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Quality of life changes after lumbar decompression in patients with tandem spinal stenosis

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ABSTRACT

Objective: Tandem spinal stenosis (TSS) is a degenerative spinal condition characterized by spinal canal narrowing at 2 or more distinct spinal levels. It is an aging-related condition that is likely to increase as the population ages, but which remains poorly described in the literature. Here we sought to determine the impact of primary lumbar decompression on quality-of-life (QOL) outcomes in patients with symptomatic TSS.

Patients and methods: We retrospectively reviewed 803 patients with clinical and radiographic evidence of TSS treated between 2008 and 2014 with a minimum 2-year follow-up. The records of patients with clinical and radiographic evidence of concurrent cervical and lumbar stenosis were reviewed. Prospectively gathered QOL data, including the Pain Disability Questionnaire (PDQ), Patient Health Questionnaire-9 (PHQ-9), EuroQOL-5 Dimensions (EQ-5D), and Visual Analogue Scale (VAS) for low back pain, were assessed at the 6-month, 1-year, and 2-year follow-ups.

Results: Of 803 identified patients (mean age 66.2 years; 46.9% male), 19.6% underwent lumbar decompression only, 14.1% underwent cervical + lumbar decompression, and 66.4% underwent conservative management only. Baseline VAS scores were similar across all groups, but patients undergoing conservative management had better baseline QOL scores on all other measures. Both surgical cohorts experienced significant improvements in the VAS, PDQ, and EQ-5D at all time points; patients in the cervical + lumbar cohort also had significant improvement in the PHQ-9. Conservatively managed patients showed no significant improvement in QOL scores at any follow-up interval.

Conclusion: Lumbar decompression with or without cervical decompression improves low back pain and QOL outcomes in patients with TSS. The decision to prioritize lumbar decompression is therefore unlikely to adversely affect long-term quality-of-life improvements.

1. Introduction

Tandem spinal stenosis (TSS) is defined as simultaneous spinal canal narrowing in two or more distinct regions, most commonly the cervical and lumbar spine [1]. Though defined by its radiographic features, which are reportedly seen in 8–60% of the general population [1,2], between 5% and 28% of the adult population are symptomatic [3,4]. Patients classically present with a combination of the features characteristic of cervical and lumbar stenosis, including neurogenic claudication and compressive myelopathy [3]. Despite the relative frequency of this condition, studies investigating this entity are relative few [5].

Abbreviations: BMI, body mass index; EQ-5D, EuroQol 5-dimensions; ICD-9, international classification of diseases-9; MCID, minimum clinical important difference; PDQ, pain/disability questionnaire; PHQ-9, patient health questionnaire-9; PRO, patient-reported outcome; QOL, quality of life; TSS, tandem spinal stenosis; VAS, visual analogue scale

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Surgery is often indicated in symptomatic patients; however, the question remains regarding patients with symptomatic cervical and lumbar pathologies. Should these patients be treated using a staged or combined approach? Prior research has demonstrated similar improvements in both patients treated with simultaneous decompressions and those treated with serial decompression [6–8]. However, as TSS is most common among the elderly, who may not be healthy enough for a combined approach, a staged approach is often favored [3].

In patients presenting with symptoms of myelopathy, cervical decompression takes priority owing to the need to preserve neurological function. Yet in non-myelopathic patients, it has been suggested that treatment may reasonably proceed with decompression of the more symptomatic level [3]. Some prior evidence has suggested that cervical decompression may decrease the need for concomitant lumbar decompression, presumably by decompressing the ascending and descending tracts of cervical cord connecting the lower cord with higher motor and sensory centers [9]. Yet other, conflicting, evidence has failed to document an impact of cervical decompression on the symptoms of the lumbar pathology, thus favoring the adoption of a staged approach prioritizing the more symptomatic region [3,10]. To address this, we elected to investigate quality-of-life (QOL) outcomes in neurologically-intact patients presenting with the primary complaint of lower back pain with or without radicular features. Our goal was to determine if staged cervical and lumbar decompression resulted in significantly better QOL outcomes compared to lumbar decompression alone among patients with TSS and primary lumbar symptoms.

