



## Survey on Spinal Injections for lumbar degenerative stenosis among spine surgeons in Latin America

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### Abstract

**Introduction:** Epidural and facet joint injections are usually used as part of the treatment algorithm for low back and radicular pain. Current clinical practice in Latin America is not well described in the literature.

**Objectives:** Evaluate the indications and techniques of spinal injections (SI) in patients with degenerative lumbar spinal stenosis (DLSS) among spine surgeons in Latin America.

**Study Design:** Cross-sectional, international survey, narrative literature review.

**Methods:** An online survey was sent to spine surgeons and members of the AOSpine Latin America. Data included surgeon geographic information, specialty, time in professional activity, SI indications, and techniques in different scenarios of pain and stenosis localization.

**Results:** A total of 446 surgeons, 291 (65%) orthopedic surgeons, and 155 (35%) neurosurgeons replied to the survey. 92% of spine surgeons indicated a spinal steroid injection to treat DLSS. Most spinal surgeons (54%) would simultaneously perform both peridural and intraarticular lumbar facet (combined) steroid injections in patients with low back pain and radicular pain. Foraminal injection is a preferred technique for patients with central and foraminal stenosis. There are no significant differences in most of the answers between orthopedic surgeons and neurosurgeons. Almost 80% of respondents expect a good result from the injection. However, 86% of surgeons believe injection effects last less than 6 months, and only 12% think surgery will not be necessary in the future. Only 15% of spine surgeons irrespective of specialty adhere to a guideline on spine injections for DLSS.

**Conclusion:** This study provides a global perspective on how Latin American spine surgeons treat patients with DLSS concerning the use of spinal steroid injections. We observed that more than 90% of respondents use this procedure to treat DLSS. There are almost no differences between orthopedic spine surgeons and neurosurgeons when performing SI.

A foraminal injection is preferred for lateral recess and foraminal stenosis. Most of the respondents expect to achieve positive results with the procedure, but they believe that its effect will last for less than 6 months and possible need for surgery.

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## Introduction

Lumbar spinal stenosis is defined as the narrowing of the cross-sectional area of the spinal canal, localized at the central canal, lateral recess or foraminal space, and frequently generates an encroachment on the neural structures [1-4].

Degenerative changes of the spine are the most common etiology of lumbar spinal stenosis and it is considered the most frequent cause of radicular pain and neurogenic claudication in the population over 60 years old [1].

The natural history of degenerative lumbar spinal stenosis (DLSS) tends to be benign in terms of progression rate; almost 70% of the patients report no changes in their symptoms at 4 years of following [3]. Nevertheless, almost 30% of patients present progression of symptoms, leading to severe pain and functional impairment. Lumbar stenosis leads to inflammation of the nerve root resulting from compression, usually presenting as mono or multi-radicular pain, and frequently with both axial and leg pain.

Another established cause of chronic back pain is facet joint inflammation, with an incidence of 15 to 45% in the general population [1]. Facet joint arthropathy and synovitis may present with axial or buttock pain. Both facet joint arthropathy and DLSS are usually present at the same time in the degenerative spine, making it sometimes difficult to identify the specific origin of pain [5].

Initial treatment includes oral pain medication and physical therapy. If symptoms persist, spinal corticosteroid injections can be considered [6,7]. Corticosteroids can inhibit edema in mechanically compressed nerve roots exhibiting microlesions, decrease inflammation by altering leukocyte function through stabilization of lysosomal membranes, reduce the activity of phospholipase A2 and block nociceptive transmission in C fibers.

There are different types of spinal injections (SI) depending on the predominant pathology, and they can be divided into 2 groups: facet joint injections and epidural injections. The latter can be subdivided in 3 depending on the route of administration: interlaminar, transforaminal and caudal. An epidural injection is indicated when it is suspected that axial and or radicular pain are associated to stenosis of the lumbar canal. Facet joint injections are indicated in patients in which the facets are considered as the origin of the symptoms [6].

Despite a moderate and low level of evidence, there are some guidelines and consensus concerning the use of corticosteroid injections in DLSS [4,6,7]. However, substantial heterogeneity in interventions regarding timing, number of injections and patient selection is found in the literature. More importantly, to our knowledge, there is no specific evidence-based clinical guideline that defines when it is advisable to perform a facet infiltration over an epidural

injection or when it is reasonable to perform both in DLSS pathology.

Our main goal was to evaluate the indications and techniques for spinal injections in DLSS of spinal surgeons in Latin America, with particular attention to indications and preference of single or combined injection techniques. Our secondary goal was to review the literature available regarding epidural and facet corticosteroid injection in the treatment of DLSS.

## Methods

### Study Design

Prospective, therapeutic opinion survey. Cross-sectionally study using a purpose-built electronic survey. Narrative review.

### Population Studied

An electronic questionnaire was created by the authors to evaluate spinal injection use in DLSS among spine surgeons in Latin America (LA). This was distributed to LA members of AOSpine. AOSpine is an internationally-recognized professional community of spine physicians and investigators with a total of 6.403 members, 1.288 from LA. The survey respondent characteristics are resumed in Table 1.

An e-mail request to participate in the survey was sent to all LA members, accompanied by a cover letter explaining study objectives and a link to the survey, created in Survey Monkey software. Portuguese and Spanish versions of the questionnaire were created. This link was made available for 14 days, during which up to three reminder emails were sent to non-respondents.

