) cervical myelopathy with less than three levels to be decompressed 3) patients suitable for anterior cervical decompressive approaches or posterior laminectomy and fixation (lordosis angle <10° or clear kyphosis):

Table 1. Selection criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
70 years of age and older	Post-traumatic cervical myelopathy or spinal cord lesions
Cervical compressive myelopathy with ≥ 3 levels involved	Cervical myelopathy with < 3 levels to be decompressed
Cervical stenosis with OPLL or multiple spondylotic lesions	Patients suitable for anterior cervical decompressive approach
Failure of ACD	Patients suitable for posterior laminectomy and fixation (lordosis angle <10° or clear kyphosis)
Absence of cervical instability and/or severe kyphosis at the pre-operative dynamic X-rays (lordosis angle >10°)	

- ACD: anterior cervical decompression
- OPLL: ossification of posterior longitudinal ligament

Using the criteria listed above, we collected data from 30 patients treated with cervical laminoplasty The median age was 77 years (range, 70 - 86 years). Twenty-nine out of 30 cases (96,7%) presented cervical stenosis due to spondylotic degenerative lesions and only one patient (3,3%) suffered for an OPLL. This last patient presented a spinal stenosis ratio <50% and a thickness of the ossification not exceeding the K-line, hence, suitable for posterior laminoplasty according to literature (Qin R et al,

2018).

Eight patients (26,7%) were treated after failure of ACD performed in our (3) or other departments, while one (3,3%) presented multilevel cervical stenosis and a recent history of resection of the filum terminalis (operated elsewhere) in a presumed tethered cord syndrome related to Arnold Chiari type I.

Fourteen patients (46,7%) were women and 16 (53,3%) were men, with a sex ratio women/ men1:1, 1. In every patient an accurate pre-operative clinical evaluation was performed using the Modified Japanese Orthopedic Association scale

(mJOA) (Kato et al, 2015; Tetreault et al, 2016) and the Nurick scale (Ns). The same neurological assessment was performed as a follow-up at 6 (mJOA6 and Ns6) and 18 months (mJOA18 and Ns18). Ultimately, we determined the mJOA-RR (mJOA-recovery rate) as well. This was calculated using a variation of the Hirabayashi method as (mJOA18 – pre-operative mJOA)/ (18 - pre-operative mJOA) x100%, with a recovery rate of 100% indicating the best clinical result.

All cases underwent a pre-operative cervical MRI

Fig. 1. Multilevelcervical canal stenosis

To evaluate the degree of canal compression and any spinal cord alterations, and again post-operatively, at 6 and 12 months to gauge the results of decompression. We decided to express the results of decompression calculating the difference between the canal's diameter in the worst stenotic level on the pre-operative MRI and the diameter in the same level on the post-operative MRI, expressing it in terms of "percentage of decompression rate" (DR). We also performed a pre-operative standing dynamic X-ray to check for the absence of instability and to evaluate the possible presence of kyphosis, which would have required a different surgical approach. The C2-C7 Cobb lordotic angle (C2-C7LA), defined as the angle formed by the inferior end plates of C2 and C7,was used.

Another standard X-ray was performed post-operatively, after 3 months and 18 months to check the firmness of the miniplates used for the fixation of the laminae as well as for assessing any changes in the lordotic angle, measuring the ultimate C2-C7LA.

Table 2. Selected patients with their pre- and post-operative (18 months) C2-C7 LA

PATIENT	AGE	PREVIOUS SURGERY	C2-C7LA PRE-OP (°) median 22,6	C2-C7LA 18 months (°) median 17,4
1	73	/	22,1	15,4
2	71	/	29,6	21,9
3	75	ACD	18,5	13
4	78	/	26,4	20,3
5	76	/	24,5	18
6	73	/	28,1	19,9
7	80	/	25,4	17,8
8	83	ACD	14	/
9	77	ACD	23,2	16,4
10	72	/	19,6	/
11	81	ACD	19,1	13,6
12	74	/	31	25,7
13	70	ACD	27	/
14	70	/	22,7	15,2
15	70	ACD	21	/
16	79	/	19	14,4
17	81	/	24	17,6
18	75	/	19	/
19	70	/	28,4	21,1
20	86	/	21,1	/
21	83	/	30,3	/
22	75	ACD	22	17,2
23	72	/	26,1	23,5
24	81	/	19	11,4
25	73	/	27,2	/
26	85	Resection of filumterminalis	23,4	/
27	81	/	16,5	11,3
28	81	ACD	16,9	/
29	77	/	20,9	Excluded from study
30	79	/	12,3	Excluded from study

