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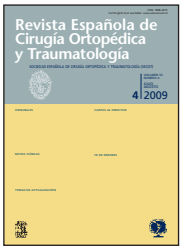

ORIGINAL PAPERS

Treatment of lateral recess stenosis by means of microendoscopic decompressive laminotomy results at one year

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KEYWORDS
Canal stenosis;
Minimally invasive surgery;
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Abstract
Purpose: To determine the efficacy of microendoscopic root decompression in lumbar lateral recess stenosis.
Materials and methods: Prospective longitudinal study of 60 patients diagnosed with lumbar canal stenosis and subjected to microendoscopic decompression by means of a METRx 18 mm tubular retractor following the METRx (Medtronic Sofamor Danek, Memphis, TN, U.S.A.) technique. Results were evaluated using the visual analog scale (VAS) for pain measurement, the Oswestry Disability Index (ODI), subjective patient satisfaction and McNab's modified score.
Results: Mean age was 54.5±10 years. Thirty-four patients (56.7%) were male and 26 (43.3%) female. The most frequently affected level was L5 (63.33%). Mean OR time was 85.17±18 minutes. Mean postoperative length of hospital stay was 4±1.2 days. Patient follow-up was 12 months. We obtained 66.6% good or excellent results with 68.3% of patients claiming to be satisfied with their outcome. Mean decrease on ODI at one year, as compared with the preoperative ODI score, was 34.3±26.2 points. Decrease on the VAS score was 6.2±2.6 points for the lower limbs and 1.6±1.8 points for the lumbar spine. All these magnitudes were statistically significant ($p<0.05$).
Conclusions: The data collected from the study indicate that microendoscopic decompressive laminotomy is a safe and effective technique for treating lumbar lateral recess stenosis, which should feature prominently among the surgeon's procedures of choice for minimally invasive spine surgery.

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PALABRAS CLAVE
Estenosis de canal;
Cirugía mínimamente invasiva;
Técnicas endoscópicas

Tratamiento de la estenosis del receso lateral mediante laminectomía microendoscópica: resultados a un año de evolución

Resumen
Objetivo: valorar la eficacia de la descompresión radicular de la estenosis del receso lateral lumbar por técnica microendoscópica.
Material y método: estudio longitudinal prospectivo de 60 pacientes diagnosticados de estenosis de canal lumbar e intervenidos mediante descompresión por vía microendoscópica usando un retractor tubular METRx de 18mm según la técnica METRx (Medtronic Sofamor Danek, Memphis, Estados Unidos). Se evalúan los resultados con la escala visual analógica del dolor (EVA), el índice de discapacidad de Oswestry (ODI), el grado subjetivo de satisfacción percibido por el paciente y la clasificación modificada de Macnab.
Resultados: la media7desviación estándar de edad es 54,5710 años, 34 (56,7%) son varones y 26 (43,3%), mujeres. El área más afectada es L5 (63,33%). La media de tiempo de la intervención quirúrgica fue 85,17718 min. La media de estancia hospitalaria postoperatoria fue 471,2 días. El tiempo de seguimiento de los pacientes fue de 12 meses. Obtuvimos un 66,6%de resultados buenos o excelentes; con una satisfacción subjetiva buena en el 68,3%de los pacientes. La disminución media del ODI al año con respecto al preoperatorio es de 34,3726,2 puntos, la de EVA de extremidades inferiores es de 6,272,6 puntos, y en la EVA lumbar, de 1,671,8 puntos, todas con significación estadística (po0,05).
Conclusiones: los datos recabados en nuestra experiencia nos indican que la laminectomía descompresiva microendoscópica es una técnica segura y efectiva para el tratamiento de la estenosis del receso lateral lumbar y una alternativa en las técnicas mínimamente invasivas de la columna.

Introduction

Lumbar canal stenosis is one of the most prevalent spine conditions in elderly patients.

The surgical procedure traditionally used by neurosurgeons and orthopedic surgeons to address lumbar canal stenosis comprised extensive decompressive laminotomy, medial facetectomy and foraminotomy[3-6]. Such a technique is often associated with significant postoperative pain (because of the large-scale muscle dissection and retraction involved)[3-5], disability (paraspinal muscle atrophy, loss of flexion stability (caused by injury to the supraspinous and infraspinous ligaments, potential secondary instability attributable to injury of the said ligaments or an excessive facetectomy)[4-9] and morbidity[4,10].

