ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 17, Issue 8, 2024

Online - 2455-3891
Print - 0974-2441

Research Article

THE SINGLE-STAGED DECOMPRESSIVE SURGERY FOR TANDEM SPINAL STENOSIS: ANALYSIS OF THE OUTCOMES

PRADEEP KUMAR JAIN, NISHCHITH SUDARSHAN, PRANOY HEGDE, ASHIRWAD KARIGOUDAR*, MADHU C SHIVASWAMY

Department of Neurosurgery, SDM College of Medical Sciences, Dharwad, Karnataka, India
***Corresponding author: Ashirwad Karigoudar; Email: drashirwadkns@gmail.com**

Received: 10 June 2024, Revised and Accepted: 24 July 2024

ABSTRACT

Objective: When the spinal canal diameter narrows in at least two separate areas of the spine, it is referred to as tandem spinal stenosis (TSS), mostly seen in cervical and lumbar regions and rarely in the thoracic region. This clinical entity can present as severe cervical myelopathy, lower extremity symptoms, or can be completely asymptomatic. The treatment protocol for operative intervention is not well-defined in the literature.

Methods: We examined information from 50 TSS patients who underwent surgery between August 2015 and August 2023. We looked at the patient's age, gender, comorbidities, length of stay in the hospital, total estimated blood loss, and surgery time. Complications were also looked at, along with the pre-operative and post-operative modified Japanese Orthopedic Association (mJOA), and Oswestry disability index (ODI) scores.

Results: For the disease types, 100 TSS cases were included. All cases had lumbar canal stenosis, with 28 (28%) cases having associated dorsal spinal canal stenosis, and 72 (72%) cases having cervical degenerative spondylosis. Fusion was required in 78 cases (78%). Post-operative follow-up recording was started 1 month following surgery till 3 years. The average post-operative mJOA score was 17.6 and the average ODI was 12.4.

Conclusions: Decompressions can be performed in stages or simultaneously to effectively control TSS. In addition to being safe and efficient, one-stage simultaneous decompression has the benefit of shortening hospital stays without requiring more surgery or blood loss. Nonetheless, it is advised that surgical indications be closely monitored and reserved for younger patients with fewer comorbidities.

Keywords: Spinal stenosis, Cervical, Lumbar, Dorsal, Simultaneous decompression.

 DOI: http://dx.doi.org/10.22159/ajpcr.2024v17i8.52209. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

A compromised spinal canal diameter in a minimum of two distinct regions is referred to as tandem spinal stenosis (TSS) [1]. Canal stenosis is the progressive reduction of accessible space in the spinal canal due to congenital, degenerative, infectious, neoplastic, or congenital disease. Congenital TSS results from inherent anatomical abnormalities present at birth, whereas developmental TSS is due to changes occurring during growth. Degenerative TSS, the most common type, stems from age-related wear and tear, including osteophyte formation, ligamentum flavum hypertrophy, and intervertebral disk degeneration [2]. Clinically, patients with TSS often present with a combination of symptoms reflective of cervical and lumbar spinal stenosis, such as neck and lower back pain, radiculopathy, myelopathy, and neurogenic claudication. These symptoms can significantly impair the quality of life, necessitating effective and timely intervention [3].

While stenosis can occur at any level, it often affects the segments with the greatest range of motion. The clinical triad of upper and lower motor neuron symptoms, lower extremity claudication, and gait disturbance is another way to describe TSS. The range of TSS prevalence is 0.12–34% [4]. Surgical intervention in cases of TSS is crucial due to the progressive nature of the condition and its potential to cause severe neurological impairment. Delay in surgical treatment can lead to worsening symptoms, including increased pain, loss of motor function, and potentially irreversible damage to the spinal cord and nerve roots. Various surgical techniques are employed to alleviate the pressure on the spinal cord and nerves, including foraminotomy, unroofing of lateral recesses, and multilevel decompressive laminectomy. These procedures aim to enlarge the spinal canal and foramina, thereby relieving nerve compression [5].

