

Improvement in Radicular Pain after Endoscopic Transforaminal Lumbar Discectomy at Discs with Advanced Degenerative Changes

Melhora da dor radicular após discectomia lombar transforaminal endoscópica em discos com alterações degenerativas avançadas

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Abstract

Objectives To evaluate the correlation between radiologic changes (Pfirrmann and Modic) and radicular pain intensity in patients who underwent transforaminal endoscopic surgery for lumbar disc herniation.

Methods Series of cases with 39 patients, 50 intervertebral discs in preoperative evaluation from January 29, 2018 to August 28, 2019 in an endoscopic spine surgery service. Demographic data, surgical indication, operative details and complications were obtained from medical records. The patients were divided into three groups based on the Modic classification (Modic absence, Modic 1 and Modic 2) and into two groups considering the Pfirrmann classification (Pfirrmann IV and Pfirrmann V). Data were processed in IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA), with a significance level of $p < 0,05$.

Results There was no difference between genders; age: $50,36 \pm 15,05$ years old; disease level: L2–L3 1 (2%), L3–L4 2 (4%), L4–L5 9 (18%), L5–S1 8 (16%), L3–L4 + L4–L5 4 (8%), and L4–L5 + L5–S1 26 (52%); location: right foraminal 7 (14%), left foraminal 15

Keywords

- ▶ sciatica
- ▶ intervertebral disc displacement
- ▶ lumbosacral region

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(30%), central 9 (18%) and diffuse 19 (38%); radicular pain: left 25 (50%), right 11 (22%), and bilateral 14 (28%); preoperative visual analogue scale (VAS): $9,5 \pm 0,91$, postoperative: $2,5 \pm 1,79$; surgery duration: $100 \pm 31,36$ minutes; and follow-up: $8,4 \pm 6,7$ months. Less postoperative sciatica was registered in the Modic 2 versus Modic 1 group ($p < 0,05$). There was no difference in the postoperative radicular pain between the Pfirrmann groups (IV versus V).

Conclusion Although there is no clinical difference between the groups, in advanced stages of disc degeneration, endoscopic transforaminal discectomy proved to be effective in diminishing radicular pain in patients with lumbar disc herniation.

Resumo

Objetivos Avaliar a correlação entre as alterações radiológicas (Pfirrmann e Modic) e a intensidade da dor radicular em pacientes submetidos a cirurgia endoscópica transforaminal para hérnia de disco lombar.

Métodos Uma sequência de casos com 39 pacientes, 50 discos intervertebrais em avaliação pré-operatória, no período de 29 de janeiro de 2018 a 28 de agosto de 2019, no serviço de cirurgia endoscópica da coluna vertebral. Os dados demográficos, indicação cirúrgica, detalhes operatórios e complicações foram todos obtidos junto aos prontuários clínicos. Os pacientes foram divididos em três grupos, com base na classificação Modic (ausência de Modic, Modic 1 e Modic 2) e em dois grupos, considerando a classificação de Pfirrmann (Pfirrmann IV e Pfirrmann V). Os dados foram processados no software IBM SPSS Statistics for Windows, versão 22.0 (IBM Corp., Armonk, NY, EUA), com nível de significância de $p < 0,05$.

Resultados Não houve diferença entre os gêneros; idade: $50,36 \pm 15,05$ anos; nível da doença: L2–L3 1 (2%), L3–L4 2 (4%), L4–L5 9 (18%), L5–S1 8 (16%), L3–L4 + L4–L5 4 (8%), e L4–L5 + L5–S1 26 (52%); localização: foraminal direito em 7 pacientes (14%), foraminal esquerdo em 15 pacientes (30%), central em 9 pacientes (18%), e difuso em 19 pacientes (38%); dor radicular: esquerda em 25 pacientes (50%), direita em 11 pacientes (22%), e bilateral em 14 pacientes (28%); escala visual analógica (EVA) pré-operatório: $9,5 \pm 0,91$, pós-operatório: $2,5 \pm 1,79$; tempo cirúrgico: $100 \pm 31,36$ minutos; e acompanhamento de $8,4 \pm 6,7$ meses. Foi registrada menos dor ciática pós-operatória nos grupos Modic 2 versus Modic 1 ($p < 0,05$). Não houve diferença na dor radicular pós-operatória entre os grupos Pfirrmann (IV versus V).

