

COMPARISON OF THE RESULTS OF MIS-TLIF AND OPEN TLIF TECHNIQUES IN LABORERS

COMPARAÇÃO DOS RESULTADOS DO MIS-TLIF VERSUS TLIF ABERTO EM TRABALHADORES BRAÇAIS

COMPARACIÓN DE LOS RESULTADOS DE LAS TÉCNICAS MIS-TLIF Y TLIF ABIERTA EN OBREROS

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ABSTRACT

Objective: To compare clinical outcomes in laborers who have undergone open transforaminal interbody fusion (TLIF) and minimally invasive transforaminal interbody fusion (MIS TLIF). **Methods:** 78 patients were submitted to lumbar arthrodesis by the same two spine surgeons partners from January 2008 to December 2012. Forty-one were submitted to traditional open arthrodesis and 37 to the minimally invasive procedure. Three patients were not included because they had already retired from work. The analyzed variables were length of hospitalization, length of follow-up, type of access (TLIF or MIS TLIF), need for blood transfusion, percentage of improvement or worsening after surgery, pre- and postoperative VAS scale, time off work, pre- and postoperative Oswestry disability index, and general aspects of the laborers such as age, education, profession, working time, amount of daily weight carried at work, and use or not of personal protective equipment. **Results:** Time off work was longer in the TLIF group (average of 9.84 months) compared with the MIS TLIF group (average of 3.20 months). Significant improvement in postoperative VAS and Oswestry was achieved in both groups. Average length of hospitalization was 5.73 days for the TLIF group and 2.76 days for the MIS TLIF group. **Conclusions:** Minimally invasive transforaminal lumbar interbody fusion presents similar results when compared to open TLIF, but has the benefits of less postoperative morbidity, shorter hospitalization times, and faster rehabilitation in laborer patients.

Keywords: Arthrodesis; Lumbar vertebrae; Spinal fusion; Minimally invasive surgical procedures; Occupational health.

RESUMO

Objetivo: Comparar resultados clínicos em trabalhadores braçais submetidos à artrodese transforaminal aberta (TLIF) e minimamente invasiva (MIS-TLIF). **Métodos:** Setenta e oito pacientes foram submetidos à artrodese lombar pela mesma dupla de cirurgiões de coluna, de janeiro de 2008 a dezembro de 2012, sendo 41 artrodeses por cirurgia aberta tradicional e 37 por procedimento minimamente invasivo. Três pacientes não foram incluídos na pesquisa por já estarem aposentados. As variáveis analisadas foram: tempo de internação, tempo de seguimento, via de acesso (TLIF ou MIS-TLIF), necessidade de hemotransfusão, porcentagem de melhora ou piora após cirurgia, escala visual analógica (EVA) no pré e pós-operatório, tempo para retornar ao trabalho após a cirurgia, questionário Oswestry no pré-operatório e pós-operatório, além de aspectos gerais do trabalhador braçal como: idade, escolaridade, profissão, tempo de trabalho, peso que carrega diariamente no trabalho, uso ou não de equipamento de proteção individual (EPI). **Resultados:** O tempo de retorno ao trabalho foi maior no grupo de TLIF (média de 9,84 meses) em comparação ao grupo de MIS-TLIF (média de 3,20 meses). Houve melhora significativa da EVA e do questionário Oswestry no pós-operatório em ambos os grupos. O tempo de internação hospitalar médio foi de 5,73 dias para a TLIF e de 2,76 dias para o MIS-TLIF. **Conclusões:** A artrodese transforaminal minimamente invasiva apresenta resultados similares à da TLIF aberta, com os benefícios adicionais de menor morbidade pós-operatória, menor período de internação e reabilitação precoce em pacientes trabalhadores braçais.

Descritores: Artrodese; Vértebras lombares; Fusão vertebral; Procedimentos cirúrgicos minimamente invasivos; Saúde do trabalhador.

