How to Cite:
Ul Haq, N., Ali, A., Mehmood, T., Khan, M. J., Sonia, S., & Shah, S. N. (2023). Incidence of neurological deficits of post spinal surgery syndrome. *International Journal of Health Sciences*, *7*(S1), 228–236. https://doi.org/10.53730/ijhs.v7nS1.14179

Incidence of neurological deficits of post spinal surgery syndrome

Dr. Naeem Ul Haq
Associate Professor Neurosurgery Unit Mardan Medical Complex / Bacha Khan Medical College, Mardan

Dr. Amjad Ali
Professor of Medicine, Bacha Khan Medical College, Mardan
Corresponding author email: dramjadali75@gmail.com

Dr. Tariq Mehmood
Assistant Professor Community Medicine, Bacha Khan Medical College, Mardan

Dr. Muhammad Javed Khan
Assistant Professor Paediatric Surgery, Bacha Khan Medical College, Mardan

Dr. Sonia
Post Graduate Resident Radiology Unit, Mardan Medical Complex, Mardan

Dr. Syed Nasir Shah
Registrar Neurosurgery Unit Mardan Medical Complex, Mardan

***Abstract*---**Background: Post spinal surgery syndrome (PSSS) is characterized by chronic discomforts post one or more spine operations. Despite advancements in surgical technology, failure rate of back operations has not decreased. These conditions may occur preoperatively, intraoperatively, and postoperatively. Objectives: The primary purpose of this investigation was to ascertain the incidence and causes of neurological complications in patients who have undergone spinal surgery and subsequently developed PSSS. Methods: Cross sectional research was performed at Mardan Medical Complex, Mardan, comprising 82 patients (50 males and 32 females). X-ray studies, MRI, and electromyography was the tool for initial lumbar surgery to confirm the initial diagnosis. Participants were requested to submit the questionnaire and then, their scores were calculated and analyzed as per standard protocols. Results: The potential causes of PSSS, indicated 16 (19.5%) patients with incorrect diagnosis, 24 (29.3%) of the due to surgical technical errors, 10 (12.2%) due to improper pre-operative patient selection and 20

(24.4%) as a result of recurrent disc herniation after surgery. The frequency of cases of complications was spinal fusion (64.09%), followed by kinesiophobia (47.38%), laminectomy (45.98%), depression (40.3%), numbness in lower limbs (36.9%), myelopathy (14.5%) and other neurological deficits (12.56%). Prevalence of various neurological deficits in male and female patients were evidenced with 37 (74%) male patients and 27 (84.37%) female patients experienced numbness as a neurological deficit in PSSS, 8 (16%) male and 4 (12.5%) female patients had myelopathy, 44 (88%) male patients and 28 (87.5%) female patients had chronic pain, 42 (84%) of male patients and 28 (87.5%) of female patients had radiculopathy. Conclusion: Neurological deficits are a common and significant complication of PSSS. These bear negative effects on life quality and may be mitigated by early intervention and management.

***Keywords*---**Numbness, Myelopathy, Paralysis, Radiculopathy, Spine injury.

Introduction

Post spinal surgery syndrome (PSSS), is lumbar or radicular ache that persists subsequent to surgeries conducted to manage alterations of lumbar spine (disc, stenosis, tumor, etc.) and is also known as post-laminectomy syndrome[1]. It is collection of symptoms that develop after spinal surgery [2-3]. Despite the term, the symptoms can occur following any form of back surgery, not just unsuccessful ones [4]. PSSS symptoms differ from patient to patient, however, typical clinical manifestations reveal persistent and chronic ache. The pain may be mild, aching, burning, or shooting, and may be confined to the back or radiate down the legs [5-6]. Many patients with PSSS have limited mobility as a result of back or leg pain, stiffness, and paralysis. A prevalent symptom of PSSS is numbness or tingling in the back, legs, or feet [7]. Psychological symptoms involve chronic pain that bear negative impact on a person's mental health and many patients with PSSS may exhibit anxiety, depression, and other psychological symptoms [8].

