POSTEROLATERAL, POSTERIOR AND MI-TRANSFORAMINAL LUMBAR INTERBODY FUSION: A STUDY OF 212 CASES

FUSÃO PÓSTERO-LATERAL, POSTERIOR E MI-TRANSFORAMINAL: ESTUDO COMPARATIVO 212 CASOS

FUSIÓN POSTEROLATERAL, POSTERIOR Y MI-TRANSFORAMINAL: ESTUDIO DE 212 CASOS

Bruno Miguel Brígido Maia[1], Luís Pedro Duarte Silva[1], Isabel Cristina Gomes Costa Simões[1], Pedro Carvalhais Simões[1], Luís Pedro Sousa Ferreira Teixeira[1]

1. Spine Center, Cirurgia da Coluna, Coimbra, Portugal.

ABSTRACT

Objective: Degenerative disc disease is a common problem that could require surgical treatment. The aim of this study was to compare clinical outcomes, complications and benefits associated with intersomatic fusions by the MI-TLIF, PLIF and PLF techniques. Methods: A total of 212 patients were retrospectively reviewed. All patients underwent the same pre- and postoperative clinical evaluations using the Oswestry Disability Index (ODI), Visual Analog Scale (VAS), and SF-36. Follow-ups were performed for at least one year. Inpatient days, complications, blood loss and operative times were equally quantified. Results: Estimated blood loss for MI-TLIF was statistically lower compared to the amount of blood recovered by Cell Saver device on PLIF and PLF groups. Mean surgical time for MI-TLIF were not significantly different compared to PLIF and PLF groups. Inpatient days were significantly lower in the MI-TLIF group, with an average decrease of one day. Four complications were recorded in the PLIF group, 2 in the PLF group, and one in the MI-TLIF group. Analysis of the clinical parameters revealed post-operative improvements at all time points, with the most statistically significant differences occurring at the first six months. Better results were achieved with the MI-TLIF technique. Conclusions: Compared to more invasive techniques, MI-TLIF showed fewer complications, less blood loss and shorter hospitalization times. Longer operative times in this group can be explained by the greater technical complexity and incipient learning curves. Interbody fusion by PLIF, PLF and MI-TLIF provided good clinical outcomes, but faster recovery was obtained with less invasive techniques. **Level of evidence: III; Type of study: Retrospective comparative case study.**

Keywords: Chronic disease; Spine; Surgery; Complications.

RESUMO

*Objetivo: O objetivo deste estudo foi comparar resultados clínicos, complicações e benefícios associados às fusões intersomáticas pelas técnicas MI-TLIF, PLIF e PLF. Métodos: 212 doentes foram revistos retrospectivamente. Todos os doentes foram submetidos ao mesmo método de avaliação clínica pré e pós-operatória usando o índice de incapacidade Oswestry (ODI), o Score visual analógico para a dor (VAS) e a escala SF-36. Os follow-ups foram realizados durante o período de um ano. O tempo de internamento, complicações, perdas sanguíneas e tempos operatórios também foram contabilizados. Resultados: As perdas sanguíneas estimadas para o grupo MI-TLIF foram estatisticamente inferiores comparativamente com a quantidade de sangue recuperada pelo sistema "Cell Saver" nos grupos PLIF e PLF. O tempo médio de cirurgia para o MI-TLIF não apresentou diferenças estatísticas comparativamente aos grupos PLIF e PLF. O tempo de internamento foi significativamente inferior no grupo MI-TLIF, apresentando uma diminuição média de um dia. Quatro complicações foram registradas no grupo PLIF, duas no grupo PLF e uma no grupo MI-TLIF. A análise dos parâmetros clínicos revelou melhorias pós-operatórias em todos os grupos, com diferenças mais acentuadas nos primeiros seis meses. Conclusão: comparativamente com as técnicas mais invasivas, o MI-TLIF demonstrou uma menor taxa de complicações, menos perdas sanguíneas e menor tempo de internamento. Os tempos operatórios superiores neste grupo, podem ser explicados pela maior complexidade técnica e curvas de aprendizagem incipientes. Os doentes operados pelas técnicas PLIF, PLF e MI-TLIF apresentaram excelentes resultados clínicos, porém as técnicas menos invasivas, associam-se a uma recuperação mais rápida. **Nível de evidencia: III. Tipo de estudo: Estudo comparativo retrospetivo.***

Descritores: Doença crônica; Coluna vertebral; Cirurgia; Complicações.