RESUMEN

Objetivo: Comparar los resultados clínicos en obreros sometidos a artrodosis transforaminal abierta (TLIF) y cirugía mínimamente invasiva (MIS-TLIF). **Métodos:** Setenta y ocho pacientes fueron sometidos a artrodosis lumbar por el mismo par de cirujanos de columna entre enero de 2008 y diciembre de 2012, siendo 41 artrodosis por cirugía abierta tradicional y 37 procedimientos mínimamente invasivos. Tres pacientes no se incluyeron en el estudio debido a que ya están jubilados. Las variables analizadas fueron la duración de la estancia hospitalaria, el tiempo de seguimiento, vía de acceso (TLIF o MIS-TLIF), necesidad de transfusión de sangre, el porcentaje de mejoría o empeoramiento después de la cirugía, la escala VAS (escala analógica visual) en el pre y postoperatorio, tiempo para volver al trabajo después de la cirugía, el cuestionario Oswestry pre y postoperatorio, además de los aspectos generales del trabajador como la edad, educación, profesión, tiempo de trabajo, la carga de peso diario en el trabajo, uso o no de equipo de protección personal (EPP). **Resultados:** El tiempo de retorno al trabajo fue mayor en el grupo TLIF (media de 9,84 meses) en comparación con el grupo MIS-TLIF (media 3,20 meses). Se observó mejoría significativa en VAS y el cuestionario Oswestry en el postoperatorio en ambos grupos. La estancia hospitalaria media fue de 5,73 días para TLIF y 2,76 días para MIS-TLIF. **Conclusiones:** La fusión transforaminal mínimamente invasiva muestra resultados similares a la TLIF abierta, con los beneficios añadidos de menor morbilidad postoperatoria, menor estancia hospitalaria y rehabilitación temprana de los obreros.

Descriptores: Artrodosis; Vértebras lumbares; Fusión vertebral; Procedimientos quirúrgicos mínimamente invasivos; Salud laboral.

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INTRODUCTION

Spinal diseases correspond to approximately 30 cases of retirement out of every 100 thousand people receiving social welfare benefits, as well as being among the main causes of medical leave.¹ The way to lift objects and the laborer's mass related to the mass of the object should be observed to prevent damage to the spine. The International Labour Organization (ILO-1988) recommends that in activities that involve lifting a total weight of more than 55 kg, steps must be taken to reduce it. It is observed that back problems among Brazilian laborers who handle heavy loads represent approximately 70% of cases.¹

According to the specialized literature, incorrect handling and manual movement of loads are the most frequent cause of occupational accidents involving individuals.¹

Brazil is a country that invests very little in the prevention of accidents at work. According to Silva et al.² the majority of accidents are due to poor working conditions, where the laborer's own body is the work tool.

Lumbar arthrodesis has been widely used for different pathological conditions of the spine resulting from degeneration, trauma or neoplasm. Reports from the beginning of the last century have described lumbar arthrodesis, whether by the anterior (ALIF, by Capener³ in 1932) or posterior (PLIF, by Cloward⁴ in 1953) routes. Following on from those ideas, transforaminal lumbar interbody fusion (TLIF), which uses a less invasive approach by the posterior unilateral route, was perfected and popularized by Harms and Jerszensky.⁵ Since 1991, when Obenchain⁶ described the first laparoscopic lumbar discectomy, the field of minimally invasive surgery of the spine has continued to evolve. Surgeons and patients have been attracted by the advantages of minimally invasive surgery, such as the fact that it causes less tissue trauma during the surgical approach, less postoperative pain, shorter hospitalization times, and a faster return to daily activities.⁷⁻¹⁰

There are no comparative studies in the literature on the results of minimally invasive arthrodesis and open arthrodesis in the Brazilian population of laborers. This study therefore compares these techniques in this specific population.

MATERIALS AND METHODS

This is a retrospective, descriptive study with 78 patients submitted to transforaminal lumbar arthrodesis by the same pair of spine surgeons at Hospital Lificenter, Hospital Santa Rita and Hospital Vila da Serra de Belo Horizonte, in Minas Gerais, in the period from January 2008 to December 2012. This study gained approval from the Ethics Committee of our Institution.