Multiple potential causes of PSSS include scar tissue, recurrent local herniation or nerve damage. Subsequent to surgery, scar tissue can form around the spinal nerves, causing discomfort and mobility restrictions [9-10]. While during surgery, damage to the nerves cause chronic pain and other symptoms. In some cases, patients may experience recurrent herniation in the same region of the spine, causing pain and other symptoms. In the event that the spinal fusion fails to heal adequately, chronic pain and other symptoms may result [11-13].

PSSS is treated based on the specific symptoms and underlying causes. Medication, nerve blocks, and spinal cord stimulation are all examples of pain management techniques. Physical therapy can increase mobility and decrease discomfort [14]. In some circumstances, additional surgery may be required to treat underlying cause of PSSS. Patients with psychological symptoms may benefit from psychotherapy, medication, or other psychological therapies [15-16]. Radiological investigations remain a cornerstone of PSSS assessments.

Previously, X-rays and CT scans were the investigation of choice, but now MRI is the standard. Gadolinium-enhanced T1-weighted images enable the distinction between disc herniation and postsurgical fibrosis [16-18].

After spine surgery, post-operative neurological complications can range from minimal paresthesia to quadriplegia. These complications may affect patient recovery, duration of hospital stay, postoperative quality of life, and health care expenditures. The incidence of neurological complications following anterior/posterior cervical discectomy, fusion, and thoracolumbar fusion increased from 0.68% in 1999 to 1.055% in 2011. Any injury to spinal cord that occurs directly during an operation is classified as a perioperative spinal cord injury. Other lesions to nerve roots (radiculopathies) and peripheral nerve palsies can be more extensive [19].

Neurological deficits are one of the most significant and debilitating symptoms of PSSS [20-21]. Neurological deficits may include motor paralysis, sensory loss, and impaired reflexes, all bearing significant impact on the quality of life of a patient [22-23]. It has been reported that the neurological deficits, being common complication of PSSS, affect approximately one-third of patients. Variability in the incidence of neurological deficits is likely due to variations in patient characteristics and surgical procedures. Although the precise mechanisms underlying the development of neurological deficits in PSSS are not completely understood, they may be associated with nerve damage, scar tissue formation, or recurrent herniation [24-25].

The primary purpose of this investigation was to ascertain the incidence and causes of neurological complications in patients who have undergone spinal surgery and subsequently developed PSSS. This will help clinicians better comprehend the prevalence of these complications and identify patients at a greater risk to minimize the incidence of neurological complications in PSSS.

Material and Methods

This was a sort of cross-sectional research performed at Mardan Medical Complex, Mardan, Khyber Pakhtunkhwa, Pakistan during the year 2022-23. A sum of 82 patients (50 males and 32 females) was the participants who endured spinal surgery and subsequently developed PSSS.

Men and women over age of 18 admitted with a diagnosis of PSSS, confirmed through clinical data of lumbar pain and persistent radicular alteration, after one or more lumbar surgeries performed for the purpose of treating an alteration such as disc herniation, narrowing, or bulging. X-ray studies, magnetic resonance imaging, and electromyography prior to initial lumbar surgery to confirm the initial diagnosis, as well as radiographic studies upon consultation to confirm the current status of the patient. Excluded from the study were patients who underwent revision surgery due to superficial infection of a surgical incision and who did not experience any back or leg pain, having vestibular or neurological deficits, recent surgery or implant in another area of the body, patients with cardiopulmonary disease, patient identified as having a psychological disorder, extensive lower extremity paralysis and failed spinal surgery.

Individuals who had undergone spinal surgery (4 to 6 weeks) and were willing to participate were included based on inclusion and exclusion criteria. Before commencing study, all participants provided written consent. Participants were requested to submit the questionnaire and then, their scores were calculated and analyzed as per standard protocols [26].

Since this research involved direct patient recruitment, ethical approval was therefore necessary and was granted by the institutional ethical review board. The study was conducted in accordance with ethical principles, such as protecting the privacy of patient data and obtaining the necessary permissions to access patients' medical records.

