

Original Article

Practice Variation between Salaried and Fee-for-Service Surgeons for Lumbar Surgery

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ABSTRACT: Objective: To examine differences in surgical practices between salaried and fee-for-service (FFS) surgeons for two common degenerative spine conditions. Surgeons may offer different treatments for similar conditions on the basis of their compensation mechanism. **Methods:** The study assessed the practices of 63 spine surgeons across eight Canadian provinces (39 FFS surgeons and 24 salaried) who performed surgery for two lumbar conditions: stable spinal stenosis and degenerative spondylolisthesis. The study included a multicenter, ambispective review of consecutive spine surgery patients enrolled in the Canadian Spine Outcomes and Research Network registry between October 2012 and July 2018. The primary outcome was the difference in type of procedures performed between the two groups. Secondary study variables included surgical characteristics, baseline patient factors, and patient-reported outcome. **Results:** For stable spinal stenosis ($n = 2234$), salaried surgeons performed statistically fewer uninstrumented fusion ($p < 0.05$) than FFS surgeons. For degenerative spondylolisthesis ($n = 1292$), salaried surgeons performed significantly more instrumentation plus interbody fusions ($p < 0.05$). There were no statistical differences in patient-reported outcomes between the two groups. **Conclusions:** Surgeon compensation was associated with different approaches to stable lumbar spinal stenosis and degenerative lumbar spondylolisthesis. Salaried surgeons chose a more conservative approach to spinal stenosis and a more aggressive approach to degenerative spondylolisthesis, which highlights that remuneration is likely a minor determinant in the differences in practice of spinal surgery in Canada. Further research is needed to further elucidate which variables, other than patient demographics and financial incentives, influence surgical decision-making.

RÉSUMÉ : Différences de pratiques entre les chirurgiens salariés et les chirurgiens payés à l'acte dans le cas de la chirurgie lombaire.

Objectif : Examiner les différences de pratiques entre les chirurgiens salariés et les chirurgiens rémunérés à l'acte dans le cas de deux pathologies dégénératives courantes de la colonne vertébrale. À cet égard, il se pourrait que les chirurgiens offrent des traitements différents pour des conditions similaires sur la base de leur mécanisme de rémunération. **Méthodes :** L'étude a évalué les pratiques de 63 chirurgiens de la colonne vertébrale (39 chirurgiens rémunérés à l'acte et 24 qui étaient salariés) répartis dans huit provinces canadiennes qui ont pratiqué des interventions chirurgicales pour deux pathologies lombaires : la sténose rachidienne stable et le spondylolisthésis dégénératif. Cette étude a aussi intégré une analyse multicentrique et ambispective de patients vus consécutivement, opérés de la colonne vertébrale et inscrits au registre du *Canadian Spine Outcomes and Research Network* (CSORN) entre octobre 2012 et juillet 2018. Le principal aspect évalué a été les différences de pratiques chirurgicales privilégiées au sein de ces deux groupes. Les variables secondaires à l'étude comprenaient les caractéristiques chirurgicales, les caractéristiques de base des patients au début de l'étude ainsi que l'évolution de leur état de santé rapportée par eux-mêmes. **Résultats :** Pour les sténoses rachidiennes stables ($n = 2234$), les chirurgiens salariés ont, sur le plan statistique, effectué moins de fusions non instrumentées ($p < 0,05$) que les chirurgiens rémunérés à l'acte. Pour les spondylolisthésis dégénératifs ($n = 1292$), les chirurgiens salariés ont

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effectué significativement plus d'instrumentations et de fusions intersomatiques ($p < 0,05$). Enfin, on n'a pas noté de différence statistique entre les deux groupes en ce qui concerne l'évolution de l'état de santé des patients. **Conclusions :** La rémunération des chirurgiens peut être associée à différentes pratiques en ce qui regarde la sténose rachidienne lombaire stable et le spondylolisthésis lombaire dégénératif. Les chirurgiens salariés privilégient une approche plus conservatrice pour la sténose rachidienne et une approche plus active pour le spondylolisthésis dégénératif, ce qui indique que la rémunération est probablement un déterminant mineur dans les différences de pratiques de la chirurgie de la colonne vertébrale au Canada. D'autres recherches sont en définitive nécessaires pour mieux saisir les variables, outre les caractéristiques démographiques des patients et les incitations financières, qui influencent la prise de décision chirurgicale.