Conclusão Embora não exista diferença clínica entre os grupos, em estágios avançados da degeneração discal, a discectomia transforaminal endoscópica mostrou-se eficaz na redução da dor radicular em pacientes com hérnia de disco lombar.

Palavras-chave

- ▶ ciática
- ▶ deslocamento do disco intervertebral
- ▶ região lombossacral

Introduction

Open microdiscectomy is the gold standard treatment for lumbar disc herniation. Percutaneous endoscopic lumbar discectomy has a lot of benefits when compared with open surgery, such as minor surgical trauma and blood loss, shorter hospitalization, faster recovery, and lower postoperative morbidity due to the preservation of the dorsal musculature and of the osteoligamentous structures. This minor tissue trauma during endoscopic surgery results in faster rehabilitation, leading to lower costs to society.^{1–5}

The treatment of lumbar disc herniation with advanced disc degenerative disease, which is represented by more advanced stages in the Modic and Pfirrmann classifications,

still has no consensus regarding the best treatment method between discectomy or arthrodesis.

Taking that into consideration, the objective of the present study is to evaluate the correlation between radiologic abnormalities (Pfirrmann and Modic) and radicular pain variation (pre- and postoperative) in patients who underwent transforaminal endoscopic surgery for lumbar disc herniation.

Materials and Method

This is a study of a series of cases with an initial sample of 80 patients who underwent surgical treatment for lumbar disc herniation by percutaneous transforaminal endoscopic approach, between January 29, 2018 (1st entrance of this procedure in the data bank) and August 28, 2019 (last patient

with at least 3 months of follow-up) in a spine endoscopic surgery service.

The inclusion criteria were: radicular pain, failure of 12 weeks of conservative treatment, and diagnosis of lumbar disc herniation with magnetic resonance imaging (MRI). The exclusion criteria were: other cause of pain than lumbar disc herniation, previous lumbar arthrodesis, spondylolisthesis, tumor, infection, lumbar fractures, and Pfirrmann grades I, II and III. In patients who had lumbar pain and sciatica, only those whose pain source was mainly radicular were included. Due to the small sample and to the incapability of association analysis, Pfirrmann grade III patients were excluded.

The selected patients were investigated for demographic data, surgical indications, and operative details registered in medical records, as well as pre- and postoperative evaluation by the visual analogue scale (VAS) (varying from 0 to 10, with 0 corresponding to no pain and 10 to the worst pain ever experienced in the leg), where an improvement of 2 points was considered as good clinical result.^{6,7}

The radiological parameters (Pfirrmann and Modic classification) were evaluated by experienced radiologist specialized in spine diseases, without access to the clinical features of the patients.

The patients were divided into 3 groups according to the Modic classification (Absence of Modic, Modic 1 and Modic 2), and into 2 groups according to the Pfirrmann classification (Pfirrmann IV and Pfirrmann V).

All procedures were performed the same surgeon (Carvalho S. T. C.), who had an experience of ~ 30 years of spinal endoscopic surgery. The patients had local anesthesia and were sedated with propofol and remifentanyl; they were positioned in the prone position on a radiograph-permeable table, under orthograde 2-plane fluoroscopic control, over a hip and thorax roll to relieve the abdominal and thoracic organs and diminish epidural bleeding. The operating table can be adjusted for kyphosis intraoperatively at the lumbar level. The surgeon operated from the side of the disc prolapse, and the video monitor and C-arm were positioned on the opposite side.

After the position of the iliac crest was determined, the skin incision had a distance from the midline to the puncture point depending on the level approached (6 to 8 cm for L2–L3, 8 to 10 cm for L3–L4, and 12 to 14 cm for L4–5 and L5–S1). Following disinfection and sterile draping, the entry point was marked, always superiorly to the iliac crest, and a line was drawn across the superior articular process (SAP) to the midline of the lower endplate.

The spinal needle was inserted orthograde to the disc space. Ideally, when seen in the fluoroscopy, the tip of the needle should be advanced to the posterior vertebral body line on the lateral view and to the middle of the medial pedicle line on the anteroposterior view. With the spinal needle lodged into the disc, the nucleus pulposus was stained blue (using a 2-mL admixture of contrast media and Methylene blue for discography), and the surgeon proceeded with the following steps: guidewire passage through spinal needle; removal of spinal needle; limited incision (8-mm) of skin at entry site; delivery of tapered cannulated obturator along the guidewire; insertion

of obturator into the disc (on reaching the annulus); advancement of beveled, oval-shaped working cannula (into disc) along the obturator; and obturator removal. Next, the endoscope was inserted through the cannula, and the pathologic nucleus (stained blue for easy distinction and attached to the annular fissure) and any fibrous scar tissue were released and completely removed using endoscopic forceps and a radio-frequency device. The working cannula was adjusted to find and remove the hyperplastic superior facet, the herniated disc, the vertebral posterior edge, and the osteophytes that existed around the traversing nerve root using a high-speed drill and a bone reamer or a bone cutter (inside-out).