As TSS is a relatively rare condition, the optimal treatment strategy remains a topic of considerable debate within the medical literature. Historically, the standard approach involved staged surgeries, where one region was addressed initially, followed by subsequent surgery on the other region [6]. This staged method has generated significant controversy, particularly regarding which area should be operated on first. Some studies suggest that the region exhibiting the most severe pathology should be prioritized for initial surgery, followed by the less affected area at a later time. This approach is based on the rationale that treating the dominant area of pathology first may provide the most immediate relief of symptoms and prevent further deterioration [7].

However, some recent studies have suggested that single-staged decompressive surgery offers significant advantages over these traditional approaches. This technique allows for the simultaneous decompression of both cervical and lumbar regions in one surgical session, reducing the overall recovery time, minimizing anesthesia exposure, and potentially lowering the risk of post-operative complications. In addition, single-staged surgery ensures a more comprehensive and coordinated approach to addressing the complex pathology of TSS, leading to improved patient outcomes and faster returns to daily activities [8].

We started an 8-year retrospective analysis of 100 TSS patients with symptoms who had concurrent spinal decompressive surgery.

METHODS

This was a retrospective review of the results of a hundred patients with TSS who underwent one-stage decompressive surgery in the department of neurosurgery of a tertiary care medical institute who

were included in this study on the basis of a predefined inclusion and exclusion criteria. The duration of the study extended from August 2015 to August 2023. Our university's Institutional Ethical Review Board approved the project.

Patients with sensory and autonomic symptoms who presented with radicular pain, neurologic claudication, or discomfort in the back, neck, or limbs were taken into consideration. We ran dynamic X-rays and magnetic resonance imaging (MRI) with myelography for every patient to rule out instability. We assessed the lumbar, dorsal, and cervical regions that showed symptoms. A myelographic criteria of constriction >50% of the dural sac was used to diagnose lumbar canal stenosis (LCS). A complete reduction of the spinal canal's dorsoventral diameter to 10 mm or less was the requirement in the cervical spine.

The patient's age, gender, comorbidities, and occupation data were extracted and studied from the medical records. The Oswestry Disability Index (ODI) [9] and the pre-operative Modified Japanese Orthopedic Association Score (mJOA) [10] of the patients were determined from the record. The mJOA score is calculated by summing the scores of all four categories (Table 1).

ODI score was determined using formula ODI score(%)=(total score/number of sections answered×5)×100

Section	Description
1. Pain intensity	Assesses the level of pain intensity.
2. Personal care (e.g., Washing and dressing)	Evaluates how pain affects the patient's ability to care for themselves.
3. Lifting	Measures the patient's ability to lift objects.
4. Walking	Assesses the patient's walking abilities and limitations.
5. Sitting	Evaluates the patient's ability to sit for varying periods.
6. Standing	Measures the ability to stand for different durations.
7. Sleeping	Assesses how pain impacts sleep quality.
8. Social life	Evaluates how pain affects social activities.
9. Driving/riding	Measures the impact of pain on social activities.
10. Traveling	Assesses the impact of pain on the ability to travel and move around.

No pain=0, Mild pain=1, Modrate pain=2, Severe pain=3, Very severe pain=4, Worst pain=5

Evaluation was done on operational factors such as blood loss, surgery length, and operating problems. At the 1-month and 6-month follow-up, the post-operative mJOA score and ODI were recorded, and the data were averaged.

Several parameters, including the location of compressive pathology, the degree of degenerative process, and intervertebral instability, were taken into consideration while choosing the surgical approach. Under the same general anesthesia, patients had decompressive spinal operations along with stabilization of the unstable spine segments. On 2nd post-operative day following surgery, patients were often mobilized and given the necessary activities for rehabilitation.

SPSS 22.0 software was used to carry out the statistical analysis. The standard deviation and mean are used to express all data. A statistically significant difference was defined as $p<0.05$.

