Spine

SPINE Volume 42, Number 17, pp E1016–E1023

CLINICAL CASE SERIES

Multidisciplinary Evaluation Leads to the Decreased Utilization of Lumbar Spine Fusion

An Observational Cohort Pilot Study

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Study Design. Observational cohort pilot study.

Objective. To determine the impact of a multidisciplinary conference on treatment decisions for lumbar degenerative spine disease.

Summary of Background Data. Multidisciplinary decision making improves outcomes in many disciplines. The lack of integrated systems for comprehensive care for spinal disorders has contributed to the inappropriate overutilization of spine surgery in the United States.

Methods. We implemented a multidisciplinary conference involving physiatrists, anesthesiologists, pain specialists, neurosurgeons, orthopaedic spine surgeons, physical therapists, and nursing staff. Over 10 months, we presented patients being considered for spinal fusion or who had a complex history of prior spinal surgery. We compared the decision to proceed with surgery and the proposed surgical approach proposed by outside surgeons with the consensus of our multidisciplinary conference. We also assessed comprehensive demographics and comorbidities for the patients and examined outcomes for surgical patients.

Results. A total of 137 consecutive patients were reviewed at our multidisciplinary conference during the 10-month period. Of these, 100 patients had been recommended for lumbar spine fusion by an outside surgeon. Consensus opinion of the multidisciplinary conference advocated for nonoperative management in 58 patients (58%) who had been previously recommended for spinal fusion at another institution ($\chi^2 = 26.6$; $P < 0.01$). Furthermore, the surgical treatment plan was revised as a product of the conference in 28% (16 patients) of the patients who ultimately underwent surgery ($\chi^2 = 43.6$; $P < 0.01$). We had zero 30-day complications in surgical patients.

Conclusion. Isolated surgical decision making may result in suboptimal treatment recommendations. Multidisciplinary conferences can reduce the utilization of lumbar spinal fusion, possibly resulting in more appropriate use of surgical interventions with better candidate selection while providing patients with more diverse nonoperative treatment options. Although long-term patient outcomes remain to be determined, such multidisciplinary care will likely be essential to improving the quality and value of spine care.

Key words: cost-effectiveness, fusion, lumbar fusion, lumbar spine, multidisciplinary, multidisciplinary conference, spine surgery, utilization, value.

Level of Evidence: 3

Spine 2017;42:E1016–E1023

Despite the recent advent of multidisciplinary spine clinics, the treatment plan for degenerative lumbar spine conditions often remains in the purview of a single spine surgeon who typically makes all of the operative and nonoperative management decisions.[1,2] The benefits of shared decision making in degenerative spine surgery between surgeon and patient have been extensively studied and demonstrated,[3–7] and various decision support tools have been developed to facilitate this process.[8] However, surgeons largely practice without direct communication with other nonsurgical providers including physiatrists and anesthesia pain specialists.

We have previously written about the utility of multidisciplinary approaches in adult deformity surgery[9] and other clinicians have described the utility of multidisciplinary approaches in treating complex spinal conditions.[9,10] The advantage of multidisciplinary approaches may extend

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Acknowledgment date: August 12, 2016. First revision date: October 24, 2016. Second revision date: November 28, 2016. Acceptance date: December 5, 2016.

The manuscript submitted does not contain information about medical device(s)/drug(s).

No funds were received in support of this work.

Relevant financial activities outside the submitted work: grants.

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DOI: 10.1097/BRS.0000000000002065

even to lumbar degenerative conditions, however, as the rates of surgical procedures and magnetic resonance imaging (MRI) utilization decrease after implementation of multidisciplinary care pathways[11–13] without evidence of a decline in patient outcomes.[14] As the overutilization of advanced imaging and lumbar fusion continues to drive ballooning costs in spine surgery without a concurrent improvement in outcomes, the declining healthcare value is leading to increasing pressure from payer groups to restrict spine surgery access and expenditure.[15]

In light of these facts, we recently implemented a weekly multidisciplinary conference to review patients with lumbar degenerative spine conditions. Required attendees at this conference include members from physical medicine and rehabilitation, anesthesiology, anesthesia pain, neurosurgery, orthopedic spine surgery, nursing, physical therapy, and social work. We hypothesized that forcing direct communication among local content experts in lumbar degenerative conditions would lead to changes in the treatment plan that had been proposed by an external surgical provider.

