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ANTERIOR LUMBAR INTERBODY FUSION (ALIF): EPIDEMIOLOGICAL AND RADIOLOGICAL PROFILE

ARTRODESE LOMBAR ANTERIOR: PERFIL EPIDEMIOLÓGICO, RADIOLÓGICO

ARTRODESIS LUMBAR ANTERIOR: PERFIL EPIDEMIOLÓGICO, RADIOLÓGICO

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ABSTRACT

Objective: Evaluate the epidemiological and radiographic data of patients submitted to the Anterior Lumbar Interbody Fusion (ALIF) technique and the possible complications related to this procedure. Methods: A longitudinal and retrospective study was carried out to analyze electronic medical records and image files of patients who underwent spinal surgery using the ALIF technique between February 2019 and January 2021. Epidemiological data such as age, gender, and level of surgery were analyzed. Radiographic evaluations of lumbar lordosis from L1 to S1 were performed using the COBB technique and the anterior and posterior height of the disc space. The presence of intraoperative and postoperative complications in the patients was analyzed. Results: Initially, 70 patients were analyzed. The most prevalent operated level was L5-S1. The length of stay of the patients varied between 36 and 72 hours. Intraoperative bleeding ranged from 20mL to 400mL. Three patients had significant venous lesions. Differences between anterior and posterior lordosis and height measurements were significant ($p < 0.001$). Lordosis had a mean increase of 10.3°, anterior height had a mean increase of 7.9mm, and posterior height of 4.0mm. Six cases of intra and postoperative complications were observed. Conclusion: The patients showed improvement in the radiological parameters of the anterior and posterior height of the vertebral discs, with a significant increase in lumbar lordosis. Complication rates were 9.8%, and we had a short hospital stay. ***Level of Evidence II; Retrospective Longitudinal Study.***

Keywords: Arthrodesis; Lordosis; Radiography; Degenerative Disc Disease.

RESUMO

Objetivo: Avaliar os dados epidemiológicos e radiográficos de pacientes submetidos à técnica de Artrodese Lombar Anterior (ALIF) e avaliar as possíveis complicações relacionadas a este procedimento. Métodos: Realizou-se um estudo longitudinal e retrospectivo com análise dos prontuários eletrônicos e arquivos de imagem dos pacientes submetidos a cirurgia da coluna pela técnica de ALIF, no período entre fevereiro de 2019 e janeiro de 2021. Dados epidemiológicos como idade, sexo e nível de cirurgia foram analisados. Foram feitas avaliações radiográficas da lordose lombar de L1 a S1 através da técnica de COBB e da altura anterior e posterior do espaço discal. Foram analisados a presença de complicações intra e pós-operatórias dos pacientes. Resultados: Foram analisados inicialmente 70 pacientes. O nível operado mais prevalente foi L5-S1. O tempo de internamento dos pacientes variou entre 36 e 72 horas. O sangramento intraoperatório variou de 20mL a 400mL. Três pacientes apresentaram lesões venosas importantes. As diferenças entre as medidas de lordose e altura anterior e posterior foram significativas ($p < 0,001$). A lordose teve aumento médio de 10,3°, a altura anterior teve aumento médio de 7,9mm e a altura posterior de 4,0mm. Foram observados 06 casos de complicações intra e pós-operatórias. Conclusão: Os pacientes apresentaram melhora nos parâmetros radiológicos de altura anterior e posterior dos discos vertebrais, com um aumento da lordose lombar significativo. As taxas de complicações foram de 9,8 % e tivemos um curto período de internação hospitalar. ***Nível de Evidência II; Estudo Longitudinal e Retrospectivo.***