- ACD: anterior cervical decompression
- C2-C7LA: C2-C7 Cobb lordotic angle

In all patients an "open-door" laminoplasty was performed. A rigid cervical collar was positioned in all patients for no longer than 24-36 hours. After this time, all patients promptly started physical therapy in the post-operative period with a median of 48 hours (range 36-72 hours). All were discharged or transferred to a rehabilitation center within a week. Driving was forbidden for at least 6 weeks.

Surgical Technique

Under general anesthesia and in the prone position, all patients underwent a posterior median cervical incision centered to C3-C6 with a median length of 6 cm. The muscles were detached via a subfascial technique from the posterior arc of C3, C4, C5 and C6, always sparing the posterior deep extensor muscles' insertion to the C2 spinous process, excluding C7 in the laminoplasty. Then we created bony grooves bilaterally on the lateral border of the laminae with a diamond drill and paying attention to avoid damaging the facet joints. These grooves were full in thickness only on one side (the worst clinically symptomatic side) and partially on the opposite one. The lamina was then elevated using the contralateral groove as a fulcrum on the intended side and then lifted in order to enlarge the canal. The lifted laminae were fixed to the ipsilateral articular masses using titanium miniplates (Centerpiece™ Plate Fixation System, Medtronic)
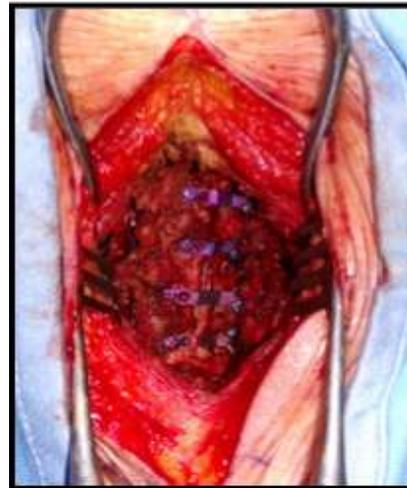

Fig. 2A. Cervical canal decompression by laminoplasty

Fig. 2B. Laminoplastyfixation with titaniumminiplates

In the last 7 cases we began using an ultrasonic bone scalpel (Misonix, Inc., New York, USA) to perform the bony grooves

Fig. 3. Ultrasonic Bone Scalpel

This device resulted in faster surgical times and a safer technique to preserve the integrity of the underlying dura mater.

Results

Two patients (6, 7%) showed surgical complications: one presented fever and wound swelling two weeks after discharge. He had developed a post-operative deep wound abscess that required re-opening, removing of the plates and laminae, and a posterior lateral mass fixation. The second patient showed severe cervical mechanical pain three weeks after surgery with X-ray evidence of C3-C5 instability, consequently prompting posterior fixation surgery. Both cases improved but they were excluded from this series. None of the remaining 28 patients (93,3%) died or were lost to follow-up before the end of the study.

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Therefore, with a minimum follow-up of 18 months, our series includes 28 patients. One (3,6%) of these had a car accident after the end of the study (18 months from surgery) with consequent C1-C2 fractures that required posterior decompression and screw fixation. Another one, after a substantial neurological improvement, presented a clinical deterioration 28 months from surgery, in terms of diffuse and increasingly invalidating muscle pain. A muscle biopsy showed an autoimmune myopathy.

Two patients (7,1%) showed an immediate (13 and 27 hours respectively) post-operative transient sensory (one) and a mixed motor/sensory (the second one) deterioration of the lower limbs accompanied by dysesthesia. In both cases, an urgent MRI showed evidence of central spinal cord multiple hyper intensity on T2-weighted images, caused by an excessively fast spinal cord re-expansion with re-perfusion damage.