METHODS

This study was approved by the institutional review board of the Virginia Mason Medical Center (VMMC) and informed consent was waived. We retrospectively reviewed cases presented at our weekly multidisciplinary spine conference, which included patients who were (i) scheduled to undergo spine surgery involving up to three levels of fusion; (ii) recommended up to three levels of spinal fusion at another institution and came to VMMC for a second opinion; or (iii) presented with unusual spinal pathology that required a multidisciplinary approach for diagnosis or treatment planning.

Since November 2015, multidisciplinary spine conferences were convened each Tuesday morning at 7:45 AM to include a quorum of 10 providers at minimum, including at least one provider from each of the following areas: physical medicine and rehabilitation (PM&R), the anesthesia pain service, neurosurgery and orthopedic spine surgery, nursing, physical therapy, and social work. Physician assistants and nurse practitioners were also present. Each provider was given an equal voice and vote in the decision making process for each patient.

The patients reviewed in this multidisciplinary conference presented to any of the involved services, including neurosurgery, orthopedic spine surgery, PM&R, or the anesthesia pain service. The providers used the above selection criteria to determine the appropriateness of each patient for presentation at the spine conference. The consulting physician presented the patient's case at the conference and discussed their assessment of the patient and any treatment recommendations made at other institutions. Imaging studies were reviewed by the group as a whole.

Consensus opinion was reached by the group in attendance on how to proceed with the care of the patient and the opinion was then recorded in the patient's electronic medical record (EMR). The BREE criteria, a set of rigorous, evidence-based standards developed in Washington State, provide a framework for judging these various patient-specific parameters and are used to guide the decision making process in the conference.[16] The BREE collaborative criteria specifically require assessment of disability despite nonsurgical therapy and patient fitness for surgery.[16] In particular, the group considered the patient's level of disability (based on patient reported outcome measures), previous operative and nonoperative management, comorbidities and their associated surgical and anesthesia risk, and potential to benefit from the considered surgical and nonsurgical therapies. These rigorous criteria allow for a standardized process for patient evaluation and screening. Once the group made a decision whether or not to offer surgery, the consulting physician conveyed the group's consensus recommendations to the patient.

After institutional review board (IRB) approval, records of consecutive patients who were presented at the multidisciplinary conference between November 2015 and August 2016, inclusive, were reviewed. A total of 137 patients were identified, with 100 patients of this group carrying a recommendation for spinal fusion surgery by a spine surgeon at another institution as documented in outside consultation reports and confirmed by the patient at the time of initial consultation at VMMC. We reviewed the records of these 100 patients in detail and extracted data from our EMR including primary spine diagnosis, patient demographics [age, sex, race, home state, body mass index (BMI), current smoking status], comorbidities (diabetes, hypertension, coronary artery disease, and osteoporosis), baseline survey characteristics [Oswestry Disability Index (ODI), Patient Health Questionnaire 9 (PHQ-9), Generalized Anxiety Disorder 7 (GAD-7), and Patient Reported Outcomes Measurement Information System (PROMIS) scores], prior treatment history [physical therapy (PT), epidural steroid injections (ESI), and prior surgery], outside surgeon recommendations, and conference decision and rationale. We obtained 30-day complication rates for all patients who eventually underwent surgery at VMMC, including any hospital readmissions, surgical site infections, pneumonia, urinary tract infection, myocardial infarction, and death.

Patient characteristics were summarized using frequency distributions for categorical variables, and means, medians and standard deviations for continuous variables. Categorical variables were compared using Pearson χ^2 statistic. Continuous variables were compared using the two-tailed Student t test. All statistical analyses were performed using Stata version 11.0 (StataCorp, College Station, TX). All tests were two sided and $P < .05$ were considered statistically significant.