The inclusion criteria were laborers submitted to lumbar arthrodesis by the TLIF technique, whether traditional open or minimally invasive. (We define minimally invasive arthrodesis as a procedure performed using a tubular retractor followed by percutaneous pedicle screw fixation).

The inclusion criteria for laborers were: those engaged in professional activities that mainly use the upper and/or lower limbs, associated with a total daily weight lifted of more than 35 kg. The patients were divided into two groups: 35 to 50 kg lifted/day, and more than 50 kg lifted/day. Patients who had already retired were not included in the research.

Searches were carried out in the Pubmed, Bireme, and Scielo databases, using the keywords: TLIF, laborer, minimally invasive surgery, open transforaminal versus minimally invasive arthrodesis.

Questionnaires were applied to all the patients, laborers who had undergone minimally invasive or open TLIF. All the patients signed an informed consent form and were in agreement with the research.

To compare the variables raised in the research for the groups "Open surgery" (OS) and "Minimally invasive surgery" (MIS), the Mann-Whitney test was used for the quantitative variables, and the Chi-square test (replaced by Fisher's exact test where necessary) for the qualitative variables.

To determine the difference in the VAS and Oswestry scores be-

tween preoperative and postoperative values, the Wilcoxon signed-rank test was used.

To determine the correlation of the VAS and Oswestry scores with follow-up time, Spearman's correlation coefficient (measure of correlation limited between 1 and -1) was used. The closer the coefficient is to -1, the greater the negative correlation. The closer the coefficient is to 1, the greater the positive correlation. A level of significance of 5% was used. The software used in the analysis was R version 2.15.2.

RESULTS

The patients in this study were mostly industrial workers (18 patients) – an industrial assembler and industrial cooks. The remaining patients were: mechanics (16), electricians (12), truck drivers (7), fire fighters (6) and police officers (6), among other professions, including: personal trainer, textile factory worker, and drinks deliverer.

The average age of the workers who underwent OS was 48.29 years, while the average age of those who underwent MIS was 42.27 years. (Table 1)

To compare the groups that underwent the different types of surgery through the quantitative variables, the Mann-Whitney test was used. (Table 1 and Figure 1) Thus, it can be seen that there was a significant difference in hospitalization times of patients between the types of surgery; the OS group tended to present longer hospitalization times than the MIS group. In the OS group, at least 50% of the patients had a hospitalization time of five days or less, while in the MIS group, at least 50% of the patients had a hospitalization time of three days or less.

There was significant difference in return to work time of patients between the surgery types; the OS patients tended to present longer times than the MIS patients. In the MIS group, at least 50% of the patients returned to work in 2.5 months or less, while in the OS group, at least 50% of the patients returned to work in 7 months or less.

Table 1. Descriptive measurements and Mann-Whitney test for quantitative variables by type of surgery.

Variable	Type of surgery	N	Mean	E.P.	1 Q	2 Q	3 Q	P-value
Age (years)	OS	41.00	48.29	1.66	42.00	47.00	54.00	0.018
	MIS	37.00	42.27	1.94	33.00	43.00	49.00	
Hospitalization time (days)	OS	41.00	5.73	0.82	3.00	5.00	7.00	< 0.001
	MIS	37.00	2.76	0.23	2.00	3.00	4.00	
Follow-up time (months)	OS	41.00	24.07	2.40	12.00	24.00	36.00	0.169
	MIS	37.00	19.08	1.68	12.00	18.00	24.00	
Service time (years)	OS	41.00	16.22	1.83	7.00	15.00	22.00	1.000
	MIS	37.00	15.35	1.45	8.00	15.00	20.00	
Improvement index	OS	41.00	0.66	0.07	0.60	0.80	0.90	0.001
	MIS	37.00	0.88	0.02	0.80	0.90	1.00	
Pre-VAS score	OS	41.00	9.50	0.11	9.00	10.00	10.00	0.078
	MIS	37.00	9.76	0.09	10.00	10.00	10.00	
Post-VAS score	OS	41.00	3.31	0.38	2.00	3.00	4.00	0.173
	MIS	37.00	2.54	0.35	0.50	2.00	5.00	
Time to return to work (days)	OS	41.00	9.84	1.19	4.00	7.00	12.00	< 0.001
	MIS	37.00	3.20	0.46	1.50	2.50	4.00	
Pre-Oswestry score	OS	41.00	40.15	3.95	24.00	32.00	64.00	< 0.001
	MIS	37.00	61.08	2.44	52.00	66.00	72.00	
Post-Oswestry score	OS	41.00	18.44	3.25	4.00	10.00	20.00	0.149
	MIS	37.00	12.65	2.36	0.00	6.00	22.00	

