

# Complications of the Anterior Approach to Lumbar Spine in a Series of 197 Patients

Federico D. Sartor

Traumatología del Comahue, Neuquén, Argentina

## ABSTRACT

**Objective:** To analyze complications related to the anterior approach to the lumbar spine. **Materials and Methods:** Descriptive and retrospective study of a series of patients who underwent surgery by an anterior approach to the lumbar spine between 2006 and 2019. The study population was 197 patients. The variables considered were age, gender, diagnosis, surgical plan, lumbar levels involved, and the presence of immediate, early or late complications. The Clavien-Dindo classification was used for surgical complications. **Results:** 197 patients were evaluated. The average age was 53.39 years, and there were 106 women (53.81%) and 91 men (46.19%). The most frequent diagnosis was degenerative disc disease in 51 patients (25.89%). 34 patients presented complications (17.26%): 4 immediate complications (2.03%), 22 early complications (11.16%), and 9 late complications (4.57%). The most frequent immediate complication was arterial injury (2 patients). The most frequent early complication was vertebral endplate injury (5 patients). The most frequent late complication was vertebral body fracture (4 patients). Two patients died as a consequence of their complications. **Conclusion:** In our series of patients, the most frequent complications were vascular injury (intraoperative), vertebral endplate injury (early), and vertebral body fracture (late). The author considers that the anterior approach to the lumbar spine performed by a team trained in this type of approach is a safe technique, with a low rate of complications.

**Keywords:** Anterior lumbar approach; surgical complications; anterior arthrodesis; instrumented anterior arthrodesis; vascular injury.

**Level of Evidence:** IV

## Complicaciones del abordaje anterior de columna lumbar en una serie de 197 pacientes

## RESUMEN

**Objetivo:** Analizar las complicaciones relacionadas con la cirugía de columna lumbar por vía anterior. **Materiales y Métodos:** Estudio descriptivo y retrospectivo de una serie de pacientes operados por abordaje anterior de la columna lumbar entre 2006 y 2019. La población estaba formada por 197 pacientes. Las variables consideradas fueron: edad, sexo, diagnóstico, plan quirúrgico (artrodesis anterior, doble vía combinada, revisión anterior, extracción del implante), niveles lumbares involucrados, complicaciones intraquirúrgicas inmediatas, tempranas o tardías. Se utilizó la clasificación de Clavien-Dindo para las complicaciones quirúrgicas. **Resultados:** Se evaluó a 197 pacientes, con una edad promedio de 53.39 años (106 mujeres, 53,81% y 91 hombres, 46,19%). El diagnóstico más frecuente fue discopatía degenerativa en 51 pacientes (25,89%). Treinta y cuatro (17,26%) sufrieron complicaciones: 4 inmediatas (2,03%), 22 (11,16%) tempranas y 9 (4,57%) tardías. La complicación inmediata más frecuente fue la lesión arterial (2 pacientes). La complicación temprana más frecuente fue la lesión del platillo vertebral (5 pacientes). La complicación tardía más frecuente fue la fractura del cuerpo vertebral (4 pacientes), dos pacientes fallecieron como consecuencia de las complicaciones. **Conclusión:** En nuestra serie, las complicaciones más frecuentes fueron: lesión vascular (inmediata), lesión del platillo vertebral (temprana) y fractura del cuerpo vertebral (tardía).

**Palabras clave:** Abordaje lumbar anterior; complicaciones quirúrgicas; artrodesis anterior; artrodesis anterior instrumentada; lesión vascular.

