

ORIGINAL ARTICLE

Percutaneous lumbar discectomy: a systematic review

Marcelo Ferraz de Campos^{a,b}, Thiago Salatii^a, José Carlos Rodrigues Junior^a, Ricardo Maximo Grecco^a, Ingrid Soares de Souza^a, Agatha Mesaroch^a, Naomi Rodrigues Andrade^c, Yasmin Matos Araújo Silva^c, Cynthia A. Kallas Bachur^c, José Alexandre Bachur^c



^aCentro Universitário Faculdade de Medicina do ABC, São Caetano do Sul, SP-Brasil.

^bHospital Heliópolis, Departamento de Neurocirurgia, São Paulo, SP- Brasil.

^cUniversidade de Franca, Franca, SP-Brasil.

Corresponding author
jabachur@hotmail.com

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Abstract

Introduction: Low back pain is a clinical condition with a multifactorial etiopathogenesis, which has a high socioeconomic impact, especially in the economically active population, as it is associated with frequent absenteeism and reduced quality of life. Through intervertebral disc degeneration, a progressive instability of the compromised region is observed, triggering a harmful positive feedback mechanism that further promotes intervertebral disc disease. Built by the interaction between the predisposing biopsychosocial components, a multidisciplinary therapeutic proposition is suggested. In persistent low back pain, treatment involves surgical procedures such as Percutaneous Lumbar Discectomy.

Objectives: to evaluate the scientific evidence regarding the clinical outcomes and safety of this surgery.

Method: systematic review duly registered in Prospero (CRD42022370811), based on the PICOD question, elaborated from a Boolean search in different databases for scientific articles, evaluated and selected in a paired way based on the eligibility criteria. In addition to extracting data related to the proposed objectives, the articles included were evaluated in relation to their level of evidence and strength of recommendation.

Results: among the 12 articles included, it was observed that it is a clinically effective and safe procedure. In the set of evidences gathered, they are of high and moderate level of evidence with respective strength of recommendation strong/good and weak/moderate.

Conclusion: Percutaneous Lumbar Discectomy promotes significant reduction of pain and increase in body functionality, in addition to preserving local musculoskeletal structures and preventing post-surgical joint instability. It is, therefore, a safe and clinically effective minimally invasive procedure for patients with herniated discs.

Keywords: low back pain, degenerative disc disease, disc decompression, systematic review.

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Authors summary

Why was this study done?

This study was carried out with the aim of gathering evidence on the perception of the clinical effectiveness and safety of the surgical procedure called Percutaneous Lumbar Discectomy, among patients with herniated discs.

What did the researchers do and find?

A systematic review was carried out, in accordance with the recommended method. Scientific articles were found on the proposed theme, in which relevant positive information was observed about the clinical effectiveness and safety of the aforementioned surgical procedure.

What do these findings mean?

Percutaneous Lumbar Discectomy is a good option for a minimally invasive surgical procedure that provides greater medical assertiveness in cases of herniated discs that are resistant to conservative treatment.

INTRODUCTION

Low back pain is a clinical condition of multifactorial etiopathogenesis, which includes: risk factors, lifestyle, occupational risk and inappropriate postures¹, among others.

According to data from the Brazilian Institute of Geography and Statistics, back pain is the second most prevalent condition negatively related to health², affecting about 80% of adults throughout their lives³.

Low back pain triggers a high socioeconomic impact, especially in the economically active population⁴, as it is associated with frequent absenteeism and reduced quality of life⁵. In the United States of America, the costs associated with low back pain are estimated at around 2 million dollars⁶, in the United Kingdom it is approximately 1.6 million euros, and worldwide the economic impact is between 6.6 million and 12.3 million euros⁷.

Built by the interaction between the predisposing biopsychosocial components, a multidisciplinary therapeutic proposition⁸ is suggested, paying special attention to age, gender, body mass index, underlying diseases, labor and socioeconomic conditions, in addition to muscle imbalances⁹. It is important to identify the level of pathological contribution of the lumbar paraspinal muscles, necessary for carrying out movement and biomechanical stabilization, both locally and in the body¹⁰. Patients with Chronic Low Back Pain (CLBP) have reduced quality of life, reduced muscle strength, as well as constant pain¹¹.