RESUMEN

*Objetivo: La enfermedad degenerativa del disco es un problema común que puede requerir tratamiento quirúrgico. El objetivo de este estudio fue comparar resultados clínicos, complicaciones y beneficios asociados a las fusiones intersomáticas mediante las técnicas MI-TLIF, PLIF y PLF. Métodos: Un total de 212 pacientes fue evaluado retrospectivamente. Todos los pacientes fueron sometidos a las mismas evaluaciones clínicas pre y postoperatorias utilizando el Índice de Discapacidad de Oswestry (ODI), Escala visual analógica (EVA) y SF-36. Los seguimientos se realizaron durante al menos uno año. Los días de hospitalización, las complicaciones, la pérdida de sangre y los tiempos operatorios también se cuantificaron. Resultados: La pérdida de sangre estimada para MI-TLIF fue estadísticamente inferior en comparación con la cantidad de sangre recuperada por el dispositivo Cell Saver en los grupos PLIF y PLF. El tiempo quirúrgico promedio para MI-TLIF no fue significativamente diferente en comparación con los grupos PLIF y PLF. Los días de internación fueron significativamente inferiores en el grupo MI-TLIF, con una disminución promedio de uno día. Se registraron cuatro complicaciones en el grupo PLIF, dos en el grupo PLF y una en el grupo MI-TLIF. El análisis de los parámetros clínicos reveló mejorías postoperatorias en todos los puntos del tiempo, con las diferencias estadísticamente más significativas ocurriendo en los primeros seis meses. Se obtuvieron mejores resultados con la técnica MI-TLIF. Conclusiones: En comparación con las técnicas más invasivas, MI-TLIF mostró menos complicaciones, menos pérdida de sangre y tiempos de internación más cortos. Los tiempos operativos superiores en este grupo se pueden explicar por la mayor complejidad técnica y las curvas de aprendizaje incipientes. La fusión intersomática por PLIF, PLF y MI-TLIF proporcionó buenos resultados clínicos, pero se obtuvo una recuperación más rápida con técnicas menos invasivas. **Nivel de evidencia: III. Tipo de Estudo: Estudio comparativo retrospectivo.***

Descriptores: Enfermedad crónica; Columna vertebral; Cirugía; Complicaciones.

Study conducted at the Spine Center, Cirurgia da Coluna, Coimbra, Portugal.
Correspondence: Av. Emídio Navarro 17, 3000-150 Coimbra, Portugal. bruno_miguel_maia@hotmail.com

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INTRODUCTION

Lumbar interbody fusion is used to treat various symptomatic spinal deformities and instabilities.[1] The main goal is achieve a stable fusion with improved disc height and vertebral alignment, relieving pressure on the neural structures.[2] There are different techniques available, and each one has its benefits and disadvantages.[3] Posterior Lumbar Interbody Fusion (PLIF) continues to be widely used, allowing access to the majority of intervertebral disc spaces and nerve roots bilaterally.[4] However, the disruption of soft tissues and neural retraction required may contribute to post-operative discomfort and long-term disability.[5]

Minimally invasive transforaminal lumbar interbody fusion (MI-TLIF) has been shown to be a valuable alternative to traditional PLIF and posterolateral fusion (PLF).[6] With a transforaminal approach, an appropriate disc space exposure can be achieved, reducing epidural scarring.[7] Due to its unilateral approach, better preservation of lumbar spine musculoligamentous complex can be obtained. Additional benefits are less pain, early ambulation, and shorter hospitalization times.[8]

The aim of this retrospective study is to report our experience in the treatment of lumbar instabilities, comparing the clinical outcomes, drawbacks and benefits associated with these techniques.

METHODS

Patient selection:

We performed a retrospective analysis of 212 patients with degenerative disc disease treated in our hospital between February 2013 and December 2014. The patients were divided into three groups: PLIF with two cages (n=77), TLIF with one banana-shaped cage (n=70) and PLF (n=65).

Patients in this series had low back pain as their predominant symptom, with varying degrees of radicular pain and neurological symptoms. All of them were treated conservatively with physiotherapy and nonsteroidal anti-inflammatory drugs for at least three months, without success, before being considered for surgery.

Preoperative evaluation was conducted with a detailed neurological examination and radiological imaging, involving static (anterior-posterior and lateral) and dynamic plain radiographs, magnetic resonance imaging (MRI), and/or computed tomography (CT). Informed consent was delivered and signed by every patient, and the study was approved by our institution's ethics committee (process number 27/2016).