To compare groups by type of surgery through the qualitative variables, the Chi-square test was used, and where necessary, Fisher's exact test. Thus, it can be seen in Table 2 and Figure 2 that: there was a significant association between the variable blood transfusion and the type of surgery performed. Only patients in the OS group received blood transfusions (39.5%).

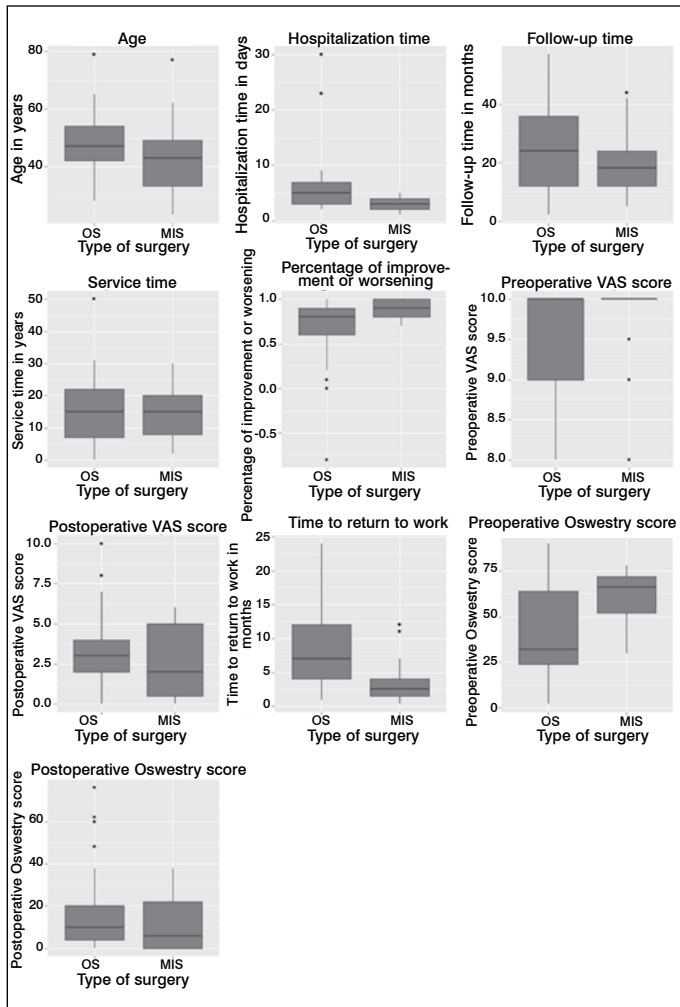


Figure 1. Boxplot for quantitative variables by type of surgery.

Table 2. Contingency and Chi-square test or Fisher's exact test for qualitative variables by type of surgery.