Due to its location in the central region of the human body, it is postulated that the lumbar spine is of vital importance for body biomechanics, as it transmits mechanical forces generated by musculotendinous components, while absorbing and dissipating mechanical impacts through the intervertebral discs, mainly during the spinal load that is distributed vertically and laterally to the endplates, in order to allow the stable mobility of the spine¹². Through degeneration of the intervertebral disc, progressive instability of the affected region and other regions of the spine is observed, predominantly between the fourth and fifth lumbar vertebrae and the first sacral vertebrae¹³.

With little clarified etiology, the progressiveness of the degeneration can be modified by the way of life, discopathies can be developed by mechanical, environmental and genetic factors^{14,15}. Dehydrated intervertebral discs become fibrocartilaginous decreasing

their stability and triggering a harmful positive feedback mechanism that further promotes intervertebral disc disease¹⁶.

The clinical implications of discopathies in symptomatic patients consist of bouts of chronic low back pain, weakness in the lower limbs, tingling and numbness of the extremities and increased pain depending on the movement performed, with impairment of the individual's quality of life, which can be treated in invasive or non-invasive¹⁷.

Physiotherapy is among the non-invasive non-pharmacological methods, which include a range of techniques for rehabilitation, improvement of quality of life and reduction of symptoms¹⁸. However, in persistent low back pain, treatment involves a range of non-surgical procedures, in addition to surgical ones, such as disc decompression for neuropathic pain through Percutaneous Lumbar Discectomy (PLD), among others⁸.

PLD is a minimally invasive surgery that offers the least aggression to the body, thanks to advanced technological resources¹⁹, commonly indicated in cases of disc herniation with clinically intractable pain, for a minimum period of three months, associated or not with minimal neurological deficit, characterized by mild loss of muscle strength and/or changes in surface sensitivity^{20,21}. Except in cases of extruded hernia, root canal narrowing, spondylolisthesis, advanced disc degenerative process with air in the disc or recent conventional surgery at the same level²⁰.

Given the context described above, the present study was carried out with the general objective of evaluating the scientific evidence related to clinical outcomes in patients with lumbar disc herniation submitted to percutaneous lumbar discectomy. The objective was also to gather data on the safety of this minimally invasive surgical intervention.

METHOD

This is a systematic review, developed based on some of the recommendations proposed in the instrument called PRISMA (Main Items for Reporting Systematic Reviews and Meta-analyses)²², motivated from the guiding clinical question, elaborated based on the PICOD strategy, which represents the acronym for Patient, Intervention, Comparison, Outcomes and Design²³. These recommendations are considered essential for the

elaboration of a consistent systematic review of clinical studies²⁴⁻²⁷.

Based on the state of the art described in the introduction of the present study, the following clinical question was formulated: What is the scientific evidence on the clinical outcomes subsequent to the surgical procedure of percutaneous lumbar discectomy, in patients with Lumbar Disc Herniation? From which, the following terms were extracted and identified as scientific descriptors with the MeSH Terms operating system (<https://www.ncbi.nlm.nih.gov/mesh/>): “percutaneous”, “discectomy”, “percutaneous”, “lumbar vertebrae”, “humans”. For reasons of contextual proximity, the following descriptors were also listed: “automated”, “discectomy”, “nucleotomy”, “microdiscectomy”, “endoscopic”, and “laser”, with the aim of establishing an adequate Boolean search strategy with the database: MEDLINE/PubMed (<https://www.ncbi.nlm.nih.gov/pubmed/>), SPORTDiscus – EBSCO (<https://web-p-ebshost.ez43.periodicos.capes.gov.br/>) and SCOPUS (<https://www.scopus.ez43.periodicos.capes.gov.br/>). Which was performed on 06/21/2022, as follows: ((automated AND/OR (percutaneous AND ((discectomy OR discectomy) OR nucleotomy)) AND “lumbar vertebrae” AND humans) NOT (microdiscectomy OR endoscopic OR laser)).

