

COMPARISON OF INTERLAMINAR AND TRANSFORAMINAL APPROACHES IN ENDOSCOPIC LUMBAR DISCECTOMIES

COMPARAÇÃO DAS ABORDAGENS INTERLAMINAR E TRANSFORAMINAL EM DISCECTOMIAS ENDOSCÓPICAS LOMBARES

COMPARACIÓN DE ABORDAJES INTERLAMINAR Y TRANSFORAMINAL EN DISCECTOMÍAS LUMBARES ENDOSCÓPICAS

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ABSTRACT

Objective: In this study, we aim to compare total surgical time and length of hospital stay for the interlaminar endoscopic lumbar discectomy (IELD) and transforaminal endoscopic lumbar discectomy (TELD). **Method:** This is a retrospective observational study in which we collected data from one center's medical records, from March 2022 to February 2023, of patients who underwent uniportal endoscopic lumbar discectomies. The following data were collected: age, gender, endoscopic approach, length of stay, total surgical time, and surgical levels. The data were applied to a nonparametric test, the Mann-Whitney U test. A type I error of up to 5% was accepted as a statistically significant difference. **Results:** From the total of 107 patients (49 males and 58 females), the median duration of hospital stay was 19 hours. The most common surgical level was L5-S1, and the interlaminar uniportal endoscopic approach was performed in 87.85% of the cases. A significant statistical difference was observed in the total surgical time when comparing the interlaminar approach with the transforaminal approach when all levels (L2-L3 to L5-S1) are considered together in the analysis. Ultimately, no statistically significant difference was observed in the length of stay when comparing the interlaminar approach with the transforaminal approach. **Conclusions:** The study showed a statistically significant difference in total surgical time, showing shorter operative time for the interlaminar approach. There was no statistically significant difference in the duration of hospital stay. **Level of Evidence IV; Comparative Retrospective Study.**

Keywords: Minimally Invasive Surgical Procedures; Endoscopy; Intervertebral Disc Degeneration; Retrospective Studies.

RESUMO

Objetivos: Neste estudo pretendemos comparar o tempo cirúrgico total e o tempo de internação hospitalar entre a discectomia lombar endoscópica interlaminar (DLEI) e discectomia lombar endoscópica transforaminal (DLET). **Métodos:** Trata-se de um estudo observacional retrospectivo, no qual coletamos dados de prontuários de um único centro, de março de 2022 a fevereiro de 2023, de pacientes submetidos à discectomia endoscópica lombar uniportal. Foram coletados os seguintes dados: idade, sexo, abordagem endoscópica, tempo de internação, tempo cirúrgico total e níveis cirúrgicos. Os dados foram aplicados a um teste não paramétrico, teste U de Mann-Whitney. Um erro tipo I de até 5% foi aceito como diferença estatisticamente significativa. **Resultados:** Do total de 107 pacientes (49 homens e 58 mulheres), o tempo mediano de internação hospitalar foi de 19 horas. O nível cirúrgico mais comum foi L5-S1 e a abordagem endoscópica interlaminar uniportal foi realizada em 87,85% dos casos. Foi observada diferença estatística significativa no tempo cirúrgico total quando comparamos a abordagem interlaminar com a abordagem transforaminal quando todos os níveis (L2-L3 a L5-S1) são considerados juntos na análise. Em última análise, não foi observada diferença estatisticamente significativa no tempo de internação quando comparamos a abordagem interlaminar com a abordagem transforaminal. **Conclusões:** O estudo mostrou diferença estatisticamente significativa no tempo cirúrgico total, mostrando menor tempo operatório para a abordagem interlaminar. Não houve diferença estatisticamente significativa no tempo de internação. **Nível de Evidência IV; Estudo Retrospectivo Comparativo.**

Descritores: Procedimentos Cirúrgicos Minimamente Invasivos; Endoscopia; Degeneração do Disco Intervertebral; Estudos Retrospectivos.