### Assessment

Assessment was based on a questionnaire consisting of 19 multiple-choice questions addressing indications and technique chosen depending on the location of the dominant pain (lumbar or radicular) and on location of the pathology (central, lateral recess or foraminal stenosis). The survey also included outcome expectations and complications of this procedure. The questions included in the questionnaire are presented in Table 2.

### Statistical Analysis

The survey data was compiled in Excel spreadsheet files. The study sample was described by calculating the frequencies and percentages for categorical variables. The statistical analysis was performed using the Pearson  $\chi^2$  analysis. Key questions were analyzed according to countries, specialty (neurosurgery versus orthopedic surgery) and years of practice.  $p < 0.05$  was considered to be statistically significant. All analyses were performed using Minitab18 and RStudio Version 1.1.383.

**Table 1:** Survey respondent characteristics

| Survey respondent characteristics              |     |       |
|------------------------------------------------|-----|-------|
|                                                | n   | %     |
| Total                                          | 446 | 100   |
| Specialty                                      |     |       |
| Neurosurgeon                                   | 155 | 34.75 |
| Orthopedic surgeon                             | 291 | 65.25 |
| Time of professional activity in spine surgery |     |       |
| Less than 5 years                              | 75  | 16.82 |
| Between 5 and 10 years                         | 91  | 20.4  |
| Between 10 and 15 years                        | 94  | 21.08 |
| Between 15 and 20 years                        | 79  | 17.71 |
| More than 20 years                             | 107 | 23.99 |
| Country                                        |     |       |
| Argentina                                      | 113 | 25.34 |
| Brazil                                         | 100 | 22.42 |
| Chile                                          | 60  | 13.45 |
| Mexico                                         | 60  | 13.45 |
| Colombia                                       | 34  | 7.62  |
| Other*                                         | 79  | 17.71 |

\*Uruguay, Paraguay, Panama, Guatemala, Ecuador, Dominican Republic and Costa Rica

**Table 2:** Survey on Spinal Injections for lumbar degenerative stenosis questionnaire

| Survey on Spinal Injections for lumbar degenerative stenosis questionnaire |                                                                                                                                                                                                                           |                                               |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
|                                                                            | Questions                                                                                                                                                                                                                 | Response options                              |
| 1                                                                          | Time of professional activity in spine surgery                                                                                                                                                                            | Less than 5 years                             |
|                                                                            |                                                                                                                                                                                                                           | Between 5 and 10 years                        |
|                                                                            |                                                                                                                                                                                                                           | Between 10 and 15 years                       |
|                                                                            |                                                                                                                                                                                                                           | Between 15 and 20 years                       |
|                                                                            |                                                                                                                                                                                                                           | More than 20 years                            |
| 2                                                                          | Specialty                                                                                                                                                                                                                 | Orthopedic Surgeon                            |
|                                                                            |                                                                                                                                                                                                                           | Neurosurgeon                                  |
| 3                                                                          | Country where you work                                                                                                                                                                                                    |                                               |
| 4                                                                          | What percentage of your patients with lumbar degenerative stenosis (DLSS) with significant radicular pain and failure to conservative treatment you perform a spinal steroid injection?                                   | Never                                         |
|                                                                            |                                                                                                                                                                                                                           | 1 to 25%                                      |
|                                                                            |                                                                                                                                                                                                                           | 26 to 50%                                     |
|                                                                            |                                                                                                                                                                                                                           | 51 to 75%                                     |
|                                                                            |                                                                                                                                                                                                                           | 76 to 100%                                    |
| 5                                                                          | In a patient with symptomatic DLSS with sciatic or leg pain without significant pain relief after conservative treatment, for how long you maintain conservative treatment before considering a spinal steroid injection? | Less than 1 week                              |
|                                                                            |                                                                                                                                                                                                                           | Between 1 and 2 weeks                         |
|                                                                            |                                                                                                                                                                                                                           | Between 2 and 4 weeks                         |
|                                                                            |                                                                                                                                                                                                                           | Between 1 and 3 months                        |
|                                                                            |                                                                                                                                                                                                                           | I never perform or indicate spinal injections |