The election of inclusion and exclusion criteria was carried out according to the principles proposed in the specialized literature²⁷⁻²⁹. As eligibility criteria, we chose to include clinical trials in patients with lumbar disc herniation who underwent percutaneous lumbar discectomy, without language or publication date restrictions. As exclusion criteria, among the included documents, we opted for those studies carried out in children, in patients with structural locomotion restrictions, articles without access in full or, with contents not related to the objectives proposed in the present study.

All documents found were gathered in the virtual environment of the application Rayyan QCRI - Qatar Computing Research Institute (<https://rayyan.qcri.org/welcome>)³⁰, for the identification and elimination of all existing duplicates between the documents listed in the different databases. of data. Then, the 1st stage of the assessment of eligibility for inclusion or exclusion of each of the related documents was carried out in pairs between three reviewers, members of the research team. At this stage, after reading the article, each evaluator indicated in a spreadsheet one of the three options (included, maybe, or excluded), and these individual options were transferred to a general spreadsheet, for the purpose of analyzing the level of agreement between the evaluators, followed by the definition of the eligibility of each study through the absolute agreement between the options indicated by each evaluator. In those situations of divergence between the indicated options or of doubt (maybe), the definition was

consensual, in the midst of a collective evaluation of the study in question, between the evaluators and the researcher responsible for the present study, as recommended in the literature²⁹.

Quantitative data relating to the document identification stages in the different databases up to the exclusion stage, the screening process, eligibility, inclusion and exclusion of scientific documents to be analyzed, are indicated in the flowchart (figure 1), located in the results section.

As proposed in the literature²⁸, prior to data extraction, the present study was registered (registration code: CRD42022370811) in the database of systematic review protocols called PROSPERO (<https://www.crd.york.ac.uk/prosperto/>), with the objectives of: avoiding duplication of studies on the chosen topic, providing full transparency on the preparation method, as well as ratifying and/or improving the methodological quality of the study under development through the opinion issued by the respective team of evaluators.

Data related to primary or secondary variables were selected and extracted independently between examiners, as previously described, including in situations of disagreement about certain data(s)^{26,29}.

The Grade or Strength of Recommendation and the Level of Evidence were evaluated, also in pairs, based on the descriptors of the Oxford and Grade³¹⁻³³ scales.

Although ethical approval is not required in this type of study, the ethical character of the present study was ensured by strict compliance with the commitments assumed with the registration system, as well as the guarantee of the veracity of each stage and, due consideration of the task carried out by the different authors who are members of the research team during its construction process.

■ RESULTS

All data related to the eligibility process of scientific documents are indicated in the flowchart (Figure 1), in which it is observed that among the 44 articles identified in the aforementioned data platforms, 73% were excluded based on the exclusion criteria pre-established, and the remaining 27% became the constituent components of the sample space of the present systematic review study.

Regarding the literary aspects of the articles included (table 1), it is noted that among the documents published in the period from 1989 to 2011, 4 (33%) are authored affiliated with China, 3 (25%) with France, 2 (17%) to Turkey, while the other remaining 25% (3) are equally associated with Korea, USA and Italy.