To be considered sufficient, the decompression had to obtain a nerve showing pulsations similar to the heart rate and an amount of disc material removed matching the amount seen on the MRI. When complete, the endoscope was withdrawn and the skin was sutured.

Data was processed in IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA) license #10101131007, with the calculation of the means and standard deviation (SD). The comparison of the variables of the Modic group were done by the likelihood ratio and Kruskal-Wallis tests, and the likelihood ratio, the t Student for paired data and the Mann-Whitney tests were used for the Pfirrmann group. The significance level considered was $p < 0,005$.

The present study was accepted by the Ethics and Research Committee under the acceptance number 4.191.443.

Results

From an initial sample of 80 patients, 39 were selected, and 50 intervertebral discs were evaluated. There was no difference between the gender of the patients; age: $50,36 \pm 15,05$ years old; surgery level: L2–L3 1 (2%), L3–L4 2 (4%), L4–L5 9 (18%), L5–S1 8 (16%), L3–L4 + L4–L5 4 (8%), and L4–L5 + L5–S1 26 (52%); herniation location: right foraminal 7 (14%), left foraminal 15 (30%), central 9 (18%), and diffuse 19 (38%); leg pain: left 25 (50%), right 11 (22%), and both sides 14 (28%); VAS: preoperative $9,5 \pm 0,91$, postoperative $2,5 \pm 1,79$; surgery duration $100 \pm 31,36$ minutes; and follow-up: $8,4 \pm 6,7$ months.

When comparing the groups with the Modic alterations, it was noted that there was a lower intensity of radicular pain in the postoperative of the Modic 2 group when compared with the Modic 1 group (► **Table 1**).

When analyzing the Pfirrmann groups (Pfirrmann IV versus Pfirrmann V), there was no difference when comparing the clinical and radiologic characteristics, neither in the intensity of sciatica (► **Table 2**).

Discussion

A meta-analysis study with nine randomized clinical trials comparing endoscopic surgery with the open approach for symptomatic lumbar disc herniation found that the satisfaction of the patients and the hospitalization time were, respectively, higher and lower in the group that underwent endoscopic surgery.⁸

Table 1 Clinical and radiological characteristics between MODIC groups

	ABSENCE OF MODIC	MODIC 1	MODIC 2	p-value
Gender				
Male	11/46%	6/25%	7/29%	0.751 ¹
Female	10/38%	9/35%	7/27%	
Age (years old)	50.14 ± 13.58	49.67 ± 20.61	46.64 ± 13.90	0.800 ²
Surgery Level				
L5-S1	5/62%	1/13%	2/25%	0.219 ¹
L4-L5	3/33%	1/11%	5/56%	
L3-L4	1/50%	1/50%	0	
L2-L3	1/100%	0	0	
L4-L5 L5-S1	10/38%	9/35%	7/27%	
L3-L4 L4-L5	1/25%	3/75%	0	
Herniation location				
Right foraminal	3/43%	3/43%	1/14%	0.813 ¹
Left Foraminal	6/40%	3/20%	6/40%	
Central	3/33.3%	3/33.3%	3/33.3%	
Diffuse	9/47%	6/32%	4/21%	
Leg pain				
Left	10/40%	6/24%	9/36%	0.466 ¹
Right	6/55%	4/36%	1/9%	
Two sides	5/36%	5/36%	4/28%	
Leg Pain Visual Analogue Scale				
Preoperation	9.71 ± 0.78	9.20 ± 0.86	9.64 ± 0.92	0.872 ²
Postoperation	2.33 ± 1.68	2.93 ± 2.25	1.93 ± 1.14	<i>p</i> < 0.0001 ²
Δ (Post-Pre)	- 7.38 ± 1.77	- 6.26 ± 2.31	- 7.71 ± 1.54	0.183 ²
Follow-up (months)	11.25 ± 7.33	7.65 ± 7.89	7.36 ± 5.81	0.132 ²

1- Likelihood ratio; 2- Kruskal –Wallis.

