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Predisposing factors for failed back surgery syndrome following lumbar instrumentation: retrospective study

Factores predisponentes del síndrome de cirugía lumbar fallida tras instrumentación lumbar: un estudio retrospectivo

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Palabras clave:
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ABSTRACT

Objective: to identify the main predisposing factors for failed back surgery syndrome (FBSS) in patients undergoing lumbar instrumentation (L4-S1) between April 2022 and March 2023. **Material and methods:** this was a retrospective, observational study involving 59 patients with persistent or recurrent lumbar pain following lumbar spine surgery. Sociodemographic and clinical data were analyzed using parametric statistics. **Results:** FBSS occurred in 59.3% of patients. The most affected age group was 61-70 years, and 61% were women. Fibrosis was present in 61% and arachnoiditis in 13.5% of cases. Obesity and overweight were observed in 72.9%, but no statistically significant association was found between FBSS and demographic variables or comorbidities. **Conclusion:** FBSS remains a prevalent and clinically significant outcome in lumbar spine surgery, with fibrosis as a potentially major factor. Future strategies should include improved surgical planning, comprehensive postoperative follow-up, and a multidisciplinary approach.

RESUMEN

Objetivo: *identificar los principales factores predisponentes para el síndrome de cirugía lumbar fallida (FBSS, por sus siglas en inglés) en pacientes sometidos a instrumentación lumbar (L4-S1) entre abril de 2022 y marzo de 2023.* ***Material y métodos:*** *se realizó un estudio retrospectivo, observacional, que incluyó a 59 pacientes con dolor lumbar persistente o recurrente después de una cirugía de columna lumbar. Se analizaron datos sociodemográficos y clínicos utilizando estadística paramétrica.* ***Resultados:*** *el FBSS se presentó en 59.3% de los pacientes. El grupo de edad más afectado fue el de 61 a 70 años, y el 61% eran mujeres. La fibrosis estuvo presente en 61% y la aracnoiditis en 13.5% de los casos. La obesidad y el sobrepeso se observaron en 72.9%, pero no se encontró una asociación estadísticamente significativa entre el FBSS y las variables demográficas o las comorbilidades.* ***Conclusión:*** *el FBSS sigue siendo un resultado prevalente y clínicamente significativo en la cirugía de columna lumbar, siendo la fibrosis un factor potencialmente importante. Las estrategias futuras deberían incluir una mejor planificación quirúrgica, un seguimiento postoperatorio integral y un enfoque multidisciplinario.*

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INTRODUCTION

Failed back surgery syndrome (FBSS), also known as post-laminectomy syndrome or failed spinal surgery, is defined as persistent or recurrent lumbar pain following one or more surgical procedures aimed at correcting spinal pathology.[1,2] This condition reflects not only a clinical and anatomical failure but also a disconnection between surgical expectations and postoperative reality, both for the patient and the treating physician.[3,4]

FBSS is increasingly recognized as a complex, multifactorial entity rather than a singular diagnosis. It encompasses a broad spectrum of contributing factors, including surgical technique, pre-existing comorbidities, postoperative complications, and psychosocial elements such as depression, anxiety, and somatization.[5-7] The prevalence of FBSS has been reported to range between 10 and 40% across various studies, and in some series, it exceeds 60%, underscoring its significance in spine care.[2,8]

The burden of lumbar pain continues to rise globally, particularly with the aging population. According to the World Health Organization, over 600 million individuals worldwide suffer from chronic low back pain a figure expected to grow due to increased life expectancy and a higher incidence of degenerative spinal condition.[9,10] In Mexico, the prevalence of nontraumatic back pain in urban communities was reported to be 8.0% over a 7-day period.[11] Furthermore, musculoskeletal disorders, with low back pain being the most prominent, were the leading cause of Years Lived with Disability (YLDs) in the country between 1990 and 2021, showing a 57.3% increase in YLDs, reaching 840.6 per 100,000 population by 2021.[12]

In this context, FBSS poses a major challenge to healthcare systems, especially in institutions which serve both active and retired workers and their families under contractual health benefits.