RESUMEN

Objetivos: En este estudio nuestro objetivo es comparar el tiempo quirúrgico total y la duración de la estancia hospitalaria de la discectomía lumbar endoscópica interlaminar (DLEI) y la discectomía lumbar endoscópica transforaminal (DLET). **Métodos:** Se trata de un estudio observacional retrospectivo, en el que se recogieron datos de las historias clínicas de un centro, desde marzo de 2022 hasta febrero de 2023, de pacientes sometidos a discectomías lumbares endoscópicas uniportales. Se recogieron los siguientes datos: edad, sexo, abordaje endoscópico, estancia hospitalaria, tiempo quirúrgico total y niveles quirúrgicos. Los datos se aplicaron a una prueba no paramétrica, la prueba U de Mann-Whitney. Se aceptó como diferencia estadísticamente significativa un error tipo I de hasta el 5%. **Resultados:** Del total de 107 pacientes (49 hombres y 58 mujeres) la mediana de duración de la estancia hospitalaria fue de 19 horas. El nivel quirúrgico más frecuente fue L5-S1 y el abordaje endoscópico uniportal interlaminar se realizó en el 87,85% de los casos. Se observó una diferencia estadística significativa en el

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tiempo quirúrgico total al comparar el abordaje interlaminar con el abordaje transforaminal cuando todos los niveles (L2-L3 a L5-S1) se consideran juntos en el análisis. Al final, no se observó ninguna diferencia estadísticamente significativa en la duración de la estancia hospitalaria al comparar el abordaje interlaminar con el abordaje transforaminal. Conclusiones: El estudio mostró una diferencia estadísticamente significativa en el tiempo quirúrgico total, mostrando un tiempo operatorio más corto para el abordaje interlaminar. No hubo diferencias estadísticamente significativas en la duración de la estancia hospitalaria. **Nivel de Evidencia IV; Estudio Retrospectivo Comparativo.**

Descriptor: Procedimientos Quirúrgicos Mínimamente Invasivos; Endoscopía; Degeneración del Disco Intervertebral; Estudios Retrospectivos.

INTRODUCTION

Degeneration of the intervertebral disc is commonly linked to disc herniation. As individuals age, the fibrochondrocytes within the disc experience senescence, leading to a decrease in the production of proteoglycans. This decline in proteoglycans contributes to dehydration and eventual collapse of the disc. This, in turn, intensifies the strain on the annulus fibrosus, causing tears and fissures and ultimately facilitating herniation of the nucleus pulposus. Consequently, repetitive mechanical stressors applied to the disc result in a gradual onset of symptoms, often of a chronic nature. Conversely, axial overloading imposes significant biomechanical forces on a healthy disc, potentially causing the extrusion of disc material through a compromised annulus fibrosus, potentially causing compressive effects on neural structures, and causing a local inflammatory response.¹ Injuries of this nature typically lead to more severe acute symptoms.²

The prevalence of lumbar disc herniations, even when asymptomatic, has been estimated to exceed 50% within certain populations,³ with an annual incidence of 0.5 to 5%.^{2,4} Lumbar disc herniation is more prevalent in the third to fifth decade and predominates in males (2:1 ratio).^{2,5} However, the accurate incidence of symptomatic lumbar disc herniations remains elusive due to a lack of consensus regarding the definition of a symptomatic herniation (such as back pain alone versus radicular pain versus a combination of both).³ The prevalence of low back pain among adults throughout life is 60 to 80%, and the prevalence of sciatica pain, most frequently caused by herniated intervertebral discs, lasts at least two weeks and is 1.6%.⁶

The standard treatment of symptomatic disc herniation is conservative, based on the use of medications and appropriate rehabilitation.¹ In most cases, approximately 66%,^{7,8} there is a regression of the herniation without the need for surgical intervention. In cases with cauda equina syndrome, severe and progressive neurological deficits, and failure of conservative treatment, surgical discectomy is indicated.⁹ Among the currently widely used surgical approaches, endoscopic discectomy and open microdiscectomy stand out,^{10,11} due to its advantages in shorter operative time, less blood loss, less paravertebral muscle injury, faster function recovery, and satisfactory clinical outcomes.^{12,13} The choice between these surgical modalities not only depends on the specific characteristics of the disc herniation and the patient's condition but also depends on the surgeon's preference and ability.⁹

The full endoscopic technique has been developed through the last years with improvements in the optics, high-resolution camera, light source, high-speed burr, and irrigation pump.¹⁴ It is an adequate alternative to the microscopic technique.¹⁵ The two most commonly used approaches in current endoscopic surgery are the transforaminal endoscopic lumbar discectomy (TELD) and the interlaminar endoscopic lumbar discectomy (IELD).¹⁶ The choice of the technique depends on the hernia's location (central, posterolateral, foraminal, or extraforaminal), the level to be operated (the transforaminal window is broader at higher lumbar levels, and the interlaminar window is broader at lower levels), and the surgeon's preference.¹⁴

Therefore, this study aims to assess and contrast the aggregate surgical duration and duration of hospitalization associated with the interlaminar and transforaminal uniportal endoscopic approaches.