Since tearing of soft tissue is the most important factor in the response to surgical tension[5], it stands to reason that surgeons show now be increasingly focusing on minimally invasive procedures. The greatest advantage of such procedures is the reduction of the trauma inflicted on the tissue and of unnecessary exposure[4,5,8,10-15].

Ever since the introduction of microendoscopic discectomy, it has been possible to extend the small-scale laminotomy usually performed to excise an intervertebral disc and, through the same minimally invasive approach, release the root when there is a concomitant sclerotic component, without interfering with the midline osteoligamentous structures or significantly injuring the paravertebral musculsture[3,5,7,14].

The purpose of this study was to determine the efficacy of microendoscopic decompression of nerve root stenosis at the level of the lumbar lateral recess.

Materials and methods

A prospective longitudinal dynamic cohort study was performed of patients diagnosed with lumbar canal lateral recess stenosis operated at the Meixoeiro Hospital in Vigo, Spain, between April 2002 and April 2006 by microendoscopic decompressive laminotomy (MEDL) with an 18 mm METRx tubular retractor in accordance with the METRx (Medtronic Sofamor Danek, Memphis, TN; U.S.A. technique. All surgeries were performed by the same surgical team using the same microendoscopic technique.

The subjects for the study were recruited from the patients who attended the trauma surgery outpatient facility provided that they fulfilled certain criteria:

— Inclusion criteria: symptoms compatible with canal stenosis (lumbar sciatica, sciatica and/or neurogenic claudication), lateral recess stenosis revealed by imaging techniques (magnetic resonance and/or computerized tomography), single-level clinical symptoms, clinical-radiological concordance regarding the level involved, persistence of symptoms further to conservative treatment (administration of pain-killers and/or non-steroid anti-inflammatory drugs and

rehabilitation therapy) for a period of no less than 6 months.

— Exclusion criteria: symptoms compatible with canal stenosis with no clinical-radiological correlation, central or congenital canal stenosis, grade I or higher degenerative or isthmic spondylolisthesis at the affected level, involvement at two or more levels, marked instability at the affected level revealed by flexion and extension radiographs (displacement > 3mm[16], patients with scoliotic curves greater than 20°, tumor or pseudotumor involvement related to the affected level (synovial cysts, bone tumors, intradural dumors, etc.), patients with a previous surgical history at the affected level, patients faking the disorder or with a clear functional component.

All patients included in the study were seen preoperatively in order to gather the necessary data for their anamneses (including demographic characteristics, health status, any concomitant morbidities) and to perform a physical examination (neural provocation tests, exploration of osteotendinous reflexes, a motor and sensory exam and detection of potential symptoms of neurogenic claudication). Patients were subjected to the same physical examination postoperatively at 6 months and one year.

In order to gather data preoperatively as well as to assess the results obtained at postoperative follow-up appointments 6 and 12 months from surgery, each patient was asked to fill out a form to determine their functional status (Oswestry's Disability Index [ODI]), and a table to rate their spinal pain (from 0 [no pain] to 10 [severest pain possible] points) and their lower limb pain (Visual Analog Scale [VAS] for the lower-back and the lower limbs)[17].

An additional questionnaire was provided in order to determine subjective patient satisfaction levels[4,17] (table 1). Moreover, they were specifically asked about their residual pain, their ability to carry out their usual occupational or physical activities (modified Macnab score[1] as modified by Turnet et al[2]) (table 2).

An independent observer who was not involved in the selection or the treatment of patients was in charge of gathering and analyzing the data.

Table 1 Patient satisfaction questionnaire proposed by Weiner et al[4]

1. On the whole, how successful has your procedure been?
   a. Highly successful. Complete or nearly complete pain relief
   b. Fairly successful. An acceptable recovery was achieved
   c. Not very successful. Slight recovery
   d. The procedure was a failure. There was no recovery
   e. Worse tha before surgery
2. Would you recommend the same procedure if you had a friend with the same condition?
   a. Yes
   b. No

Table 2 Modified Mcnab score[1,2]

Excellent or good result	Inexistent or occasional (mild or moderate) lumbar or radicular pain Patient i sable to carry out his or her usual activities Little or no restrictions to perform physical activities
Moderate or regular pain	Persistent mild or occasional moderate lumbar and/ or radicular pain Patient is able to work with some restrictions Patient is able to perform the majority of usual daily activities
Poor result	Persistent moderate or occasional severe lumbar and/ or radicular pain, little or no relief following surgery Persistence of radicular symptoms; patient is incapable of work Severe restrictions to daily activities

The SPSS-PC® 15.0 version for Windows software was used to carry out the statistical analysis of the sample.