Keywords: Health economics; Lumbar spine surgery; Spinal stenosis; Degenerative spondylolisthesis; Fee-for-service; Salary; Physician compensation

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Introduction

Increasing rates of spinal fusion with evolving indications have been well documented.¹⁻³ Differences in surgical treatment are likely explained by both patient and surgeon factors. Previous attempts at the establishment of guidelines have provided mostly low-quality evidence for surgical indications.⁴ For example, the addition of interbody fusion has failed to provide any clear benefit in patient outcomes research.⁵ Furthermore, financial incentive has been shown to be a major confounder in the decision-making of physicians in multiple specialties, but interestingly has not been extensively studied in spine surgery.^{1,6-8} This is surprising given the disparities in surgeon remuneration between decompression alone and interbody fusion, which can be up to fourfold higher.^{7,9,10} Canada is one of few countries in the world with a universal health care system. Although there exists regional variability, remuneration for surgical procedures is based on government fee schedules termed fee-for-service (FFS) or a fixed service contract, essentially an annual salary. Other countries have a blend of public and private health care funding. In the United States, payment structure increases in complexity, where fees are often pre-negotiated between providers and insurance companies prior to providing care.¹¹ Furthermore, the introduction of bundled care payment models has further increased both variability and complexity.¹² For this reason, Canada's universal health care system provides a unique environment to study the impact of compensation on surgical management as variability in remuneration is markedly reduced.

Through the identification of unnecessary spending, precious health care resources can be saved and value-based care optimized. Therefore, the primary purpose of this study was to examine differences in surgical practice between FFS and salaried physicians for two common degenerative lumbar spine conditions. A secondary goal was to investigate any differences in baseline patient characteristics, treatment characteristics, and patient reported outcome measures based on method of surgeon remuneration. The study alternative hypothesis was that salaried physicians would be more conservative in terms of surgical approach of both conditions.

Methods

Study Design

This was a multicenter, ambispective review of consecutive spine surgery patients enrolled by the Canadian Spine Outcomes and Research Network (CSORN) between October 2012 and July 2018.

A survey was designed and sent to all spine surgeons enrolling patients in CSORN (Appendix 1). Questions included queries

pertinent to their mode of remuneration, their practice, and their training.

CSORN is a group of 70 neurosurgical and orthopedic spine surgeons from 18 tertiary care academic and nonacademic hospitals across eight provinces that prospectively collects data on patients with spinal conditions. This database serves as a national registry created to answer research questions and to facilitate the implementation of best practices.

A national database research coordinator audits data quality and performance and sends reports to each contributing hospital site coordinator on a quarterly basis. Reports track data completion and follow-up rates to facilitate internal data validation at each site. A national privacy and security framework was created for CSORN that includes a governance structure, standard operating procedures, training processes, physical and technical security, and privacy impact assessments. This model ensures privacy and security of personal health information. Written informed consent is obtained from all participating patients. Patient identification is anonymized to ensure that patients in the Network cannot be individually identified. All 18 participating sites obtained Research Ethics Board (REB) approval prior to any data collection. Decisions regarding data collection, storage, and analysis are independent of any particular company or commercial interest.

Patient Sample

Local research coordinators enrolled consecutive patients at each site. All patients that provided informed written consent with a diagnosis of: (1) spinal stenosis without instability ($n = 2234$) or (2) degenerative lumbar spondylolisthesis ($n = 1292$) who were treated surgically were included in this study. No patients were excluded from the analyses.

Patient Variables

Collected baseline patient characteristics included socio-demographic factors (age, sex, body mass index, smoking status, and marital status), insurance claim status, work status, comorbidities, and symptom duration.

Outcome Measures

The primary outcome was the difference in surgical procedure type between FFS and salaried physicians for these two diagnoses. Procedure type were categorized as either: (1) decompression alone, (2) decompression and uninstrumented fusion, (3) decompression and instrumented fusion, and (4) decompression, instrumented fusion, and interbody fusion. Secondary