2. Materials and methods

After obtaining approval from our institutional review board, we queried the medical records for patients seen between 2008 and 2014 for tandem spinal stenosis. Patients with TSS were screened for using the International Classification of Diseases-9 (ICD-9) by selecting for patients with diagnosis codes for both cervical (723.0) and lumbar stenosis (724.01, 724.02, or 724.03). At our institution, these diagnoses and indications are assigned based upon the primary treating surgeon, all of whom at our center are fellowship trained. While variability and specific exceptions exist, cervical stenosis typically was defined as clinically significant based on a spinal canal sagittal diameter of < 10 mm [11] and lumbar stenosis by a mid-sagittal diameters < 12 mm. [12].

The medical records of patients identified on the preliminary screen were reviewed to verify the diagnosis of tandem spinal stenosis. We included all patients with a definitive diagnosis of TSS and full medical records who presented with predominant lower back or extremity complaints. Electronic medical records were considered complete if they contained imaging from the initial consultation, demographic information (including age, body mass index (BMI), and gender), and treatment plan (surgery vs. non-operative management). We also obtained details regarding the surgical approach, levels treated, and indication for surgery. Patients were excluded if their medical charts were incomplete, they were younger than 18 years of age, had active malignancy, had confirmed neuromuscular disease, had predominately complaints of myelopathy or upper extremity symptoms, or had a history of spinal trauma.

Where both cervical and lumbar spine segments were thought to benefit from decompression, cervical operations were prioritized as a means of prophylaxis against future neurological deterioration. Lumbar operations were generally performed 6–8 weeks following the cervical operation to allow the patient adequate time to recover. The decision to perform cervical operations first was based upon two-factors: 1) at least one prior study had suggested cervical decompression may help alleviate lumbar symptoms [13], and 2) some case reports have suggested that failure to treat the cervical stenosis prior to lumbar surgery may be associated with cervical cord injury during positioning [14–17]. We have not seen the latter to occur in our experience though.

2.1. Patient reported outcomes

Quality of life (QOL) scores were measured using the following patient reported outcome (PRO) measures, all of which have been previously validated in spine patient populations: the Visual Analogue scale (VAS) for low back pain, Pain Disability Questionnaire (PDQ) [18], Patient Health Questionnaire-9 (PHQ-9) [19], and EuroQOL-5 Dimensions (EQ-5D) [20]. These scores were acquired through our institutional Knowledge Program (KP). The KP is an outcome assessment tool embedded within our electronic medical record for the collection of QOL data. These data are systematically collected in a prospective fashion at the time of patient visits to spine health providers. Lower scores correspond to improvement on the PHQ-9, PDQ, and VAS; higher scores denote better performance on the EQ-5D. Patients were determined to have achieved the minimum clinically important difference using the following benchmarks established in the existing literature: PHQ-9 (5), PDQ (26), VAS (2.1), and EQ-5D (0.1) [21,22]. Categorical data were compared using χ^2 tests, dichotomous data using Fisher-Exact tests, and continuous data using Student's t-tests and one-way analysis of variance (ANOVA). Post-hoc analysis of ANOVA results was performed using paired t-tests and Tukey honest significant difference. We defined statistical significance using an α of 0.05.

3. Results

We identified 2769 patients as having TSS based on ICD-9 coding. Of these, 1645 patients were excluded due to lack of radiographic evidence of both cervical and lumbar stenosis, 272 patients were excluded for having predominating upper extremity complaints or having undergone cervical decompression only, 38 patients were excluded because they did not have QOL data for any of the predefined follow-up timepoints, and 11 patients were excluded as the spinal stenosis was secondary to a non-degenerative pathology (e.g. tumor). Of the remaining 803 patients, 157 (19.6%) received lumbar decompression surgery only, 113 (14.1%) patients received cervical decompression surgery followed by lumbar decompression surgery 6–8 weeks later, and 533 (66.4%) patients received no surgery.