Clinical assessment:

Clinical charts were reviewed for: analytic studies, age, sex, operated levels, operative times, intraoperative blood loss, clinical results, and complications.

Clinical outcomes were evaluated using the Oswestry Disability Index (ODI) for lumbar disability, the Visual Analogue Scale (VAS) for back and leg pain, and SF-36 for quality of life. Patients were evaluated pre-operatively and then at one, three, and six months and one-year post-surgery.

Surgical technique

A detailed description of MI-TLIF, PLIF and PLF is available in the literature.[9-11] The intraoperative three-dimensional (3D) O-arm system was used to acquire images to guide screw placement. All procedures were performed by senior orthopedic spine surgeons, using a strictly standardized technique.

Radiologic assessment

The accuracy of pedicle screw placement was verified by intra-operative images using the O-arm navigation system.

Statistical Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS, Chicago, IL, USA). Data are shown as mean ± standard error. Student's t-test was used to compare continuous variables, and the Mann-Whitney U test was applied when ordinal and quantitative variables had no standard normal distribution. P values below 0.05 were accepted as significant.

RESULTS

The mean follow-up period was 15 months, ranging from 12 to 18 months. For the purposes of this study, we only included the results of the first 12 months. Preoperative demographics showed similar distribution between groups (Table 1). None of the MI-TLIF patients needed to be converted to open surgery. In terms of intraoperative parameters, the following differences were recorded:

EBL (Estimated blood loss):

EBL for MI-TLIF was statistically lower compared to the amount of blood recovered by the Cell Saver device in the PLIF (143.57±6.74 vs 345.85±40.03 mL, p=0.02) and PLF (143.57±6.74 vs 284.19±42.59 mL, p=0.03) groups. There were no significant differences between the PLF and PLIF groups (Table 2).

Operative Times:

The mean surgical time for MI-TLIF was not significantly different compared to the PLIF and PLF groups. No statistical differences were recorded between open surgery groups.

Inpatient days:

Differences were found with regard to length of hospital stay. Inpatient days were significantly lower in the MI-TLIF group compared to the PLIF group (3.05±1.32 vs 4.08±0.99 days, p=0.04) and PLF (3.05±1.32 vs 4.42±1.23 days, p=0.04) groups.

Complications:

Two durotomies were recorded in PLIF group. Similarly, two durotomies were recorded in the PLF group. In the MI-TLIF group, a superficial wound infection was recorded.

There were no screw misplacements in this study. All screws were positioned using the O-arm navigation system.

Table 1. Demographic characteristics of MI-TLIF, PLIF and PLF groups.

Parameters	MI-TLIF (n = 70)	PLIF (n = 77)	PLF (n = 65)
Sex			
Male	31	35	34
Female	39	42	31
Mean age (years)	57.32±12.86	58.77±9.23	59.69±8.34
Operated levels			
1	46	42	37
2	24	35	28
Follow-up (months)	16.31±7.2	16.63±6.1	15.54±6.8

Table 2. Intraoperative parameters and clinical outcomes comparing the PLIF and PLF groups.

Parameters	PLIF (n = 77)	PLF (n = 65)	p value
Operative time (min)	224.02±56.9	216.52±45.8	0.54
Blood loss (mL)	345.85±40.03	284.19±42.59	0.22
Inpatient days	4.08±0.99	4.42±1.23	0.82
VAS score			
Pre-operative	5.32	5.27	
six months	1.9	2.05	
one year	2.36	2.44	
one year variation	2.96	2.83	0.615
ODI score			
Pre-operative	39.99	42.65	
six months	22.23	23.61	
one year	19.6	20.64	
one year variation	20.39	22.01	0.564

Clinical Outcomes

In this Study, the pain index improved from 6.37 to 1.93 in the MI-TLIF group ($p< 0.05$), from 5.32 to 2.36 in the PLIF group ($p < 0.05$), and from 5.27 to 2.44 in the PLF group ($p < 0.05$). The disability index score also had good outcomes, improving from 42.29 to 17.3 in the MI-TLIF group ($p < 0.05$), from 39.99 to 19.16 in the PLIF group ($p < 0.05$), and from 42.65 to 20.64 in the PLF group ($p < 0.05$). Similar results were obtained for the SF-36 quality of life score in terms of physical (Figure 1) and mental health status (Figure 2).

Although we did not obtain statistically significant differences between groups for disability scores (ODI), the MI-TLIF group was statistically more effective in terms of pain improvement compared with the PLIF (Table 3) and PLF groups (Table 4).