|    |                                                                                                                                                                                         |                                                                        |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| 6  | In a patient with DLSS with significant low back pain and radicular pain do you perform:                                                                                                | Peridural steroid injection                                            |
|    |                                                                                                                                                                                         | Intraarticular lumbar facet steroid injection                          |
|    |                                                                                                                                                                                         | Both injections in the same opportunity                                |
|    |                                                                                                                                                                                         | I never perform or indicate spinal injections                          |
| 7  | In a patient with DLSS with significant low back pain without radicular pain you perform:                                                                                               | Peridural steroid injection                                            |
|    |                                                                                                                                                                                         | Intraarticular lumbar facet steroid injection                          |
|    |                                                                                                                                                                                         | Both                                                                   |
|    |                                                                                                                                                                                         | I never perform or indicate spinal injections                          |
| 8  | In a patient with DLSS with significant radicular pain without (or minimal) low back pain you perform:                                                                                  | Peridural steroid injection                                            |
|    |                                                                                                                                                                                         | Intraarticular lumbar facet steroid injection                          |
|    |                                                                                                                                                                                         | Both                                                                   |
|    |                                                                                                                                                                                         | I never perform or indicate spinal injections                          |
| 9  | In a patient with DLSS and lumbosciatic pain secondary to nerve root compression in the lateral recess area, if you decide to perform a spinal injection which technique would you use? | Interlaminar steroid injection                                         |
|    |                                                                                                                                                                                         | Foraminal steroid injection (or selective nerve root block/ injection) |
|    |                                                                                                                                                                                         | Caudal steroid injection                                               |
|    |                                                                                                                                                                                         | I never perform or indicate spinal injections                          |
| 10 | In a patient with DLSS and lumbosciatic pain secondary to nerve root compression in the foramina, if you decide to perform a spinal injection which technique would you use?            | Interlaminar steroid injection                                         |
|    |                                                                                                                                                                                         | Foraminal steroid injection (or selective nerve root block/ injection) |
|    |                                                                                                                                                                                         | Caudal steroid injection                                               |
|    |                                                                                                                                                                                         | I never perform or indicate spinal injections                          |
| 11 | In a patient with DLSS and neural claudication secondary to central spinal stenosis, if you decide to perform a spinal injection which technique would you use?                         | Interlaminar steroid injection                                         |
|    |                                                                                                                                                                                         | Foraminal steroid injection                                            |
|    |                                                                                                                                                                                         | Caudal steroid injection                                               |
|    |                                                                                                                                                                                         | I never perform or indicate spinal injections                          |
| 12 | In what percentage (in average) of your patients would you expect a good result (defined as a relief of more than 50% of the pain)?                                                     | 0 to 20%                                                               |
|    |                                                                                                                                                                                         | 21 to 40%                                                              |
|    |                                                                                                                                                                                         | 41 to 60%                                                              |
|    |                                                                                                                                                                                         | 61 to 80%                                                              |
|    |                                                                                                                                                                                         | 81 to 100%                                                             |
| 13 | For how long (in average) do you expect a good result (defined as a relief of more than 50% of the pain) with the spine injection?                                                      | Less than 1 month                                                      |
|    |                                                                                                                                                                                         | Between 1 and 3 months                                                 |
|    |                                                                                                                                                                                         | Between 3 and 6 months                                                 |
|    |                                                                                                                                                                                         | Between 6 month and 1 year                                             |
|    |                                                                                                                                                                                         | More than 1 year                                                       |
| 14 | What percentage of your patients in which you perform a spine injection due to DLSS you believe will not require surgery in the future?                                                 | 0 to 20%                                                               |
|    |                                                                                                                                                                                         | 21 to 40%                                                              |
|    |                                                                                                                                                                                         | 41 to 60%                                                              |
|    |                                                                                                                                                                                         | 61 to 80%                                                              |
|    |                                                                                                                                                                                         | 81 to 100%                                                             |

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|    |                                                                                                                                                                                         |                                                                             |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 15 | You think the best result of an intraarticular lumbar facet steroid injection is when in the MRI you see:                                                                               | Significant facet joint fluid (more than 1.5 mm)                            |
|    |                                                                                                                                                                                         | Facet Synovitis                                                             |
|    |                                                                                                                                                                                         | Severe facet osteoarthritis                                                 |
|    |                                                                                                                                                                                         | Any of the above                                                            |
|    |                                                                                                                                                                                         | Results depend on clinical presentation, not MRI findings                   |
| 16 | Do you think the addition of intraarticular lumbar facet steroid injection significantly improves the result of an epidural steroid injection to relief the pain in a patient with DLS? | Yes                                                                         |
|    |                                                                                                                                                                                         | No                                                                          |
|    |                                                                                                                                                                                         | I do not combine both injections                                            |
| 17 | Select the 3 most frequent effect adverse of the spinal injection including intraarticular lumbar facet steroid injection and peridural interlaminar steroid injection                  | Insomnia                                                                    |
|    |                                                                                                                                                                                         | Hiccup                                                                      |
|    |                                                                                                                                                                                         | Allergic reaction                                                           |
|    |                                                                                                                                                                                         | Facial Flushing                                                             |
|    |                                                                                                                                                                                         | Headache                                                                    |
|    |                                                                                                                                                                                         | Peridural hematoma                                                          |
|    |                                                                                                                                                                                         | Infection                                                                   |
|    |                                                                                                                                                                                         | Pain in the puncture site                                                   |
| 18 | In a patient with DLSS how many spine injections you would perform (repeat procedure) if you obtain a good pain relief with them before suggesting surgery?                             | None                                                                        |
|    |                                                                                                                                                                                         | 1 injection                                                                 |
|    |                                                                                                                                                                                         | 2 injections                                                                |
|    |                                                                                                                                                                                         | 3 injections                                                                |
|    |                                                                                                                                                                                         | 4 or more                                                                   |
| 19 | Are you aware of valid guidelines on spine injections for DLSS?                                                                                                                         | No                                                                          |
|    |                                                                                                                                                                                         | Yes, and I adhere to them                                                   |
|    |                                                                                                                                                                                         | Yes, but I do not always adhere to them (do not consider them always valid) |

## Results

### Sample characteristics

Responses were received from 446 surgeons, including 291 (65.25%) orthopedic surgeons and 155 (34.75%) neurosurgeons. The majority of respondents had more than 10 years of professional activity in spine surgery (62.7%) (Table 1). The largest number of responses were from Argentina (25.34%), Brazil (22.42%), Chile (13.45%) and Mexico (13.45%) (Figure 1).

### Spinal infiltration indication

Regarding current practices, 92.5% of spine surgeons performed a spinal steroid injection in patients with DLSS, with no difference between orthopedic surgeons (96%) and neurosurgeons (84%) (Table 3, Figure 2).