SPSS version 23.0 was used for construction and analysis of datasets according to our inclusion criteria. After executing the trial, the patients' data and medical reports were compiled in Microsoft Excel (2007), while categorical variables were analyzed using One-way ANOVA including Tukey test and Chi-square tests. Continuous data set was displayed as means and standard deviations, whereas categorical data were displayed as percentages at $p<0.05$.

Results

The average age of the study population was 53.43 ± 15.82 years. The p-value of 0.792 indicated there was no statistically significant difference in age between compared categories. The average weight was 77.03 ± 18.79 kilograms, with p-value of 0.58. The average BMI of the patients was 30.15 ± 3.09 having non-significant p-value of 0.619. The number and percentage of masculine and female study participants revealed that 60.97% of 82 participants were male, while 39.03% were female ($p<0.05$). The extremely low p-value of 0.00001* indicated that there was a statistically significant difference between the two categories in terms of gender distribution. The quantity and proportion of participants from rural and urban areas showed that 45.12% of total 82 participants were from rural regions, while 54.87 % were from urban areas. The low p-value of 0.00018* suggests that there is a statistically significant difference between the two groups in terms of location distribution (Table 1).

The potential causes of PSSS, along with their associated probabilities and values were described indicating 16 (19.5%) patients in the study experienced PSSS as a result of an incorrect diagnosis having statistically significant difference ($p<0.05$). 24 (29.3%) of the patients in the study experienced PSSS as a result of surgical technical errors ($p<0.05$) having p-value of 0.012*. Ten (12.2%) of the study's patients experienced PSSS as a result of improper pre-operative patient selection ($p<0.05$). Twenty (24.4%) of the patients in study suffered from PSSS as a result of recurrent disc herniation after surgery with a p-value of 0.021*, showing statistically significant difference in the groups ($p<0.05$). 12 patients (14.6%) in study had PSSS owing to other causes (Table 2).

The frequency of cases of complications were also studied in the study population and it was found that most of the complication incurred in PSSS were spinal fusion (64.09%), followed by kinesiophobia (47.38%), laminectomy (45.98%), depression (40.3%), numbness in lower limbs (36.9%), myelopathy (14.5%) and

other neurological deficits (12.56%) (Figure 1). The table displays the incidence of two distinct categories of spinal problems in PSSS among male and female patients, along with chi-square test statistic and p-value for each comparison. Eight (16%) of the male patients and four (12.5%) of female patients in PSSS study experienced myelopathy having non-significance value of 0.9514 ($p \geq 0.05$). Similarly non-statistically significant difference between males and females in this sample regarding the incidence of radiculopathy was found regarding incidence of spinal issues in PSSS (Table 3).

Table 4 depicts the incidence of various neurological deficits in male and female patients with PSSS, along with the chi-square test statistic and p-value for each comparison. It was evident that 37 (74%) male patients and 27 (84.37%) female patients in this study experienced numbness or sensation as a neurological deficit in PSSS, with non-significant difference between male and female population ($p \geq 0.05$). Eight (16%) male and four (12.5%) female patients in the study experienced myelopathy as a neurological deficit in PSSS. 44 (88%) male patients and 28 (87.5%) female patients in the study experienced chronic pain as a neurological deficit in PSSS. 42 (84%) of the male patients and 28 (87.5%) of female patients in the PSSS study experienced radiculopathy. 2 (4%) male patients and 1 (3.125%) female patients in the PSSS study experienced paralysis as a neurological deficit. Laminectomy was found at the rate of 26 (52%) in male and 18 (56.25%) in female patients (Table 4).