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Received on September 19<sup>th</sup>, 2022. Accepted after evaluation on July 27<sup>th</sup>, 2023 • Dr. FEDERICO D. SARTOR • fedes\_3@yahoo.com  <https://orcid.org/0000-0001-6061-2445>

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## INTRODUCTION

Anterior spine surgery was first described by Capener<sup>1</sup> in 1932, for the treatment of spondylolisthesis, and shortly thereafter by Ito<sup>2</sup> in 1934, for the treatment of Pott's disease. In his 1932 description, Capener discussed anterior treatment of high-grade spondylolisthesis. He referred to the possibility of placing a bone graft to fix the body of L5 to the sacrum, forming a buttress. According to the researchers, this would be the oldest bibliographic reference related to lumbar spine surgery and the anterior approach.<sup>1</sup> Since then, this technique has been perfected and has improved in stability, safety and indications.<sup>3</sup>

Currently, indications for the anterior approach include: degenerative, tumor, traumatic and infectious diseases.<sup>4</sup>

Complications of the anterior approach are different from those mentioned for the posterior approach, including vascular and visceral injuries.<sup>4</sup> Some of them are life-threatening if not treated by a team trained in this type of approach.

The objective of this study was to describe and analyze the complications related to anterior lumbar spine surgery.

## MATERIALS AND METHODS

A descriptive and retrospective study was performed on a series of patients operated on by the same surgical team, using an anterior approach to the lumbar spine, between 2006 and 2019. Patients who participated in the study provided written consent.

A non-probabilistic sample was selected from all patients operated consecutively, by anterior approach, according to the surgical records of the treating team. The inclusion criteria were: 1) patients operated by the surgical team, between 2006 and 2019, through an anterior approach to the lumbar spine, either as the only approach or as part of a surgical treatment that included some other type of approach (lateral or posterior approach); 2) patients operated through an anterior approach as the first stage of surgical treatment or as a revision of a surgery through another approach; 3) patients with a history of abdominal surgeries (cesarean section, cholecystectomy, appendectomy, among others).

A total of 226 medical records were found. Patients with incomplete clinical records or loss to follow-up before completion of six months after surgery were excluded. The study population consisted of 197 patients.

The data corresponding to the study variables were recorded from medical records and image files. The following variables were considered: age, sex, diagnosis, surgical plan (anterior arthrodesis, combined double approach, anterior revision, implant extraction), lumbar levels involved, presence of intraoperative or immediate complications (intraoperative or immediate complications were defined as events occurring during surgery and up to 48 h later), early complications (defined as events occurring after 48 h of surgery up to 0+6 months), late complications ( $\geq 0+6$  months after surgery).

In addition, the Clavien-Dindo classification was used for surgical complications.<sup>5</sup>

### Surgical technique

All patients were operated on by the same surgical team, consisting of one or two spinal surgeons plus a general surgeon with training in anterior spinal approaches and vascular disease.

For high lumbar levels (L2-L3 and L3-L4), the access surgeon is positioned to the patient's right and the spinal surgeon to the left; for low lumbar levels (L4-L5 and L5-S1), the positions are reversed (the access surgeon stands to the patient's left and the spinal surgeon stands to the right).<sup>6</sup>

The skin incision can be medial (supraumbilical or infraumbilical) or transverse, Pfannenstiel type,<sup>7</sup> depending on the levels to be operated on.

The abdominal contents are carefully mobilized towards the midline. The spine is approached medially to the iliac psoas muscle. It is essential to detect and, when appropriate, ligate the left iliolumbar vein in a safe manner, depending on the level to be operated. In the first cases of the series, a linen thread ligature was used, but, after one episode of ligature dehiscence, this step was replaced by a metal clip (Ligaclip®, Ethicon Inc., Johnson & Johnson, NJ, USA).

After performing a discectomy of the affected level, a non-locking PEEK (polyether-ether-ketone) implant was placed for anterior arthrodesis, using a small fragment plate to avoid anterior subsidence of the implant.

At the time of closure, the anterior rectus sheaths are approximated with separate absorbable sutures (Vicryl®, Ethicon Inc., Johnson & Johnson, NJ, USA). The fascia is closed with continuous absorbable sutures and the skin is closed with an intradermal monofilament suture (Ethilon® Nylon, Ethicon Inc., Johnson & Johnson, NJ, USA). No drains are left in the bed.

All medical records and surgical records were evaluated by the author of the paper.