Fig. 4. Spinalcord hyper intensity in T2 weighted images due to Re-expansion damage

Both patients recovered from the clinical symptoms mentioned above before the 6-month clinical follow-up, where they showed a normal central spinal cord signal on the MRI. None of the 28 subjects showed post-operative radiculopathy such as C5 palsy (dropped shoulder syndrome).

**Table 3.** Post-operative Complications

COMPLICATIONS	RATE
Woundinfection	3,3% (1/30)
Post-operative instability	3,3% (1/30)
Transient re-perfusion damage	7,1% (2/28)
Radiculopathy (C5 palsy)	None
Reduced ROM	46,4% (13/28)
Post-operative axialpain	71,4% (20/28)

- ROM: range of movement

Thirteen (46,4%) out 28 patients showed a minimal reduction of the cervical range of movement (ROM), while 20 subjects (71,4%) complained about a high rate of axial neck pain (median VAS 7) during the first 4-5 days after surgery. Eventually all improved to a median VAS of 4 after about one week and to a median VAS of 2 at the 3-month follow-up.

Table 4. Post-operative VAS
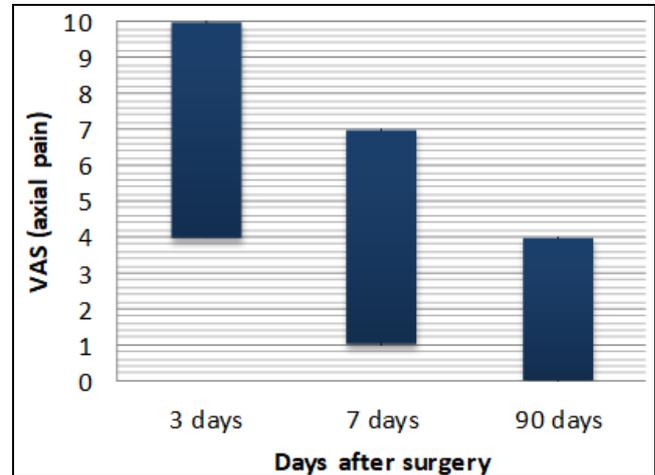
All 28 subjects showed adequate decompression of the spinal canal in the post-operative MRI with a DR median value of 76, 4% (range, 45, 2%-91, 6%), but only 19 patients (67, 8%) showed a radiological improvement of the pre-operative alterations on T2 weighted-images of the spinal cord at the 18-month MRI follow-up.

C2-C7 LA was evaluated pre-operatively in all cases and a median value of 22,6 (range, 12,3-30,3) was found. Unfortunately, it was only possible to compare it again with18 subjects (64,3%) at the 18-month evaluation visit, because 4 patients refused to perform the X-rays and the others had moved abroad. Ultimately, the median value of C2-C7LA of the18 patients at 18 months after surgery was 17,4 (range 11,3-25,7), with a medium loss of lordosis of about 5,2 degrees.

With regards to the clinical results, 27 patients (96,4%) presented a functional improvement (Ns value of 6) while one case (3,6%) remained stable with a Ns value of 3 during all follow-ups, although he showed an improvement of the mJOA score. Six (21, 4%) patients showed a further improvement with Ns18, while the other 21 (75%) presented a stable functional situation at the same follow-up length. When we consider the mJOA score, this improved in all 28 patients at the 6-month follow-up, while 23 patients (82, 1%) showed a higher mJOA score at 18 months from surgery. Pre-operative mJOA score had a median value of 12/18 (range, 7-16), while mJOA6 and mJOA18 respectively reached an average of 14,2/18 (range,

10-18) and 15,8/18 (range, 12-18). The median value of the mJOA recovery rate was 69,7% (range, 33,3 – 100%).