Table 1: Surgeon demographics

	Fee for service	Salary	Total
	n (%)		
Age category			
30–40	9 (23.1%)	5 (20.8%)	14 (22.2%)
41–50	13 (33.3%)	9 (37.5%)	22 (34.9%)
51–60	11 (28.2%)	7 (29.2%)	18 (28.6%)
61–65	5 (12.8%)	2 (8.3%)	7 (11.1%)
65+	1 (2.6%)	1 (4.2%)	2 (3.2%)
Sex			
Female	4 (10.3%)	1 (4.2%)	5 (7.9%)
Male	35 (89.7%)	23 (95.8%)	58 (92.1%)
Specialty			
Neurosurgery	4 (10.3%)	17 (70.8%)	21 (33.3%)
Orthopedics	35 (89.7%)	7 (29.2%)	42 (66.7%)
Years of practice			
0–5	7 (17.9%)	4 (16.7%)	11 (17.5%)
6–10	7 (17.9%)	5 (20.8%)	12 (19.0%)
11–15	5 (12.8%)	5 (20.8%)	10 (15.9%)
16–20	6 (15.4%)	4 (16.7%)	10 (15.9%)
21–30	10 (25.6%)	6 (25.0%)	16 (25.4%)
+30	4 (10.3%)	0 (0.0%)	4 (6.3%)
Percentage of spine surgery			
26–50	2 (5.1%)	1 (4.2%)	3 (4.8%)
51–75	2 (5.1%)	1 (4.2%)	3 (4.8%)
76–100	35 (89.7%)	22 (91.7%)	57 (90.5%)
Total	39 (61.9%)	24 (38.1)	63

outcome measures included number of surgical levels, use of minimally invasive technique, and patient reported outcome measures (PROMs): back and leg pain numeric rating scale, Short Form-12, Oswestry Disability Index, and EuroQOL-5D. Research coordinators, unaware of the study hypothesis, collected baseline questionnaires, and PROMs at 12 months post-operatively. Collection was in person, via post or utilizing an online patient portal.

Statistical Analysis

Binary logistic regression modeling was used to evaluate differences in types of procedures performed, adjusting for surgeon characteristics (differences in specialty training (ortho vs neuro), years in practice, location of fellowship training), and baseline patient characteristics (age, BMI, and smoking status). An a priori level of 5% was used to determine statistical significance. The adjusted analyses were performed to help isolate the mode of remuneration as a main difference between the two groups and were based on factors shown to affect outcomes in spine surgery literature and/or theorized as potential confounders. ANCOVA was utilized to assess differences in baseline questionnaire scores and in PROMs, adjusted for age, BMI, smoking status. Analyses were conducted using SPSS (IBM Corp. Released 2019. IBM

SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.)

Results

In total, 63 out of 70 surgeons completed the survey. Table 1 summarizes the surgeon demographics. Thirty-nine surgeons (62%) were paid FFS and 24 (38%) were salaried. Totally, 42/63 (66.7%) of surgeons had an orthopedic training background. Of note, 17/24 (70.8%) of salaried surgeons were neurosurgeons. All but three surgeons did their residency training in Canada, and only one surgeon was not fellowship trained in spine surgery. Fellowship training was completed in Canada for 45.8%, 35.6% in the USA, and 18.6% outside North America.

Stable Lumbar Spinal Stenosis

Controlling for baseline patient and surgeon characteristics, FFS physicians performed significantly more decompression with uninstrumented fusions than salaried physicians (6.8% vs 1.4%, odds ratio (OR) = 5.6, $p < 0.005$). There were no significant differences between groups with regard to decompression alone, instrumented, or interbody fusions (Table 2).

Examining baseline characteristics, patients treated by salaried physicians were significantly older ($p < 0.003$), more likely to be male ($p < 0.01$), and had a lower average BMI ($p < 0.02$). Salaried physicians saw more patients with previous surgery (32.3% vs 25.4%, $p < 0.008$). No other statistical differences were observed (Table 3).

Salaried surgeons operated on significantly fewer spinal levels (1.77 vs 2.01, OR = 1.153, $p < 0.006$). Salaried physicians performed significantly fewer minimally invasive (MIS) procedures (25.6% vs 36.9%, OR = 4.074, $p < 0.001$).

Table 4 reveals that there was no statistically significant difference in baseline patients reported questionnaire scores between groups. Of the 2234 stenosis patients, 1748 were eligible for follow-up; the remaining had not yet reached the 12-month post-surgical mark. Follow-up data were obtained from 1335 (76%). Using ANCOVA to account for possible confounders, those treated by salary physicians had significantly higher ODI scores at 12-month follow-up ($p < 0.026$). There were no other statistically significant differences in PROMs at 12 months between remuneration groups.