As to the number of SI, 59% of spine surgeons would perform up to 2 injections if they obtain a good result on the first procedure. Only 4% would infiltrate 4 or more times in

the same scenario (Figure 3).

Regarding timing, 70 % of the spine surgeons surveyed waited for more than 2 weeks of conservative treatment before indicating a SI and 38% waited more than 1 month (Figure 4).

Only a 14.8% of spine surgeons, irrespective of specialties replied they followed the indications of an epidural/facet injection guideline (Figure 5).

### Spinal infiltration type

As for the type of injection performed, 54% of spine surgeons would indicate both peridural and intraarticular lumbar facet steroid injections in patients with low back pain and radicular pain, with no difference between orthopedic surgeons and neurosurgeons (Figure 6). After analyzing the distribution by country, it was found that 81.7% of spine surgeons in Chile would perform both spinal infiltration types to treat patients with radicular pain and low back pain ( $p<.001$ ).

In patients with low back pain without radicular pain, 54% of the surgeons would perform only a facet steroid injection (Figure 7).

In case of patients with radicular pain and no low back pain, 55.6% of the surgeons would perform a peridural injection without facet injection, with no significant differences between orthopedic and neurosurgeons. In the same scenario, 10% of neurosurgeons and 24% of orthopedic surgeons ( $p=0.018$ ) would indicate an injection of both peridural and intra-articular lumbar facet steroid injection, with significant difference between specialties (Table 4).

### Spinal infiltration technique

Regarding techniques employed according to stenosis location, the vast majority of spine surgeons (85%) would use a foraminal steroid injection technique in patients with DLSS and sciatic pain secondary to nerve root compression in the lateral recess area (Figure 8). Similar trends were observed in patients with DLSS and sciatic pain secondary to nerve root compression in foraminal space (69%) (Figure 9).

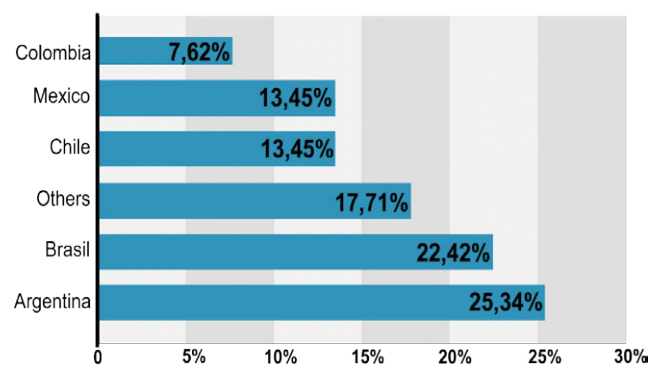


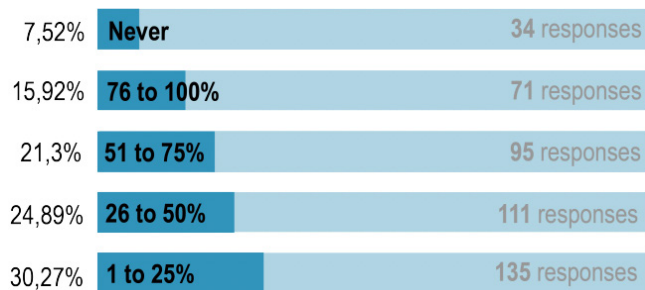
Figure 1: Overall responses by country.



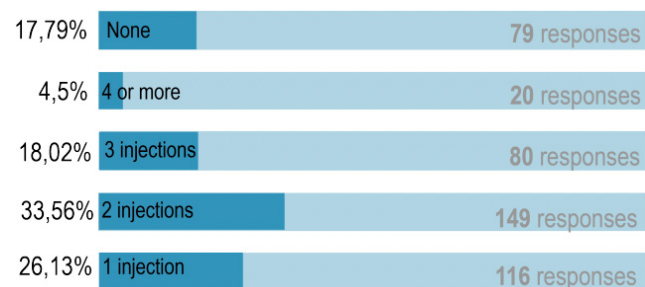
**Table 3:** What percentage of your patients with lumbar degenerative stenosis (DLSS) with significant radicular pain and failure to conservative treatment you perform a spinal steroid injection?

| What percentage of your patients with lumbar degenerative stenosis (DLSS) with significant radicular pain and failure to conservative treatment you perform a spinal steroid injection? |             |       |           |        |       |          |        |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------|-----------|--------|-------|----------|--------|--------|
|                                                                                                                                                                                         | Specialty % |       | Country % |        |       |          |        |        |
| Options                                                                                                                                                                                 | NS          | OS    | Argentina | Brazil | Chile | Colombia | Mexico | Other* |
| 1% to 25%                                                                                                                                                                               | 30.97       | 29.9  | 14.16     | 37     | 23.33 | 8.82     | 48.33  | 45.57  |
| 26% to 50%                                                                                                                                                                              | 26.45       | 24.05 | 25.66     | 30     | 23.33 | 29.41    | 21.67  | 18.99  |
| 51% to 75%                                                                                                                                                                              | 17.42       | 23.37 | 31.86     | 16     | 31.67 | 32.35    | 6.67   | 11.39  |
| 76% to 100%                                                                                                                                                                             | 9.68        | 19.24 | 24.78     | 10     | 16.67 | 23.53    | 11.67  | 10.13  |
| Never                                                                                                                                                                                   | 15.48       | 3.44  | 3.54      | 7      | 5     | 5.88     | 11.67  | 13.92  |

\*Uruguay, Paraguay, Panama, Guatemala, Ecuador, Dominican Republic and Costa Rica with less than 7% of representation. NS, neurosurgeon; OS, orthopedic surgeon.