Variables	Factors	Type of surgery						P-value	O.R.	L.I.	L.S.
		OS		MIS		Total					
Blood transfusion	Not	23	60.5%	37	100.0%	60	80.0%	< 0.001*	1.000		
	Yes	15	39.5%	0	0.0%	15	20.0%		0.019	0.005	0.325
	Total	38	100.0%	37	100.0%	75	100.0%				
Level of education	Elementary school	19	76.0%	6	24.0%	25	100.0%	0.009*	1.000		
	Secondary school	18	46.2%	21	53.8%	39	100.0%		3.694	1.214	11.244
	Higher education	4	28.6%	10	71.4%	14	100.0%		7.917	1.804	34.737
	Total	41	52.6%	37	47.4%	78	100.0%				
Weight lifted per day	More than 50 kg	30	73.2%	25	67.6%	55	70.5%	0.588	1.000		
	Less than 50 kg	11	26.8%	12	32.4%	23	29.5%		1.309	0.494	3.471
	Total	41	100.0%	37	100.0%	78	100.0%				
Use of protective equipment	No	23	56.1%	11	29.7%	34	43.6%	0.019	1.000		
	Yes	18	43.9%	26	70.3%	44	56.4%		3.020	1.184	7.706
	Total	41	100.0%	37	100.0%	78	100.0%				
Sex	Female	13	31.7%	12	32.4%	25	32.1%	0.945	1.000		
	Male	28	68.3%	25	67.6%	53	67.9%		0.967	0.373	2.506
	Total	41	100.0%	37	100.0%	78	100.0%				

* Fisher's exact test.

Variable use of personal protective equipment (PPE): it was found that of the total number of patients, 56.4% had used PPE while 43.6% had not. In the OS group, 56.1% of patients had used PPE, while 43.9% had not. In the MIS group, 70.3% of the patients had used PPE, while 29.7% had not.

The Wilcoxon test was used to determine whether there was any significant difference between the pain scales before and after surgery. (Table 3 and Figure 3) It was observed that the postoperative VAS score was significantly lower than the preoperative VAS score (less than 50% of individuals had a decrease of up to seven points in the VAS score).

The postoperative Oswestry score was significantly lower than the preoperative Oswestry score (less than 50% of individuals decreased by up to 30 points).

To determine whether there was any significant difference between the pain scales before and after surgical intervention, stratified by type of surgery, the Wilcoxon test was used again (Table 4 and Figure 4), with no statistical difference being observed between the improvement in preoperative and postoperative VAS scores for the two types of surgery.

In terms of Oswestry score, the MIS group showed a greater decrease in the postoperative period than the OS group (p-value < 0.001). In the OS group, at least 50% of the patients showed a decrease of 14 points in the postoperative period, while in the MIS group, at least 50% of the patients showed a decrease of 52 points.

Spearman's correlation test was used to determine whether there were any correlations between the preoperative and postoperative Oswestry scores for each type of surgery with the variable follow-up time. (Table 5)

We also found a significant negative correlation between postoperative Oswestry score and follow-up time in the patients who underwent minimally invasive surgery. In other words, in these patients, the longer the follow-up time, the lower the postoperative Oswestry score.

DISCUSSION

Lumbar arthrodesis surgery is associated with extensive dissection of the soft tissues, and several authors have reported the negative consequences of this procedure, with a significant increase in morbidity.¹¹ Because MIS-TLIF involves parasagittal access between the multifidus and the longissimus (erector spinae), it preserves the natural posterior tension band created by the inter- and supraespinous ligaments, as well as the insertion, vascularization and innervation of the paravertebral musculature.¹²⁻¹⁴

Transforaminal access, whether open or minimally invasive, promotes complete exposure of the posterolateral aspect of the