3.1. Demographics

The average ages of patients within the lumbar surgery only, cervical and lumbar surgery, and conservative treatment cohorts were 65.7 years, 62.9 years, and 67.1 years, respectively. Patients undergoing two-stage surgery were more commonly male (65%) than were patients undergoing lumbar-only decompression or conservative management ($p < 0.01$). There was no difference between the cohorts with respect to BMI. Between the surgical cohorts, there were no differences between surgical approach used, clinical or radiographic indications for surgery, or perioperative complications. The two-stage surgery group was more likely to receive a multi-level operation compared to the lumbar surgery only group (67% vs. 49%, respectively, $p < 0.01$). (Table 1)

3.2. Quality of life outcomes

The proportion of each cohort with Follow-up QOL data at each of the follow-up intervals were as follows (baseline, 6 months, 1 year, 2 years, respectively): lumbar (116/157 [74%], 79/157 [50%], 55/157 [35%], 39/157 [25%]), cervical and lumbar (79/113 [70%], 54/113 [48%], 42/113 [37%], 35/113 [31%]), and conservative (533/533 [100%], 153/533 [29%], 127/533 [24%], 124/533 [23%]). The conservatively managed cohort demonstrated significantly better baseline QOL scores in all measurement tools other than VAS, for which there was no significant difference between cohorts. The average pre- to postoperative change in score for each questionnaire was (lumbar, 2-stage, and conservative cohorts, respectively) VAS (6 month: -0.6,

Table 1
Demographics of included patients divided by treatment regimen.

	Lumbar		Cervical + Lumbar		Conservative	p-Value
n	157		113		533	–
Age	65.7 ± 9.7		62.9 ± 10.6		67.1 ± 11.4	< 0.01*
Male	69 (44%)		74 (65%)		234 (44%)	< 0.01*
BMI	29.4 ± 5.3		30.4 ± 6.1		29.3 ± 6.1	0.2
Initial Surgery						
Fusion	89	(57%)	56	(50%)		0.2
Laminectomy	52	(33%)	50	(44%)		0.06
Laminotomy	16	(10%)	7	(6%)		0.2
Single-Level	80	(51%)	37	(33%)		< 0.01
Multi-Level	77	(49%)	76	(67%)		< 0.01
Indication for Lumbar Operation						
Stenosis Only	81	(52%)	65	(58%)		0.3
+ Spondylolisthesis	56	(36%)	31	(27%)		0.2
+ Scoliosis	14	(9%)	12	(11%)		0.6
+ Spondylosis	6	(4%)	5	(4%)		0.8
Back Pain Only	7	(4%)	6	(5%)		0.7
+ Leg Pain	109	(69%)	69	(61%)		0.2
+ Leg Spondylosis	5	(3%)	3	(3%)		0.8
+ Leg Weakness	3	(2%)	5	(4%)		0.2
Leg Pain Only	21	(13%)	19	(17%)		0.4
+ Leg Weakness	6	(4%)	4	(4%)		0.9
Leg Weakness Only	4	(3%)	2	(2%)		0.7
Leg Numbness Only	2	(1%)	5	(4%)		0.1
Complications						
Durotomy	18	(11%)	9	(8%)		0.3
Infection	6	(4%)	2	(2%)		0.3
CSF Leak	2	(1%)	1	(1%)		0.8

Key: BMI – body mass index.
*$p \leq 0.05$.