## Statistical Analysis

Categorical variables are expressed as number and percentage, and quantitative variables as mean and its respective dispersion measure and standard deviation (SD), according to their distribution.

To compare the proportions of each variable, the  $\chi^2$  test was used. A p value <0.05 was considered significant. Analyses were performed with the IBM® SPSS version 21 statistical software (SPSS Inc., Chicago, IL, USA).

## RESULTS

Initially, a total of 226 patients were obtained. Twenty-nine were excluded because they had incomplete data or did not meet the inclusion criteria.

The records of 197 patients who had undergone surgery for a previous lumbar spine approach, between 2006 and 2019, were evaluated. The average age was 53.39 years (SD 14.61). 53.81% were women (106 cases) and 46.19% were men (91 cases), these differences were not statistically significant ( $p = 0.285$ ).

The most frequent diagnoses were: degenerative disc disease (51 patients, 25.89%), followed by spondylolisthesis (26 patients, 13.20%), lumbar spinal stenosis (25 patients, 12.69%), symptomatic disc protrusion/extrusion (24 patients, 12.18%). The remaining diagnoses are listed in [Table 1](#).

**Table 1.** Pre-surgical diagnosis

Pre-surgical diagnosis	Patients	%
Degenerative disc disease	51	25.89
Spondylolisthesis	26	13.20
Lumbar spinal stenosis	25	12.69
Symptomatic disc protrusion/extrusion	24	12.18
Other	20	10.15
Lumbar spinal stenosis + spondylolisthesis	15	7.61
Nonunion	11	5.58
Degenerative lumbar scoliosis	5	2.54
Degenerative disc disease + lumbar spinal stenosis	5	2.54
Degenerative disc disease + spondylolisthesis	5	2.54
Degenerative disc disease + symptomatic disc protrusion/extrusion	4	2.03
Lumbar spinal stenosis + lumbar degenerative scoliosis	3	1.52
Discarthrosis	3	1.52
Total	197	100

Regarding the surgical plan, an anterior approach was performed as the only access in 143 (73%) patients, followed by an anterior approach plus a posterior approach in 36 (18%) patients. In 12 cases (6.09%), the anterior surgery was a revision of a previous operation. **Table 2** shows the details of all the approaches.

**Table 2.** Surgical plan

Surgical plan	Patients	%
Anterior approach	143	72.59
Anterior + posterior approach	36	18.27
Revision of anterior approach	12	6.09
Anterior approach + other	6	3.05
Total	197	100

The most frequently affected levels were: L4-L5, L5-S1 in 66 patients (33.50%); L5-S1 in 65 (32.99%) and L4-L5 in 31 (15.74%). **Table 3** lists all affected levels.

**Table 3.** Involved levels

Involved levels	Patients	%
L4-L5, L5-S1	66	33.50
L5-S1	65	32.99
L4-L5	31	15.74
L3-L4, L4-L5, L5-S1	13	6.60
L3-L4, L4-L5	7	3.55
Other	6	3.05
L2-L3, L3-L4, L4-L5, L5-S1	6	3.05
L3-L4	3	1.52
Total	197	100

Thirty-four patients (17.26%) had surgery-related complications ( $p < 0.001$ ). Four intraoperative or immediate (2.03%), 22 (11.16%) early, and nine (4.57%) late complications were recorded. Only one patient suffered both early and late complications: an infection that became chronic.

The most frequent immediate complications were: vascular injury (75%) (2 cases of iliac artery injury and one of ileolumbar vein dehiscence) and perforation of the cecum (one case, 25%). Two patients who suffered immediate complications (arterial injury and perforation of the cecum) died of causes directly related to the surgical procedure.

The most frequent early complications were: vertebral plate injury (5 patients, 23%) and vertebral body injury (3 patients, 13.63%), followed by implant subsidence (2 cases, 9.09%), foreign body granuloma (2 cases, 9.09%) and infection (2 cases, 9.09%). Early complications are detailed in [Table 4](#) ( $p = 0.758$ ).