An univariate analysis was undertaken to describe the sample (mean and standard deviation were calculated for the quantitative variables and frequencies were calculated for the categorical ones) and a bivariate analysis was conducted with the variables of interest to establish the different relations. Parametric (Student's t test for paired data and ANOVA) and non-parametric (Wilcoxon signed-rank test) tests were used to compare quantitative variables (non-parametric tests were used when the variable in question did not follow a normal distribution according to the Kolmogorov-Smirnov test or when there was a variance difference on the Levene test). Quantitative variables were compared by means of Pearson's chi-square test, applying Fischer's Exact Test as necessary (expected frequency in any cell: <5). Statistical significance was determined at $p<0.05$.

Surgical technique

METRx materials and instruments were used to carry out the microendoscopic decompressive laminotomy through an interlaminar approach. The purpose of this technique is the same as that for conventional surgery, namely to decompress the nerve root. This is achieved by applying open surgery techniques through a tubular retractor under direct endoscopic vision with an extra-spinal approach.

The patient is placed in a genupectoral position. The entry point is established at 20 mm from the midline toward the affected side and at the level of the corresponding disc space. A Kirschner wire is introduced at this point and directed torward the lower border of lamina of the vertebra above the level that needs to be addressed. This position is verified with a lateral fluoroscopic guide. Sequential cannulated dilators are introduced over the wire (fig. 1) with a turning movement that dilates the fibers of the paravertebral muscles. Subsequently, a 16 mm tubular

Figure 1 Sequential introduction of metal dilators.

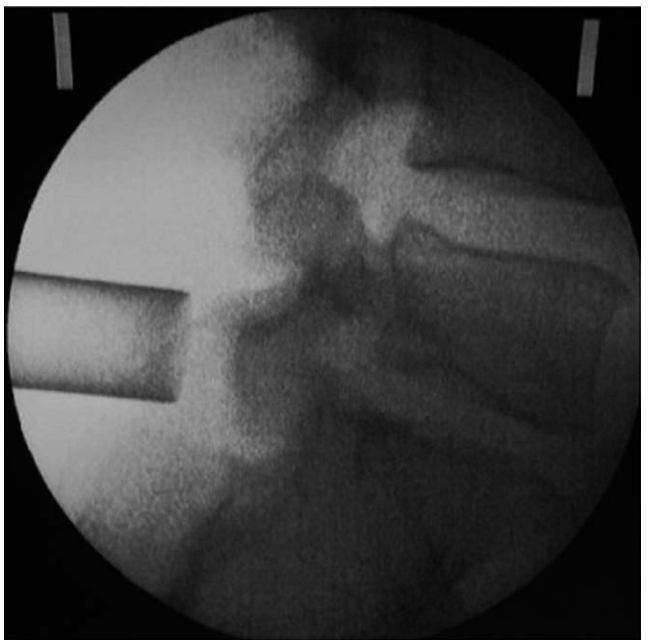

Figure 2 Placement of the tubular retractor (fluoroscopic view).

retractor is introduced (fig. 2). A 25° scope with a 90° vision angle is introduced through the tubular retractor.

The procedure proper starts by removing any remains of muscle fibers and fatty tissue that may be covering the ligamentum flavum and the laminae. Recalibration is performed by resecting the osteophytes or hypertrophic edges of the interapophyseal joints with a Midas Rex mocrodrill and a laminotomy punch. In order to access the contralateral side, it is necessary to perform an unroofing procedure by slightly reaming the lower part of the spinous processes with the microdrill and laminectomy punches (fig. 3). Once the unroofing has been completed, flavectomy and recalibration can proceed. In the event that there is a concomitant disc herniation, the discectomy can be carried out through the same tubular retractor. At this point, it is necessary to verify that the nerve root has been adequately decompressed. Subsequently, any disc fragments that may have migrated to the medullary canal can be removed.