−1.1, 0; 1 year: −0.8, −1.1, 0; 2 year: −1.4, −0.3, −0.1), PDQ Functional component (6 month: −11.3, −15.8, −0.7; 1 year: −11.7, −14.1, 0.2; 2 year: −9.5, −8.4, −0.3), PDQ Psychosocial component (6 month: −5.7, −7.4, 0.7; 1 year: −5.8, −8.2, 0.8; 2 year: −5.3, −3.4, −0.1), total PDQ (6 month: −17.0, −24.2, 0.1; 1 year: −17.5, −22.2, 1.2; 2 year: −14.8, −11.8, −0.3), PHQ-9 (6 month: −1.8, −3.0, 0.4; 1 year: −0.3, −2.9, −0.3; 2 year: −2.3, −2.3, −0.1), and EQ-5D (6 month: 0.135, 0.167, 0.025; 1 year: 0.107, 0.159, 0.010; 2 year: 0.080, 0.084, 0.036).

At all periods of follow-up, the lumbar decompression-only group showed statistically significant improvement in PDQ Functional component, PDQ Psychosocial component, total PDQ, and EQ-5D index. The lumbar decompression-only group also demonstrated significant improvement in VAS scores at 2-year follow-up. The group that underwent staged cervical and lumbar decompression demonstrated significant improvement in all QOL measures 6 months and 1 year post-operatively. However, only PDQ Functional component and total PDQ scores remained significantly improved from preoperative values at 2-year follow-up for the 2-stage cohort. The conservatively managed group showed no significant improvement from baseline on any QOL measure at any follow-up period. Although the conservatively managed cohort had better baseline QOL scores on all measurements other than VAS, there were no differences in QOL scores between the three cohorts at any follow-up other than for VAS scores, for which the surgical cohorts demonstrated significantly lower scores than the conservatively managed cohort at all follow-up intervals (Table 2).

4. Discussion

Our results illustrate that for neurologically-intact TSS patients presenting with a primary clinical complaint of low back pain with or without radicular symptoms, lumbar decompression-alone may provide similar quality of life improvements relative to patients undergoing staged cervical and lumbar decompression. In both surgical groups, improvements on all QOLs were superior relative to the group treated with conservative management. Additionally, none of the patients in either group experienced an intraoperative spinal cord injury secondary to positioning, which is a feared concern in patients with cervical spine stenosis [16].

Teng and Papatheodorou published an early series describing the surgical management of patients with concomitant cervical and lumbar stenosis [23]. The authors reported a series of 12 patients, of whom 10 were treated with decompression of the cervical and lumbar spines. Relative to those treated with conservative management alone, surgically managed patients were more likely to return to work and were in general held to have superior neurological outcomes. Despite this, the authors did not offer any description regarding the relative benefits of staging the cervical and lumbar decompression surgeries, or whether the order of decompression had an effect on outcomes.

Epstein et al were the first set of authors to compare the outcomes of different management strategies for patients with TSS [24]. In their series of 24 patients, the authors reported that decompression of either level led to improvement in lower extremity symptoms. Interestingly, it was noted that among patients undergoing staged, cervical followed by lumbar decompression, the lumbar symptoms (i.e. lower extremity radicular pains) were generally the first to regress suggesting that compression of long tracts in the cervical spine may contribute to lower extremity symptomatology. As would be expected, lumbar decompression alone did not relieve cervical symptoms, implying that cervical decompression should be pursued first in patients with complaints localizable to both regions of stenosis.

The term “tandem spinal stenosis” was coined shortly thereafter by Dagi et al. [3] who reported a series of 19 patients treated with TSS using both cervical and lumbar decompression. They found patient outcome to be inversely related to the duration of the patient’s symptoms at the time of surgery, though like Epstein et al. [24], they reported improvement in the majority of patients. Unlike Epstein et al, Dagi and colleagues recommended that the first surgical stage

Table 2
Comparison of quality of life outcomes at 6-, 12-, and 24-month outcomes between patients undergoing operative and conservative management.