**Figure 2:** What percentage of your patients with DLSS with significant radicular pain and failure to conservative treatment you perform a steroid injection?



**Figure 3:** In a patient with DLSS, how many spine injections would you perform (repeat procedure) before suggesting surgery?

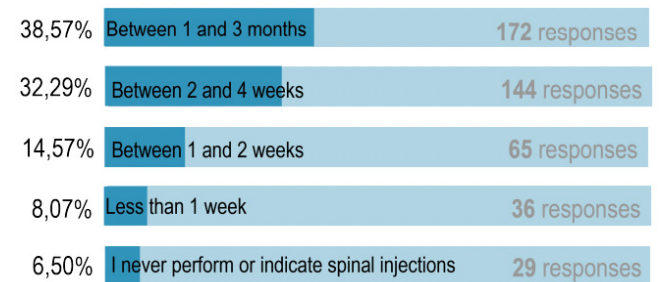
For patients with central canal stenosis, 37% of spine surgeons performed an interlaminar steroid injection. In this group, 26% decide against a spinal injection (Figure 10).

Significant differences were observed between specialties when selecting to never indicate a spinal infiltration technique for foraminal ( $p=0.036$ ) and also for central ( $p=0.049$ ) stenosis location (Table 5), neurosurgeons indicate a spinal injection less often.

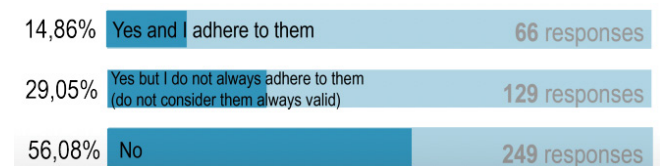
### Procedure expectations

78% of the spine surgeons expected a good outcome (defined as a relief of more than 50% of the pain) with a SI in over 40% of the patients (Figure 11). Also, 86% of the spine

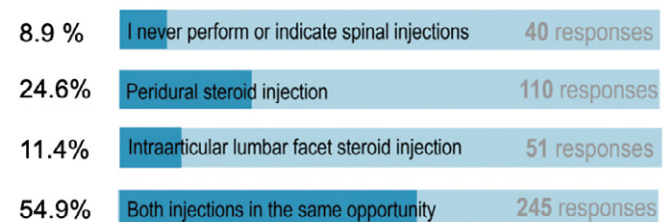
surgeons expected the effects to last no longer than 6 months and 59% not more than 3 months (Figure 12). Only 12% of spine surgeons believe that more than 60% of patients with DLSS will prevent the need for surgery in the future with SI (Figure 13).



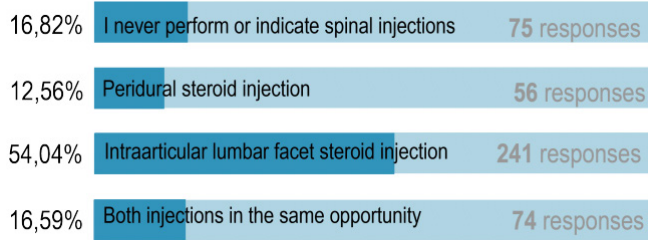
**Figure 4:** In a patient with symptomatic DLSS with sciatic pain without significant pain relief after conservative treatment, for how long do you maintain conservative treatment before considering a spinal steroid injection?



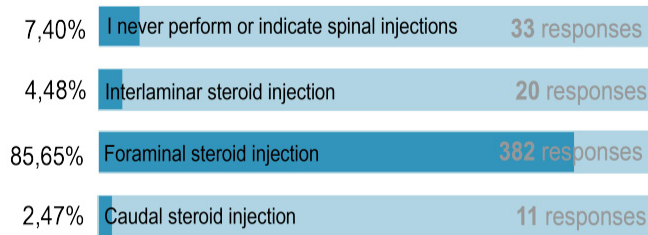
**Figure 5:** Do you follow the indications of any epidural or facet joint infiltration guidelines?



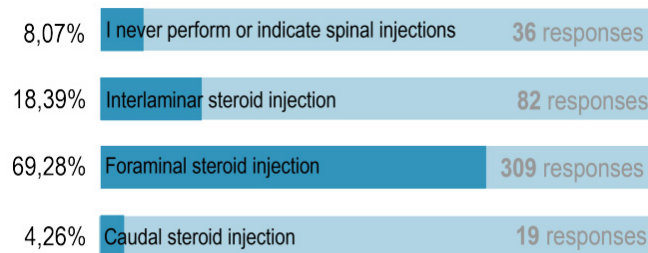
**Figure 6:** In a patient with DLSS with significant low back and radicular pain what do you perform?



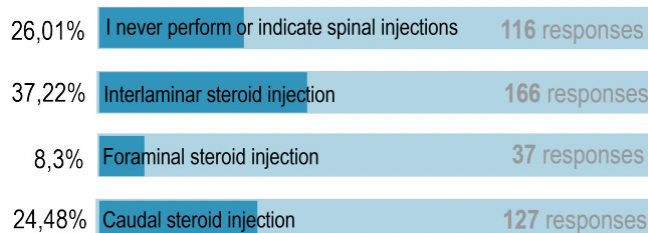
**Figure 7:** In patients with DLSS with significant low back pain without radicular pain, what do you perform?