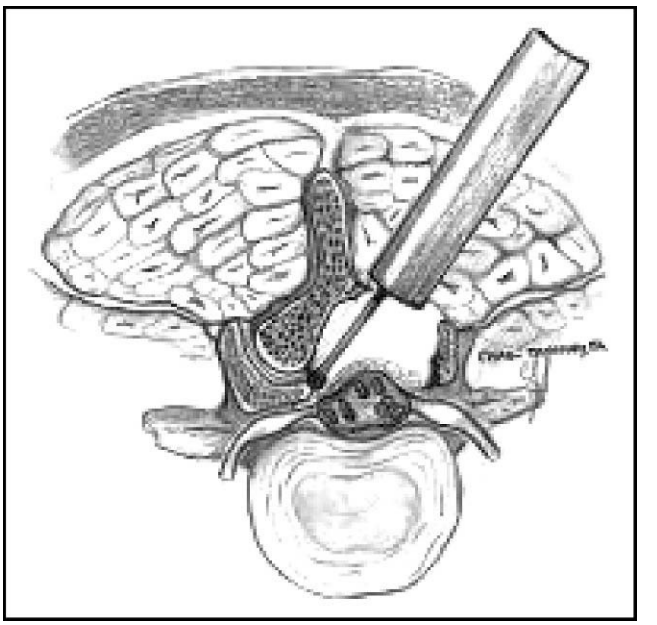

Figure 3 Unroofing of the neural foramen and bilateral decompression.

If a discectomy is deemed necessary once the decompressive laminectomy has been completed, the tubular retractor is slowly removed with the scope, making sure there is no hemorrhage. The wound is sutured with two or three stitches of resorbable material.

Postoperatively, we normally leave a redon wound drainage system on for 24 hours. We administer prophylactic antibiotics for 24 hours as well as analgesic medication. The patient is instructed to get up from bed on the day after surgery, to ambulate the second day and they are normally allowed to leave hospital on the third day. Physical exercise is normally indicated to enhance paraspinal muscles; alternative elevation of the lower limbs from the supine position is also recommended.

Results

Of the 60 patients studied, 34 (56.7%) were male and 26 (43.3%) female. Mean age was 54.5±10 years. Length of patient follow-up was 12 months (transverse study at 12 months).

The most frequently affected level was L4-L5 (38 {63.33%) patients. The L5-S1 level was affected on 17 occasions and level L4-L5 on 5 occasions.

Mean OR time was 85.17±18 min. Mean length of preoperative hospital stay was 2.8±4.8 days and mean length of postoperative hospital stay was 4±1.2 days.

An analysis of the concomitant conditions reported in other articles in the literature, such as those associated with higher levels of comorbidity and factors potentially affecting the result[18], shows that 28.3% of patients experienced some degree of depression or anxiety. 8.3%of patients[5] in our study had a heart condition; 5 patients were diabetic (3 were insulin-dependent and 2 non insulin-dependent), and another 5 presented with some sort of obstructive pulmonary disease (either asthma or chronic obstructive pulmonary disease) (table 3). We did not find any statistically significant association between the patients' demographic characteristics (age, sex, habits, comorbidities) and the results obtained on the patient satisfaction survey we conducted[4] and Macnab's modified classification[1,2] (p was >0.05 in all cases).

Table 3 Distribution of concomitant diseases in the population under study

Concomitant disease	Patients, n (%)
Heart disease	5 (8.3)
Acute myocardial infarction	3 (5)
Aortic stenosis	1 (1.7)
Atrial fibrillation	1 (1.7)
Pulmonary involvement	5 (8.3)
COPD	4 (6.7)
Chronic bronchitis	1 (1.7)
Diabetes	5 (8.3)
IDDM	3 (5)
NIDDM	2 (3.3)
Anxiety/ depression	17 (28.3)
BMI	
Normal	15 (25)
Overweight	30 (50)
Obesity	15 (25)

IDDM: insulin-dependent diabetes mellitus; NIDDM: non insulin-dependent diabetes mellitus; COPD: chronic obstructive pulmonary disease; BMI: body mass index.

At postoperative follow-up, 46 (76.6%) patients presented with chronic lower-back pain (associated to either sciatica or neurogenic claudication, but never in isolation). 53.3% had nerve root pain (in 18 patients radiculalgia was intermittent and in 14 continuous). 61.7%of patients in our study experienced neurogenic claudication. As far as the hip joint was concerned, 11.7%of patients presented with unilateral hip arthritis and 5% bilateral hip arthritis. No alterations were observed in the sacroiliac joints.

Twenty-five (41.6%) patients showed disc protrusion or disc herniation related with their lateral recess stenosis. 73.3% of patients were afflicted with spondyloarthritis associated with their lateral recess stenosis and 7 patients had grade I spondylolisthesis.

For the descriptive analysis, we classified complications into intraoperative and postoperative complications. In the first group we included 7 cases (6 patients presented with a dural sac tear and one patient had a cauda equina syndrome secondary to an epidural hematoma); the second group comprised 2 postoperative complications derived from a superficial infection of the surgical wound.