**Table 4.** Early complications

Early complications	Patients	%
Fracture of the vertebral plate	5	22.73
Vertebral body injury	3	13.64
Subsidence of the implant	2	9.09
Foreign body granuloma	2	9.09
Infection	2	9.09
Hospital-acquired pneumonia	1	4.55
Residual lumbosciatica / deep vein thrombosis / L5-S1 spondylolysis	1	4.55
Nonunion	1	4.55
Subcutaneous hematoma	1	4.55
Implant repositioning	1	4.55
Wound infection	1	4.55
Pleural effusion	1	4.55
Urinary tract infection	1	4.55
Total	22	100%

The most frequent late complication was vertebral body fracture (4 patients, 44.44%). Late complications are detailed in [Table 5](#) ( $p = 0.416$ ).

**Table 5.** Late complications

Late complications	Patients	%
Vertebral body fracture	4	44.44
Subsidence of the implant	1	11.11
Chronic infection, antibiotic treatment	1	11.11
Untreated fall	1	11.11
Loosening of plate screws	1	11.11
Abdominal eventration	1	11.11
Total	9	100

According to the Clavien-Dindo classification, 35 patients had complications: nine were grade I, seven were grade II, 14 were grade IIIA, one was grade IIIB, two were grade IVA, and two were grade V (Table 6).

**Table 6.** Complications according to Clavien-Dindo classification

Clavien-Dindo classification			Total	
Grade			n	%
I		Normal postoperative deviation without the need for pharmacological or surgical treatment.	9	26
II		Requirement for pharmacological treatment with drugs	7	20
III		Requirement for surgical, endoscopic or radiographic intervention		
	IIIA	Intervention without the need for anesthesia	14	40
	IIIB	Procedure under general anesthesia	1	2.8
IV		Life-threatening complication, requiring intensive care unit management		
	IVA	Simple organic dysfunction	2	5.71
	IVB	Multiple organ dysfunction		
V		Death	2	5.71

## DISCUSSION

In 1997, Mayer published a series of patients operated on by an anterior approach which he called *minilaparotomy* for the lumbar spine, retroperitoneal for L2-L3, L3-L4 and L4-L5 segments, and transperitoneal for L5-S1, and reported that the approach is atraumatic.<sup>3</sup> The retroperitoneal approach with a minimal skin incision allowed standardization of the approach and minimization of related visceral complications. This surgical technique with variants of the authors was the one used to treat the operated patients in this series.

In 2017, Phan et al. published a meta-analysis in which they concluded that complications are similar regardless of whether the surgical team has an “access” surgeon or not. Nevertheless, they mentioned that the access surgeon should be available if needed.<sup>8</sup> In our experience, the eventual availability of a general surgeon with training in spinal anatomy was impractical and difficult to coordinate. It was decided that the general surgeon with training in the approach route should form a stable part of the surgical team.

The complication rate of the series (17.26%) is comparable with the results obtained by Brewster et al. in 2008 (15.5%)<sup>9</sup> and by Baker et al. in 1993 (15.6%).<sup>10</sup>

Brewster et al. reported that vascular injury was the most frequent complication in their series (5.3%), and that venous injury was more common than arterial injury. In our series, there were two cases of arterial vascular lesions and one case of dehiscence of iliolumbar vein ligation in the immediate postoperative period. This injury rate could be explained by the presence of a vascular surgeon trained in previous approaches within the team or by the lack of recording of vascular lesions that resolved satisfactorily during the procedure without the need for reintervention or active behavior in the postoperative period.

One of the patients with arterial injury suffered an acute arterial obstruction that was detected in the immediate postoperative period. Surgical reperfusion maneuvers were performed (<6 h), without positive outcomes. Amputation of the left lower limb was necessary, and the patient was successfully fitted with an orthosis. The other patient had bilateral acute arterial ischemia, required bilateral supracondylar amputation, and died postoperatively from complications associated with the arterial injury.