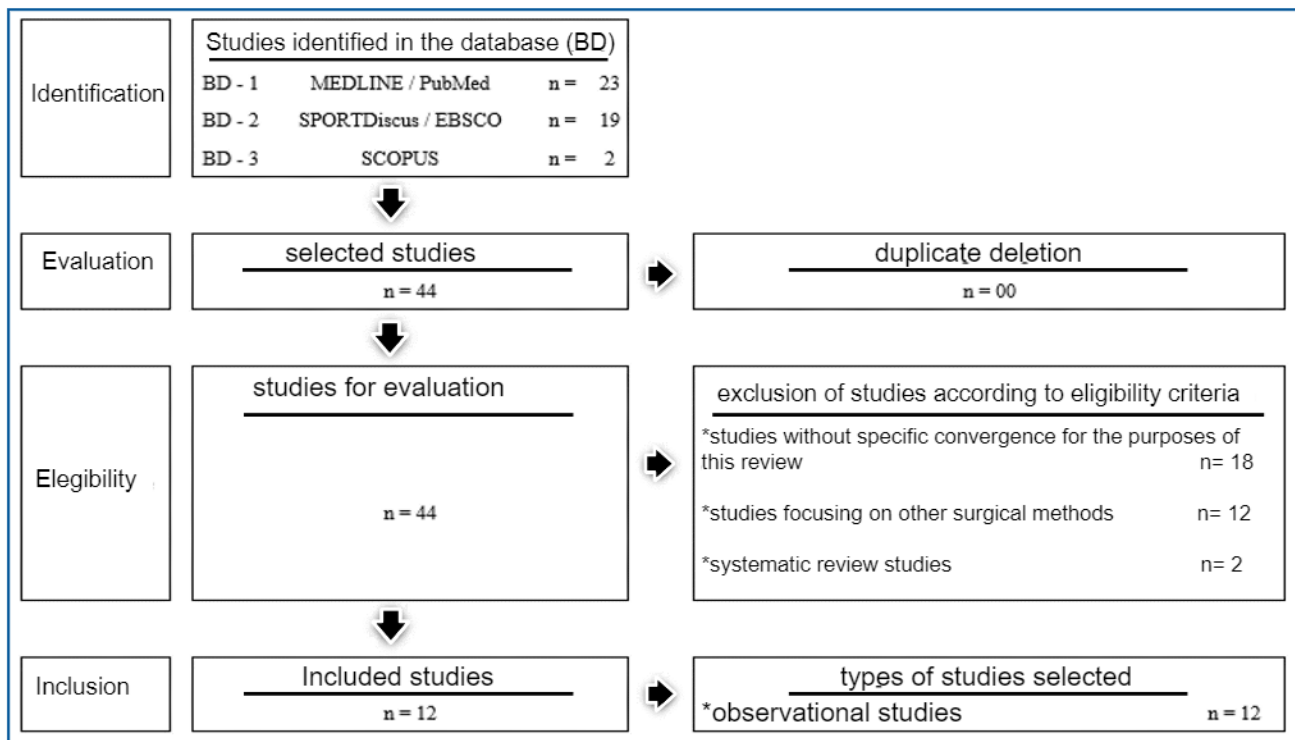


Figure 1: Flowchart of the stages of the process of eligibility of studies for analysis