Inclusion criteria

The following criteria were included in the study:

1. Patients diagnosed with TSS who underwent one-stage decompressive surgery
2. Age above 18 years

Table 1: Modified Japanese Orthopedic Association Score (mJOA)

Category	Score	Description
Upper extremity function	0	Unable to move hands.
	1	Unable to eat with a spoon but able to move hands.
	2	Unable to button shirt but able to eat with a spoon.
	3	Able to button shirt with great difficulty.
	4	Able to button shirt with slight difficulty.
	5	No dysfunction.
Lower extremity function	0	Complete loss of motor and sensory function.
	1	Sensory preservation without the ability to move legs.
	2	Able to move legs but unable to walk.
	3	Able to walk on a flat floor with a walking aid (i.e., cane or crutch).
	4	Able to walk up and/or downstairs with a handrail.
	5	Moderate to significant lack of stability but able to walk without a handrail or walking aid.
	6	Mild lack of stability but walks with smooth reciprocation.
	7	No dysfunction.
Sensory function (Upper extremity)	0	Complete loss of hand sensation.
	1	Severe sensory loss or pain.
	2	Mild sensory loss.
	3	No sensory loss.
Bladder function	0	Inability to urinate.
	1	Marked difficulty in urination (retention or overflow incontinence).
	2	Mild-to-moderate difficulty in urination (frequency and hesitancy).
	3	Normal urination.

3. Surgery was performed between August 2015 and August 2023
4. Medical records of a follow-up period of more than 6 months post-surgery were available.

Exclusion criteria

The following criteria were excluded from the study:

1. Age <18 years
2. Patients with spinal cord and cauda equina tumors
3. Patients with vertebral compression fractures
4. Patients with a history of prior spine surgery
5. Patients requiring emergency hematoma or abscess evacuation
6. Patients with single-level disk herniations.

RESULTS

Out of the 100 cases with TSS, there were 63 (63%) males and 37 (37%) females. There was a significant male preponderance in cases of TSS with a M: F ratio of 1:0.587 (Fig. 1).

The analysis of the age distribution of the studied cases showed that the most common age group among males was 51–60 years, with 40 individuals (45.45%), whereas for females, the same age group also had the highest representation, with 20 individuals (22.73%). In the 41–50 age group, there were 10 males (11.36%) and 5 females (5.68%). The least represented age group was under 40 years, with 2 males (2.27%) and 1 female (1.14%). For those above 60, there were 11 males (12.50%) and an equal number of females (12.50%). The mean age for males was 53.1±9.52 years, whereas for females, it was 57.6±10.38 years. The mean age of female patients was more as compared to males and the difference was statistically significant ($p=0.0016$) (Table 2).

Table 2: Gender-wise age distribution of the studied cases

Age group	Males (n=63)		Females (n=37)	
	Number	Percentage	Number	Percentage
<40	2	2.27	1	1.14
41–50	10	11.36	5	5.68
51–60	40	45.45	20	22.73
Above 60	11	12.50	11	12.50
Total	53	60.23	37	42.05
Mean age	53.1±9.52		57.6±10.38	

p=0.0016* (Significant)

All 100 cases had cervical canal stenosis, with 12 (12%) cases having associated dorsal spinal canal stenosis and 88 (88%) cases had cervical degenerative spondylosis with LCS. In 22 (22%) cases, instability was present [Table 3].

All 100 patients were evaluated and 88 (88%) patients underwent surgery for lumbar and cervical TSS and 12 (12%) patients underwent surgery for cervical and dorsal TSS (Fig. 3). The average pre-operative mJOA score was 8.5±2.4 whereas pre-operative-ODI score was 38.9±6.32. Instability of the lumbar spine as evidenced by dynamic X-rays was noted in 22 (22%) patients. Post-operative follow-up recording was started 1 month following surgery till 3 years.

At the final follow-up visit, the average post-operative mJOA score was 17.6 and the average ODI was 12.4 (Table 4). There was an improvement in pre-operative and post-operative mJOA and ODI scores and the difference was found to be statistically highly significant (p<0.0001).