Despite technological advances in surgical instrumentation and spinal fusion techniques, outcomes remain inconsistent. In Mexico, a total of 52,267 spinal surgery procedures were performed in 2022, with spinal fusion being the most common.[13] Studies have reported that preoperative predictors such as prolonged pain duration, obesity, or multiple prior surgeries may increase the risk of FBSS.[4,6,14] Additionally, intraoperative complications including excessive nerve manipulation, inadequate decompression, and hardware misplacement have also been linked to unfavorable results.[15,16]

Among the most frequently cited postoperative complications contributing to FBSS are epidural fibrosis and arachnoiditis. These conditions can lead to chronic neuroinflammation, nerve root tethering, and neuropathic pain that is often refractory to conventional treatment.[5,15] The high incidence of such findings in the postoperative population reinforces the need for surgical precision, timely diagnosis of complications, and multidisciplinary management strategies.

Given the increasing demand for spinal procedures and the growing population affected by chronic lumbar pain, understanding the predisposing factors associated with FBSS is essential. This study aims to analyze these factors in patients who underwent lumbar instrumentation surgery from L4 to S1 between April 2022 and March 2023, providing insights that may inform clinical decision-making and improve patient outcomes within a specialized Mexican healthcare context.

MATERIAL AND METHODS

Study design and setting

This was a retrospective, observational, and descriptive study conducted at the Spine Surgery Unit at a tertiary Hospital in Mexico City. The study period covered patients operated between April 2022 and March 2023, with a minimum follow-up of 12 months.

Study population

The study included adult patients (both sexes) undergoing lumbar spinal instrumentation at levels L4 to S1 during the study period. Patients were recruited consecutively based on inclusion and exclusion criteria.

Inclusion criteria: patients aged 18-80 years, with lumbar instrumentation from L4 to S1, complete clinical records, at least 12 months of follow-up, and a preoperative pain score ≥ 3 on the visual analog scale (VAS).

Exclusion criteria: patients without postoperative lumbar pain. Patients with incomplete data collection sheets. Patients lost to follow-up within the first 12 months.

Sample size and data collection

A total of 59 patients met the study criteria and were included in the final analysis. Data were collected through the electronic medical records system (SIAH) and follow-up assessments in the spine clinic.

The following variables were recorded: demographics: age, sex. Anthropometric data: body mass index (BMI). Comorbidities: hypertension, diabetes, obesity, others. Preoperative pain: intensity (VAS), and duration. Postoperative complications: presence of epidural fibrosis or arachnoiditis. Postoperative pain: VAS scores at 12 months. Presence of failed back surgery syndrome (FBSS), defined as persistent pain ≥ 3 on the VAS at 12 months post-surgery.

Statistical analysis

Descriptive statistics were used to analyze the data. Measures of central tendency and dispersion (mean, standard deviation, median, mode) were applied based on the Kolmogorov-Smirnov test for normality ($p > 0.05$). Parametric statistics were employed for normally distributed variables.

Associations between categorical variables (e.g., sex, BMI category, comorbidities) and the development of FBSS were tested using the Chi-square (χ^2) test, with a significance level of $p < 0.05$.

All data were processed and analyzed using IBM SPSS Statistics software, version XX (insert version used if available).

Ethical considerations

This study was conducted in accordance with the principles of the declaration of Helsinki and national research guidelines (Article 17 of the Mexican General Health Law for Health Research). Due to its observational and retrospective design, informed consent was not required. Patient confidentiality was strictly maintained throughout the study.

RESULTS

A total of 59 patients were included in this prospective study, all of whom underwent lumbar instrumentation surgery from L4 to S1 between April 2022 and March 2023. The analysis focused on demographic characteristics, clinical factors, complications, and postoperative outcomes at the 12-month follow-up *(Table 1)*.

Demographics and baseline characteristics

The majority of the patients were in the age group of 61 to 70 years (39%), followed by those aged 51 to 60 years (22%). Younger age groups, such as 18 to 30 years and 31 to 40 years, represented a minority of the sample (each accounting for 5.1%). The gender distribution showed a predominance of female patients (61%), compared to males (39%).