Table 1: Literary Aspects of the Articles Included

A	Authors	Title and bibliographic data	Country
A1 (39)	Chun-Gen Wu e cols.	Transabdominal percutaneous L5 S1 lumbar discectomy: interventional technique, early results, and complications. J Vasc Interv Radiol. 2007; Sep;18(9):1162-8. doi: 10.1016/j.jvir.2007.06.008.	France
A2 (40)	M Revel e cols.	Automated percutaneous lumbar discectomy versus chemonucleolysis in the treatment of sciatica. A randomized multicenter trial. Spine (Phila Pa 1976). 1993; 18(1):1-7. doi: 10.1097/00007632-199301000-00001.	Italy
A3 (41)	C T Moon e cols.	Availability of discographic computed tomography in automated percutaneous lumbar discectomy. J Korean Med Sci. 1995;10(5):368-72. doi: 10.3346/jkms.1995.10.5.368.	USA
A4 (42)	Nicolas Amoretti e cols.	Clinical follow-up of 50 patients treated by percutaneous lumbar discectomy. Clin Imaging. 2006;30(4):242-4. doi: 10.1016/j.clinimag.2006.01.019.	France
A5 (43)	Stephen J Haines e cols.	Discectomy strategies for lumbar disc herniation: results of the LAPDOG trial. J Clin Neurosci. 2002;9(4):411-7. doi: 10.1054/jocn.2002.1120.	Turkey
A6 (44)	P Gobin e cols.	Percutaneous automated lumbar nucleotomy. J Neuroradiol. 1989;16(3):203-13.	Turkey
A7 (45)	G J Teng e cols.	Automated percutaneous lumbar discectomy: a prospective multi-institutional study. J Vasc Interv Radiol. 1997;8(3):457-63.	China
A8 (46)	Kadir Kotil e cols.	A minimally invasive transmuscular approach to far-lateral L5-S1 level disc herniations: a prospective study. J Spinal Disord Tech. 2007;20(2):132-8. doi: 10.1097/01.bsd.0000211268.43744.2a.	France
A9 (47)	Zhiqun Wu, e cols.	Percutaneous treatment of non-contained lumbar disc herniation by injection of oxygen-ozone combined with collagenase. Eur J Radiol. 2009;72(3):499-504. doi: 10.1016/j.ejrad.2008.07.029.	Korea
A10 (48)	Hasan Mirzai e cols.	The results of nucleoplasty in patients with lumbar herniated disc: a prospective clinical study of 52 consecutive patients. Spine J. 2007;7(1):88-92; discussion 92-3. doi: 10.1016/j.spinee.2006.02.033.	China
A11 (49)	D Fiume e cols.	Automated percutaneous discectomy in herniated lumbar discs treatment: experience after the first 200 cases. J Neurosurg Sci. 1994;38(4):235-7.	China
A12 (50)	Hui Zhu e cols.	The efficacy of coblation nucleoplasty for protrusion of lumbar intervertebral disc at a two-year follow-up. Int Orthop. 2011;35(11):1677-82. doi: 10.1007/s00264-010-1196-0.	China

When evaluating the outcomes described in the different studies included in this SR (Table 2), we observed a consensus that PLD is a safe surgical procedure, especially when monitored by CT, using or not the TENG instrument. It can also be considered effective in reducing pain and improving function in around 40 to 70% of patients, especially in those with small disc herniations

located in the posteroforaminal or extraforaminal region, although the results are also favorable in cases of posteromedian hernias. Such effectiveness of this surgical procedure, considered minimally invasive, can be attributed to the fact that it is possible to directly visualize the neuroforamen, preserve the facet joint and prevent postoperative instability.

Table 2: Purposeful aspects and observed outcomes

A	Objective(s) of the Study	Observed Outcomes
A1	To evaluate the results resulting from the treatment by Percutaneous Automated Lumbar Nucleotomy (PALN) in a group of patients with lumbar disc herniation	Positive results regarding pain are observed in approximately 77% of patients undergoing PALN.
A2	Evaluate the perception of pain in patients with lumbosacral radicular pain treated with PLD	PLD presents positive results in pain reduction, when compared with the results obtained with open surgery.
A3	To compare the treatment efficacy and cost-effectiveness of DPLA and in relation to the results of conventional discectomy (CD), performed in adult patients with diagnostic images of disc herniation.	Satisfactory primary results are observed both in patients with lumbar disc herniation treated with PLD (41%) and in patients treated with CD (40%).
A4	To monitor pain perception in patients with lumbar discogenic disease treated by PLD.	There is a need for more clinical studies to prove the greater efficacy of PLD in relation to CD.
A5	To evaluate the effectiveness of the APLD surgical technique for decompressing L5-S1 disc herniation at the extreme lateral level.	The location of the disc herniation is a parameter that seems to be very important in the effectiveness of PLD in terms of pain.
A6	To evaluate the effectiveness of the nucleoplasty technique in patients with leg pain caused by radicular invasion.	An improvement is observed in 50% of cases with posteromedian hernias and between 70 and 79% of cases with posteroforaminal or extraforaminal hernias.
A7	To evaluate over a two-year period, the efficacy of coblation nucleoplasty treatment for protruded lumbar intervertebral disc	The APLD can be considered effective. It allows a direct visualization of the L5-S1 neuroforamen, and because it is minimally invasive, it allows the preservation of the L5-S1 facet joint, and prevents postoperative instability.
A8	To compare the results of Automated Percutaneous Lumbar Discectomy (APLD) with those of chemonucleolysis in a group of patients with sciatic pain related to disc herniation	PLD can be considered effective in reducing pain, especially in patients with small disc hernias (<6 mm) contained, with disc height greater than or equal to 50% and with annular integrity.
A9	Evaluate the importance of using discographic computed tomography (DCT) in monitoring APD	Coblation nucleoplasty can have satisfactory clinical results for a period of 24 months.
A10	Evaluate the APLD procedure performed with a newly designed percutaneous instrument.	It is suggested that the chemonucleolysis procedure be performed before APLD can be considered a useful intervention.
A11	To evaluate the safety and clinical results resulting from the Percutaneous Lumbar Discectomy (PLD) procedure in the management of L5-S1 disc herniation.	It is suggested that monitoring through TCD may increase the success rate of APLD in patients with protruded disc disease.
A12	To evaluate the therapeutic results of combined oxygen-ozone collagenase injection for the treatment of lumbar disc herniation compared to PLD surgery.	APLD with the Teng instrument in patients positioned properly, presents excellent results.

