


# Respiratory function in patients with lumbar stenosis: A comparative analysis

## *Função respiratória em pacientes com estenose lombar: uma análise comparativa*

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### ABSTRACT

Degenerative diseases of the spine are conditions that involve loss of structure and normal function of the spine and may lead to worsening functional capacity, decreased exercise tolerance, and reduced quality of life due to neurogenic lameness and chronic low back pain. The choice of arthrodesis is due to the presence of evolutionary neurological injury or intractable pain. **Objective:** To analyze and compare spirometric values and respiratory muscle strength in patients with lumbar stenosis. **Method:** cross-sectional study with 38 patients of both sexes, divided into a group of 19 operated patients and another group of 19 patients awaiting surgery, aged between 50 and 80 years, who were evaluated by spirometry and manovacuometry. **Results:** In our study, it was observed that pulmonary function was within the reference values, considering that the group of operated patients presented better performance in spirometry and manovacuometry. **Conclusion:** Operated patients showed improvement in lung function compared to non-operated patients.

**Keywords:** Arthrodesis, Muscle Strength, Spirometry

### RESUMO

As doenças degenerativas da coluna vertebral são condições que envolvem a perda de estrutura e a função normal da coluna e podem levar à piora da capacidade funcional, a diminuição da tolerância ao exercício e a redução da qualidade de vida por claudicação neurogênica e dor lombar crônica. A escolha da artrodese ocorre devido a presença de lesão neurológica evolutiva ou dor intratável. **Objetivo:** Analisar e comparar valores espirométricos e força muscular respiratória em pacientes com estenose lombar. **Método:** Estudo transversal com 38 pacientes de ambos os sexos, dividido em um grupo de 19 pacientes operados e outro grupo de 19 pacientes que aguardavam cirurgia, com idade entre 50 e 80 anos, que foram avaliados por espirometria e manovacuometria. **Resultados:** Em nosso estudo, observou-se que a função pulmonar estavam dentro dos valores de referências, considerando que o grupo de pacientes operados apresentou melhor desempenho em espirometria e manovacuometria. **Conclusão:** Pacientes operados apresentaram melhora na função pulmonar em comparação com pacientes não operados.

**Palavras Chave:** Artrodese, Força Muscular, Espirometria

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## INTRODUCTION

Degenerative diseases of the spine are conditions involving the loss of structure and normal function of the spinal cord.<sup>1-4</sup> The degenerative process is frequently divided into three distinct stages, namely dysfunction, instability, and stabilization.<sup>3-5</sup>

It can be considered normal due to aging and may not necessarily be the cause of painful conditions,<sup>2</sup> but can also result in pain syndromes affecting the spine, the upper or lower limbs, and may also be associated with neurological disorders of the lower and the upper limbs caused by compression on the spinal cord and nerve roots, such as: disc herniation, spinal stenosis, a narrowing of the spinal canal, and also infections, tumors, arthritis, and arthrosis.<sup>1,2</sup>

There is a number of approaches to treating pain syndromes. The procedure may be a conservative or surgical one, including pharmacological or non-pharmacological treatment. Selecting the best treatment entails several stages and depends on a careful medical evaluation and the patient's choice.<sup>1-4</sup>

The interest in these behaviors and the best evidence-based intervention for the treatment of degenerative spine alterations have been responsible for a growing number of patients in orthopedic medical offices and Brazilian emergency rooms.<sup>6</sup>

Nagi et al.<sup>7</sup> emphasize that 40% of the population have low-back pain symptoms during their lifetime, whereas in 20% the symptoms interfere with their quality of life. In general, lumbar disorders account for about 18% of the total annual cases seeking medical care, which thus demonstrates the socioeconomic importance of this disease and that of the interventions for its treatment.<sup>8</sup>

Cecin et al.<sup>9</sup> report on an incidence of 53.4% of low-back pain among the economically active Brazilian population, and 32.6% had sciatica following the clinical condition.

The Surgical treatment of degenerative changes by the lumbar spine arthrodesis technique was introduced in the mid-1920s;<sup>10</sup> it is used as a therapeutic option in for treating incapacitating pain. The procedure consists of bony fusion between vertebrae, resulting in the elimination of motion between the involved spinal levels, and is typically used as a therapeutic possibility against this incapacitating pain.<sup>9</sup> Metallic implants that are part of the surgical instrumentation<sup>10</sup> can be used, which has, among its main goals, the objective of increasing postoperative stability and promoting the consolidation of the arthrodesis.<sup>11</sup>

The use of arthrodesis in the treatment of lumbar degenerative disc disease aims to stabilize the joint and produce pain relief, which results in the patient's satisfaction and possibility to resume work.<sup>12</sup>

Studies assessing lung function in patients with lumbar stenosis have not been found in the literature.