Degenerative Spondylolisthesis

After adjusting for patient and surgeon factors, there were no statistically significant differences in the rates of decompression-alone procedures between groups; however, FFS physicians performed significantly more uninstrumented (OR = 8.36, $p < 0.001$) and instrumented fusions (OR = 2.42, $p < 0.001$), but salaried physicians performed more interbody fusions than their FFS colleagues (OR = 3.03, $p < 0.001$) (Table 5).

Patients treated by salaried physicians had a lower average BMI at baseline (28.2 vs 29.2, $p < 0.007$) but were otherwise very similar to the FFS group (Table 6).

There was no statistically significant difference in the number of surgical levels (1.49 vs 1.47) between surgeon groups. Salaried physicians utilized fewer minimally invasive procedures (13.9% vs 44.6%, OR = 9.95, $p < 0.001$).

Of the 1292 spondylolisthesis patients, 1023 were eligible for follow-up. Post-surgical follow-up data were obtained from 819 (80%). At both baseline and 12 month follow-up, there were no

Table 2: Types of operative procedures for lumbar spinal stenosis without instability by surgeon remuneration; adjusted for patient variables (age, BMI, smoking status) and surgeon differences (specialty, years in practice, location of fellowship training)

Procedure	Fee for service	Salary	Total	p-value	Odds ratio (95% CI)
	n (%)				
Decompression alone	878 (48.8%)	294 (67.9%)	1172 (52.5%)	0.075	1.40 (0.97–2.02)
Decompression and fusion (uninstrumented)	123 (6.8%)	6 (1.4%)	129 (5.8%)	0.005	5.64 (1.70–18.75)
Decompression and fusion (+rod/screw)	302 (16.8%)	66 (15.2%)	368 (16.5%)	0.276	1.30 (0.81–2.10)
Decompression and fusion (+cage)	498 (27.7%)	67 (15.5%)	565 (25.3%)	0.423	1.20 (0.77–1.89)
Total	1801 (80.6%)	433 (19.4%)	2234		

Table 3: Lumbar spinal stenosis patient demographics by surgeon remuneration

	Fee for service	Salary	Total	p-value	Odds ratio (95% CI)
	n (%)				
Sex					
Female	737 (40.9%)	144 (33.3%)	881 (39.4%)	0.010	1.37 (1.08–1.75)
Male	1064 (59.1%)	289 (66.7%)	1353 (60.6%)		
Smoking status					
No	1392 (83.2%)	313 (83.5%)	1705 (83.2%)	0.867	1.03 (0.74–1.42)
Yes	282 (16.8%)	62 (16.5%)	344 (16.8%)		
Insurance claims					
No	1002 (85.1%)	272 (86.3%)	1274 (85.3%)	0.868	1.03 (0.70–1.52)
Yes	176 (14.9%)	43 (13.7%)	219 (14.7%)		
Working status					
Not working	266 (40.8%)	60 (40.0%)	326 (40.6%)	0.817	1.05 (0.71–1.53)
Working	386 (59.2%)	90 (60.0%)	476 (59.4%)		
Symptom duration					
≤2 years	455 (35.2%)	142 (37.9%)	597 (35.8%)	0.227	1.16 (0.91–1.48)
+2 years	836 (64.8%)	233 (62.1%)	1069 (64.2%)		
Previous surgery					
No	1247 (74.6)	254 (67.7)	1501 (73.4)	0.008	1.40 (1.09–1.81)
Yes	424 (25.4)	121 (32.3)	545 (26.6)		
Mean (standard deviation)					
Age	64.5 (11.8)	66.1 (11.3)		0.003	1.02 (1.006–1.03)
Body mass index	29.5 (5.8)	28.6 (5.2)		0.021	0.98 (0.95–0.99)
Comorbidities	2.9 (1.9)	3.1 (1.9)		0.233	1.04 (0.98–1.11)

statistically significant differences between patient PROM scores for salary vs FFS physicians (Table 7). Both groups demonstrated significant improvement.