	Lumbar	p-Value vs. Pre-Op	Cervical + Lumbar	p-Value vs. Pre-Op	Conservative	p-Value vs. Baseline	p-Value Among Cohorts
VAS Low Back							
Pre-Op/Baseline	6.5 ± 2.5	—	6.0 ± 2.3	—	6.5 ± 2.1	—	0.3
6 Month	5.9 ± 2.5	0.2	4.9 ± 2.3	0.04*	6.5 ± 2.1	1.0	< 0.01*
1 Year	5.7 ± 2.5	0.1	4.9 ± 2.3	0.05*	6.5 ± 1.9	1.0	< 0.01*
2 Year	5.1 ± 2.6	0.01*	5.7 ± 1.8	0.6	6.4 ± 2.1	0.7	0.01*
PDQ-Functional							
Pre-Op/Baseline	52.9 ± 15.8	—	57.2 ± 17.2	—	43.5 ± 19.5	—	< 0.001*
6 Month	41.6 ± 19.0	< 0.001*	41.4 ± 21.2	< 0.001*	42.8 ± 20.0	0.7	0.9
1 Year	41.2 ± 19.9	< 0.001*	43.1 ± 22.3	< 0.001*	43.7 ± 19.0	0.9	0.7
2 Year	43.4 ± 21.2	< 0.01*	48.8 ± 15.3	0.01*	43.2 ± 19.4	0.9	0.3
PDQ-Psychosocial							
Pre-Op/Baseline	29.3 ± 13.1	—	31.0 ± 14.0	—	24.7 ± 12.8	—	< 0.001*
6 Month	23.6 ± 12.9	< 0.01*	22.6 ± 14.8	< 0.01*	25.4 ± 13.6	0.6	0.4
1 Year	23.5 ± 13.5	< 0.01*	22.8 ± 16.0	< 0.01*	25.5 ± 12.7	0.5	0.4
2 Year	24.0 ± 13.1	0.03*	27.6 ± 13.5	0.2	24.6 ± 12.9	0.9	0.4
PDQ-Total							
Pre-Op/Baseline	82.2 ± 26.8	—	88.2 ± 29.7	—	68.1 ± 30.3	—	< 0.001*
6 Month	65.2 ± 29.9	< 0.001*	64.0 ± 33.7	< 0.001*	68.2 ± 31.8	1.0	0.6
1 Year	64.7 ± 31.7	< 0.001*	66.0 ± 36.7	< 0.001*	69.3 ± 29.9	0.7	0.6
2 Year	67.4 ± 31.9	< 0.01*	76.4 ± 26.8	0.05*	67.8 ± 31.0	0.9	0.3
PHQ-9							
Pre-Op/Baseline	7.9 ± 6.5	—	8.9 ± 7.0	—	6.8 ± 5.5	—	0.01*
6 Month	6.1 ± 5.3	0.07	5.9 ± 6.6	0.02*	7.2 ± 5.7	0.5	0.3
1 Year	7.6 ± 6.0	0.8	6.0 ± 5.9	0.03*	6.5 ± 4.7	0.6	0.3
2 Year	5.6 ± 4.2	0.06	6.6 ± 6.2	0.1	6.7 ± 5.6	0.9	0.6
EQ-5D							
Pre-Op/Baseline	0.494 ± 0.207	—	0.486 ± 0.217	—	0.590 ± 0.220	—	< 0.001*
6 Month	0.629 ± 0.219	< 0.001*	0.653 ± 0.216	< 0.001*	0.615 ± 0.228	0.2	0.6
1 Year	0.601 ± 0.234	< 0.01*	0.645 ± 0.207	< 0.001*	0.600 ± 0.209	0.7	0.5
2 Year	0.574 ± 0.201	0.04*	0.570 ± 0.238	0.07	0.626 ± 0.196	0.1	0.2

Key: EQ-5D – EuroQol 5-Dimensions; PDQ – pain disability questionnaire; PHQ-9 – patient health questionnaire-9; VAS – visual analogue scale.
*p-value ≤ 0.05.
†Improvement exceeds 1-year minimum clinically important difference.

performed should address the more symptomatic region.