## OBJECTIVE

This knowledge is important for us when preoperatively intervening with pulmonary rehabilitation protocols in order to minimize and prevent complications. Thus, the aim of this study was to analyze and compare the spirometric values and respiratory muscle strength in patients with lumbar stenosis who underwent fusion surgery with those awaiting surgery at a university hospital in São Paulo.

## METHOD

A cross-sectional study was conducted, in which we evaluated 38 patients of both sex with stenosis of the lumbar spine aged between 50 and 80 years, at spine surgery clinic in the *Departamento de Ortopedia e Traumatologia da Irmandade da Santa Casa de Misericórdia de São Paulo* over the period from August to December 2015.

Altogether, 89 patients were recruited, of whom 42 met the inclusion criteria. Patients were divided into two groups: 22 underwent fusion surgery of the lumbar spine and 20 were not submitted to surgery, but were referred for surgery.

**Inclusion criteria:** Patients with lumbar stenosis who had undergone fusion surgery more than six months before the study, or patients with lumbar stenosis who had been referred for surgery but were still waiting for it to be carried out. Those who agreed to participate in the research and signed a voluntary informed consent term.

**Exclusion criteria:** Cognitive alterations that prevented them from understanding the guidelines for data collection and the presence of previous or current cardiopulmonary disease that might jeopardize the evaluation results.

The study was approved by the institution's Research Ethics Committee (CAAE 38278114.5.0000.5479).

All patients were instructed to fill out the evaluation form with their personal data; the anthropometric measurements were taken by the same professional.

The height (cm) and weight (kg) of all participating patients were measured with a

pair of mechanical scales and anthropometric ruler (Welmy®).

Following this evaluation, spirometry was performed with the aid of a Koko spirometer system (PDS Instrumentation), which measured the forced vital capacity (FVC), forced expiratory volume in one second (FEV1), the FEV1/FVC ratio, forced expiratory flow 25-75% (FEF 25-75%), and peak expiratory flow (PEF) predicted by age, height and gender according to the equation by Pereira et al.<sup>13</sup> It was performed with the patient seated, using a nose clip. Patients were instructed to hold the device by pressing the mouthpiece firmly against the lips, thereby preventing air leakage, and performed four normal inspiration and expiration cycles, a maximal inspiration, and then a forced maximal expiration.<sup>13</sup>

Subsequently, three consecutive measurements were taken, with a 30- to 60-second rest period between measurements, with the highest value obtained being used.<sup>13</sup>

Respiratory muscle strength was evaluated by using a manometer (Comercial Médica®) for measuring the maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP), in accordance with consensus guidelines on respiratory muscle testing.<sup>14-16</sup>

The measurements were performed with the patient seated, using a nose clip. While holding this position, the patient was instructed to put on the nose clip and hold the manometer by pressing the mouthpiece firmly against the lips, thereby preventing air leakage, taking a maximum inspiration from the residual volume for the measurement of MIP, and a maximum expiration from the total lung capacity to determine MEP.<sup>14-16</sup> Three consecutive measurements of MIP and MEP were then made, with a 30- to 60-second rest period between measurements, with the highest value obtained being used.

The respiratory evaluations were carried out by the same examiner, who did not know whether the patient had or had not undergone surgery, in order for the assessment to be a blind one.

The software used for conducting statistical analyses was Statistical Package for Social Sciences (SPSS) version 13.0. To study the association among qualitative variables, we used Fisher's exact test.

The comparison of quantitative variables between the groups was made by using Student's t-test (parametric) and Mann-Whitney test (nonparametric). The significance level was 5% ( $p \leq 0.05$ ).

## RESULTS

The study included 42 patients: 22 patients in the group of operated patients, and 20 in the non-operated group. Of these, four patients did not complete the evaluations, three in the operated group and one in the non-operated group, which thus resulted in 38 patients having been evaluated, 19 patients in each group. The group of non-operated patients (N Op) (n = 19) was compared to the group of operated patients (Op) (n = 19); there was observed no significant difference between the groups in relation to gender. Table 1 shows the analysis of patients as to their homogeneity in age and body mass index (BMI).

## SPIROMETRY

Table 2 shows the spirometry variables for the N Op Group and Op Group. It

**Table 1.** Anthropometric profile in the evaluation of patients in the non-operated group (n=19) and in the operated group (n=19)

variables	groups	average	Std Deviation	p
age (years)	N Op	64.84	6.85	0.398
	Op	59.68	8.50	
BMI (kg/m <sup>2</sup> )	N Op	29.51	4.84	0.621
	Op	28.76	4.44	

Source: Cardiorespiratory Physiotherapy Service – Irmandade da Santa Casa de Misericórdia de São Paulo. Caption: BMI = body mass index; N Op = Non-operated; Op = Operated.