Discussion

After controlling for patient’s baseline differences and surgeon factors, we observed that surgical approach with regard to common conditions of the lumbar spine is different between salaried and FFS spine surgeons in Canada. Salaried surgeons performed fewer uninstrumented fusion procedures, operated on fewer levels, and used fewer minimally invasive techniques when treating stable

lumbar spine stenosis. Salaried surgeons, however, showed the opposite trend in the treatment of degenerative spondylolisthesis for which they performed more interbody fusions. Baseline patient characteristics were similar in both groups. Outcome measures reflected no differences in patients treated by either FFs or salaried groups for either diagnosis. Our results support the finding that factors other than patient demographics appear to influence the surgical decision making in this population. Although remuneration likely does play a role, its impact is likely overshadowed by surgeon training, experience, and regional practices.

One hypothesis to explain our results stems from a crude analysis of compensation/time ratio. If one assumes that remuneration is a

Table 4: Adjusted* baseline and 12-month follow-up PROMS for stable spinal stenosis patients by surgeon remuneration

	Fee for service	Salary	p-value
	Mean (standard deviation)		
Baseline NBPRS	6.99 (2.26)	6.70 (2.45)	0.092
Follow-up	3.49 (2.62)	3.76 (2.62)	0.293
Baseline NLPRS	7.48 (2.04)	7.39 (2.16)	0.525
Follow-up	3.40 (3.03)	3.93 (2.89)	0.076
Baseline PCS	32.09 (8.32)	32.25 (7.86)	0.798
Follow-up	41.65 (9.92)	41.02 (9.62)	0.496
Baseline MCS	48.47 (8.39)	49.56 (8.07)	0.082
Follow-up	51.94 (7.77)	52.01 (6.70)	0.921
Baseline ODI	47.26 (15.92)	45.76 (15.13)	0.204
Follow-up	28.18 (19.65)	32.09 (19.63)	0.026
Baseline EQ5D	0.52 (0.21)	0.54 (0.21)	0.340
Follow up	0.74 (0.19)	0.71 (0.18)	0.068

NBPRS=Numeric Back Pain Rating Scale; NLPRS=Numeric Leg Pain Rating Scale; PCS=Physical Component Score of the SF12; MCS=Mental Component Score of the SF12; ODI=Oswestry Disability Index; EQ5D=European Quality of Life-5D.

*Adjusted for age, BMI, smoking status, specialty, years in practice, location of fellowship training; follow up results additionally adjusted for baseline questionnaire score.

Table 5: Types of operative procedures for degenerative spondylolisthesis patients by surgeon remuneration adjusted for patient variables (age, BMI, smoking status) and surgeon differences (specialty, years in practice, location of fellowship training)

Procedure	Fee for service	Salary	Total	p-value	Odds ratio (95% CI)
	n (%)				
Decompression alone	190 (21.3%)	72 (17.9%)	262 (20.3%)	0.125	1.34 (0.92–1.96)
Decompression and fusion (uninstrumented)	56 (6.3%)	7 (1.7%)	63 (4.9%)	<0.001	8.36 (3.13–22.3)
Decompression and fusion (+rod/screw)	177 (19.9%)	68 (16.9%)	245 (19.0%)	<0.001	2.42 (1.62–3.61)
Decompression and fusion (+cage)	467 (52.5%)	255 (63.4%)	722 (55.9%)	<0.001	3.03 (2.20–4.19)
Total	890 (68.9%)	402 (31.1%)	1292		

driver of procedure choice, doing more extensive surgery may not produce acceptable monetary benefit for the FFS surgeon, while reflecting an indifference to the salaried surgeon. As previously mentioned, reimbursement in Canada is dictated by individual province fee schedules. For example, under the Ontario Health Insurance Plan (OHIP), a single-level decompression in the lumbar spine is valued at \$1004.70CAD, with a posterior uninstrumented fusion yielding an additional \$408.00CAD, \$867.00CAD for a posterior instrumented fusion, and an interbody device an additional \$510.00CAD.¹³ Similarly, in British Columbia, these same procedures are valued at \$789.13CAD, \$490.15CAD, \$1769.22CAD, and \$403.00CAD, respectively.¹⁴ In practice, the additional time required to do an interbody fusion is not reflected in the fee schedule, which may be a disincentive for the FFS surgeon, especially considering the paucity of proven clinical benefits. On the other hand, the addition of a posterior uninstrumented fusion (higher in the FFS group for both diagnoses), which remunerates approximately the same as an interbody fusion with less hassle, may provide a better cost-effective basis for the FFS surgeon.