Regarding body mass index (BMI), 49.2% of patients were classified as overweight, 27.1% had normal weight, and 23.7% were obese. These findings indicate a high prevalence of overweight and obesity among patients undergoing lumbar instrumentation, which may have implications for surgical outcomes and recovery.

Preoperative pain characteristics

Pain duration prior to surgery varied among patients. Over half of the patients (52.5%) reported having chronic lumbar pain for six to nine months before undergoing surgery. Another significant portion

Table 1: Demographic and clinical characteristics (N = 59).

Variable	Category	n (%)
Age (years)	18-30	3 (5.1)
	31-40	3 (5.1)
	41-50	8 (13.6)
	51-60	13 (22.0)
	61-70	23 (39.0)
	71-80	9 (15.3)
Sex	Male	23 (39.0)
	Female	36 (61.0)
BMI category (kg/m^2)	Normal (18.5-24.9)	16 (27.1)
	Overweight (25.0-29.9)	29 (49.2)
	Obese (≥ 30.0)	14 (23.7)
Preoperative pain duration (months)	< 3	2 (3.4)
	3-6	5 (8.5)
	6-9	31 (52.5)
	9-12	21 (35.6)
Preoperative pain intensity (VAS)	Moderate (4-6)	5 (8.5)
	Severe (≥ 7)	54 (91.5)
Postoperative complications	Arachnoiditis	8 (13.6)
	Epidural fibrosis	36 (61.0)
FBSS diagnosis	Present	35 (59.3)
	Absent	24 (40.7)

BMI = body mass index. FBSS = failed back surgery syndrome.

(35.6%) experienced pain for 9 to 12 months, while only 8.5 and 3.4% reported pain lasting three to six months and less than three months, respectively *(Figure 1)*.

In terms of intensity, as assessed by the VAS, 91.5% of patients experienced severe pain (VAS > 7) prior to surgery, while the remaining 8.5% reported moderate pain (VAS 4-6). No patients had mild or absent pain at the time of preoperative evaluation, which underscores the severity of symptoms leading to surgical intervention.

Incidence of failed back surgery syndrome

The primary outcome of the study was the presence of FBSS at the 12-month postoperative follow-up, defined as persistent lumbar pain with a VAS score ≥ 3. The results revealed that 59.3% (n = 35) of patients met the criteria for FBSS, indicating that more than half of the patients continued to experience chronic lumbar pain despite surgical intervention.

Postoperative complications

Two major postoperative complications were analyzed due to their known association with persistent pain after spinal surgery: epidural fibrosis and arachnoiditis.

Epidural fibrosis was diagnosed in 61.0% of patients (n = 36), making it the most frequent postoperative finding. This condition involves the formation of scar tissue around nerve roots, potentially leading to nerve compression and recurrent pain.

Arachnoiditis, a chronic inflammatory condition of the arachnoid membrane, was observed in 13.6% of cases (n = 8). This complication is known to cause nerve root adhesions and significant neuropathic pain, which can be resistant to conventional treatments.

Postoperative pain outcomes at 12 months

At the 12-month follow-up, pain intensity remained a significant concern. Approximately 49.2% of the patients continued to experience severe pain (VAS > 7), 20.3% reported moderate pain (VAS 4-6), and only 30.5% experienced mild pain (VAS 1-3). These findings suggest that a considerable proportion of patients derived limited symptomatic relief from the surgery, highlighting the persistent burden of chronic pain in this population.

Statistical correlations

Chi-square tests were used to assess the relationship between sociodemographic and clinical variables and the presence of FBSS. No statistically significant

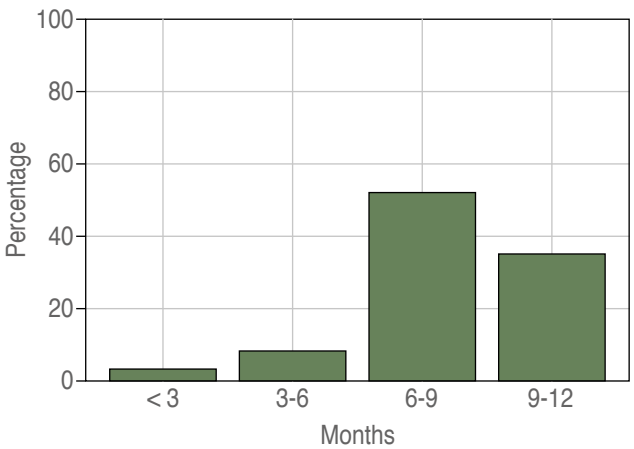

Figure 1: Distribution of patients by pain duration prior to surgery.