When considering lumbar spine anatomy, where the intervertebral foramen dimensions diminish as the interlaminar spaces increases from L1 to L5; the transforaminal approach is recommended for high lumbar levels to L3/L4 and for those cases with foraminal or lateral recess stenosis; the interlaminar approach is suggested for L4/L5 and L5/S1 levels and cases with central and lateral recess stenosis.⁹

The most significant advantage of the transforaminal approach in detriment of the interlaminar would be the fact that the first can be done under local anesthesia in an outpatient environment, avoiding the risk of general anesthesia (used for the interlaminar approach), especially in elderly patients with comorbidities, resulting in lower costs for the health care of these type of patients.¹⁰

Xu et al.¹¹ studied the difference in the clinical results of patients who underwent transforaminal endoscopic surgery for lumbar disc herniation, considering the Modic alterations. In the three analyzed groups (control, Modic type I, and Modic type II), there was a significant improvement in the radicular pain measured by the VAS in 3 months, 1 year and in the last year of postoperative follow-up when compared

with the preoperative values. It is important to mention that there was no difference between the three groups.

These authors found the presence of nerve root lesion in 5 patients: 3 in the control group, 1 in the Modic type I, and 1 in the Modic type II, with complication rates of 6,6, 6,8 and 8% in these groups, respectively. Recurrence happened in 16 patients: 8 in the control group, 4 in the Modic type 1, and 4 in the Modic type II, with rates of 4,4, 9,1, and 8 in these three groups, respectively.¹¹

In our study, a significant improvement in post-operative sciatica was noted in the three groups analyzed (Absence of Modic, Modic 1 and Modic 2) after transforaminal endoscopic discectomy. However, there was a statistically significant difference in the post-operative VAS value between Modic 1 and Modic 2 groups, being of less intensity in the last group. The difference was not considered clinically significant, because it wasn't greater than 2 points in the VAS scale.

The present research showed the presence of paresis (strength grade IV on the Medical Research Council Scale) in six patients preoperatively: two in the Absence of Modic group, one in the Modic 2, and three not classified. One

Table 2 Clinical and radiological characteristics between PFIRRMANN groups

	Pfirmsmann iv	Pfirmsmann v	p
Sex			
Male	16/73%	6/27%	0.723 ²
Female	17/68%	8/32%	
Age (years)	47.45 ± 16.17	53.29 ± 16.95	0.271 ²
Surgery Level			
L5-S1	7/78%	2/22%	0.562 ¹
L4-L5	7/78%	2/22%	
L3-L4	2/100%	0	
L2-L3	1/100%	0	
L4-L5 L5-S1	13/59%	9/41%	
L3-L4 L4-L5	3/75%	1/25%	
Herniation Location			
Right Foraminal	7/100%	0	0.096 ¹
Left Foraminal	10/62%	6/38%	
Central	7/78%	2/22%	
Diffuse	9/60%	6/40%	
Leg Pain			
Left	16/62%	10/38%	0.201 ¹
Right	9/90%	1/10%	
Two Sides	8/73%	3/27%	
Preoperation	9.42 ± 0.97	9.29 ± 0.91	0.539 ³
Postoperation	2.42 ± 1.56	2.43 ± 2.20	0.737 ³
Δ (Post-Pre)	- 7.00 ± 1.83	- 6.85 ± 2.17	0.902 ³
Follow-up (months)	8.57 ± 7.30	7.77 ± 6.90	0.822 ³

1- Likelihood ratio; 2- T de Student; 3- Mann-Whitney.

patient in the Modic 1 group presented paresis after surgery. These patients were treated conservatively with normalization of muscle weakness approximately after 3 months of treatment. The recurrence was found in five patients: three in the Absence of Modic group, one in the Modic 1 group, and one not classified.

Considering the complications, a multicentered study with > 26,000 cases found a prevalence < 1% for percutaneous endoscopic discectomy, such as: dysesthesia 0.45%, dural tears 0.17%, discitis 0.25%, motor or sensitive impairment 0.32%, and recurrence 0.79%.¹²

The general risk factors for recurrence in percutaneous endoscopic surgery are: male gender, obesity, age > 50 years old, trauma history, and central disc herniation. However, there are factors related to the surgical technique, such as: less experienced surgeons (< 200 cases) and the usage of inadequate material.^{9,13}

In our study, all patients were submitted to the transforaminal technique for lumbar disc herniation in discs with

advanced degeneration (Pfirmsmann IV and V). Significant improvement was noted not only statistically but also clinically in the sciatica pain level according to the VAS scale in the last postoperative follow-up; however, there was no difference between the two groups.

