



Original Article

Evaluation of the discal height gain and lumbar lordosis variation obtained by the techniques of transforaminal and posterior lumbar intersomatic fusion[☆]



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ABSTRACT

Objective: Evaluate the discal height and lumbar lordosis gains, comparatively, according to the two lumbar arthrodesis techniques, transforaminal lumbar interbody fusion (TLIF) and posterior lumbar interbody fusion (PLIF), used in the treatment of spinal degenerative diseases.

Methods: The present study, retrospective, was done with 60 patients who underwent decompression and 1 level lumbar arthrodesis in the Hospital Santa Casa de Misericórdia de Vitória (HSCMV), between January 2010 and December 2015. The patients were divided in two groups of 30 each, according to the utilized intersomatic arthrodesis technique: TLIF or PLIF. All patients presented pathologies at the L4-L5 level. In this study, the discal height gain and lumbar lordosis variation were evaluated by analyzing spinal radiographies of the pre and post-operative periods from patients of the two groups, measured by the software Surgimap[®]. In addition, the pain intensity in the post-operative period was estimated by the Visual Analog Scale for Pain (VAS Pain).

Results: Both techniques presented a gain in the discal height in the post-operative. There was no statistically significant difference between the discal height variation obtained with the PLIF technique when compared to the TLIF technique ($p = 0.139$). In the same way, there was no statistically significant difference in the lumbar lordosis variation between the two studied groups ($p = 0.184$). By the EVA Pain analysis, there was no significant difference in the pain intensity in the post-operative period between both arthrodesis surgeries.

[☆] Study conducted at Hospital Santa Casa de Misericórdia de Vitória, Vitória, ES, Brazil.

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Conclusion: There is no difference in the discal height gain and lumbar lordosis variation, as well as in the pain intensity in the post-operative periods, in patients who underwent 1 level intersomatic arthrodesis when comparing the PLIF and TLIF techniques.

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Avaliação do ganho de altura discal e lordose lombar obtido pelas técnicas de fusão intersomática transforaminal e posterior

R E S U M O

Palavras-chave:

Artrodese

Disco intervertebral

Lordose

Objetivo: Avaliar o ganho de altura discal e lordose lombar, comparativamente, conforme as duas técnicas de artrodese lombar, fusão intervertebral lombar transforaminal (TLIF) e fusão intervertebral lombar posterior (PLIF), usadas para o tratamento de doenças degenerativas da coluna vertebral.

Métodos: O presente estudo, retrospectivo, foi feito com 60 pacientes submetidos a descompressão e artrodese lombar de um nível em nossa instituição de janeiro de 2010 a dezembro de 2015. Os pacientes foram divididos em dois grupos de 30 cada, conforme a técnica de artrodese intersomática TLIF ou PLIF. Todos apresentavam patologias no nível de L4-L5. Neste estudo, avaliaram-se o ganho de altura discal e a variação na lordose lombar por meio da análise das radiografias de coluna vertebral do período pré e pós-operatório dos pacientes dos dois grupos, mensurados por meio do programa de computador Surgimap®. Além disso, estimou-se a intensidade de dor no período pós-operatório por meio da Escala Visual Analógica (EVA).

Resultados: Ambas as técnicas apresentaram ganho de altura discal no pós-operatório. Não existiu diferença estatisticamente significativa entre a variação da altura discal obtida com a técnica PLIF quando comparada com técnica TLIF ($p = 0,139$). Da mesma forma, não houve diferença estatisticamente significativa entre a variação de lordose lombar observada entre os dois grupos ($p = 0,184$). Por meio da análise da EVA, não houve diferença significativa na dor no período pós-operatório entre ambas as cirurgias de artrodese.

Conclusão: Não houve diferença no ganho de altura discal e lordose lombar, assim como na intensidade de dor no período pós-operatório, em pacientes submetidos a artrodese intersomática de um nível quando comparadas as técnicas PLIF e TLIF.

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Introduction

Many aspects of the clinical and surgical treatments of the lumbar spine degenerative diseases still need more detailed studies.¹ Regarding the surgical treatment of these conditions, techniques involving lumbar intersomatic fusion were introduced as treatment options²; among these techniques are the transforaminal lumbar intervertebral fusion (TLIF) and the posterior lumbar intervertebral fusion (PLIF).³ TLIF consists of an intervertebral fusion technique in which the approach to the intervertebral space is made through the intervertebral foramen. In the PLIF technique, the approach is made by the posterior way with retraction of the dural sac and nerve roots.^{2,4} In both, the discectomy is succeeded by the positioning of the intervertebral fusion component (cage), which contains bone graft.^{4,5}

Lumbar spine degenerative diseases usually induce reduction of the intervertebral disc height corresponding to the

compromised level.⁶ Studies indicate that the reestablishment and the increase of the discal height obtained by the aforementioned surgical techniques provide an increase in the lumbar lordosis, an indirect decompression of the neural foramen, as well as improved clinical post-operative results.⁷ Indications for the use of PLIF or TLIF techniques include: discal degenerative diseases, low-grade spondylolisthesis, lumbar spinal stenosis, and recurring disc herniation.^{2,8}

There are evidences that after the realization of the lumbar fusion techniques, the reduction in lumbar lordosis may cause degenerative processes of adjacent segments and anterior body inclination, resulting in chronic pain. Therefore, the lumbar lordosis analysis in patients who underwent lumbar fusion procedures is relevant.⁹

It is noticeable that there is still scarce literary focus in the comparison of the analyzed techniques regarding the intervertebral disc height increment. Therefore, the present study intends to compare the discal height gain and lumbar lordosis variation obtained in the post-operative period of patients

with lumbar pathologies and L4-L5 level commitment, submitted to decompressive surgery associated with the surgical techniques TLIF and PLIF.