Descritores: *Artrodese; Lordose; Radiografia; Doença degenerativa do disco.*

RESUMEN

Objetivo: Evaluar los datos epidemiológicos y radiográficos de pacientes sometidos a la técnica de Artrodesis Lumbar Anterior (ALIF) y evaluar las posibles complicaciones relacionadas con este procedimiento. Métodos: Se realizó un estudio longitudinal y retrospectivo con análisis de historias clínicas electrónicas y archivos de imágenes de pacientes intervenidos de columna vertebral mediante la técnica ALIF, en el período comprendido entre febrero de 2019 y enero de 2021. Datos epidemiológicos como edad, sexo y nivel quirúrgico fueron analizados. Las evaluaciones radiográficas de la lordosis lumbar de L1 a S1 se realizaron mediante la técnica COBB y la altura anterior y posterior del espacio discal. Se analizó la presencia de complicaciones. Resultados: Se analizaron 70 pacientes. El nivel operado más prevalente fue L5-S1. El tiempo de estancia de los pacientes varió entre 36 y 72 horas. El sangrado intraoperatorio osciló entre 20 ml y 400 ml. Tres pacientes tenían lesiones venosas importantes. Las diferencias entre la lordosis anterior y posterior y las medidas de altura fueron significativas ($p < 0,001$). La lordosis tuvo un aumento medio de 10,3°, la altura anterior tuvo un aumento medio de 7,9 mm y la altura posterior

Study conducted by the Hospital do Trabalhador, Curitiba, PR.
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de 4,0 mm. Se observaron seis casos de complicaciones intra y postoperatorias. Conclusiones: Los pacientes mostraron mejoría en los parámetros radiológicos de altura anterior y posterior de los discos vertebrales, con aumento significativo de la lordosis lumbar. Las tasas de complicaciones fueron del 9,8% y hubo una corta estancia hospitalaria. ***Nivel de Evidencia II; Estudio Longitudinal y Retrospectivo.***

Descriptores: *Artrodesis; Lordosis; Radiografía; Enfermedad Degenerativa del Disco.*

INTRODUCTION

The demand for medical treatment related to degenerative diseases of the spine has grown in recent years, mainly due to increased life expectancy. The main cause of low back pain is intervertebral disc degeneration (IVDD), leading to foraminal and spinal canal stenosis.[1] It is currently estimated that 53% of the economically active Brazilian population will suffer from low back pain at some point in their lives, and 33% will have associated sciatica, affecting their physical, functional, and emotional capacity.[2]

Conservative treatment is the gold standard for DDD; however, in cases where this is ineffective, lumbar fusion plays an important role in treating low back pain and sciatica, especially when associated with vertebral instability.[1,3] In this context, a technique that has become common among spine surgeons is anterior lumbar arthrodesis (ALIF). Some current studies demonstrate that ALIF is an effective treatment for DDD with or without radiculopathy, including pathologies with instability such as spondylolisthesis,[4] with significant improvement in clinical-functional scores.[5]

Compared to other surgical approaches, the ALIF technique allows superior restoration of normal anatomy, including foraminal area, anterior disc height, lumbar lordosis, and sagittal balance.[6,7] Unlike posterior approaches, which involve extensive muscle dissection, the ALIF technique does not interfere with any spinal muscles and does not include muscle detachments.[5,8] Some studies have shown advantages of this technique over traditional approaches, including shorter surgical and hospital stays, less postoperative pain, and low risk of complications in general.[9] However, the anterior approach to the spine has some risks of specific complications: vascular injuries (arterial and venous), visceral injuries, and[10-12] sexual and sympathetic plexus dysfunction. The joint approach with an access surgeon, commonly a general or vascular surgeon, has become routine in major referral centers for spine surgery. This teamwork provides greater safety to the procedure, justifying the low complication rates.[9]

Given the increasing use of this technique, we designed a study aiming to evaluate the epidemiologic and radiographic data of patients undergoing the ALIF technique and assess the possible complications related to this procedure.

MATERIALS AND METHODS

This is a longitudinal, retrospective study conducted in a tertiary hospital, a reference in spinal surgery. After approval by the Research Ethics Committee (CAAE: 58184222.2.0000.5225), a search was performed of the electronic medical records and image files of patients undergoing spinal surgery using the ALIF technique, with *Cages* of 10, 12, and 15 degrees of lordosis and blocked with *transcage* screws (Nuvasive®), between February 2019 and January 2021.

The procedures were performed by six spine surgeons, members of the Brazilian Spine Society, experienced in the technique, and three access surgeons. The orthopedic and access surgeons were not the same in all surgeries.