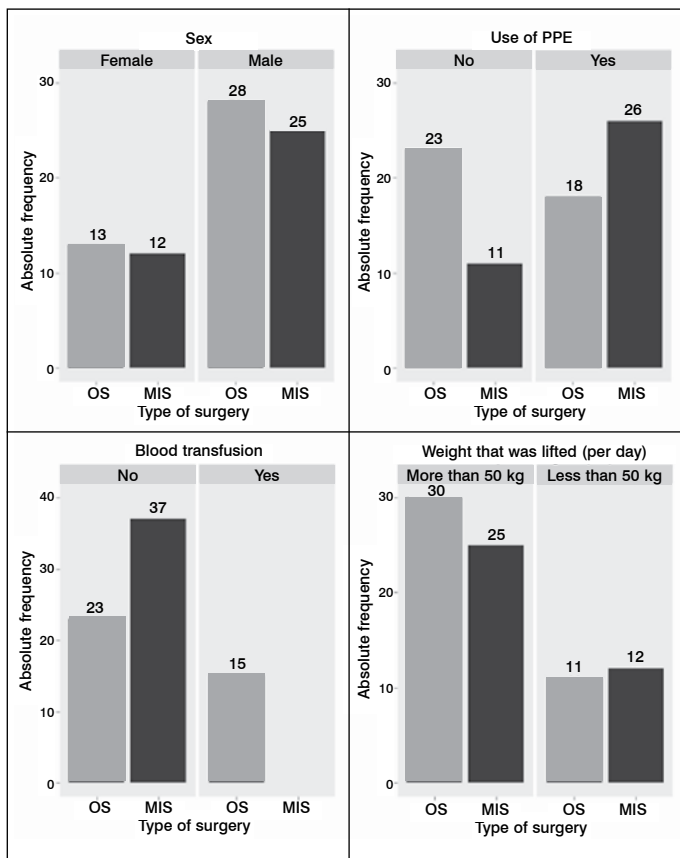


Figure 2. Qualitative variables by type of surgery.

Table 3. Descriptive measurements and Wilcoxon test of the difference between post- and preoperative periods for the variables VAS and Oswestry scores.

Variable	N	Mean	E.P.	1 Q	2 Q	3 Q	P-value
VAS score of the difference (Post - Pre)	78.00	-6.68	0.28	-8.00	-7.00	-5.00	< 0.001
Oswestry score of the difference (Post - Pre)	78.00	-34.39	2.81	-52.00	-30.00	-14.00	< 0.001

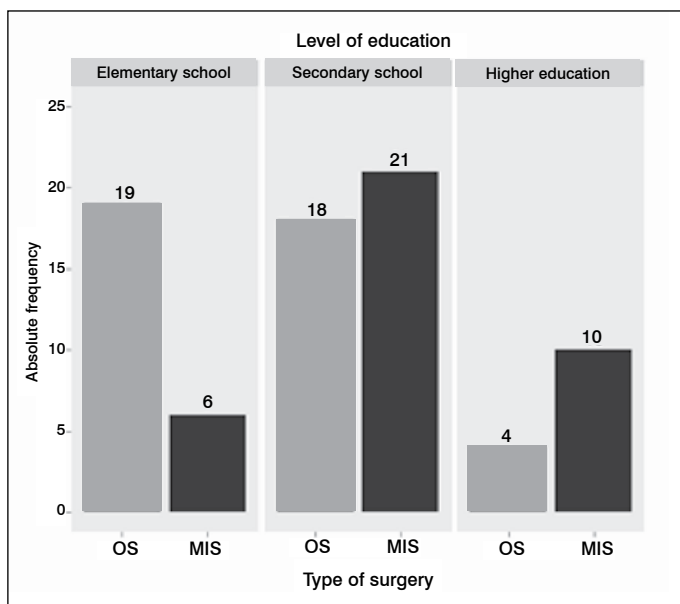


Figure 3. Boxplot of the difference between post- and preoperative variables VAS and Oswestry scores.

Table 4. Descriptive measurements and Wilcoxon test of the difference between post- and preoperative periods for the variables VAS and Oswestry scores stratified by type of surgery.

Variable	Type of surgery	N	Mean	E.P.	1 Q	2 Q	3 Q	P-value
VAS score of the difference (Post - Pre)	OS	41.00	-6.20	0.40	-8.00	-7.00	-5.00	< 0.001
	MIS	37.00	-7.22	0.38	-9.00	-7.00	-5.00	< 0.001
Oswestry score of the difference (Post - Pre)	OS	41.00	-21.71	3.48	-32.00	-14.00	-10.00	< 0.001
	MIS	37.00	-48.43	3.22	-66.00	-52.00	-30.00	< 0.001