Materials and methods

The study was retrospective, with 60 patients submitted to surgical procedure at the Hospital Santa Casa de Misericórdia de Vitória (HSCMV) between January of 2010 and December of 2015. The patients attended in this period were randomly selected in two groups of 30 individuals each, according to the intersomatic arthrodesis technique (TLIF or PLIF). All the patients have been submitted to decompression and posterior instrumentation associated. Cages used in both procedures presented similar dimensions (PLIF – Baumer® and TLIF – Blackstone Construx®). The patients selected were over 18 year old, affected by discal degenerative disease, low-grade spondylolisthesis or lumbar spinal stenosis, with compromised L4-L5 level, refractory to the non-surgical treatment.

Lumbar spine radiographs were analyzed in the profile view of pre and post-operative period of each patient, obtained from the records of patients attended by the Spine Group of the HSCMV. The obtained parameters from each patient, with the software Surgimap®, included:

1. Average of the anterior and posterior heights of the L4-L5 disc of the pre-operative divided by the average of anterior and posterior vertebral body height of L4 in the pre-operative.
2. Average of the anterior and posterior heights of the L4-L5 disc of the post-operative divided by the average of the anterior and posterior vertebral body height in the post-operative.
3. Measure of the lumbar lordosis in the pre-operative.
4. Measure of the lumbar lordosis in the post-operative.

The L4 vertebral body was used as a reference for the averages calculation to avoid errors related to the variation in the magnification of the images in each radiographic technique, once the vertebral body height remains constant after the surgery.

Data from the 0-10 Visual Analog Scale (VAS) were included in this study, obtained from the patient's records of both study groups, to become a parameter to analyze the clinical result regarding the pain. The scores were collected in the first 24 h period of the post-operative.

The statistical analysis was obtained using the software SPSS® version 23.0. The statistical inference was developed at a level of 5%. The percent values of the discal height and lumbar lordosis in the post-operative were compared to the pre-operative values using the Student's *t* test for paired samples. The comparison of the discal height variation between the PLIF and TLIF techniques was made using the Student's *t* test for independent samples, as well as the comparison of the lumbar lordosis variation between the two techniques.

Table 1 – Age of the patients submitted to the PLIF and TLIF techniques.

Group	Age range (years)	Age average (years)	Age median (years)	Standard deviation (years)
PLIF	24-74	50.3	49	11.1
TLIF	25-69	46.6	49	12

Table 2 – Sex of the patients submitted to the PLIF and TLIF techniques.

Group	Male sex (%)	Female sex (%)
PLIF	46.66	53.33
TLIF	56.66	43.33

Table 3 – Discal height percentage in relation to the L4 vertebral body height, from pre and post operatory of the 60 patients.

	Mean	Median	SD
Discal height in relation to the L4 vertebral body height in the PRE-OPERATORY	0.45	0.43	0.1
Discal height in relation to the L4 vertebral body height in the POST-OPERATORY	0.51	0.5	0.08

Results

Data were analyzed from 30 patients submitted to the PLIF technique and 30 patients submitted to the TLIF technique. The age of the patients submitted to the TLIF technique varied between 25 and 69 years, with an average \pm standard deviation (SD) of 46.6 ± 12 years. The age of the patients submitted to the PLIF technique varied between 24 and 74 years, with an average \pm SD of 50.3 ± 11.1 years (Table 1).

As for the sex, from the PLIF group patients, 46.66% were male, and 53.33% were female. From the TLIF group patients, 56.66% were male, and 43.33% were female (Table 2).

Therefore, the PLIF and TLIF groups were similar regarding sex and age distribution.

The discal height variation presented a normal distribution ($p=0.081$). There was a statistically significant difference between the percent height of the discal height (in relation to the L4 body height), when comparing the post to the pre-operative of the 60 patients, with a percent height significantly higher in the post operatory ($p=0.00$).

The discal height percentage in relation to the L4 body height in the pre operatory of the patients had an average \pm SD of 0.45 ± 0.10 , while the post operatory had an average of 0.51 ± 0.08 (Table 3).

There was no statistically significant difference between the variation of discal height obtained with the technique PLIF and the technique TLIF ($p=0.139$). The height variation for the PLIF group had an average of 0.07 ± 0.06 , while the TLIF group had an average of 0.05 ± 0.06 (Table 4). This indicates

Table 4 – Discal height variation.