Preoperative assessment on the VAS for lumbar pain resulted in a mean score for the whole population of 5.42±1.58. At 6 months from surgery the mean lumbar VAS score was 2.9±1.9. At one year, the score was 3.8±2.1. At 6 months, mean decrease on the lumbar VAS score was 2.45±1.7 points. The mean improvement of the lumbar VAS score obtained at one year with respect to the preoperative value was 1.6±1.8 points.

The mean score for preoperative pain in the lower limbs was 8.5±0.8 points on the Visual Analog Scale; at 6 months the score was 1.7±2.4 points, and at one year 2.2±2.7 points. Mean pain score decrease at 6 months with respect to the pre-operative period was 6.7±2.4 points; at one year this decrease reached a mean value of 6.2±2.6 points.

Mean preoperative ODI was 67,1±13,9 points; at 6 months a mean ODI was obtained of 30.6±23.4, at one year the value was of 32.7±24.5 points. At 6 months' follow-up a mean ODI decrease of 36,5±23,3 points was obtained with

Table 4 Distribution of the VAS and ODI scores obtained preoperatively, at 6 months and at one year from surgery

	Value, mean ±SD	t	Decrease*, mean ±SD	p
Pre-op lumbar VAS	5.42±1.58	26.439		
Lumbar VAS at 6 months	2.9±1.9	12.012	2.45±1.7	<0.05
Lumbar VAS at 1 year	3.8±2.1	13.979	1.6±1.8	<0.05
Postoperative LL. LL. VAS	8.5±0.8	80.982		
LL. LL. VAS at 6 months	1.7±2.4	5.54	6.7±2.4	<0.05
LL. LL. VAS at 1 year	2.2±2.7	6.189	6.2±2.6	<0.05
Pre-op ODI	67.1±13.9	37.37		
ODI at 6 months	30.6±23.4	10.104	36.5±23.3	<0.05
ODI at 1 year	32.7±24.5	10.334	34.3±26.2	<0.05

SD: standard deviation; VAS: visual analog scale; LL. LL. lower limbs; ODI: Oswestry Disability Index.
*Decrease from the preoperative.

respect to the preoperative period. At one year, this decrease was of 34.3±26.2 points (table 4).

The reoperation rate in our study was 3.3%; one patient had to be reoperated due to a hematoma in the immediate postoperative period and another because of epidural fibrosis.

At 6 months from surgery 78.3%of patients (47 patients) claimed to be satisfied or highly satisfied with their operation[4]. At one year, 68.3% of patients (41 patients) claimed to be satisfied, 18.3% said they were moderately satisfied and 13.3% were dissatisfied.

Following the Macnab modified classification[1,2], a good result was obtained in 40 (66.6%) patients, a fair result in 10, and a poor result in 10.

In order to determine whether the good, fair and poor results obtained on the subjective patient questionnaire[4] and the Macnab modified classification[1,2] were comparable, we used the kappa concordance index, which provided us with the degree of correlation between both classifications (kappa, 0.933; $p<0.001$).

Discussion

Lumbar canal stenosis is a condition whose prevalence is bound to increase in line with the higher rates of life expectancy and which causes patients disabling pain on performing such simple activities as ambulation.

Generally, degenerative lumbar canal stenosis manifests itself between the fifth and the seventh decade of life, whereas congenital lumbar canal stenosis and lateral recess stenosis tend to appear between the third and the fourth decades of life; the latter condition is more prevalent in females than in males[19]. In our series, mean patient age was 54.5 years, although according to Arbit et al[19], 25 patients were in their fourth decade of life.

In line with other authors[20], we found that the most frequently affected level was L5 (L4-L5 lateral stenosis, which was observed in 63.33%of patients in our study.

In our study, 25 patients presented with disc protrusion or herniation associated with their lateral recess stenosis. According to Arbit et al[19], posterolateral disc protrusion or hypertrophy of the upper articular process are the main causes of lateral recess stenosis and, according to Dai et al[21], coexistence of both conditions is not exceptional.

The clinical symptoms in out group of patients were similar to those published in the literature. The most prevalent symptom was lumbar pain (albeit never in isolation) in 76.6%of cases, and the second most prevalent, with varying intensities, was neurogenic claudication (61.7% of cases). We found nerve root pain in 53.3%of our cases.

As far as treatment is concerned, most authors indicate surgery for patients unresponsive to treatment where canal stenosis has been shown to be the culprit for their symptoms, or in those patients where appropriate conservative treatment has failed.