**Figure 8:** In a patient with DLSS and lumbosciatic pain due to compression in the lateral recess area, if you decide to perform a spinal injection, which technique would you use?



**Figure 9:** In a patient with DLSS and lumbosciatic pain due to compression in the foramina, if you decide to perform a spinal injection, which technique would you use?



**Figure 10:** In a patient with DLSS and lumbosciatic pain due to compression in the central canal, if you decide to perform a spinal injection, which technique would you use?

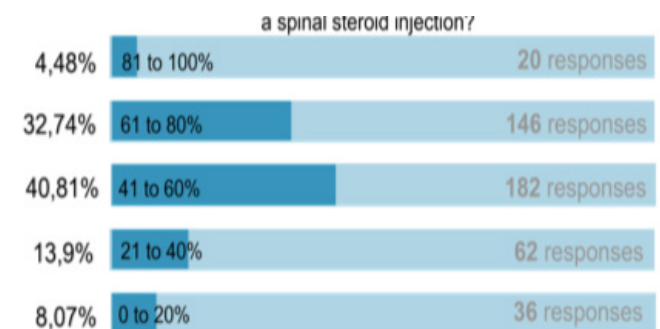
## Facet Joint Steroid Injections

Almost 50% of the surgeons believed that the results of an intraarticular lumbar facet steroid injection depend on clinical presentation, not on MRI findings. The other 50% think that results depend on facet synovitis (24%), severe facet osteoarthritis (15%) or significant facet joint fluid (11%) as seen in the MRI (Figure 14).

63% of the surgeons believed that adding an intraarticular lumbar facet steroid injection significantly improved the results of an epidural steroid injection in a patient with DLSS. In the other hand, 36% of respondents think it has no impact on the improvement of pain relief (Figure 15)

## Complications

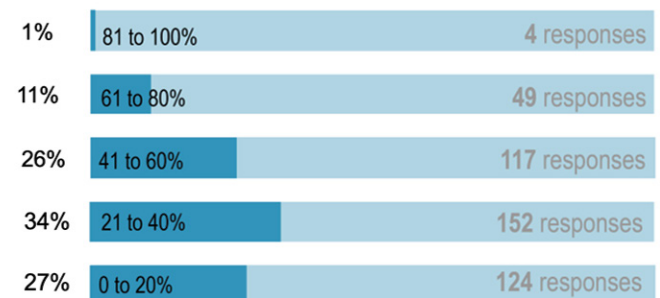
The 3 most frequent adverse effects from SI, including both intraarticular lumbar facet and epidural steroid injections, was pain in the puncture site (70%), cephalgia post puncture (38%) and vasovagal reaction (26%). Less frequent were facial flushing, allergic reaction, infection and insomnia (Figure 16).



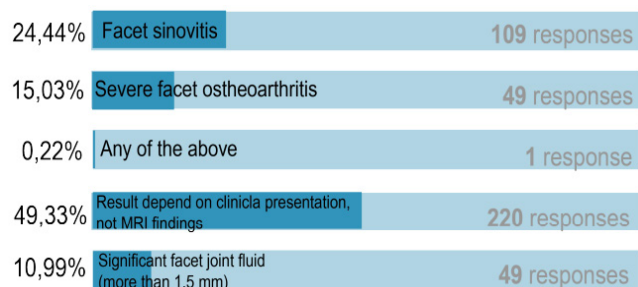
**Figure 11:** The spine surgeons expected a good outcome (defined as a relief of more than 50% of the pain) with a SI in over 40% of the patients



**Figure 12:** For how long do you expect a good result (pain relief > 50%) with the spine injection?



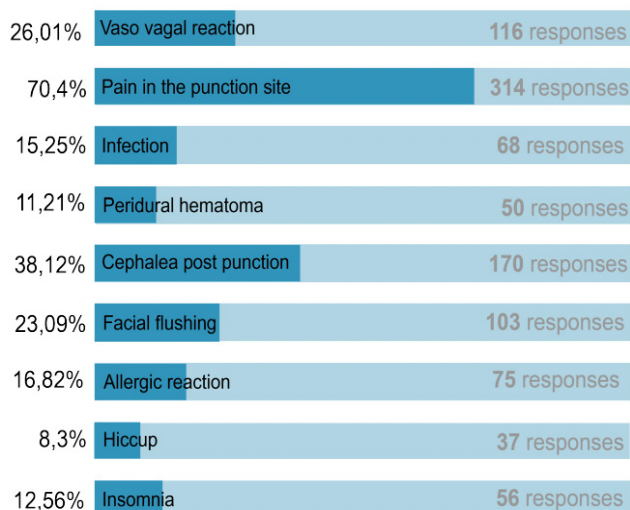
**Figure 13:** What percentage of your patients in which you perform a spine injection due to DLSS will not require surgery in the future?



**Figure 14:** The best result of an intra-articular lumbar facet steroid injection is when the MRI shows



**Figure 15:** Do you think that the addition of an intra-articular facet steroid injection significantly improves the results of an epidural steroid injection in terms of pain relief in the DLSS patient?