Salaried surgeons receive the same remuneration regardless of the listed fee for a particular procedure. This fact should remove remuneration incentive from their operative decisions. One would

expect that this may translate in less exhaustive surgery across the board. This was seen for stable spinal stenosis, where the FFS group performed more uninstrumented fusion than the salaried group. The proportion of patients undergoing uninstrumented fusion was, however, small in both groups and thus cannot be considered a big driver. On the other end, despite the lack of financial incentives, salaried surgeons performed three times more interbody fusions than FFS surgeons when treating degenerative spondylolisthesis, which cannot be explained by monetary incentives. Without the noncompelling financial incentives of adding an interbody fusion, a hypothesis is that the potential minor clinical benefit of interbody fusion may be seen as valuable by the salaried surgeons, but not worth it by the FFS surgeons.

Conflicting results for these two common interventions may in fact show that remuneration does not play a significant role in the management of these patients. Our results clearly highlight the preference sensitive nature of elective spine surgery.^{15–17} This is particularly true for elective spinal fusion, which due to its high cost and varied outcomes is the source of much concern and controversy not only in the USA but also most industrialized nations.^{18,19} While it has been postulated that gross increasing rate of spinal fusion is in part due to both regional payer policies,

Table 6: Degenerative spondylolisthesis patient demographics by surgeon remuneration

	Fee for service	Salary	Total	p-value	Odds ratio (95% CI)
	n (%)				
Sex					
Female	574 (64.5%)	238 (59.2%)	812 (62.8%)	0.056	1.28 (0.99–1.65)
Male	316 (35.5%)	164 (40.8%)	480 (37.2%)		
Smoking status					
No	730 (86.2%)	343 (89.3%)	1073 (87.2%)	0.112	1.38 (0.93–2.06)
Yes	117 (13.8%)	41 (10.7%)	158 (12.8%)		
Insurance claims					
No	660 (89.6%)	284 (87.9%)	944 (89.1%)	0.46	1.18 (0.76–1.83)
Yes	77 (10.4%)	39 (12.1%)	116 (10.9%)		
Working status					
Not working	119 (35.4%)	49 (35.3%)	168 (35.4%)	0.613	1.12 (0.72–1.73)
Working	217 (64.6%)	90 (64.7%)	307 (64.6%)		
Symptom duration					
≤2 years	219 (27.7%)	98 (25.4%)	317 (26.9%)	0.572	1.09 (0.82–1.44)
+2 years	574 (72.3%)	287 (74.6%)	861 (73.1%)		
Previous surgery					
No	1247 (74.6%)	254 (67.7%)	1501 (73.4%)	0.365	1.17 (0.83–1.64)
Yes	424 (25.4%)	121 (32.3%)	545 (26.6%)		
Mean (standard deviation)					
Age	65.5 (9.9)	65.5 (8.6)		0.825	0.99 (0.98–1.01)
Body mass index	29.2 (5.8)	28.2 (6.1)		0.006	0.97 (0.95–0.99)
Comorbidities	3.2 (1.9)	3.1 (1.9)		0.476	0.98 (0.92–1.04)

Table 7: Adjusted* baseline and 12-month follow up PROMS for degenerative lumbar spondylolisthesis patients by surgeon remuneration

	Fee for service	Salary	p-value
	Mean (standard deviation)		
Baseline NBPRS	6.96 (2.28)	6.79 (2.41)	0.310
Follow up	2.89 (2.55)	3.03 (2.49)	0.504
Baseline NLPRS	7.44 (2.15)	7.41 (2.16)	0.833
Follow up	2.95 (2.90)	2.74 (2.77)	0.335
Baseline PCS	32.53 (8.24)	32.50 (8.43)	0.957
Follow up	43.73 (9.46)	43.36 (9.73)	0.640
Baseline MCS	49.24 (8.47)	50.06 (8.33)	0.156
Follow up	53.03 (7.25)	53.28 (6.77)	0.655
Baseline ODI	46.01 (14.81)	45.32 (15.02)	0.507
Follow up	23.97 (18.49)	25.38 (18.07)	0.322
Baseline EQ5D	0.52 (0.21)	0.52 (0.21)	0.830
Follow up	0.77 (0.18)	0.77 (0.18)	0.817

NBPRS=Numeric Back Pain Rating Scale; NLPRS=Numeric Leg Pain Rating Scale; PCS=Physical Component Score of the SF12; MCS=Mental Component Score of the SF12; ODI=Oswestry Disability Index; EQ5D=European Quality of Life-5D.