The traditional surgical technique used for lumbar canal stenosis has been extended decompressive laminectomy[7,6]. Recourse to these extended decompressive procedures, which do not spare the integrity of the facet joints or preserve the spinous process or the interspinous ligaments, could result in a greater incidence of mechanical failure in the structure of the spine and lead to a failed back syndrome[11]. Studies carried out on biomechanical models emphasize the importance of the posterior spine for preserving spinal stability[16]. For that reason, several minimally invasive techniques have been developed in order to reduce the incidence of iatrogeny and minimize trauma to the tissues and unnecessary exposure. All of this is intended to reduce the length of hospital stay, decrease postoperative morbidity and return patients sooner to their previous lifestyles[5,4,11-16].

Numerous studies have been published that demonstrate that it is possible to perform an effective bilateral decompression by means of a unilateral approach[3-5,7,9,13,22,23], with the help of either a microscope or an endoscope. This approach affords the theoretical advantage of reducing injury to soft tissues and the adverse response of surgical tension, while at the same time it preserves the integrity and stability of spinal structures[5].

The endoscopy-assisted unilateral approach used in our study to achieve decompression afforded us 66.6%good or excellent results with a subjective patient satisfaction rating of 68.3% In the review performed at one year, a statistically significant improvement was observed ($p<0.05$) in terms of both functional status (mean ODI decrease with respect to the pre-op period was 34.3±26.2 points) and pain in the lower limbs (the VAS score for pain in the lower limbs was 6.2±2.6 points). The improvement obtained in terms of lumbar pain was lower (mean improvement in lumbar VAS score at one year from surgery was 1.6±1.8), although still statistically significant ($p<0.05$). This poorer result could be attributed to the high incidence (73%) of lumbar spondyloarthritis observed in Imaging studies; but we did not find a statistically significant relationship ($p>0.05$).

In a prospective study, Weiner et al[4] analyze the results of 30 patients subjected to bilateral decompression by means of a unilateral approach and found 87%good results (follow-up: 0.75 years). Mariconda et al[22], using the same type of approach, obtained 68% good results at 4 years. With the same technique, Oertel et al[13] report 85.3%good results alter a mean follow-up of 4 years; whereas Kim et al[9], at 12 months from surgery, obtained a mean decrease of 3.1 points on the lumbar VAS score, 3.5 points on the lower limb VAS score and 35 points on the Oswestry Disability Index.

Using other minimally invasive techniques, Fokter et al[24], in a retrospective study of 58 patients, obtained 63.8%of excellent or good results with 58.6% patient satisfaction after a mean follow-up of 27 months. In 2003, Gunzburg et al[11] published a study where they achieved 58.3% good results using minimally invasive surgery with a mean follow-up of 1.7 years.

Khoo et al[7] published a study where, performing microendoscopic decompressive laminotomy (MEDL), they obtained symptomatic improvement in 68% of patients, with mean follow-up of 1 year. Palmer et al[3] obtained 81% good results and a mean VAS decrease of 5.6 points applying this technique to 8 patients with canal stenosis and spondylolisthesis. Rosen et al[23] used microendoscopic decompressive laminotomy (MEDL) to perform the decompression in 50 patients over 75 years of age. These authors achieved a mean reduction of 3.3 points on the

lumbar VAS score, 3.4 points on the lower limb VAS score and 21 points on the Oswestry Disability Index (mean follow-up: 7 months).

Using conventional surgery, Atlas et al[25] reported 58% good results at 1 year from surgery. Yukawa et al[26] achieved a mean ODI decrease of 37 points with a 2-year follow-up. In their metaanalysis, Turner et al[2] report 64%excellent or good results in the medium term (3-6 years).

In our study we had a 15%complications rate. In line with other studies published in the literature[2,12,13,22,27], the most usual complication was an incidental dural sac lesion (10%). All patients were treated conservatively, with complete bed-rest and serum therapy, without applying any kind of primary suture or repair and without any subsequent sequelae being observed (inveterate cerebrospinal fluid leaks, formation of fluid collections or pseudomeningocele). This amount of dural sac lesions could be attributed to the steep learning curve associated with this new surgical technique and, even if their incidence is high, it is nevertheless comparable to the findings of other authors in the literature (3.5-14%)[2,12,13,23,27-29]. The second most prevalent complication was skin infection (2 cases), which was resolved with oral antibiotic administration. Lastly, one patient presented with an epidural hematoma and developed a secondary cauda equina syndrome, for which reason he had to be reoperated. In a review conducted at one year, this patient had fully recovered his sphincter function but was still afflicted with residual paresis in the right-side L5 and S1 nerve roots. We believe that formation of this hematoma could be related to the type of wound drainage used, i.e. a high-vacuum system. On some occasions, if the drainage is too superficial and the space created is too narrow, then when the vacuum is applied the holes in the drain may be blocked due to soft tissue collapse. From this time onwards, we decided to leave the redon wound drainage system on for 24 hours but with no vacuum applied. None of our cases showed any signs of macroscopic instability in flexion and extension radiographs performed at one year from surgery, following the criteria laid down by Kleeman et al[16].