METHODS

This is a retrospective observational study where data was collected between March 2022 and February 2023. The inclusion criteria consisted of patients diagnosed with lumbar intervertebral

disc herniation undergoing uniportal endoscopic spine surgery without age restrictions. Patients with incomplete medical records or incomplete images were excluded. The institutional review board approved this study, and informed consent was waived. (protocol number: 69927523.0.0000.0085; approved on June 27, 2023).

The following measurements were used for standardization: age measured in years, gender (male or female), endoscopic approach, length of stay measured in hours, total surgical time, and surgical levels.

De-identified data was stored in an Excel spreadsheet (Microsoft Corporation, Redmon, Wash.) After data clean-up and quality evaluation, it was imported into RStudio (RStudio, PBC, Boston, MA) for statistical analysis. Continuous data were described by the median and its minimum (min) and maximum (max) values. The absolute frequency (n) and respective categorical proportion (%) described the categorical data.

The data were tested for normality, and since no normal distribution was observed, a nonparametric test, the Mann-Whitney U test, was used. A type I error of up to 5% was accepted as a statistically significant difference.

RESULTS

A total of 107 patients were included in the study after applying the inclusion and exclusion criteria, including 49 males and 58 females. The median age was 43 years and the median length of stay was 19 hours (Table 1). The most common surgical level was L5-S1, and the interlaminar uniportal endoscopic approach was performed in 87.85% of the cases (Table 2). From the surgeries performed by the interlaminar approach, the majority was at the L5-S1 level (68.1%),

Table 1. Demographic characteristics.

Gender - n (%)	
Male	49 (45.80)
Female	58 (54.20)
Age - median years (min-max)	43 (19-77)
Weight - median kilograms (min-max)	77 (47-153)
Height - median meters (min-max)	1.70 (1.51-1.90)
Total Surgical Time - median minutes (mix-max)	156 (35-291)
Length of Stay - median hours (min-max)	19 (7-93)

Table 2. Endoscopic approach and surgical levels.

Endoscopic Approach - n (%)	
Interlaminar	94 (87.85)
L2-L3	0 (0)
L3-L4	2 (2.1)
L4-L5	28 (29.8)
L5-S1	64 (68.1)
Transforaminal	13 (12.15)
L2-L3	1 (7.7)
L3-L4	1 (7.7)
L4-L5	9 (69.2)
L5-S1	2 (15.4)
Surgical Levels - n (%)	
L2-L3	1 (1.0)
L3-L4	3 (2.80)
L4-L5	37 (34.60)
L5-S1	66 (61.60)

and from the surgeries performed by the transforaminal approach, the majority was at the L4-L5 level (69.2%). (Table 2)

When comparing the interlaminar approach with the transforaminal approach, a significant statistical difference was observed in the total surgical time (Table 3). However, when the comparison was made separately for the L4-L5 and L5-S1 levels, no statistical difference was observed (Tables 4 and 5).

Ultimately, no statistically significant difference was observed in the length of stay when comparing the interlaminar approach with the transforaminal approach (Table 6).

DISCUSSION

The findings of this study shed light on important aspects related to uniportal endoscopic approaches for lumbar intervertebral disc herniation. As discussed, disc degeneration and herniation are prevalent conditions with significant social and economic impacts.^{2,3} In some cases, surgery is required to adequately treat a herniated lumbar disc.⁹ The endoscopic technique has evolved over the last few years and gained interest among spine surgeons as an alternative to the traditional microscopic technique.^{14,15,17} There are uniportal and biportal techniques in endoscopic surgery. The biportal emerged to provide greater protection to neural structures. However, the most widely adopted technique currently is the uniportal approach. Both techniques are effective in treating degenerative lumbar disc diseases, with uniportal techniques offering earlier postoperative relief of lower back pain.^{15,18}

The uniportal technique may be performed by the transforaminal (TELD) and the interlaminar (IELD). The crucial step in the TELD technique is precisely positioning the working cannula in the safe zone of Kambin's triangle, located between the operating level's descending and emerging roots.¹⁴ The IELD approach is more intuitive due to the surgeon's anatomical familiarity with posterior access to the lumbar spine. The medial pedicular line serves as a reference for positioning the working cannula.¹⁴

This study focused on comparing the interlaminar and transforaminal uniportal endoscopic approaches, specifically evaluating the aggregate surgical duration and duration of hospitalization. Although many studies confirm the effectiveness of the TELD technique,^{17,19,20} many surgeons queried its efficacy for L5-S1 lumbar disc herniation, considering the narrower foramen and the higher iliac crest at this

level, which can lead to prolonged surgical time and more radiation exposure.¹⁶ When surgeries at all levels (L1-L2 to L5-S1) are evaluated together, the results of this study indicate a significant statistical difference in total surgical time between the IELD and TELD approaches. This finding suggests that the IELD approach is more time-efficient, potentially influencing cost, resource utilization, and patient convenience. In previous studies,^{16,21-24} the IELD takes shorter surgical time and less radiation exposure than TELD. In addition to greater familiarity with the access route, the shorter time needed to use the drill in the interlaminar approach may justify the shorter surgical time.