*Adjusted for age, BMI, smoking status, specialty, years in practice, location of fellowship training; follow up results additionally adjusted for baseline questionnaire score.

institutional, and provider financial incentives,^{18,19} a recent study suggested that surgeon incentives (or conflicts of interest) do not materially drive fusion rates.¹⁵ While variable access (so called “supply-sensitive care”) to more costly and remunerative treatment alternatives certainly cannot and should not be directly or indirectly discounted, the issue of financial incentive is not that simple. It is generally thought that variation is more fundamentally driven by clinical uncertainty, patient and provider preference, and regional surgical signatures, an issue that is not by any means unique to the USA.^{15,20–23} Traditionally, surgeon preference is believed to be a primary driver; however, this has been shown to be a multifactorial issue where patient, primary care providers and surgeon attitudes play varying, nonlinear, aligned, and mal-aligned roles that requires further study^{22,24} from a variety of perspectives.

There is little supporting evidence in the literature on this topic. Shoenfeld et al.¹⁰ postulated that “provider inducement” is a strong confounder in the surgical treatment of degenerative lumbar spine disorders. This group reviewed 28,344 patients undergoing surgical treatment for spinal stenosis, degenerative spondylolisthesis, and disc herniation; 21,290 patients treated by FFS physicians were compared to 7054 patients treated by salaried physicians at Department of Defense facilities. In this study, FFS physicians were at 1.25 (1.20–1.30) times odds of offering an interbody fusion as compared to patients treated in facilities employing salaried surgeons. When looking specifically at a diagnosis, patients with lumbar spine stenosis were at 1.39 (1.15–1.69) times greater odds of receiving an interbody fusion by FFS surgeons. Similarly, patients with a disc herniation were at 2.61 (2.36–2.89) times the odds of interbody fusion by the FFS group. There was no difference between fusion for spondylolisthesis for the two pay structures [OR = 0.99 (0.84–1.16)]. These findings may be explained by their more favorable monetary benefit of adding an interbody fusion than the Canadian one.

Patient selection seemed equivalent between both groups. Salaried surgeons treated older patients and performed more revision cases in the stable stenosis diagnosis but for both diagnoses, FFS surgeons were treating patients with higher BMIs, making both groups comparable from a technical difficulty perspective. FFS surgeons performed more MIS surgeries for both diagnoses. There is no direct additional remuneration for performing MIS procedures in Canada. One explanation could be that once over the initial learning curve, MIS decompression and fusions may be quicker to perform than open surgical approaches, and thus increase potential revenues.^{25,26}

The strengths of this study include its prospective data collection, robust methodology, and sample size. This is also a novel topic which, to the authors’ knowledge, has not been studied in a standardized payer setting. The authors do, however, acknowledge multiple limitations. This study lacks the ability to describe surgical practices outside of the CSORN network. This work is a thus a reflection of practice at academic centers in Canada and may be confounded by referral patterns to these centers. Participation of trainees, which could significantly increase surgical time and thus impact remuneration, was not accounted for in this study.

Similarly, payment structure is seen to vary between provinces in Canada. Although the primary purpose of this study was not a regional analysis of surgical practices in Canada, the authors acknowledge that this may be a confounding factor.

A thorough attempt was made at controlling for as many surgeons and patient factors as possible to isolate remuneration mode.

The unequal distribution of neurosurgeons and orthopedic surgeons in salaried versus fee-for-service surgeons likely plays an important role in surgical decision making, as experience and location of fellowship training. As such, we controlled for these three important potential confounders; however, it is likely that other factors pertinent to health care systems play a role in this complex decision-making process and were not controlled for or measured.

Conclusion

The treatment of degenerative diseases of the lumbar spine remains controversial. In this study, surgical practices for treatment of spinal stenosis and degenerative spondylolisthesis were seen to vary in opposite directions based on method of compensation. Salaried surgeons treated spinal stenosis with more conservative surgical approaches, while treating spondylolisthesis with more aggressive approaches. These results support the notion that remuneration does not, on its’ own, impact surgical decision making in a consistent fashion in Canada and that factors such as experience, training, and regional variation likely play a significant role.

Supplementary Material. To view supplementary material for this article, please visit <https://doi.org/10.1017/cjn.2022.259>

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