In the present research, the endoscopic transforaminal surgery for lumbar disc herniation with advanced disc degenerative disease, represented by more advanced stages in the Modic and Pfirmsmann classification, showed to be clinically efficient in diminishing pain (strong preoperatively to mild postoperatively). There was no clinical difference for those patients who had advanced degenerative discal disease.

The limitations of the present research were the sample size, the relatively short patient follow-up, and the fact that it was performed in only one specialized center; however, it still brings important data about advanced degenerative disc disease treated with a minimally invasive method.

Conclusion

The present study showed that, even in advanced disc degeneration, the transforaminal percutaneous endoscopic discectomy appeared to be an efficient method in reducing radicular pain in patients with lumbar disc herniation.

The improvement of the postoperative pain was noticed in all groups analyzed by the Modic classification (Absence of Modic, Modic 1, and Modic 2) or by the Pfirmsmann classification (Pfirmsmann IV and Pfirmsmann V), with no clinical difference in the sciatica reduction between the groups.

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Conflict of Interests

The authors have no conflict of interests to declare.

References

- Kapetanakis S, Gkadaris G, Thomaidis T, Charitoudis G, Kazakos K. Comparison of quality of life between men and women who underwent Transforaminal Percutaneous Endoscopic Discectomy for lumbar disc herniation. *Int J Spine Surg* 2017;11(04):28-40
- Gadjradj PS, van Tulder MW, Dirven CM, Peul WC, Harhangi BS. Clinical outcomes after percutaneous transforaminal endoscopic discectomy for lumbar disc herniation: a prospective case series. *Neurosurg Focus* 2016;40(02):E3-E9
- Wu J, Zhang C, Zheng W, Hong CS, Li C, Zhou Y. Analysis of the Characteristics and Clinical Outcomes of Percutaneous Endoscopic Lumbar Discectomy for Upper Lumbar Disc Herniation. *World Neurosurg* 2016;92:142-147
- Jiang X, Zhou X, Xu N. Clinical effects of transforaminal and interlaminar percutaneous endoscopic discectomy for lumbar disc herniation: A retrospective study. *Medicine (Baltimore)* 2018;97(48):e13417-e13422
- Li Y, Wang B, Wang S, Li P, Jiang B. Full-Endoscopic Decompression for Lumbar Lateral Recess Stenosis via an Interlaminar Approach versus a Transforaminal Approach. *World Neurosurg* 2019;128:e632-e638
- Falavigna A, Teles AR, Braga GLD, Barazzetti DO, Lazzaretti L, Tregnago AC. Instrumentos de Avaliação Clínica e Funcional em Cirurgia da Coluna Vertebral. *Coluna/Columna* 2011;10(01):62-67

- 7 Oliveira JAA, Guerra e Silva VT, Almeida, LEPCAd, Meireles RdSP, Lopes GdR, Mello APd, Almeida PC, Silva LECTd. T1 pelvic angle in improvement of pain in high-grade lumbar spondylolisthesis. *Coluna/Columna* 2020;19(02):108–111
- 8 Cong L, Zhu Y, Tu G. A meta-analysis of endoscopic discectomy versus open discectomy for symptomatic lumbar disk herniation. *Eur Spine J* 2016;25(01):134–143
- 9 Pan M, Li Q, Li S, et al. Percutaneous Endoscopic Lumbar Discectomy: Indications and Complications. *Pain Physician* 2020;23(01):49–56
- 10 Ruetten S, Komp M. Endoscopic Lumbar Decompression. *Neurosurg Clin N Am* 2020;31(01):25–32
- 11 Xu J, Li Y, Wang B, et al. Percutaneous Endoscopic Lumbar Discectomy for Lumbar Disc Herniation with Modic Changes via a Transforaminal Approach: A Retrospective Study. *Pain Physician* 2019;22(06):E601–E608
- 12 Zhou C, Zhang G, Panchal RR, et al. Unique Complications of Percutaneous Endoscopic Lumbar Discectomy and Percutaneous Endoscopic Interlaminar Discectomy. *Pain Physician* 2018;21(02):E105–E112
- 13 Park CH, Park ES, Lee SH, et al. Risk Factors for Early Recurrence After Transforaminal Endoscopic Lumbar Disc Decompression. *Pain Physician* 2019;22(02):E133–E138