associations were found between FBSS and age (p = 0.140), sex (p = 0.151), BMI (p = 0.252), comorbidities (p = 0.333), or the duration of preoperative pain (p = 0.200). These findings suggest that traditional risk factors alone may not fully account for the development of FBSS and that additional, possibly unmeasured, variables may contribute to poor postoperative outcomes.

DISCUSSION

This study aimed to analyze the predisposing factors associated with failed back surgery syndrome in patients who underwent lumbar instrumentation surgery from L4 to S1. The findings from this study support and contrast with several previous investigations on the nature, predictors, and outcomes of FBSS.

Our findings revealed a notably high incidence of FBSS (59.3%) in the study population, aligning with previously reported rates in the literature, which range from 10 to 40%, and even up to 60% in specific series.[1-4]

The high prevalence of FBSS aligns with the chronic and disabling nature of lumbar spine pathology described by Chan and Peng (2011), who emphasized that FBSS is not a single disease but rather a multifactorial syndrome involving biomechanical, inflammatory, and psychological components.[5]

Although FBSS is a well-known clinical entity, it remains challenging to predict. In our study, classic risk factors such as age, sex, BMI, and preoperative pain duration showed no significant correlation with the development of FBSS. This aligns with literature suggesting that FBSS is a multifactorial condition that cannot be attributed solely to demographic or physical variables. Ellis et al.[6] emphasize that preoperative psychosocial states such as depression, anxiety, and somatization may contribute significantly to postoperative pain outcome. Unfortunately, such variables were not evaluated in our analysis and should be considered in future prospective studies.

Despite advances in surgical techniques and preoperative assessment, a significant proportion of patients continue to suffer from chronic pain after spinal procedures. Our data reinforce the idea that despite surgical intervention, a large proportion of patients remain symptomatic.

Although the most affected age group was 61 to 70 years and there was a predominance of female patients, these variables did not demonstrate statistical significance in relation to postoperative pain outcomes. Similarly, comorbidities such as hypertension, diabetes, and overweight or obesity did not show a direct correlation with FBSS, despite the high prevalence of these conditions in the study cohort.

One of the most critical findings was the high incidence of epidural fibrosis, diagnosed in over 60% of patients. This supports the hypothesis that postoperative fibrosis may play a key role in the pathophysiology of FBSS. Fibrotic scar tissue can cause mechanical compression of nerve roots and disrupt normal neural signaling, leading to persistent or worsening pain.

Fibrosis, as described in the literature, may cause nerve root tethering, reduce cerebrospinal fluid dynamics, and provoke ongoing inflammatory responses that maintain or amplify pain.[5,6]

While this condition is well documented post-laminectomy, its high frequency in our cohort underscores the need for more refined surgical techniques and possibly the use of anti-fibrotic adjuncts during surgery.

Although this study did not demonstrate a statistically significant association between fibrosis and pain severity, its frequent occurrence underscores the need for strategies aimed at minimizing postoperative scar formation, such as surgical techniques with minimal tissue manipulation or the use of anti-fibrotic agents.

In addition, arachnoiditis was observed in 13.6% of patients. Though less common, this chronic inflammatory condition of the arachnoid membrane is often devastating, as it involves nerve root adhesions and chronic neuropathic pain. It is particularly concerning due to its resistance to conventional analgesic and rehabilitative approaches.[5,6] Its presence further supports the view of FBSS not merely as a surgical failure but as a consequence of postoperative neuroinflammatory and scarring processes.

Although less prevalent, its presence is clinically relevant, as this condition is notoriously difficult to treat and often leads to intractable neuropathic pain. These findings highlight the importance of early identification and management of such complications to prevent irreversible neurological deficits and reduce long-term disability.