Table 1: Demographic and clinical profile of the patients

S. No	Characteristics	Value	p-value
1	Age (Mean±SD) years	53.43±15.82	0.792
2	Weight (Mean±SD) Kg	77.03±18.79	0.580
3	Body mass index	30.15±3.09	0.619
4	Gender n(%) Male Female	82 (100) 50 (60.97) 32 (39.03)	**0.00001***
5	Location n(%) Rural Urban	 37 (45.12) 45 (54.87)	**0.00018***

*Indicated that the value is significant at $p<0.05$

Table 2: Possible causes for post spinal surgery syndrome

S. No	Possible causes	Value n(%)	p-value
1	Inaccurate diagnosis	16 (19.5)	**0.027***
2	Technical error due to surgery	24 (29.3)	**0.012***
3	Improper pre-operative patient selection	10 (12.2)	**0.086***
4	Recurrent disc herniation after surgery	20 (24.4)	**0.021***
5	Others	12 (14.6)	0.211

*Indicated that the value is significant at $p<0.05$

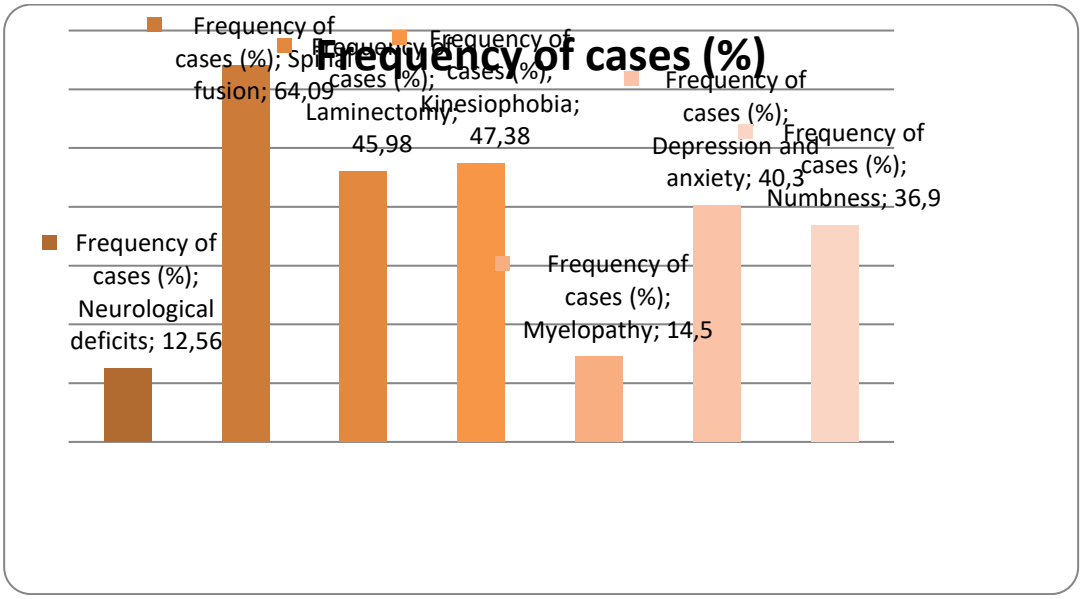

Figure 1: Frequency of complications caused due to post spinal surgery syndrome

Table 3: Incidence of myelopathy vs radiculopathy in patients with PSSS

S. No	Spinal issues in PSSS	Male n(%)	Female n(%)	x2	p-value
1	Myelopathy	8 (16)	4 (12.5)	0.0037	0.9514
2	Radiculopathy	42 (84)	28 (87.5)	0.0019	0.9650

Table 4: Incidence of neurological deficits of post spinal surgery syndrome

S. No	Neurological deficits	Male n(%)	Female n(%)	x2	p-value
1	Numbness or tingling	37 (74)	27 (84.37)	0.0469	0.8285
2	Myelopathy	8 (16)	4 (12.5)	0.0037	0.9514
3	Chronic pain	44 (88)	28 (87.5)	0.0229	0.8820
4	Radiculopathy	42 (84)	28 (87.5)	0.0019	0.9650
5	Paralysis	2 (4)	1 (3.125)	0.1636	0.6859
6	Laminectomy	26 (52)	18 (56.25)	0.0002	0.9879

Discussion

Spinal surgery is a high-risk field with a growing patient population. Results are extremely favorable, but neurologic injury, the most severe complication, may result in life-threatening complications [27]. We found that incorrect diagnosis, surgical technical errors, improper pre-operative patient selection, recurrent disc herniation after surgery *etc* were the potential causes of PSSS. The frequency of cases of complications revealed that most of the complications incurred in PSSS were spinal fusion, kinesiophobia, laminectomy, depression, numbness in lower limbs, myelopathy and other neurological deficits. It was evident from our study that mostly the patients experienced numbness as a neurological deficit in PSSS, myelopathy, chronic pain radiculopathy and 3 patients were paralyzed.