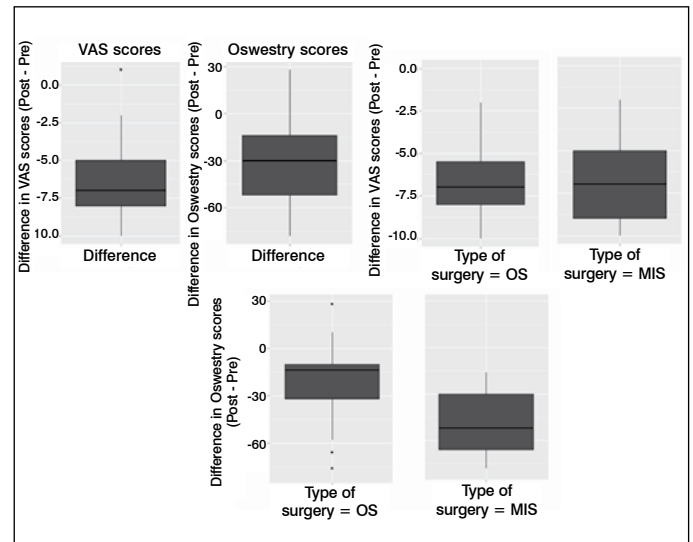


Figure 4. Boxplot of the difference between post- and preoperative variables VAS and Oswestry scores stratified by type of surgery.

Table 5. Spearman's correlation test between the Oswestry scores and follow-up time and time of pain before surgery, stratified by type of surgery.

Variables	Type of surgery	Follow-up time	
		R	P-value
Pre-Oswestry score	OS	-0.125	0.437
	MIS	-0.072	0.671
Post-Oswestry score	OS	0.048	0.764
	MIS	-0.488	0.002

intervertebral disc, requiring minimal retraction of nerve roots and dural sac in order to perform the intersomatic arthrodesis, and the insertion of an intersomatic spacer.¹⁵⁻¹⁷ The retractors are used merely as protectors during the proper preparation of the intersomatic space and insertion of the bone graft and spacer. The separation of tissues is therefore unilateral and minimal, significantly reducing the risk of neural injury caused by traction and manipulation.¹⁸ The percutaneous screws also ensure that the soft parts of the layers adjacent to the operated layer remain intact, preventing the occurrence of a proximal iatrogenic instability.¹⁹

In this study, another clear advantage of MIS-TLIF was the reduction of intraoperative bleeding when compared to open TLIF. Substantial blood loss is frequently reported in the literature in association with open arthrodesis. This reduction in bleeding observed in MIS virtually does away with the need for blood transfusion and its associated risks. Both groups achieved an improvement in VAS and Oswestry scores. It was expected that the groups would maintain this relationship of equivalence, demonstrating the benefits of transformaminal arthrodesis, whether by the open or minimally invasive route.²⁰ However, as already described by several authors, the immediate benefits of a significant reduction in surgical morbidity justify the use of the minimally invasive technique, which proved

to be as effective and safe as open surgery. Khoo,²¹ in the World Congress of Minimally Invasive Spine Surgery and Techniques, 2008, showed similar results to those of the present study, with two years of follow-up. However, the author also noted that with four years of follow-up, the patients of the MIS group tended to continue to show lower scores, while the OS group tended to show an increase in VAS and Oswestry scores.

The average time to return to work was 9.84 months for the OS group and 3.20 months for the MIS group.

A longer learning curve and adequate training are essential for the safe development of this technique. Unlike traditional open access routes, minimally invasive surgeries are limited to the area of surgical interest, exposing only the anatomical points of interest, in a guided field of vision.²²⁻²⁶ Familiarity with the procedure enables the surgeon to perform the surgery safely, without having to expose anatomical structures not involved in the procedure.²⁷

CONCLUSIONS

There are major benefits of MIS-TLIF when compared to open TLIF in laborers. The patients who underwent open TLIF tended to present longer hospitalization times than those who underwent MIS-TLIF, and needed longer time to return to work. In addition, they were more likely to require a blood transfusion, which was not observed in the patients who underwent MIS-TLIF.

Both groups showed an improvement in pre- and postoperative scores, with a tendency to better results in the MIS group.

Prospective studies with long follow-up times are still needed to better establish the comparison between the techniques.

All authors declare no potential conflict of interest concerning this article.

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