Numerous Publications consider demographic factors (female gender, age, etc.) and the presence of disease (cardiac, obstructive pulmonary, depression) to be factors predisposing patients to a poor surgical result[10,18,20]. In our study we found no statistically significant correlation between the patients' demographic characteristics and the results obtained from the patient satisfaction survey. Nor did the patients' previous health status (concomitant conditions) influence (in any statistically significant manner) the result of the surgical procedure, as measured by the patient satisfaction questionnaire, the modified Macnab classification, the mean decrease on lumbar and lower VAS scores and the mean reduction in the Oswestry Disability Index.

The rate of reoperations following decompressive surgery stands between 9 and 17%[6,13,20,22,30] and increases with time[30]. In our study, the reoperations rate was 3.3% (2 patients reoperated, one for an epidural hematoma and the other for epidural fibrosis; this patients was subjected to discectomy and decompressive laminotomy because he presented with concomitant disc herniation). Jansson et al[30] reported a reoperations rate of 11%at 10 years, although they pointed out that most of these surgical procedures were performed in the first 2 years. Although our incidence is low, it must be taken into consideration that the follow-up of this study is extremely short and the percentage can be expected to rise as time passes.

Limitations of the study

The present study has a short follow-up (1 year), which implies that results may change with the passage of time.

Ours is not a randomized study and we have not compared the results obtained with a control Group. In addition, given that patient selection, the surgical technique, the methods of evaluation and the surgeons themselves are different in each study, our results cannot be directly compared with those obtained by other authors. In order to make as appropriate a comparison as possible with the results published in the literature, we have classified our results into 3 categories: good, fair and poor results, with the same criteria as used by Turner et al[2] (Macnab modified classification[1]). In order to find out whether this classification (into good, fair and poor results), obtained from the subjective patient satisfaction survey[4], is comparable to the modified Macnab classification[1,2], we used the kappa concordance index, which provides us with the degree of correlation between both classifications. In our case, the kappa concordance index was 0.933 ($p<0.001$), for which reason we consider that the degree of correspondence is high and, therefore, the classification methods are comparable.

To conclude, in our experience, microendoscopic decompressive laminotomy (MEDL) is a safe and effective technique for treatment of lumbar lateral recess stenosis and an alternative among minimally invasive spine surgery techniques to try and minimize soft tissue injury and preserve the integrity and the stability of the lumbar spine.

Conflict of interests

The authors have declared that they have no conflict of interests.

References

1. Macnab I. Negative disc exploration. An analysis of the causes of nerve root involvement in sixty-eight patients. J Bone Joint Surg. 1971;53-A:891-903.
2. Turner JA, Ersek M, Herron L, Deyo R. Surgery for lumbar spinal stenosis: attempted metaanalysis of the literature. Spine. 1992;17:1-8.
3. Palmer S, Turner R, Palmer R. Bilateral decompressive surgery in lumbar spinal stenosis associated with spondylolisthesis: unilateral approach and use of a microscope and tubular retractor system. Neurosurg Focus. 2002;13:1-6.
4. Weiner BR, Walker M, Brower RS, et al. Microdecompression for lumbar spinal canal stenosis. Spine. 1999;24:2268-72.
5. Guiot B, Khoo LT, Fessler RG. A minimally invasive technique for decompression of the lumbar spine. Spine. 2002;27:432-8.
6. Yuan S, Albert J. Nonsurgical and surgical management of lumbar spinal stenosis. J Bone Joint Surg Am. 2004;86-A:3219-30.