**Table 2.** Comparison of spirometric variables between the operated and non-operated groups

variables	groups	average	Std Deviation	p
FVC (l)	N Op	2.42	0.57	0.001
	Op	3.30	0.86	
FEV <sub>1</sub> (l)	N Op	2.11	0.51	0.050
	Op	2.57	0.83	
FEV <sub>1</sub> /FVC	N Op	0.87	0.05	0.013
	Op	0.79	0.12	
FEF <sub>25/75%</sub> (l/min)	N Op	2.65	0.94	0.686
	Op	2.80	1.27	
PEF (l/min)	N Op	234.38	83.19	0.621
	Op	250.94	118.04	

Source: Cardiorespiratory Physiotherapy Service – Irmandade da Santa Casa de Misericórdia de São Paulo. Caption: FVC = forced vital capacity; FEV<sub>1</sub> = forced expiratory volume in one second; FEV<sub>1</sub>/FVC = vital capacity and expiratory volume in one second ratio of; FEF = forced expiratory flow average; PEF = Peak expiratory flow; N Op = Non-operated; Op = operated.

**Table 3.** Evaluation comparison of summary measurements of maximum inspiratory and expiratory pressures

variables	groups	average	Std Deviation	p
MIP(cmH <sub>2</sub> O)	N Op	49.95	22.58	0.103
	Op	62.68	24.25	
MEP(cmH <sub>2</sub> O)	N Op	58.74	20.83	0.265
	Op	66.47	21.28	

Source: Cardiorespiratory Physiotherapy Service – Irmandade da Santa Casa de Misericórdia de São Paulo. Legend: MIP = maximal inspiratory pressure; MEP = maximal expiratory pressure; N Op = Non-operated; Op = operated.

was observed that the groups showed a statistically significant difference in FVC and FEV<sub>1</sub>/FVC ratio, with higher values in the Op Group. In the FEV<sub>1</sub>, FEF<sub>25-75%</sub> and PEF showed no statistically significant difference.

## MAXIMAL RESPIRATORY PRESSURES

In the analysis of MIP and MEP, neither of the groups showed significant differences for any variable (Table 3). Nevertheless, it can be observed that the operated patients have better values for the two variables.

## DISCUSSION

Degenerative spine changes have been identified with increasing frequency in the population, both due to aging and to increased

access to medical care, which has therefore been responsible for the growing number of medical consultations, thus explaining the socioeconomic importance of this disease and the context of our research. The hypothesis as to whether or not such degenerative alterations might have an effect on respiratory function was tested. In the literature, there are no studies that evaluate the respiratory function in patients among this population, which therefore accounts for the importance of this study.

In evaluating the respiratory function, we observed a statistically significant difference in FVC and the FEV<sub>1</sub>/FVC ratio. The operated group had values that were closer to the predicted values as compared to the non-operated group. We believe that these results are due to the improvement in pain and functional capacity after surgery, but our study did not use any tool for evaluating functionality.

In the non-operated group, we hypothesized that the results might be due to the pain when analyzing the effort made during spirometry.<sup>6,12,17-19</sup>

With respect to the other spirometric variables evaluated in our study, FEV<sub>1</sub>, FEF<sub>25-75%</sub> and PEF showed no statistically significant difference between the two groups, and those results were expected due to the greater relationship between these variables and obstructive patterns, and one of the exclusion criteria was precisely that the participant presented with pulmonary disease.<sup>19,20</sup>

In analyzing the strength of respiratory muscles, the operated group obtained higher than average values of MIP and MEP when compared to the non-operated group. Although this result did not introduce statistically significant difference: during the evaluation, the group of non-operated patients was observed to have worse clinical symptoms than did the operated group, meaning they reported higher fatigue and showed contraction of accessory muscles, observed as a decreased respiratory muscle strength in these patients.<sup>14</sup>

It is believed that this result is due to the pain and immobility that patients in the non-operated group present rather than muscular weakness, because some studies observed decreasing of pain – and even the abolition of it – in 70% of cases involving operated patients.<sup>6,8</sup>

Some limitations of this study refer to the fact that no preoperative evaluation was recorded in order to assess possible pre- and postoperative differences in the same individual. Further studies are needed for evaluating and comparing, in the same

individual, the differences in the preoperative and postoperative respiratory function.

## CONCLUSION

The study population of patients with lumbar stenosis who had undergone surgical treatment by the arthrodesis technique of the lumbar spine was found to have improved lung function.

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