Another retrospective study was correlated to our research that analyzed the data of 65 patients, of which 18 constituted group I (first spine surgery performed at our institution) and 47 formed group II (first spine surgery performed at another hospital). In group I, the majority of cases had a previous diagnosis of lumbar stenosis (44.4% vs. 25.5%, p = 0.22), whereas disk herniation was the predominant diagnosis in group II (22.2% vs. 61.7%, p = 0.001). In group I, technical error during surgery was the leading cause of the syndrome (61.1%), whereas in group II, it was only 6.3% (p = 0.001). In this latter group, misdiagnosis was prevalent (57.4%), whereas there were no cases in group I (p = 0.001). The preoperative functional status of both groups and their immediate postoperative recovery were also comparable (p = 0.68). These findings were corroborated with our results [1].

Our results were comparable to the study in which 100 patients responded to the Tampa scale of kinesiophobia and were evaluated according to their level of kinesiophobia six to ten weeks after spinal surgery, that is, after the healing period. Sixty-one percent of the participants experienced a high level of kinesiophobia 6-10 weeks after spinal surgery. This study revealed that 61% of post-spinal surgery patients experienced a high prevalence of kinesiophobia after 6-10 weeks, even after 4-6 weeks of healing time [26]. Degenerative and isthmic spondylolisthesis may progress to lumbar spinal stenosis, which is commonly induced by degenerative spinal conditions [29]. Symptomatic subjects report low back pain, radicular pain, lower limb motor impairment, and claudication due to the entrapment and compression of intraspinal vascular and nervous structures. Patients with chronic and debilitating symptoms secondary to spondylolisthesis and LSS who do not respond to conservative treatment may be referred for surgery to reduce pain, improve spinal function, and enhance quality of life, after a thorough evaluation of indications and outcomes [30-31].

Conclusion

Neurological deficits are a common and significant complication of PSSS. Due to the wide variation in the incidence of neurological deficits between studies, additional research is required to identify and mitigate risk factors and most effective management strategies for these patients. Clinicians should be cognizant of the possibility of neurological deficits in PSSS patients and actively monitor for these symptoms during follow-up. Neurological deficits bearing negative impact on a patient's quality of life that can be mitigated by early intervention and management.

Conflict of interest: None.

References

1. Vargas SR, Chavarria CO, Kalfopolus BZ, Olivares LMR, Aguirre AA, Sanchez AAR. Profile of the patient with failed back surgery syndrome in the Instituto Nacional de Rehabilitación. Comparative analysis. Cirugía y Cirujanos. 2015;83(2):117-123.
2. Baber Z, Erdek MA. Failed back surgery syndrome: current perspectives. J Pain Res. 2016 Nov 7;9:979-987.