Based on the data related to the levels and quality of evidence (Table 3), we observed that, according to the Oxford Scale instrument, all studies have quality and level of evidence IIB, as they are prospective clinical trials of individuals with herniated discs with care physicians received (outcomes research), among which 9 have strength of recommendation A (good evidence to support a recommendation for use, and the other 3 were considered B (moderate evidence to support a recommendation for use). evidence based on the Grade Scale instrument, we observed that among the 12 included studies, 9 were evaluated with a HIGH level of evidence because there is a strong confidence that the true effect is close to that estimated and that it is unlikely that additional work will change the confidence in estimating the effect. The other

3 remaining studies were evaluated with a MODERATE level of evidence, by demonstrating moderate confidence in the estimated effect, in such a way that future works may modify the confidence in the effect estimate, and may even modify the estimate.

We emphasize the fact that, when analyzing the data on levels of evidence and strength of recommendation (Table 3), we observed that all studies evaluated as a HIGH level of evidence based on the Grade Scale, were also evaluated with high strength of recommendation both by the Grade Scale and the Oxford Scale. As occurred in the 3 studies considered to have a MODERATE and MODERATE level of evidence or WEAK recommendation strength, according to the assessment based on the instruments, respectively, Oxford Scale and Grade Scale.

Table 3: Levels of evidence and strength of recommendation

A	Levels of Evidence		Strength of Recommendation / Quality of Evidence	
	Oxford Scale	Grade Scale	Oxford Scale	Grade Scale
A1	IIB	HIGH	'A' - GOOD	STRONG
A2	IIB	HIGH	'A' - GOOD	STRONG
A3	IIB	HIGH	'A' - GOOD	STRONG
A4	IIB	HIGH	'A' - GOOD	STRONG
A5	IIB	MODERATE	'B' - MODERATE	WEAK
A6	IIB	HIGH	'A' - GOOD	STRONG
A7	IIB	MODERATE	'B' - MODERATE	WEAK
A8	IIB	MODERATE	'B' - MODERATE	WEAK
A9	IIB	HIGH	'A' - GOOD	STRONG
A10	IIB	HIGH	'A' - GOOD	STRONG
A11	IIB	HIGH	'A' - GOOD	STRONG
A12	IIB	HIGH	'A' - GOOD	STRONG

DISCUSSION

Open microdiscectomy has always been a surgical strategy commonly used in the treatment of herniated discs with good clinical results, despite the damage caused to the facet joints and subsequent lumbar instability³⁴. At the same time, percutaneous lumbar discectomy (PLD), also used to treat discopathies, is a minimally invasive surgical procedure that has been technologically improved and widely used over time, with the aim of reducing interdiscal pressure through puncture and aspiration. nucleus pulposus, followed by reduced pressure on the nerve root and associated with reduced pain³⁴⁻³⁶. This surgical procedure is very useful for controlling lumbosacral pain in cases of disc herniation unresponsive to epidural injections of steroidal drugs³⁷, especially in cases where there is no migration of herniated discs and the presence of unilateral disc herniation³⁸. As observed in some studies³⁹⁻⁵⁰, in which a relevant clinical improvement of patients was pointed out, especially in relation to pain and also to body functionality.