However, when we compare separately the L4-L5 and L5-S1 levels, this study shows no difference in total surgical time between IELD and TELD approaches. However, it's important to highlight that the low number of cases in this individual comparison reduces the significance of these specific data. In one previous publication²⁵ that studied only the L4-L5 level, the operative time was longer for IELD. Identifying such differences in surgical time is crucial for surgical planning and resource allocation in healthcare settings.

Notably, no statistically significant difference was observed in the length of hospital stay between the IELD and TELD approaches. This implies that, despite variations in surgical time, the postoperative recovery period leading to hospital discharge remains comparable between the two approaches. In previous studies, the hospitalization time was shorter with the TELD technique,^{21,26} contrary to our present study. However, the findings of our current study are also corroborated by previous ones,^{16,23-25} which show no difference in hospitalization time between both techniques.

Another finding of this study is the higher volume of surgeries performed through the IELD technique compared to the TELD technique at both levels (L4-L5 and L5-S1). The broader interlaminar window at the L5-S1 level, most commonly operated, facilitates such access^{14,27} and may be the main reason for this surgeon's preference. Also, the IELD technique may be the best option in cases with hernia migration, high iliac crest, low-lying segmental vessel at the neural foramen, or large disc herniation that occupies more than 50% of the spinal canal at any level.²⁷ It also became clear that the TELD approach is used more frequently at the L4-L5 level than at the L5-S1 level.

Our findings contribute to the ongoing discourse surrounding endoscopic approaches for lumbar disc herniation, shedding light on aspects that influence surgical outcomes and resource utilization. However, it's important to acknowledge this study's limitations, including its retrospective nature and the need for further research to validate and expand upon our findings.

As minimally invasive spine surgery continues to evolve, future studies and advancements will likely refine our understanding of the interlaminar and transforaminal uniportal endoscopic techniques. Continued collaboration between clinicians and researchers is crucial to enhance the evidence base, ultimately improving the quality of care and outcomes for patients undergoing surgical intervention for lumbar disc herniation.

CONCLUSIONS

In conclusion, our study comparing the interlaminar (IELD) and transforaminal (TELD) uniportal endoscopic approaches for lumbar intervertebral disc herniation has provided valuable insights into the surgical landscape. The observed significant statistical difference in total surgical time, showing shorter operative time for IELD when all levels are compared, suggests that choosing these approaches may impact efficiency, resource utilization, and overall healthcare costs. While the study did not reveal a statistically significant difference in the length of hospital stay between the two approaches, the identified discrepancy in surgical time emphasizes the need for careful consideration when selecting the surgical technique.

All authors declare no potential conflict of interest related to this article.

Table 3. Total surgical time statistical analysis.

Interlaminar	
Total Surgical Time - median minutes (mix-max)	155 (35-291)
Transforaminal	
Total Surgical Time - median minutes (mix-max)	173 (124-251)
<i>Mann-Whitney U Test</i>	<i>p = .04945</i>

Table 4. Total surgical time level L4-L5 statistical analysis.

Interlaminar	
Total Surgical Time - median minutes (min-max)	159 (92-291)
Transforaminal	
Total Surgical Time - median minutes (min-max)	185 (124-251)
<i>Mann-Whitney U Test</i>	<i>p = .1673</i>

Table 5. Total surgical time level L5-S1 statistical analysis.

Interlaminar	
Total Surgical Time - median minutes (min-max)	153.5 (35-261)
Transforaminal	
Total Surgical Time - median minutes (min-max)	154 (135-173)
<i>Mann-Whitney U Test</i>	<i>p = .9552</i>

Table 6. Length of stay statistical analysis.

Interlaminar	
Length of Stay - median hours (min-max)	20 (7-93)
Transforaminal	
Length of Stay - median hours (min-max)	17 (11-24)
<i>Mann-Whitney U Test</i>	<i>p = .1107</i>

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