**Figure 16:** Select the 3 most frequent adverse effects of spinal injection (including facet and epidural steroid injection)

## Discussion

DLSS is one of the most common causes of low back and radicular pain in older adults. According to the Framingham study cohort, a 4% prevalence of absolute lumbar stenosis was found in those under 40 years of age, increasing to 19.4% in patients between 60 to 69 years [1]. Conservative management is considered the initial treatment, except in rare situations such as progressive neurological deficit or cauda equina syndrome. Conservative treatment consists of physical therapy, analgesics and nonsteroidal anti-inflammatory drugs (NSAIDs) or opioids [4]. When the clinical response is insufficient, the use of epidural injections of corticosteroids plus local anesthetics can be considered as a treatment option [7,8].

The North American Spine Society (NASS) guidelines indicate that in patients with radiculopathy or claudication due to DLSS, short-term pain relief can be achieved with an epidural injection regimen [3]. The American Society of Interventional Pain Physicians (ASIPP) published an extensive evidence-based guideline regarding epidural interventions in the management of chronic spinal pain. Their recommendation in LSS is moderate to strong for interlaminar and caudal epidural injections, and moderate in foraminal injections, all for long-term improvement [7]. A recent meta-analysis comparing surgical treatment versus conservative treatment, including the SPORT cohort, fails to conclude which treatment is better in both groups and cannot offer a clinical recommendation, but clarifies that surgical treatment presents rates of complications and collateral effects between 10% to 24% of cases, with no collateral effects or complications in the case of non-surgical treatment [2]. Considering this information, it is to be expected that a large number of patients will choose to undergo spinal injections before considering surgical treatment. On the other hand, the 2016 National Institute for Health and Care Excellence (NICE) guidelines, which include 20 RCTs, recommend against the use of epidural injection in the setting of central canal stenosis, since they found that there was no evidence for any of the critical outcomes in the sciatica caused by spinal stenosis [4]. In our survey, we found that 92.5 % of spine surgeons would perform an SI in patients with DLSS who do not respond to conservative treatment.

There is no agreement on the recommended period of conservative treatment in before indicating a spinal injection in DLSS. Some trials performed 2 to 4 weeks before an epidural injection [9,10]. The 2013 NASS guidelines indicate that the use of epidural corticosteroids can provide short-term pain relief (2 to 6 weeks) in patients with radicular pain and neurogenic claudication secondary to DLSS, with a type B grade of recommendation [4], but they do not give any recommendation regarding conservative treatment and its duration. In our survey, 70.8 % of spine surgeons wait for more than 2 weeks before performing a corticosteroid injection and 38.5% wait more than 1 month.

As commented before, facet joint arthropathy is one of the most common causes of low back pain. Frequently, both facet joint arthropathy and DLSS are usually present at the same time in the degenerative spine, and the physician should try to identify the specific origin of the pain based on its clinical characteristics and images [6]. Since this differentiation is quite difficult in some cases, or the origin of the pain is probably mixed, in clinical practice the use of an epidural and facet injection may be combined.

There is some evidence to support the use of facet injections in patients with DLSS. Hwang et al. [11] described that the use of facet infiltration in patients with DLSS and



radiculopathy was effective for pain relief in 59.5% of patients with follow-up at 145 days. Shim et al. [12] report that 66% of patients with DLSS who received sequential infiltrations with corticosteroids, either epidural or facet joint infiltration, opted for a facet joint infiltration as a third procedure. In addition, they found that 68.4% of patients who experienced an “ineffective” first epidural injection perceived the second facet injection as “effective” for the pain relief. The retrospective study by Park et al. [13] found that 45% of DLSS patients who received facet injection had more than 30% of pain relief post-procedure. In our study, 63% of the surgeons think that the addition of intraarticular lumbar facet steroid injection significantly improves the result of an epidural steroid injection to relieve the pain in a patient with DLSS, but 36% think it is not effective in obtaining a good result. However, when presented with the case of a patient with radicular pain and no low back pain, 55.6% of the spine surgeons surveyed would opt for an epidural injection without facet injection. On the other hand, when the patient presented both, radicular and low back pain, 54.9% of the surgeons would indicate both peridural and facet steroid injection. Analysis of distribution by countries revealed that 81.7% of spine surgeons from Chile would perform both spinal infiltration types when treating patients with radicular pain and low back pain ( $p<.001$ ).

When reviewing the literature available, we found contradictory evidence regarding the use of epidural corticosteroids in degenerative lumbar stenosis, with studies showing a favorable effect [7, 8, 14-20] and others in which pain reduction is insufficient [14,21,22]. Part of this contradiction possibly is due to the heterogeneity or methodological laxity of some studies [23-25], in which patients with different degrees of severity are mixed, with insufficient classification of the severity of the pathology. Some studies also mix different techniques of spinal injection (caudal, interlaminar, and transforaminal) or even avoid standardizing the corticosteroid used [15]. All of this has already been highlighted by some authors who have drawn attention to the most important points in controversy in an effort to advise future publications [26,27].

The authors believe that the lack of specificity on the recommendations made in well-known guidelines such as NICE and NASS, in terms of timing, route of administration, and pathology involved plus these controversies found in the literature may be the reason why only a 14.7% of the surveyed surgeons claim to adhere to guidelines in DLSS pathology. Probably, the more recent evidence-based ASIPP guidelines could change this in the future [3,4,6,7].