DISCUSSION

TSS is a degenerative spine condition that is becoming more common as life expectancy is increasing. Early clinical detection and timely MRI use have helped diagnose symptomatic TSS patients [Figure 2]. The reported incidence of TSS varies greatly; it might be between 0.9 and 25% [11]. Since many surgeons view age to be an independent risk factor for poor outcomes following spine surgery, they are hesitant to handle older patients. Elderly patients with degenerative stenosis have unique obstacles and issues when undergoing spinal surgery. By providing patients with the best possible cardiac care, nutrition, quitting smoking, and physical pre-conditioning, surgeons can lower the risk of post-operative complications. However, the elective character of these procedures also raises the possibility that should the danger be too great, the surgical intervention may be postponed or deferred permanently. The surgeon should independently assess how the procedure's advantages and risks are balanced in each patient [12].

In the spine, the spondylotic process can manifest as a single segmental issue, but there are frequently several degrees of coexisting degenerative disease. The pathogenesis of TSS is complex, and it can be challenging and contentious to interpret clinical results. Due to the small cohort of patients, there is not a precise surgical protocol or prevalence. According to Hsieh *et al*. [13] and Epstein *et al*. [14], patients exhibiting symptoms in the upper motor neuron region or upper extremities should undergo cervical surgery first, whereas those exhibiting substantial problems in the lower limbs should undergo lumbar surgery first. In their evaluation of the immediate outcomes of "single region surgery" for TSS, Luo *et al*. [15] showed the benefit of addressing cervical spine surgery initially. According to their research, 69% of TSS patients with more symptomatic cervical levels who underwent cervical spine surgery alone did not require lumbar decompression, but 91% of patients in the group who had lumbar surgery performed initially needed a second-stage cervical surgery as a result of symptom exacerbations.

The previous studies have highlighted the best outcomes of phased surgery for TSS [16]. It is impossible to discount the advantages of simultaneous decompression in a single sitting, nevertheless, as the

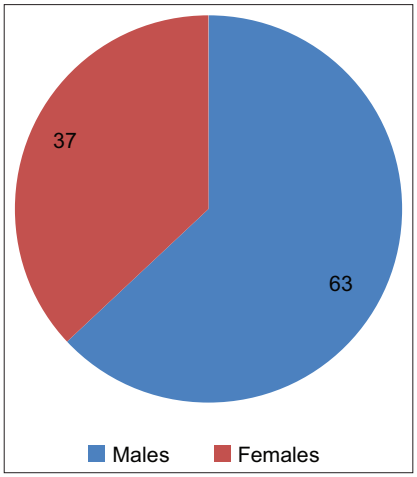

Fig. 1: Gender distribution of studied cases

Fig. 2: T2-weighted sagittal magnetic resonance imaging of the patient, dorsal canal stenosis due to ligamentum flavum hypertrophy with cord compression at dorsal levels from 9 to 11 (left) cervical canal stenosis from cervical level C3–C7 with severe cord compression (right)

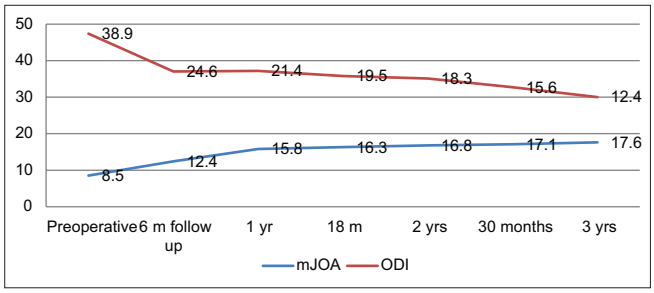

Fig. 3: Functional outcome assessment by modified Japanese Orthopaedic Association and Oswestry Disability Index scores

outcomes are encouraging and on par with a staged operation [17].

Given that the majority of patients are elderly and have numerous medical conditions, some studies have found that single-stage surgery carries a higher risk for these patients; therefore, staged surgery is suggested for these patients [18]. The average age of the 100 patients in our study was 53.1, and they all recovered well from the operation and experienced no post-operative problems.