3. Orhurhu VJ, Chu R, Gill J. Failed Back Surgery Syndrome. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2023 Jan.
4. Talbot L. Failed back surgery syndrome. BMJ. 2003 Oct 25;327(7421):985-6.
5. Cho JH, Lee JH, Song KS, Hong JY. Neuropathic Pain after Spinal Surgery. Asian Spine J. 2017 Aug;11(4):642-652.
6. Elahi F, Hitchon P, Reddy G. Acute Sciatic Neuritis following Lumbar Laminectomy. Case reports in Medicine. 2014 June:404386.
7. Choi YK. Lumbar foraminal neuropathy: an update on non-surgical management. Korean J Pain. 2019 Jul 1;32(3):147-159.
8. Woo AK. Depression and Anxiety in Pain. Rev Pain. 2010 Mar;4(1):8-12.
9. Ahuja C, Wilson J, Nori S, et al. Traumatic spinal cord injury. Nat Rev Dis Primers. 2017;3:17018.
10. Cheung JP, Luk KD. Complications of Anterior and Posterior Cervical Spine Surgery. Asian Spine J. 2016 Apr;10(2):385-400.
11. Bordoni B, Marelli F. Failed back surgery syndrome: review and new hypotheses. J Pain Res. 2016 Jan 12;9:17-22.
12. Christelis N, Simpson B, Russo M, Hicks MS, Barolat G, Thomson S, Schug S, Baron R, et al. Persistent Spinal Pain Syndrome: A Proposal for Failed Back Surgery Syndrome and ICD-11, Pain Med. 2021 April; 22(4):807–818.
13. Ganty P, Sharma M. Failed back surgery syndrome: a suggested algorithm of care. Br J Pain. 2012 Nov;6(4):153-61.
14. Patel VB, Wasserman R, Imani F. Interventional Therapies for Chronic Low Back Pain: A Focused Review (Efficacy and Outcomes). Anesth Pain Med. 2015 Aug 22;5(4):e29716.
15. Harvey AG, Gumport NB. Evidence-based psychological treatments for mental disorders: modifiable barriers to access and possible solutions. Behav Res Ther. 2015 May;68:1-12.
16. Ramnarayan R, Chaurasia B. The post spinal surgery syndrome: A review. J Craniovert Jun Spine 2023;14:4-10.
17. Costanzo R, Ferini G, Brunasso L, Bonosi L, Porzio M, Benigno UE, et al. The role of 3D-printed custom-made vertebral body implants in the treatment of spinal tumors: A systematic review. Life (Basel) 2022;12:489.
18. Nicoletti GF, Umana GE, Chaurasia B, Ponzo G, Giuffrida M, Vasta G, et al. Navigation-assisted extraforaminal lumbar disc microdiscectomy: Technical note. J Craniovertebr Junction Spine. 2020;11:316-20.
19. Muralidharan A, Shoap W, Robaidi KA, Thirumala PD. Postoperative Neurological Complications Following Revision Spine Surgery: A State Inpatient Database Analysis. Int J Spine Surg. 2020;14(4):607–614.
20. Digre KB, Brennan KC. Shedding light on photophobia. J Neuroophthalmol. 2012 Mar;32(1):68-81.
21. Monje M, Fisher PG. Neurological complications following treatment of children with brain tumors. J Pediatr Rehabil Med. 2011;4(1):31-6.
22. Leonhard SE, Mandarakas MR, Gondim FAA, et al. Diagnosis and management of Guillain–Barré syndrome in ten steps. Nat Rev Neurol. 2019;15:671–683.
23. Shahrokhi M, Asuncion RMD. Neurologic Exam. In: StatPearls Treasure Island (FL): StatPearls Publishing; 2023 Jan.
24. Lu VM, Goyal A, Quinones-Hinojosa A, Chaichana KL. Updated incidence of neurological deficits following insular glioma resection: A systematic review and meta-analysis. Clin Neurol Neurosurg. 2019 Feb;177:20-26.

25. Zetterling M, Elf K, Semnic R, Latini F, Engström ER. Time course of neurological deficits after surgery for primary brain tumours. Acta Neurochir (Wien). 2020 Dec;162(12):3005-3018.
26. Bhise D, Palkar A, Kumar A. Prevalence of Kinesiophobia in Post Spinal Surgery Patients. Int J Health Sci Res. 2021 Oct;11(10):202-208.
27. Loubresse CG. Review article: Neurological risks in the scheduled spinal surgery. Orthopaed Traumat Surg Res. 2014;100:585-590.
28. Gilberto Gomez, Clinical and radiographic outcomes using third-generation bioactive glass as a bone graft substitute for multi-level anterior cervical discectomy and fusion—a retrospective case series study. J Spine Surg. 2021 June;7(2):124–131.
29. Bayard R. Wilson et al. Depression after Spinal Surgery: A Comparative Analysis of the California Outcome Database. Mayo Clin Proc. 2017 Jan;92(1):88-97.
30. Kristin R. Archer, Early postoperative fear of movement predicts pain, disability, and physical health six months after spinal surgery for degenerative conditions. Spine J. 2014;14 :759–767.