Regarding the use of epidural corticosteroids in patients with central canal stenosis there is both evidence for and against a good outcome. To our best knowledge, the RCT by Manchikanti et al. 2015 [8] represents the best evidence

available, they studied 120 patients with central canal stenosis who presented low back and radicular pain for more than 6 months and no response to conservative treatment. In their study they compared epidural injections of local anesthetic versus local anesthetic plus betamethasone, finding significant relief and functional status improvement in 72% and 73% of patients in each group at 2 years follow-up. Manchikanti et al. 2014 [27] also found a 44% success rate when infiltrating corticosteroid plus local anesthetic via caudal and 73% via interlaminar. Do et al. 2020 [28] in contrast, describes that this is achieved only in 30% of patients with moderate central stenosis and 17.9% of the group with severe stenosis. Also, Olguner et al. 2020 [29] described that only 33.9% of patients who underwent transforaminal corticosteroid injections presented more than 50% pain relief at one year of follow-up.

When comparing transforaminal versus interlaminar techniques in DLSS, Smith et al. 2010 [30], found no difference in short-term pain improvement, long-term surgical interventions, or repeat injections between the two techniques. In 2020 Sencan et al. [31] published the results of their prospective study comparing bilateral TF and IL steroid injections in 72 patients with lumbar central canal stenosis. They reported better ODI and pain-free walking distance in the IL group at 3-month follow-up. However, the TF route showed better results in patients with more prominent neuropathic pain. As a counterpart, the meta-analysis of Wei et al. 2016 [32], including 931 patients with LSS from 9 RCT found that TF patients experienced superior pain relief compared with IL patients ( $p=0.01$ ) but similar functional and ODI improvement between the two groups.

The meta-analysis by Meng et al 2015 [20] that included 13 randomized clinical studies with 1465 patients found a significant decrease in pain in 53.7% of the patients who received local anesthetic plus corticosteroid and 56.4% of those who received local anesthetic alone. Historically, the beneficial effect of epidural injection has been considered to be in the short and medium term [10,27,33]. However, as mentioned, there is evidence of good results up to 1 and 2 years of follow-up [7,8,14,34]. In the aforementioned meta-analysis by Meng [20], significant pain relief was found for  $6.8 \pm 4.6$  months in the group with corticosteroids plus local anesthetic and for  $7.8 \pm 4.5$  months in the group with local anesthetic alone.

In our survey, we defined a good result as pain relief greater than 50%. When asked about the outcome, 78% of surgeons expected to achieve a good result.. Interestingly, expectations of a good result did not exhibit a time pattern, with 23%, 36%, and 27% of those surveyed expecting a good result in their patients of less than 1 month, between 1 to 3 months, and between 3 to 6 months, respectively. When enquired about longer-term response to injections, 86% of spine surgeons would expect a good result for less than 6



months and 59% not more than 3 months. Only 1% of those surveyed believe that the effect could be longer than a year.

Regarding expectations of obtaining results leading to avoidance of surgery, only 12% of spine surgeons believe that over 60% of patients with DLSS will avoid future surgery. On this subject, the subgroup analysis of the SPORT study published by Radcliff et al. 2013 [35], found that 33% of patients with spinal stenosis who received epidural corticosteroids, chose to maintain conservative treatment during the first 3 months, and 42% of patients who received epidural corticosteroids and were initially assigned to conservative treatment, avoided surgery for the same period.

Side effects related to the use of corticosteroids tend to be minor and include facial flushing, low-grade fever, insomnia, anxiety, agitation, hyperglycemia, fluid retention, vasovagal reaction, nerve root injury, allergy, and temporary exacerbation of pain. Although serious complications from epidural infiltration with corticosteroids are uncommon, these have been reported [36-42]. They may result from the inadvertent puncture of the nerve root or spinal cord arteries and embolization by the use of particulate corticosteroids [12,43]. Other possible mechanisms of spinal cord damage could be puncture-induced vasospasm and direct compression caused by a hematoma or abscess [43]. According to our survey, the 3 most frequent adverse effects after epidural and facet injections with corticosteroids were: pain at the puncture site (70%), cephalgia post puncture (38%), and vasovagal reaction (26%).

## Study Strengths and Limitations

A strength of the current study is the high volume of respondents, frequently difficult to achieve, given typically low response rates among surgeons. Furthermore, the responses were from surgeons experienced in the management of these patients, both neurosurgeons and orthopedic surgeons. Respondents were recruited from a range of countries across Latin America, providing an adequate representation of the clinical practice in the region.

There are several limitations. First, 5 countries accounted for roughly 90% of the respondents, which implies that the overall results might not be generalizable to some of the under-represented countries. Second, the responses regarding clinical practice are not objectively verifiable, and the surgeon's actual and perceived practice may differ. Finally, this survey aims to assess spinal surgeons' perception of spinal injections, not to evaluate their efficacy.

## Conclusion

This study provides a global perspective on how Latin American spine surgeons manage patients with DLSS with respect to the use of spinal steroid injections. We observed that 92% of orthopedic surgeons and neurosurgeons would use this procedure to treat DLSS.

More than 50% of patients with low back pain and radicular pain receive a combination of intra-articular lumbar facet steroid injection and epidural steroid injection. Most answers show no significant differences between orthopedic spine surgeons and neurosurgeons in performing steroid injections on DLSS patients.

For lateral recess and foraminal stenosis, a foraminal injection is the preferred approach. Respondents expect positive results with injection, but the effects may last less than 6 months, and surgery may eventually be necessary for most patients.

Scientific evidence is fair for low back pain and radicular pain treated with spinal injections due to lumbar spinal stenosis with steroids. There is however no evidence-based guideline with strong recommendations for selecting a facet injection, a peridural injection or both. Better designed studies are needed to improve the quality of the current recommendations.

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