One patient suffered a dehiscence of the iliolumbar vein ligation, requiring emergency surgery, a new ligation of the iliolumbar vein. His evolution was favorable with no associated complications. Following this event, it was decided to change the procedure of iliolumbar vein hemostasis; surgical ligation with surgical linen was discontinued and vascular clips were used instead.

One patient suffered a cecal perforation in the context of a long-standing appendicular surgery complicated by an abdominal bridging cecal abscess. During the immediate postoperative period, he evolved with ileus and then suffered from a perforated viscus. Postoperatively, a cecostomy and a subsequent right colectomy were performed. The patient died from complications associated with the surgery.

In our series, the most frequent early complication was vertebral plate injury (5 patients, 23%), followed by vertebral body fracture (3 patients, 13.63%). Although both complications involve the state of the vertebra, it is clear from the medical records that the vertebral plate injuries were related to the patients' degree of osteoporosis, the type of implant, and the surgical technique, whereas the vertebral body fractures were related to trauma or falls from the patients' own height. For this reason, it was decided to differentiate one type of lesion from the other and to list them separately as independent lesions.

In patients >80 years with documented osteoporosis, the vertebral body was augmented with direct anterior kyphoplasty cement (polymethylmethacrylate).

The two patients (9.09%) who had foreign body granulomas did not require surgical treatment and the condition healed on its own.

Two patients suffered infections (9.09%) that were treated with antibiotics. One of them evolved favorably in the short term. The other had had a previous infection after the posterior approach and required prolonged antibiotic treatment, which improved his symptoms.

There was one case (4.54%) of hospital-acquired pneumonia that was treated with antibiotics in the general ward, with a favorable evolution.

The most frequent late complication was vertebral body fracture (4 patients, 44.44%), associated with low-energy falls or falls from one's own height.

Implant subsidence was detected in one patient (11.11%). The implant was monitored with radiographs, and did not require active management.

One patient (11.11%) was diagnosed with a chronic infection in the context of an infection following posterior surgery. He required prolonged antibiotic treatment.

None of the men (91, 46.19%) reported altered ejaculation, retrograde ejaculation or any other type of sexual dysfunction. Retrograde ejaculation is the result of injury to the presacral neural plexus and consequent sympathetic dysfunction. This injury usually occurs during the dissection of the anterior periosteum of the lumbosacral junction.<sup>11</sup> The absence of a previously described complication in up to 45% of patients<sup>12,13</sup> could be interpreted as a result of a less traumatic surgical approach, the use of blunt elements to manipulate the presacral neural plexus and the surgical team's experience with this type of approach, or as an underreporting of this complication. This finding should be studied further in future research, as should alternative causes.

This research classifies complications according to the time of their onset, using a temporality criterion. The use of an alternative classification, such as the one proposed by Clavien-Dindo, makes it possible to analyze complications according to the complexity of the treatment performed for their resolution, providing a complementary view to the analysis of surgical complications.

Among the patients with complications, nine had grade I complications (defined as any deviation from the normal postoperative course without the need for treatment); in these cases, only the complication was recorded in the clinical record without further action by the treating team; seven had grade II complications (requiring pharmacological treatment); 14 had grade IIIA complications (requiring surgery, endoscopic or radiological), the most frequent type of complication in this series. In this group of complications, spinal lesions are mentioned: body fractures and lesions of the vertebral plate; in these cases, treatment consisted of radiological control of the lesion. One patient had a grade IIIB complication (requiring surgery under general anesthesia); the two patients with grade IVA complications (simple organ dysfunction) are mentioned under early complications; two deaths occurred (grade V).

The weaknesses of this study are its descriptive and retrospective design, the fact that it was performed in a single site and with a single surgical team, the sample with a heterogeneous group of diseases and the unregulated follow-up time.

The strengths are: the number of patients, the study of a type of approach currently used in surgical practice, the contribution from the local area with useful information from our region compared to what is reported in the international literature.

## CONCLUSIONS

In our series of patients who underwent anterior lumbar spine surgery, the most frequent complications were: vascular injury (immediate), vertebral plate or vertebral body injury (early) and vertebral body fractures (late).