Table 5. Clinical results by Nurick and mJOA scale

PATIENT	Ns0 mJOA0	Ns6 mJOA6	Ns18 mJOA18	mJOA-RR (%) median value 69,7
1	IV 13	III 15	III 16	60
2	VI 8	V 10	IV 12	66,7
3	IV 9	III 12	III 14	55,6
4	V 10	IV 13	III 14	50
5	III 10	III 13	III 14	50
6	IV 12	III 13	III 15	50
7	VI 7	IV 12	IV 13	54,5
8	III 13	I 15	I 17	80
9	III 13	I 16	I 17	80
10	III 13	0 17	0 18	100
11	IV 14	II 16	0 18	100
12	V 9	III 13	III 14	55,6
13	III 12	II 14	ii 15	50
14	IV 12	III 14	III 14	33,3
15	III 12	II 16	II 16	66,7
16	I 15	0 18	0 18	100
17	II 14	0 17	0 18	100
18	II 14	0 17	0 17	75
19	III 13	I 15	I 17	80
20	III 13	I 16	I 17	80
21	I 16	0 17	0 18	100
22	III 13	II 15	II 15	40
23	II 14	I 16	0 18	100
24	IV 14	II 15	II 16	50
25	IV 10	III 14	I 16	75
26	II 14	0 17	0 18	100
27	V 9	IV 12	III 14	55,6
28	IV 11	III 13	III 14	42,8

- Ns0; Ns6; Ns18: pre-operative Nurick scale and at 6 and 18 months post-operatively
- mJOA: modified Japanese Orthopaedic Association scale
- mJOA0; mJOA6; mJOA18: pre-operative modified Japanese Orthopaedic Association scale and at 6 and 18 months post-operatively
- mJOA-RR (recovery rate)

Table 6. Summary of results

Topics	Results (median values)
Decompression rate	76,4%
Cobb lordotic angle at the end of follow up	17,4° (18/28 subjects 64,3%)
Loss of lordosis	5,2°
Ns6 improvement	96,4% (27/28)
Ns18 improvement	21,4% (6/28)
mJOA recovery rate	69,7%

Ns6; Ns18: Nurick scale at 6 and 18 months
mJOA: modified Japanese Orthopaedic Association scale

Discussion

Cervical laminoplasty was introduced as an alternative to laminectomy for the treatment of cervical myelopathy, with the purpose to decrease the percentage of postoperative instability, the development of kyphosis and consequent neck pain, while preserving a good range of motion (Urokawa et al, 2015; Matz et al, 2009; Duetzmann et al, 2015) .

Laminoplasty is, as any posterior cervical decompression technique, mostly effective in decompressing the spinal cord by enlarging spinal canal when lordosis and correct vertebrae alignment are preserved. Hence, it is indicated only in patients with extensive cervical compressive spinal canal stenosis due to both OPLL and multiple spondylotic lesions, when three or more inter vertebral spaces are involved, especially in the elderly population (Wang et al, 2004).As matter of fact, it has been reported how in these clinical scenarios, anterior decompressive approaches would be related with a higher incidence of postoperative complications and pseudoarthrosis (Verma et al, 2013; Rihn et al, 1999; Smith et al, 2007). We agree with other authors that laminoplasty should be performed on those patients with cervical myelopathy when more than three levels are involved, in the absence of abnormal mobility and a pre-operative cervical lordosis > 10° in neutral position (Lee et al, 2017; Suk et al 2007).

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There are several studies in the literature that consider the differences in terms of clinical and radiological improvement between anterior decompressive approaches and laminoplasty in cases of OPL (Qin et al, 2018; Nayak et al, 2018; Hou et al, 2017; Miyazaki et al 2018), focusing on the rate of spinal canal stenosis as a cut off to choose one approach or the other. In 2008,Fujiyoshi et al. suggested that clinical results of laminoplasty could be inadequate if the thickness of ossification of the posterior longitudinal ligament surpasses the line that connects the midpoints of the spinal canal at C2 and C7 (K-line). More recently, Hou and colleagues showed in their prospective study how anterior decompression and fusion is highly preferable in case of spinal stenosis ratio>50%. In addition, a study by Rajshekhar et al. emphasized how patients with OPLL are 5.3 times less likely to exhibit improvement of the Nurick score than those with spondylotic cervical myelopathy. With only one case of OPLL in this series, we cannot comment on the matter.