Group	Mean	Median	SD
PLIF	0.07	0.06	0.06
TLIF	0.05	0.04	0.06

Table 5 – Lumbar lordosis measurements.

Group		Mean	SD
PLIF	Pre-operative	40.3°	14.8°
	Post-operative	43°	12.5°
TLIF	Pre-operative	49.5°	13.7°
	Post-operative	47.9°	11.3°

Table 6 – Lumbar lordosis variation (difference between post and pre-operative).

Group	Mean	SD
PLIF	2.6°	12.1°
TLIF	-1.6°	12.5°

Table 7 – Visual Analog Scale (VAS).

Group		Mean	Median	SD	p value
PLIF	VAS PO	2.7	2	2.3	0.393
TLIF	VAS PO	3.4	3	2.7	

that although both techniques promote an increase in the discal height in the post-operative, one was not proven superior to the other regarding the obtained discal height variation.

The average lumbar lordosis found in the patients submitted to the PLIF technique was $40.3^\circ \pm 14.8^\circ$ in the pre and $43^\circ \pm 12.5^\circ$ in the post-operative, while the lumbar lordosis presented in the patients who underwent the TLIF technique was $49.5^\circ \pm 13.7^\circ$ in the pre and $47.9^\circ \pm 11.3^\circ$ in the post-operative (Table 5). There was no statistically significant difference of the values between the pre and post-operative in both the PLIF ($p=0.246$) and TLIF ($p=0.479$) techniques.

The average variation of the lumbar lordosis (difference between post and pre-operative) was compared between the techniques PLIF and TLIF, obtaining values of $2.6^\circ \pm 12.1^\circ$ (lumbar lordosis gain) and $-1.6^\circ \pm 12.5^\circ$ (lumbar lordosis loss), respectively. There was no statistically significant difference of the lumbar lordosis variation between the two techniques ($p=0.184$) (Table 6).

The 0-10 VAS scores of both groups were obtained in the 24 h period after the surgical procedure (VAS PO) and there was no statistically significant difference between the obtained data for the analyzed groups (Table 7).

Discussion

The retrospective study made by Fujimori et al. made comparisons between the TLIF and the posterolateral lumbar fusion (PLF) techniques in relation to the radiographic and clinical results in patients afflicted with degenerative spondylolisthesis. The authors observed that the discal height gain in the L4-L5 level was significantly higher in patients submitted to

the TLIF technique. In relation to the lumbar lordosis variation, there was no statistically significant difference between the two groups evaluated by these authors. It was also noted a significantly higher improvement in the VAS in the TLIF group.¹⁰

Yan et al.¹¹ analyzed the TLIF and PLIF techniques in 176 adult patients afflicted with spondylolisthesis (I and II degree) at the L5-S1 or L4-L5 levels, in regards to the radiographic and clinical results. It is of note that during the 2-year follow-up there was no significant difference in the discal height when comparing the PLIF and TLIF. Both techniques presented a similar gain in relation to the pre-operative; however, the discal height and foraminal losses during these years were a common find and similar in both groups.

Radiologic parameters of patients submitted to the PLIF and TLIF surgeries were analyzed by Asil et al. in a study that compared, retrospectively, by computed tomography (CT), characteristics of the spine of patients diagnosed with spondylolisthesis and degenerative narrowing of the vertebral canal in a single level of the lumbar region. The average loss of foraminal height and the average loss of discal height, the total variation of the lumbar lordosis angle were significantly higher in the PLIF group when compared to the TLIF group ($p < 0.01$). There was no significant difference detected between the studied groups despite the variation in the levels of arthrodesis, made on only a single level, between L3-S1.¹²

In this present study, the results indicate a percentual gain of discal height with both techniques PLIF and TLIF in the post operative (PLIF: 0.07 ± 0.06 and TLIF: 0.05 ± 0.06); although a statistically significant difference was not observed when comparing the PLIF group to the TLIF group, regarding the discal height variation and the segmental lordosis variation. The presented results are compatible with other studies which evaluated these same parameters.¹¹⁻¹⁴ The radiological results of these studies demonstrate the tendency of loss of discal and foraminal height in patients evaluated in a period of 1 year or more after the surgery.¹¹⁻¹⁴ However, only a single study found a superiority in the radiological parameters of TLIF after long-term follow-up.¹² The previously described studies showed follow-ups for a longer time than this study, which focus and methods devoted to the differences among two techniques in the immediate post-operative.

By analyzing the results of the 0-10 VAS from post-operative period (mean 2.7 for the PLIF group and 3.4 for the TLIF), it was observed that the data corresponds to tolerable intensities of pain. In this study, there were no great differences in the measure of the VAS between the two arthrodesis techniques. Similar works, that utilized the 0-10 VAS, showed similar results to those presented in this study; in addition, those with longer follow-up time confirm the tendency of improvement of pain.^{11,14,15}

Conclusion

There is no significant difference in the discal height and lumbar lordosis variations, as well as in the post-operative pain, in patients who underwent intersomatic arthrodesis of 1 level when comparing the PLIF and TLIF techniques.

Conflicts of interest

The authors declare no conflicts of interest.

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