7. Khoo L, Fessler R. Microendoscopic decompressive laminotomy for the treatment of lumbar stenosis (Minimally invasive Surgery of the Spine. Chapter 18). Neurosurgery. 2002;51:S146-S154.
8. Deen HG, Fenton DS, Lamer TJ. Minimally invasive procedures for disorders of the lumbar spine. Mayo Clin Proc. 2003;78:1249-56.
9. Kim SW, Ju CI, Kim CG, Kim CG, Lee SM, Shin H. Minimally invasive lumbar spinal decompression: a comparative study between bilateral laminotomy and unilateral laminotomy for bilateral decompression. J Korean Neurosurg Soc. 2007;42:195-9.
10. Hanley E, Green NE, Spengler DM. Less invasive procedures in spine surgery. J Bone Joint Surg Am. 2003;85-A:956-961.
11. Gunzburg R, Keller TS, Szpalski M, Vandeputte K, Spratt KF. Clinical and psychofunctional measures of conservative decompression surgery for lumbar spinal stenosis: a prospective cohort study. Eur Spine J. 2003;12:197-204.
12. Podichetty VK, Spears J, Isaacs RE, Booher J, Biscup RS. Complications associated with minimally invasive decompression for lumbar spinal stenosis. J Spinal Disord Tech. 2006;19:161-6.
13. Oertel M, Ryang Y, Korinth M, Gilsbach JM, Rohde V. Long-term results of microsurgical treatment of lumbar spinal stenosis by unilateral laminotomy for bilateral decompression. Neurosurgery. 2006;59:1264-1270.
14. Poelstra K.A, Tannoury C, Srinivasan S, Anderson DG. Minimally invasive exposure techniques in spine surgery. Curr Opin Orthop. 2006;17:208-13.
15. German JW, Foley KT. Minimal access surgical techniques in the management of the painful lumbar motion segment. Spine. 2005;30:S52-S59.
16. Kleeman TJ, Hiscoe AC, Berg EE. Patient outcomes after minimally destabilizing lumbar stenosis decompression. The Port-Hole technique. Spine. 2000;25:865-70.
17. Cáceres-Palou E, López-Prats F, Mesa-Ramos M, Sánchez-Sotelo J, Suso-Vergara S. Valoración de resultados en cirugía ortopédica y traumatología. Rev Ortop Traumatol. 2005;49:119-42.
18. Aalto TJ, Malmivaara A, Kovacs F, Herno A, Alen M, Salmi L, et al. Preoperative predictors for postoperative clinical outcome in lumbar spinal stenosis: systematic review. Spine. 2006;31: E648-63.
19. Arbit E, Pannullo S. Lumbar stenosis. A clinical review. Clin Orthop. Relar Res. 2001;384:137-43.
20. Herrera RA, Rodriguez VJ. Estenosis de canal lumbar. Rev Ortop Traumatol. 2002;4:351-72.
21. Dai LY, Ni B, Jai LS, Liu HK. Lumbar disc herniation in patients with developmental spinal stenosis. Eur Spine J. 1996;5: 308-11.
22. Mariconda M, Fava R, Gatto A, Longo C, Milano C. Unilateral laminectomy for bilateral decompression of lumbar spinal stenosis: a prospective comparative study with conservatively treated patients. J Spinal Disord Tech. 2002;15:39-46.
23. Rosen DS, O'Toole JE, Eichholz KM, Hrubes M, Huo D, Sandhu FA, et al. Minimally invasive lumbar spinal decompression in the elderly: outcomes of patients aged 75 years and older. Neurosurgery. 2007;60:503-9.
24. Fokter SK, Yerby SA. Patient-based outcomes for the operative treatment of degenerative lumbar spinal stenosis. Eur Spine J. 2006;15:1661-9.
25. Atlas SJ, Deyo RA, Keller RB, Chapin AM, Patrick DL, Long JM, et al. 1-year outcomes of surgical and nonsurgical management of lumbar spinal stenosis. Spine. 1996;21:1787-94.
26. Yukawa Y, Lenke LG, Tenhula J, Bridwell KH, Riew KD, Blanke K. A comprehensive study of patients with surgically treated lumbar spinal stenosis with neurogenic claudication. J Bone Joint Surg Am. 2002;84-A:1954-9.
27. Tafazal SI, Sell PJ. Incidental durotomy in lumbar spine surgery: incidence and management. Eur Spine J. 2005;14:287-90.
28. Khan MH, Rihn J, Steele G, Davis R, Donaldson WF, Kang JD, et al. Postoperative management protocol for incidental dural tears during degenerative lumbar spine surgery. Spine. 2006;31: 2609-13.
29. Wang JC, Bohlman HH, Riew KD. Dural tears secondary to operations on the lumbar spine: management and results after a two-year-minimum follow-up of eighty-eight patients. J. Bone Joint Surg. 1998;80-A:1728-32.
30. Jansson K, Németh G, Granath F, Blomqvist P. Spinal stenosis re-operation rate in Sweden is 11% at 10 years. A national analysis of 9,664 operations. Eur Spine J. 2005;14:659-63.