Abbas *et al*. conducted a retrospective study to evaluate and compare the outcomes of single-stage surgery for TSS in elderly (age ≥65 years)

Table 3: Type of tandem spinal stenosis (TDS) in studied cases

TSS	Area involved	Number of cases	Percentage
Type of tandem spinal stenosis (TSS)	Cervical canal stenosis with dorsal canal stenosis	12	12%
	Cervical canal stenosis with lumbar canal stenosis	88	88%
Total		100	100%

Table 4: Functional outcome assessment by mJOA and ODI scores

mJOA and ODI scores	Pre-operative	At final follow-up	Significance
mJOA	8.5±2.4	17.6±3.34	p<0.0001
ODI	38.9±6.32	12.4±2.90	p<0.0001

mJOA: Modified Japanese Orthopedic Association, ODI: Oswestry Disability Index

and younger patients (age <65 years) [19]. For this purpose, the authors undertook a study comprising 62 patients with TSS managed with single-stage posterior surgery from 2007 to 2016, divided into two groups based on age: The study group (n=32) and control group (n=30). The study found that the mean ODI and mJOA showed significant improvement postoperatively in both groups with no significant difference between the groups at the final follow-up. There was no statistical difference in operative time, blood loss, and hospital stay between the groups. Excellent to good results were observed in 78.1% of the study group and 83.3% of the control group, with post-operative complications being more in the elderly group. On the basis of these findings, the authors concluded that single-stage surgery is a safe and efficacious modality with less morbidity and optimal results in elderly patients with proper pre-operative risk assessment. Similar findings were also reported by the authors such as Singrakhia *et al.* [20].

Our study, which examined post-operative outcomes, blood loss, and operating time, demonstrated that, in an optimal patient, single-phase surgery for symptomatic TSS is a safe surgical approach.

CONCLUSION

Decompressions can be performed in stages or simultaneously to effectively control TSS. In addition to being safe and efficient, one-stage simultaneous decompression has the benefit of shortening hospital stays without requiring more surgery or blood loss. Nonetheless, it is advised that surgical indications be closely monitored and reserved for younger patients with fewer comorbidities.

DECLARATION OF COMPETING INTEREST

The authors have no conflicts of interest to disclose.

FUNDING

The research received no funding from any funding agency in the public, commercial, or non-profit sectors.