Patients aged 18-100 years with degenerative spinal diseases and who underwent surgical treatment using the ALIF technique were included in the study. When there were signs of instability, as in spondylolisthesis, only low-grade (grade 1 or 2) were included. Only cases operated *alone*, i.e., without subsequent supplementation with pedicle screws, were selected. (Figure 1)

Exclusion criteria were high-grade spondylolisthesis, age over 100 years or under 18 years, patients undergoing ALIF technique with posterior supplementation, patients diagnosed with primary or metastatic neoplasms, infection in previous spinal surgeries, those who did not agree to participate in this study and those with incomplete medical records.

Epidemiological data such as age, sex, and level of surgery (one or more levels) were analyzed. Radiographic assessments of the lumbar lordosis from L1 to S1 were performed using the COBB technique (Figure 2) and the anterior and posterior height of the disc space. All these measurements were compared with radiographic values measured preoperatively and on postoperative day 1.

The presence of intraoperative and postoperative complications such as bleeding (venous and arterial lesions), visceral lesion, paralytic ileus, surgical site infection, suture dehiscence, retrograde ejaculation/dry vagina, implant migration, implant breakage, and associated fractures were assessed through chart review. Intraoperative bleeding volume and length of stay were quantified. All these patients were followed up on an outpatient basis for at least 12 months postoperatively.

Quantitative variables were represented by mean and standard deviation, while absolute and relative frequencies represented qualitative variables. Comparisons of lordosis and anterior and posterior height values between pre- and postoperative times were made using Student's t-test for paired samples. Pearson's correlation coefficient calculated correlations between measures. All analyses were performed in R statistical computing software using the 5% significance level.

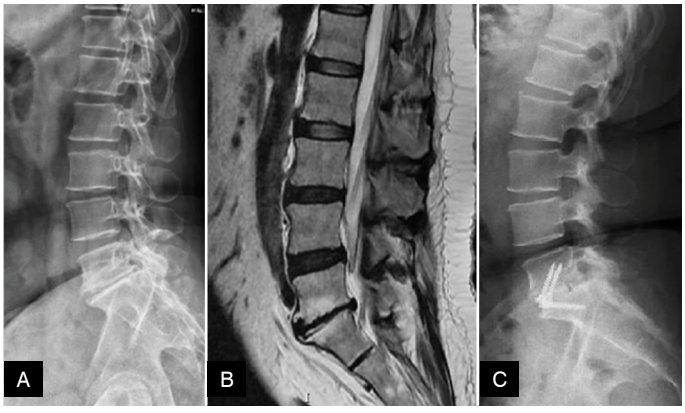

Figure 1. A: Preoperative radiograph of ALIF L5-S1; B: Sagittal T2-weighted MRI of the lumbosacral spine showing L5-S1 degenerative discopathy with disc protrusion; C: Postoperative radiograph of ALIF L5-S1.

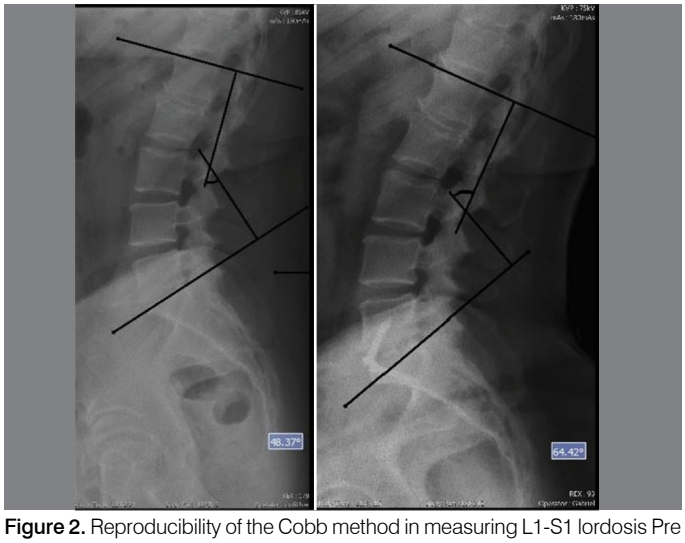

Figure 2. Reproducibility of the Cobb method in measuring L1-S1 lordosis Pre and Post-operative ALIF.