The anterior approach to the lumbar spine in the hands of a team trained in this type of approach is a safe technique, with a low rate of complications.

Conflict of interest: The author declares no conflicts of interest.

## REFERENCES

1. Capener N. Spondylolisthesis. *Br J Surg* 1932;19(75):374-86. <https://doi.org/10.1002/bjs.1800197505>
2. Ito H, Tsuchiya J, Asami G. A new radical operation for Pott's disease. *J Bone Joint Surg* 1934;16(3):499-515.
3. Mayer MH. A new microsurgical technique for minimally invasive anterior lumbar interbody fusion. *Spine* 1997;22(6):691-9. <https://doi.org/10.1097/00007632-199703150-00023>
4. Mobbs RJ, Phan K, Daly D, Rao PJ, Lennox A. Approach related complications of anterior lumbar interbody fusion: results of a combined spine and vascular surgical team. *Global Spine J* 2016;6(2):147-54. <https://doi.org/10.1055/s-0035-1557141>
5. Camino Willhuber G, Elizondo C, Slullitel P. Analysis of postoperative complications in spinal surgery, hospital length of stay, and unplanned readmission: application of Dindo-Clavien classification to spine surgery. *Global Spine J* 2019;9(3):279-86. <https://doi.org/10.1177/2192568218792053>
6. Lazanec JY, del Vecchio R, Ramare S, Mora N, Pouzet B, Saillant G. Revisión y simplificación del abordaje anterior mínimo de la columna lumbar. *Rev Ortop Traumatol* 2001;3:195-205. Available at: <https://www.elsevier.es/es-revista-revista-espanola-cirugia-ortopedica-traumatologia-129-pdf-13015922>
7. Pfannenstiel J. Über die Vortheile des suprasymphysären Fascienquerschnitts für die gynäkologischen Köliotomien, zugleich ein Beitrag zu der Indikationsstellung der Operationswege. Breitkopf und Härtel; 1900.
8. Phan K, Hu J, Scherman DB, Rao PJ, Mobbs RJ. Anterior lumbar interbody fusion with and without an "access surgeon": a systematic review and meta-analysis. *Spine (Phila PA 1976)* 2017;42(10): E592-E601. <https://doi.org/10.1097/BRS.0000000000001905>
9. Brewster L, Trueger N, Schermer C, Ghanayem A, Santaniello J. Infraumbilical anterior retroperitoneal exposure of the lumbar spine in 128 consecutive patients. *World J Surg* 2008;32(7):1414-9. <https://doi.org/10.1007/s00268-007-9433-4>
10. Baker JK, Reardon PR, Reardon MJ, Heggeness MH. Vascular injury in anterior lumbar surgery. *Spine (Phila PA 1976)* 1993;18(15):2227-30. <https://doi.org/10.1097/00007632-199311000-00014>
11. Aryan HE, Berven SH, Ames CP. Anterior lumbar interbody fusion (ALIF). En: Ozgur B, Benzel E, Garfin S (eds). *Minimally Invasive Spine Surgery*. New York, NY: Springer; 2009:143-8. [https://doi.org/10.1007/978-0-387-89831-5\\_17](https://doi.org/10.1007/978-0-387-89831-5_17)
12. Kaiser MG, Haid Jr RW, Subach BR, Miller JS, Smith CD, Rodts GE Jr. Comparison of the mini-open versus laparoscopic approach for anterior lumbar interbody fusion: a retrospective review. *Neurosurgery* 2002;51(1):97-105. <https://doi.org/10.1227/01.NEU.0000017312.04526.92>
13. Regan JJ, Hansen Y, McAfee PC. Laparoscopic fusion of the lumbar spine: minimally invasive spine surgery: a prospective multicenter study evaluating open and laparoscopic lumbar fusion. *Spine (Phila PA 1976)* 1999;24(4):402-11. <https://doi.org/10.1097/00007632-199902150-00023>