REFERENCES

1. Teng P, Papatheodorou C. Combined cervical and lumbar spondylosis. Arch Neurol. 1964 Mar;10:298-307. doi: 10.1001/archneur.1964.00460150068007, PMID 14106986
2. Hilibrand AS, Rand N. Degenerative lumbar stenosis: Diagnosis and management. J Am Acad Orthop Surg. 1999;7(4):239-49. doi: 10.5435/00124635-199907000-00004, PMID 10434078
3. Lee BH, Moon SH, Suk KS, Kim HS, Yang JH, Lee HM. Lumbar spinal stenosis: Pathophysiology and treatment principle: A narrative review. Asian Spine J. 2020;14(5):682-93. doi: 10.31616/asj.2020.0472, PMID 33108834
4. Jensen RK, Jensen TS, Koes B, Hartvigsen J. Prevalence of lumbar spinal stenosis in general and clinical populations: A systematic review and meta-analysis. Eur Spine J. 2020;29(9):2143-63. doi: 10.1007/s00586-020-06339-1, PMID 32095908
5. Sengupta DK, Herkowitz HN. Lumbar spinal stenosis. Treatment strategies and indications for surgery. Orthop Clin North Am. 2003;34(2):281-95. doi: 10.1016/s0030-5898(02)00069-x, PMID 12914268
6. Ahorukomeye P, Saniei S, Pennacchio CA, Kuo A, Mlis AC, Cheng CW, *et al*. Outcomes in surgical treatment for tandem spinal stenosis: Systematic literature review. Spine J. 2022;22(11):1788-800. doi: 10.1016/j.spinee.2022.07.088, PMID 35843535
7. Cao J, Gao X, Yang Y, Lei T, Shen Y, Wang L, *et al*. Simultaneous or staged operation for tandem spinal stenosis: Surgical strategy and efficacy comparison. J Orthop Surg Res. 2021;16(1):214. doi: 10.1186/s13018-021-02357-x, PMID 33761964
8. Bai Q, Wang Y, Zhai J, Wu J, Zhang Y, Zhao Y. Current understanding of tandem spinal stenosis: Epidemiology, diagnosis, and surgical strategy. EFORT Open Rev. 2022;7(8):587-98. doi: 10.1530/EOR-22-0016, PMID 35924651
9. Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry low back pain disability questionnaire. Physiotherapy. 1980;66(8):271-3. PMID 6450426
10. Kato S, Oshima Y, Oka H, Chikuda H, Takeshita Y, Miyoshi K, *et al*. Comparison of the Japanese Orthopaedic Association (JOA) score and modified JOA (mJOA) score for the assessment of cervical myelopathy: A multicenter observational study. PLoS One. 2015;10(4):e0123022. doi: 10.1371/journal.pone.0123022, PMID 25837285 [published correction appears in PLoS One. 2015 May 11;10(5):e0128392. doi: 10.1371/journal.pone.0128392, PMID 25962061
11. Chiles BW 3rd, Leonard MA, Choudhri HF, Cooper PR. Cervical spondylotic myelopathy: Patterns of neurological deficit and recovery after anterior cervical decompression. Neurosurgery. 1999;44(4):762-9; discussion 9-70. doi: 10.1097/00006123-199904000-00041, PMID 10201301
12. Overley SC, Kim JS, Gogel BA, Merrill RK, Hecht AC. Tandem spinal stenosis: A systematic review. JBJS Rev. 2017;5(9):e2. doi: 10.2106/JBJS.RVW.17.00007, PMID 28872572
13. Hsieh CH, Huang TJ, Hsu RW. Tandem spinal stenosis: Clinical diagnosis and surgical treatment. Changgeng Yi Xue Za Zhi. 1998;21(4):429-35. PMID 10074729
14. Epstein NE, Epstein JA, Carras R, Murthy VS, Hyman RA. Coexisting cervical and lumbar spinal stenosis: Diagnosis and management. Neurosurgery. 1984;15(4):489-96. doi: 10.1227/00006123-198410000-00003, PMID 6493458
15. Luo CA, Kaliya-Perumal AK, Lu ML, Chen LH, Chen WJ, Niu CC. Staged surgery for tandem cervical and lumbar spinal stenosis: Which should be treated first? Eur Spine J. 2019;28(1):61-8. doi: 10.1007/s00586-018-5795-6, PMID 30328532
16. Naderi S, Mertol T. Simultaneous cervical and lumbar surgery for combined symptomatic cervical and lumbar spinal stenosis. J Spinal Disord Tech. 2002;15(3):229-31; discussion 231. doi: 10.1097/00024720-200206000-00011, PMID 12131425
17. Kikuike K, Miyamoto K, Hosoe H, Shimizu K. One-staged combined cervical and lumbar decompression for patients with tandem spinal stenosis on cervical and lumbar spine: Analyses of clinical outcomes with minimum 3 years follow-up. J Spinal Disord Tech. 2009;22(8):593-601. doi: 10.1097/BSD.0b013e3181929cbd, PMID 19956034
18. Lu C, Qiu H, Huang X, Yang X, Liu D, Zhang S, *et al*. Meta-analysis of simultaneous versus staged decompression of stenotic regions in patients with tandem spinal stenosis. World Neurosurg. 2023;170:e441-54. doi: 10.1016/j.wneu.2022.11.028, PMID 36396060
19. Abbas Z, Asati S, Kundnani VG, Jain S, Prakash R, Raut S. Surgical outcomes of single stage surgery for Tandem spinal stenosis (TSS) in elderly and younger patients: A comparative study. J Clin Orthop Trauma. 2021;17:157-62. doi: 10.1016/j.jcot.2021.03.007, PMID 33854943
20. Singrakhia MD, Malewar NR, Deshmukh S, Deshmukh SS. Prospective analysis of functional outcome of single-stage surgical treatment for symptomatic tandem spinal stenosis. Indian J Orthop. 2019;53(2):315-23. doi: 10.4103/ortho.IJOrtho_316_17, PMID 30967703