In addition, PLD provides a short intervention time, a quick recovery of the patient and a short intra-hospital stay, and reduced damage to local musculoskeletal structures^{20,34,36}, when compared to open surgery. Statements that corroborate the data reported in the present study, which highlight the greater effectiveness

of PLD compared to open surgery⁴⁰, probably because it allows direct visualization of the neuroforamen associated with preservation of the facet joint and prevention of postoperative instability⁴³.

It is observed that PLD applied to patients with low back pain unresponsive to medical therapy is a safe and efficient procedure in reducing pain and improving body function⁵¹. Like the data observed in the different articles included in the present review study, in which it was also pointed out that the monitoring of PLD through computed tomography increases the success rate in the treatment of discopathies⁴⁷, as well as the use of the Teng instrument during the referred procedure⁴⁸, in addition to the proposition that: the safety and efficacy of PLD in the treatment of disc herniations in L5-S1 increases if it is preceded by a complete bowel preparation⁴⁹.

It should be noted that, due to the considerable terminological variety related to the different procedural surgical technologies for disc herniations, a rigorous structuring of the Boolean search strategy for scientific documents is necessary for the correct elaboration of a systematic review related to the surgical treatment of discopathies. Therefore, in the present study, the Boolean search was structured considering the various scientific descriptors associated with the central theme, in order to maximize the direction of the research towards the desired

and necessary literary universe. However, it is possible that other articles related to the scope of this study can be identified in other databases using this same search strategy. This fact is a possible weak point of the present review study.

CONCLUSION

Based on the qualitative aspects of the set of evidence gathered in this systematic review study, we conclude that Percutaneous Lumbar Discectomy can be considered a minimally invasive surgical procedure with high safety and effectiveness in the treatment of patients with lumbar hernia, associated with a satisfactory level of reduction of pain and improvement of body functionality.

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Resumo

Introdução: a lombalgia é uma condição clínica de etiopatogenia multifatorial, que desencadeia um elevado impacto socioeconômico especialmente na população economicamente ativa, por associar-se ao absenteísmo frequente e à redução da qualidade de vida. Observa-se mediante a degeneração do disco intervertebral, uma instabilidade progressiva da região comprometida desencadeando um mecanismo de feedback positivo prejudicial que promove ainda mais a doença do disco intervertebral. Edificada pela interação entre os componentes biopsicossocial predisponentes, sugere-se uma proposição terapêutica multidisciplinar. Na dor lombar persistente o tratamento envolve procedimentos cirúrgicos como a Discectomia Percutânea Lombar.

Objetivo: avaliar as evidências científicas relativas aos desfechos clínicos e à segurança desta cirurgia.

Método: revisão sistemática devidamente registrada no Prospero (CRD42022370811), fundamentada na pergunta PICOD acrônimo para Paciente, Intervenção, Comparação, Desfechos (outcomes) e Design, elaborada a partir de busca booleana em diferentes bases de dados por artigos científicos, avaliados e selecionados de forma pareado com base nos critérios de elegibilidade. Além da extração de dados relativos aos objetivos propostos, os artigos incluídos foram avaliados em relação ao respectivo nível de evidência e força de recomendação.

Resultados: dentre os 12 artigos incluídos, observou-se que se trata de um procedimento clinicamente efetivo e seguro. No conjunto de evidências reunidas são de alto e moderado nível de evidência com respectiva força de recomendação forte/boa e, fraca/moderada.

Conclusão: a Discectomia Percutânea Lombar promove relevante redução da dor e aumento da funcionalidade corporal, além de preservar as estruturas musculoesqueléticas locais e prevenir a instabilidade articular pós-cirúrgica. Trata-se, portanto, de um procedimento minimamente invasivo seguro e clinicamente efetivo para os pacientes portadores de hérnia discal.

Palavras-chave: lombalgia, discopatia degenerativa, descompressão discal, revisão sistemática.

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