RESULTS

A total of 70 patients treated surgically with the ALIF *stand-alone* technique (Figure 3) from February 2019 to January 2021 were initially analyzed. Still, nine did not present complete medical records and were excluded, totaling 61 patients in this study. The mean age of the patients was 51.8 years (31-84 years), with 35 women and 26 men (Table 1). The most prevalent operated level was L5S1 (85.25%). (Table 1)

The length of stay of patients ranged from 36 to 72 hours, and those who presented intraoperative vascular complications stayed longer (72 hours). Intraoperative bleeding ranged from 20mL to 400mL, averaging 53mL per patient. Three patients had significant venous lesions, all in the left iliac vein at the L4-L5 level, with intraoperative bleeding controlled with compression of the vessel and using sterile absorbable gelatin hemostatic sponge. These patients had the highest recorded bleeding, 400ml, 340ml, and 240ml, respectively. No patient presented hemodynamic instability in the transoperative period and did not need a blood transfusion.

The differences between pre-and postoperative measurements of anterior and posterior lordosis and height were all significant ($p < 0.001$) (Table 2). The lordosis had a mean increase of 10.3°, the anterior height had a mean increase of 7.9mm, and the posterior height of 4.0mm (Table 2). Patients with higher preoperative lordosis measurements had higher postoperative anterior and posterior disc height measurements. (Table 2)

The correlations of postoperative lordosis with postoperative anterior and posterior intervertebral disc height and lordosis variation with pre- and postoperative anterior and posterior height variation were not significant (Table 3). This means that individuals who showed greater variation in lordosis in the pre-and postoperative comparison did not necessarily show a greater increase in anterior and posterior height postoperatively.

In addition to the three vascular complications, we had 01 case of retrograde ejaculation – without resolution during the follow-up period, 01 urinary retention – which showed improvement on the 2nd day of hospitalization, 01 superficial infection of the surgical site – treated with oral antibiotics and without clinical repercussion (Table 1). No patient had postoperative complications with serious clinical repercussions. No patient died.

DISCUSSION

Anterior lumbar interbody fusion is becoming increasingly prevalent in the surgical treatment of lumbar DDD.[13] The anterior approach to the spine allows resection of the degenerated disc, distracts and reshapes the disc space, restoring spinal disc height and lumbar lordosis.[3,14]

ALIF is superior to other techniques, such as transforaminal lumbar interbody fusion (TLIF), in its ability to increase foraminal height and lumbar lordosis.[6,15] Phan et al., in their meta-analysis study, revealed that ALIF may be a better approach for restoring foraminal height, local disc angle, and lumbar lordosis compared to other techniques.[15] As in other studies found in the literature,[1,16] in the present study, an increase in anterior and posterior intervertebral disc height and lumbar lordosis was observed after ALIF, demonstrating this technique's efficacy for restoring these parameters.

In contrast to posterior or posterolateral approaches, such as posterior lumbar interbody fusion/transforaminal fusion (PLIF/TLIF), ALIF restores disc height, allowing foraminal re-expansion and indirect spinal nerve decompression.[1] No patient in this study had postoperative neurological damage with indirect decompression, corroborating previously published papers in the literature.[1]

Nanni FN et al.,[17] in their study on radiographic evaluation of patients undergoing ALIF – observed increased segmental lordosis and reduced lumbar lordosis. This author believes that the antalgic kyphotization may have influenced these values in the radiograph caused by pain in the immediate postoperative period (PO), considering that the control radiographs were performed in the early PO.[17] In our study, an increase in lumbar lordosis and the anterior and posterior height of the intervertebral disc was observed after ALIF

Table 1. Demographic and surgical variables.

Variable		
Age	Mean (SD)	51.8 (12.6)
Sex	Female	35 (57.4%)
	Male	26 (42.6%)
Level Operated	L4-L5	9 (14.75%)
	L5-S1	52 (85.25%)
Lordosis Pre	Mean (SD)	35.2 (12.0)
Post Lordosis	Mean (SD)	45.5 (11.2)
Anterior Height Pre	Mean (SD)	10.7 (5.0)
Previous Height Post	Mean (SD)	18.6 (4.7)
Posterior Height Pre	Mean (SD)	4.8 (2.0)
Posterior Height Post	Mean (SD)	8.8 (2.0)
Complications		6 (9.8%)

Table 2. Lordosis variation, anterior and posterior height.