Over the years, several reports focused on the advantages of laminoplasty, while others showed no statistically significant differences, in terms of clinical improvement of cervical myelopathy, between laminoplasty and laminectomy (Wang et al, 2004; Suk et al, 2007; Iseda et al, 2001; Matsunaga et al, 1999; Wada et al, 1976; Wang et al, 2003; Nurboja et al, 2012; Bartels et al, 2015; Fehlings et al, 2017).Nonetheless, these two approaches have clearly different rates of complications and the use of laminectomy has been limited by its tendency to produce segmental instability and late neurological deterioration. In fact, it has been reported in Matsunaga's series that with this latest technique a rate of post-operative kyphosis was greater than 33%. Another advantage of laminoplasty might be the possible protective effect of the replaced laminae when compared to laminectomy towards trauma, scar tissue formations and future possible posterior reoperation.

An additional important advantage of laminoplasty might also be the protective effect on adjacent level degeneration when compared to anterior approach and fusion (Iseda et al, 2001; Wada et al, 2001; Wang et al, 2003). It is well known that there is a 2.9% risk rate per patient per year to develop adjacent-level disease after ACD; also, survival rate analysis predicted that 25% of all operated patients would develop this complication at 10 years after anterior surgery, as reported by Hilibrand et al in 1999.

In 1973, Oyama et al., based on a modification of Kirita's technique of laminectomy, developed the "z-plasty method of cervical laminoplasty" (Hilibrand et al, 1999). In this method, the laminae were first thinned using a drill and then z-shaped cuts were made in each lamina; subsequently, the split laminae were lifted and fixed with sutures, reconstructing the expanding canal.

The evolution of this technique, passing throughout Tsuji's variation of en bloc laminectomy, led to the development of the expansive "open-door laminoplasty" by Hirabayashi et al. in 1983.

This approach involves bilaterally drilling bony grooves at the border of the laminae corresponding to the medial portion of the pedicles, and then an performing an excision of the lamina rim only on one side, laterally lifting en bloc the laminae towards the opposite side, as if to open a door, and finally fixing the lifted side of the laminae to the articular processes to enlarge the spinal canal. If necessary, a concomitant or more ipsilateral foraminotomy can be added.

In 1982, Kurokawa et al. suggested another approach in which joints are made bilaterally along the lateral border of the laminae, but the spinous processes and laminae are also split in the midline and consequently lifted bilaterally. This technique is also known as "double-door laminoplasty", "French window", or more commonly "French-door laminoplasty" (Hilibrand et al, 1999).

Even if there are many reports of new techniques of laminoplasty in the literature, the main approaches to enlarge the spinal canal remain the two previously mentioned methods, either Hirabayashi's or Kurokawa's approach. Many modifications were also introduced to keep the expanded lamina open, for example by using sutures, autologous bone grafts, hydroxyapatite or other ceramic materials, titanium miniplates or spacers and screws.

In recent years, new devices, such as the ultrasound osteotomy, have been employed to make this approach safer and faster. We've used this instrumentation in the last 7 cases, and we found it very useful and much faster than using the drill. More importantly, it does not carry the risk of damaging the underlying dura, with a more precise bone cut.

A meta-analysis study by Heller et al. in 2013, found no significant differences in clinical improvement between open-door and French-door laminoplasty techniques. However, a more recent

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report by Nakashima et al in 2014, showed how, with no differences in terms of post-operative complications between the two approaches, the double-door laminoplasty would seem preferable in terms of postoperative cervical alignment (less degree of kyphosis) and restriction of range of motion.

In 1996, Hosono et al. revealed how cervical axial pain is one of the most frequent and disturbing complications of this approach, affecting almost 60% of the operated people (Nakashima et al, 2014).

For that reason, new technical skills have been suggested to improve this technique's results, particularly focusing on the preservation of posterior cervical muscles attachment of C2 and C7 (Kim et al, 2007).