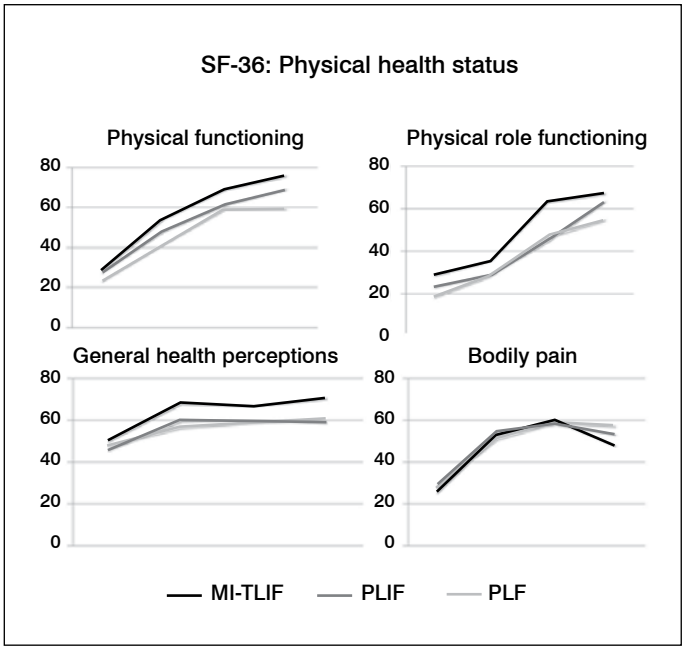

Figure 1. SF-36 – Physical health status comparing the MI-TLIF vs PLIF vs PLF groups

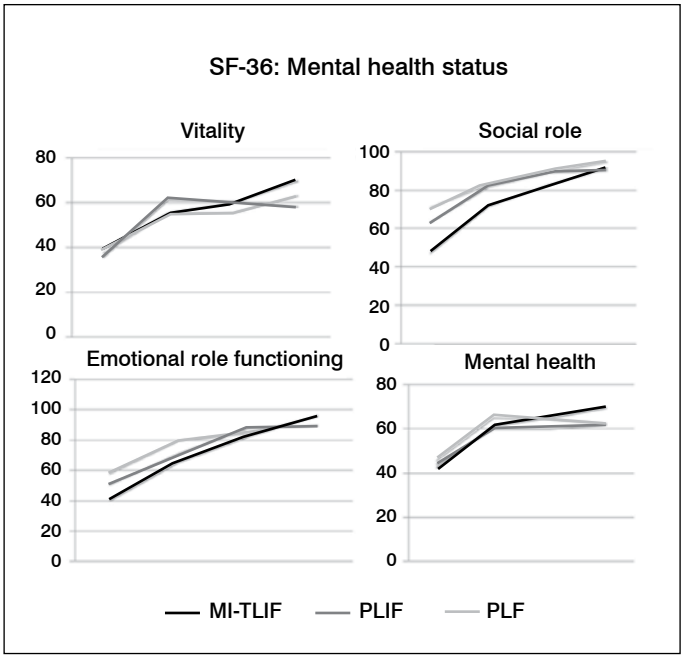

Figure 2. SF-36 – Mental health status comparing the MI-TLIF vs PLIF vs PLF groups.

Table 3. Intraoperative parameters and clinical outcomes comparing the MI-TLIF and PLIF groups.

Parameters	MI-TLIF (n = 70)	PLIF (n = 77)	P value
Operative time (min)	227.44±42.45	224.02±56.9	0.23
Blood loss (mL)	143.57±6.74	345.85±40.03	0.02
Inpatient days	3.05±1.32	4.08±0.99	0.04
VAS score			
Pre-operative	6.37	5.32	
six months	2.26	1.9	
one year	1.93	2.36	
one year variation	4.44	2.96	0.03
ODI score			
Pre-operative	42.29	39.99	
six months	19.75	22.23	
one year	17.3	19.6	
one year variation	24.99	20.39	0.452

Table 4. Intraoperative parameters and clinical outcomes comparing the MI-TLIF and PLF groups.