Measure	Preoperative Mean (SD)	Post-operative Mean (SD)	Variation Mean (95% CI)	p-value
Lordosis	35.2 (12.0)	45.5 (11.2)	10.3 (8.8 -11.8)	< 0.001
Anterior Height	10.7 (5.0)	18.6 (4.7)	7.9 (6.7 - 9.1)	< 0.001
Posterior Height	4.8 (2.0)	8.8 (2.0)	4.0 (3.5 - 4.6)	< 0.001

Table 3. Variation in posterior height.

Correlated Variables		Pearson Correlation Coefficient	p-value
Lordosis Pre	Anterior Height Pre	0.29	0.021
Lordosis Pre	Posterior Height Pre	0.33	0.009
Lordosis Post	Previous Height Post	-0.04	0.755
Lordosis Post	Posterior Height Post	0.18	0.159
Variation Lordosis	Variation Previous Height	0.11	0.397
Variation Lordosis	Variation Posterior Height	0.2	0.128

Figure 3. A: Anterior discectomy for Cage implantation; B: Implanted ALIF cage; anterior ALIF access under preoperative scar from cesarean section and evidence of implant used.

was measured in the X-ray of the 1st PO day, showing no impairment in the improvement of these radiological parameters by the clinical status of the patient, a result also corroborated by other authors.[1,16,18]

Historically, ALIF has been associated with high rates of intraoperative complications due to the use of the transperitoneal route and implant-related adverse events,[19] but this route is now an exception. The evolution of implants and retractors has also contributed to the greater safety of the procedure. Complications related to the ALIF approach are distinct from those of posterior approaches to the lumbar spine and are predominantly related to visceral[9] and vascular injuries.[9,4,13] In the present study, 9.8% of complications were observed – a result similar to that found in the literature[1,9,19] – this low rate must be related to the participation of access surgeons, which provides greater safety to the procedure.

The occurrence of vascular lesions in the literature varies from 1% to 40%, depending on the group and type of case treated, with a higher prevalence at the L4-L5 level.[19] As in other studies, vascular lesions were the most common complications in this study,[1,13] being observed in only 4.9% of patients (all at the L4-L5 level). These findings are similar to other studies in the literature,[4,9,19,20] proving the low rate of these lesions. Despite the risk of life-threatening complications associated with the anterior abdominal retroperitoneal route, we believe that teamwork between the spine surgeon and the access surgeon has made the procedure safer, where experiences are shared, leading to lower complication rates.

Flouzat-Lachaniette et al. reported urinary symptoms as the most common,[21] which was not observed in the present study. In addition, ejaculatory disorders are a commonly cited complication[4,20] related to hypogastric plexus injury during surgical corridor access.[20] One case of retrograde ejaculation was observed in our study, which did not show improvement in symptoms during the follow-up period. This patient was 52 years old with already established offspring. Particular attention should be paid to this risk when indicating the procedure in young adults interested in parenthood. No cases of dry vagina were observed, which may be biased by the omission of these symptoms by the women being assessed by the orthopedic physician.

As found in the literature, in the present study, patients submitted to the ALIF technique remained hospitalized for a short period,[4,9,12,19] and those hospitalized for a longer time presented complications.[9]

The main limitations of this study are the lack of assessment of clinical outcomes and the follow-up of only 12 months. However, this study begins a line of research in which patients will be followed up, and new results will be presented.

The ALIF technique has proven results in the literature, with significant improvement in clinical-functional scores after surgical intervention, arthrodesis rates above 90%, and serious complications of less than 10%.[22-24] Thus, we believe that we will move towards expanding ALIF indications, an even greater increase in the procedure's safety with the experience acquired, and the continuous improvement of implants and instruments.

CONCLUSION

In this study, it was found that a majority of the patients who underwent surgery at the L5-S1 level were female. Their radiological parameters showed an improvement in both the anterior and posterior height of the vertebral discs, as well as an increase in lumbar lordosis of over 10 degrees on average. The complication rate for these procedures was 9.8%, and patients had a short hospital stay. The authors of this study report no conflicts of interest in conducting this research.

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

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