It is widely known, through anatomical and biomechanical studies, that neck balancing consists of static and dynamic forces, and that the latter forces must be considered in the equilibrium between the muscles and ligaments around the neck. It has been underlined in several reports (Liu et al, 2007; Lin et al, 2015) that the detachment of posterior cervical deep extensor muscles, especially the semispinalis cervicis, which acts as the main dynamic stabilizers of the cervical spine, was associated with a higher rate of axial pain and even postoperative kyphosis. A very recent meta-analysis by Qi et al. in 2018, confirmed how the preservation of the posterior deep extensor insertion into posterior elements of C2 and C7 reaches the same clinical results of the standard approach, but with fewer postoperative complications, in terms of decreasing in range of motion and in axial neck pain. Other techniques to preserve the integrity of the posterior cervical muscles were suggested by Shiraishi et al. in 2002 and in 2012andby Kim et al. in 2007. These authors developed a "myoarchitectonic spinolaminoplasty", in which the spinous processes are excised in the midline and then detached from the laminae preserving the attachments of all the muscles with an improvement in clinical outcome, especially in terms of axial neck pain. We decided not to maintain a rigid collar in these patients, as we believe that this conduct, coupled with an early physiotherapy after surgery, might lead to further improving post-operative axial neck pain. Postoperative radiculopathy, is another possible complication after laminoplasty and the most affected nerve root seems to be the C5 palsy with the so called "dropped shoulder syndrome", which

was previously described in about 5-12% of cases in Uematsu's report from 1998 and in 4,6% of cases in Sakaura's review (Kim et al, 2007). In this review, C5 palsy is described as secondary to different possible occurrences, such as direct injury to the nerve root during surgery, nerve root traction secondary to the shift of the cord, or to a type of vascular dysfunction. Another possible and unpredictable complication, although very rare and generally transient, is a rapid postoperative spinal cord expansion with alteration of its function and onset of clinical symptoms. This entity is radiologically noticeable as high-intensity areas on T2-weighted MRI, as we described in two cases of our series. Seichi et al. reported an incidence of such complication in their series at about 6,1%.

A reduced neck ROM has been described up to 60% in Kawaguci's series (Kim et al, 2007) thanks to facet joint iatrogenic fusion secondary to joint violation during drilling. This eventuality can be decreased either by the anatomical knowledge, as well as by the recent use of the ultrasound osteotomy, which, thanks to a more precise and thinner cut, allows to stay away from the facet joints. Other complications that may occur are vertebral artery injury, displacement of the graft into the canal and closure of the expanded laminae because of hardware failure.

Our study tried to focus on the results of a series of elderly patients (over 70 years) operated on using an open door laminoplasty. We paid particular attention to the pre-operative lordotic alignment and we did not suggest laminoplasty to those with a pre-operative C2-C7LA less than 10° (Choi et al, 2018; Lee et al, 2017). At the same time, we did not pay the same attention to the post-operative cervical angles, considering that most of our patients were too old or presented many comorbidities, making an alternative spinal operation (fixation) feasible. Many articles reported that the only risk factor for post-operative kyphosis development is the preoperative Cobb lordotic angle, with an optimal preoperative angle cut-off of 8.5°, according to Choi et al. in 2018. Unfortunately, we did not manage to evaluate the T1 slope, because of missing data and, as several studies reported (Miyazaki et al, 2018), this angle seems to be the only good predictor for the development of post-laminoplasty kyphosis. Among all the patients of whom we managed to obtain standing dynamic cervical x-rays at the 18-month follow-up, and those we managed to evaluate the C2-C7LA,the finding was a loss of lordosis of about 5,2 degrees

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NeuroQuantology | July 2020 | Volume 18 | Issue 7 | Page 16-25 | doi: 10.14704/nq.2020.18.7.NQ20187

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(median value), which can be considered in line with the literature (Choi et al, 2018; Lee et al, 2017; Miyazaki et al, 2017).

Limitations

Reports of this nature have inherent limitations with the main one being the small number of patients, which make difficult or limit prognostic analysis. In addition, patients were identified using computer records, discharge letters, follow-up consultations and clinical-radiological records and, although data was checked several times, omissions may have occurred.

Conclusion

Laminoplasty represents a simple surgical technique to decompress multilevel cervical stenosis and spinal cord myelopathy. It is particularly indicated in the elderly population and high morbidity patients, because it seems to provide similar results to multilevel ACD. It has widely replaced cervical laminectomy considering it has demonstrated better results in terms of preventing post-operative cervical kyphosis and scar tissue membrane formation. However, even if more studies are needed to confirm its indication, utility and effectiveness, with higher degree of evidence, we suggest the use of laminoplasty as a fast and safe posterior cervical decompressive approach. It can avoid an otherwise extensive anterior neck operation, in any case where there is not a pre-existing kyphotic neck situation or evidence of abnormal spinal movement.

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