Parameters	MI-TLIF (n = 70)	PLF (n = 65)	P value
Operative time (min)	227.44±42.45	216.52±45.8	0.15
Blood loss (mL)	143.57±6.74	284.19±42.59	0.03
Inpatient days	3.05±1.32	4.42±1.23	0.04
VAS score			
Pre-operative	6.37	5.27	
six months	2.26	2.05	
one year	1.93	2.44	
one year variation	4.44	2.83	0.03
ODI score			
Pre-operative	42.29	42.65	
six months	19.75	23.61	
one year	17.3	20.64	
one year variation	24.99	22.01	0.68

DISCUSSION

Interbody fusion techniques were developed to preserve load-bearing capacity and restore the sagittal alignment of the Spine.[11] PLIF has been widely used to treat degenerative spine diseases. Although they allow for a stable three-column fixation, it is difficult to obtain unobstructed access to the disc space. Dural retraction potentially leads to nerve damage and postoperative residual pain.[12] In the conventional midline approach, extensive soft tissue dissection and retraction lead to denervation and back muscle atrophy, due to impaired blood flow and injury to dorsal superficial nerves.[13]

Minimally invasive surgery has been reported to be as successful as open techniques with a less traumatic approach, without compromising efficacy or increasing complication rates.[14]

With a unilateral facetectomy, TLIF allows bilateral decompression and better cage positioning.[15]

The advent of percutaneous screw placement systems allowed the development of less invasive fusion techniques such as MI-TLIF.[16] Numerous advantages, such as decreased intraoperative blood loss and lower complication rates, have been described, despite similar clinical outcomes after the first year.[17]

Several studies have recently been published comparing the TLIF and PLIF techniques. Deng-lu Yan et al.[12] reported similar complications and clinical results, with pain index scores improving from 7.08±1.13 to 2.84±0.89 in the PLIF group and from 7.18±1.09 to 2.84±0.91 in TLIF patients.

A recent metanalysis comparing MI-TLIF with traditional open TLIF and PLIF techniques showed that although minimally invasive surgery had better perioperative results (shorter hospitalization times, with reduced blood loss and postoperative pain), it is also associated with

increased readmission and complication rates. In order to achieve the best possible results with MI-TLIF, a high level of surgical skills is required, which is only possible after years of experience and training. Otherwise, MI-TLIF can yield unsatisfactory results.[18] Other studies comparing minimally invasive spine techniques, have also demonstrated potential complications, with higher rates of nerve root injuries and radiculitis, raising the question as to why some minimally invasive procedures are still being offered to patients.[19]

A two-year prospective clinical study comparing the PLF and TLIF techniques was not able to demonstrate any superiority in terms of function and improvement in leg pain. On the other hand, there was a tendency towards more leg pain at two-year follow-up in the TLIF group, bringing into question the concept of indirect transforaminal decompression.[20]

Our study comparing MI-TLIF with PLIF and PLIF showed excellent results for minimally invasive surgery. Intraoperative complications were higher in the PLIF (2.6%) and PLF (3.1%) groups, mostly due to incidental durotomies. One patient was identified with superficial surgical site infection in the MI-TLIF group being treated with antibiotics and wound care. During the first year, we did not observe any neurological injury or interbody implant migration.

The main advantages related to lesser invasive procedures were proven. In the MI-TLIF group, statistically significant differences were obtained in terms of intra-operative blood loss and shorter inpatient days. Our study revealed a medium one-day decrease in hospital stay and a 42% to 51% decrease in median operative blood loss.

Longer operative times with the MI-TLIF technique can be explained by their greater technical complexity, although there was no statistical difference compared with other groups. Shorter intervention times in the PLF group can be explained by the cage preparation procedures.

Analysis of VAS scores revealed post-operative improvements at all time points, with the most statistically significant differences occurring during the first six months. Better results were achieved with the MI-TLIF technique, as shown by the worse pain and disability scores pre-operatively and superior results in the last follow-up. For the ODI and SF-36 scores, all groups showed similar improvements, compared to preoperative status. Although there was no significant difference between groups, better results were achieved with the MI-TLIF technique.

Screw placement under navigation-guidance with O-arm system allows higher precision and safety rates compared to traditional fluoroscopy.[21-22] Previous studies performed in our Hospital comparing neuronavigation with traditional fluoroscopy showed that despite similar operative times, spinal instrumentation with intra-operative 3D imaging had significant impact in reducing complications and optimizing surgical outcomes, avoiding revision surgeries.

CONCLUSIONS

The MI-TLIF technique showed fewer complications, less blood loss, and shorter inpatient days compared to more invasive procedures.

Interbody fusion with PLIF and PLF provided good clinical outcomes, however faster recoveries were obtained with minimally invasive techniques.

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

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