Despite surgical intervention, nearly 70% of patients reported moderate to severe pain at 12 months, a finding that mirrors the broader global concern identified by the WHO, with over 600 million people suffering from low back pain.[5,9,10] These results reflect the growing burden of spinal degenerative disease in

aging populations and the limitations of current surgical interventions to provide definitive relief.

From a theoretical standpoint, FBSS has evolved from a mechanical interpretation of persistent pain to a complex biopsychosocial phenomenon. As described in the literature, FBSS is not merely the result of technical failure, but a mismatch between patient expectations and clinical outcomes.[2-5]

Furthermore, intraoperative factors such as aggressive manipulation, suboptimal decompression, or misplacement of pedicle screws –as highlighted by Jutte & Castelein– have been linked to poor outcomes.[12] While our study did not specifically document surgical nuances, the high complication rates suggest the need for enhanced surgical planning, intraoperative neuro-monitoring, and possibly second opinions before proceeding to instrumentation, especially in borderline cases.

Postoperative recovery, too, remains a critical factor. Nutritional status, oxygenation, and systemic inflammatory control all known to influence wound healing and scar formation were not directly measured but are increasingly recognized as modifiable risk factors in FBSS. The emphasis on postoperative physical therapy and personalized rehabilitation plans is also a growing area of focus in contemporary spine care.

Lastly, our results invite reflection on prevention. As discussed in recent literature, the most effective strategy to prevent FBSS may be careful patient selection, comprehensive preoperative education, and consideration of non-surgical interventions such as medial branch blocks or selective nerve root blocks in appropriately diagnosed cases.[11,15-17] In patients with high risk for persistent pain or complex psychosocial backgrounds, surgery should be considered only after exhausting conservative options and with realistic goal-setting between patient and surgeon.[17]

While most patients experienced pain for six months or longer before surgery, often considered a risk factor for chronic pain persistence this variable did not reach statistical significance. This suggests that other factors, such as surgical precision, rehabilitation adherence, psychological state, and possibly genetic predisposition, may play a larger role than previously assumed.

These findings are consistent with other studies in the field. For example, Bosscher and Heavner (2010) reported a higher FBSS rate of 83.3% in a comparable patient population, although differences in methodology, surgical technique, and patient selection may account for the variation.[14] The literature also emphasizes the multifactorial nature of FBSS, including technical, biological, and psychosocial components.

Taken together, the results of this study reinforce the need for a multidisciplinary approach to spine surgery, one that not only considers surgical indications but also includes rigorous postoperative monitoring, physical therapy, pain management, and psychological support. Identifying high-risk patients early and implementing preventive strategies could help reduce the incidence of FBSS and improve long-term outcomes.

CONCLUSION

This study demonstrates that failed back surgery syndrome remains a prevalent and complex problem among patients undergoing lumbar instrumentation between L4 and S1, with over half of the patients continuing to experience severe or moderate pain one year after surgery. Despite the high frequency of complications such as epidural fibrosis and arachnoiditis, no significant statistical associations were found between FBSS and traditional clinical or demographic variables, such as age, sex, BMI, or comorbidities.

The findings suggest that the etiology of FBSS is likely multifactorial, involving a combination of technical, biological, and possibly psychological or socioeconomic factors not fully captured in this study. The persistence of pain despite surgical intervention highlights the limitations of current treatment protocols and emphasizes the need for more individualized, multidisciplinary strategies that go beyond the surgical event itself.

Key clinical implications include the necessity for:

Thorough preoperative patient selection and counseling, standardized protocols to minimize surgical complications like fibrosis and arachnoiditis, structured and personalized postoperative rehabilitation programs, and a holistic patient care model that incorporates pain specialists, physiotherapists, and mental health professionals.

In conclusion, the management of FBSS requires a paradigm shift from a purely surgical perspective to a broader, patient-centered model of care. Future research should focus on identifying modifiable risk factors, developing predictive models for postoperative outcomes, and exploring innovative interventions to reduce chronic postoperative pain and improve the overall quality of life in this patient population.

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