It was not until 2007 however that QOL outcomes were described in this clinical population. At that time Aydogan et al described their experience of 8 patients with TSS [10]. They reported significant improvement in both neurological function – assessed using the Japanese Orthopaedic Association (JOA) Index – and lower back complaints – measured using the Oswestry Disability Index (ODI). Their study was underpowered to determine if the relative ordering of the surgical stages impacted functional outcomes, however they advocated for cervical decompression in patients with presenting with symptoms of myelopathy, consistent with the conclusions of Epstein et al. [24] and others [9,25]. Similar improvements in Nurick score, modified JOA score, and ODI score have been observed by subsequent studies using both simultaneous and staged surgeries [5,6,26].

To our knowledge though, this is the largest series comparing short- and long-term QOL outcomes in neurologically-intact patients with TSS. We previously reported that among patients with TSS who are clinically myelopathic, cervical decompression alone can produce functional outcomes similar or superior to treatment with both cervical and lumbar decompression [27]. Similarly, in the present study, we found that for non-myelopathic patients with a clinical picture dominated by lower back and extremity symptoms, lumbar decompression alone provides equivalent QOL outcomes to surgery at both cervical and lumbar locations. These results are also consistent with the findings of Dagi et al. [3], who endorsed prioritizing the more symptomatic level. It does contrast with the treatment algorithm proposed by Luo et al. [9] and Yamada et al. [8] who found that when prioritizing lumbar decompression based on the severity of symptoms, functional outcomes were worse and patients required a second, cervical decompression. Both sets of authors concluded that this likely stemmed from the fact that the baseline lumbar symptoms in these patients were derived from a combination of the cervical and lumbar spondylotic changes. Unlike our study though, Yamada et al did not report excluding patients with upper extremity neurological findings at baseline. As a result, our population may have had lower extremity symptoms that are more purely derived from their lumbar stenosis.

4.1. Limitations

Limitations of this study include the large number of patients lost to follow-up and retrospective nature of the analysis. Loss to follow-up increases the risk that statistical outliers bias the findings. The retrospective nature similarly limits our findings by preventing us from determining the reasons for early patient dropout. It is possible that patients with poorer outcomes selectively dropped out, artificially inflating the improvements seen in one or all three groups. Another limitation stems from the fact that our study focused solely on patients treated at a single tertiary-care institution. Patients reaching our center often have more extensive medical comorbidities and poorer overall health, the metric that the EQ-5D attempts to assess. As a result, the QOL changes seen here may not be generalizable to all patients with TSS. Regardless, this is both the largest population of clinically- and radiographically-confirmed cases of TSS, and the largest study examining QOL outcomes in patients receiving lumbar decompression for TSS. This study may help inform providers and patients of the expected quality of life outcomes following lumbar decompression for TSS as well as the relative benefit of including cervical decompression in patients with lumbar-predominant complaints.

5. Conclusion

This study represents the largest study examining functional outcomes in patients treated for tandem spinal stenosis. We find that both lumbar-only and combined cervical + lumbar decompression produce significant improvements in long-term QOL outcomes relative to conservative management. Additionally, in neurologically-intact patients with a primary complaint of low back or lower extremity pain, lumbar decompression alone produces similar or superior functional outcomes to combined cervical + lumbar decompression. We therefore recommend considering staged surgical decompression prioritizing the lumbar region in patients with TSS and lumbar-predominant complaints. In the absence of persistent symptoms or the appearance of clinical signs localizable to the cervical region, patients may not require an additional surgical decompression. Further prospective and multicenter studies are needed to validate these findings.

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Previous presentations

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IRB approval

IRB approval was obtained prior to initiation of the study (IRB # 12-1240).

Declaration of Competing Interest

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