RESULTS

Table 1 summarizes the patient demographics. As expected for lumbar degenerative conditions, the mean age was 60.1 years ± 11 years (range 22–88 years) with 55% of patients being females. Most patients (88%) were Caucasian, with 8% Asian and 4% African American. The majority of

TABLE 1. Patient Demographics, Comorbidities, and Treatment History With Respect to the Decision of the Multidisciplinary Conference to Offer Nonoperative management or Surgery

	All	Nonoperative	Surgery	*P*
Age	60.1	58.0	60.6	0.55
Female Sex	52%	55%	45%	0.49
In-State	86%	89%	80%	0.35
BMI	30.8	31.2	30.9	0.92
ODI	50	54	46	0.33
PHQ9	3.3	3.93	2.67	0.58
Hypertension	40%	36%	42%	0.36
Diabetes	16%	17%	15%	0.84
Osteoporosis	20%	62%	55%	0.63
CAD	12%	10%	15%	0.63
PT	58%	62%	55%	0.63
ESI	70%	67%	80%	0.36
Smoking	12%	17%	0%	0.03
Prior Surgery	38%	34%	45%	0.47

Smoking status had a statistically significant difference between the two groups.

BMI indicates body mass index; ESI, epidural steroid injections; GAD, Generalized Anxiety Disorder; ODI, Oswestry Disability Index; PHQ-9, Patient Health Questionnaire 9 (PHQ-9); PT, physical therapy.

patients (86%) were from Washington State, with the remainder coming from the Pacific Northwest or Southwest. The mean BMI was 30.8 ± 7.2 (range 14–60). Ten patients (10%) exceeded a BMI of 40, meeting the threshold for morbid obesity. Twelve patients (12%) were current and active smokers at the time of consultation at VMMC. Sixteen patients had diabetes, 40 patients had hypertension treated with at least one antihypertensive agent, six patients had a known diagnosis of coronary artery disease, and 20 patients had established osteoporosis.

The most common presenting diagnosis among patients who had been recommended for spinal fusion by an outside surgeon was spondylolisthesis (20 patients, 20%). Lumbar stenosis with claudication or radiculopathy was the second most common diagnosis (18 patients, 18%). Degenerative disc disease with axial back pain in the absence of radicular symptoms was the third most common diagnosis (10 patients, 10%). Six patients (6%) had a diagnosis of symptomatic adjacent segment disease after prior fusion. Symptomatic pseudoarthrosis was the presenting diagnosis in four patients (4%). Workup conducted as part of our multidisciplinary conference revealed misdiagnosis in four cases (4%) by the outside spine surgeon, all suspected lumbar radiculopathy identified as arising from degenerative hip changes. The mean ODI was 49.9 ± 7.2. The mean PHQ-8 was 3.3 ± 1.2. The mean GAD-7 was 4.1 ± 1.3. The mean PROMIS mental component score was 55.9 ± 8.6. The mean PROMIS physical component score was 37.7 ± 4.9.

Of these patients who had been recommended a lumbar fusion by an outside surgeon, only 58 (58%) had undergone any physical therapy. Seventy patients (70%) had undergone a prior epidural steroid injection. Thirty-eight patients (38%) had undergone prior spine surgery at the site of proposed surgery or at an adjacent level. With regard to procedure type, 82 patients (82%) were recommended to undergo lumbar posterolateral fusion by an outside surgeon, followed in frequency by lumbar interbody fusion with 16 patients (16%).

Of the 100 patients we identified for the study, the multidisciplinary conference recommended that 58 patients (58%) should not undergo any spine surgery ($\chi^2 = 26.6$; $P < 0.01$) as summarized in Figure 1 and further depicted in Table 2. The four patients identified with hip pathology rather than lumbar radiculopathy were referred to a joint specialist for further evaluation and possible treatment. Ten patients (10%) were deemed inappropriate surgical candidates caused by morbid obesity (BMI > 40). These patients were recommended to the VMMC bariatric medicine and surgery center for weight loss counseling. Ten patients (10%) were deemed inappropriate surgical candidates because they were active smokers at the time of consultation and were referred to the VMMC smoking cessation program with the acknowledgement that their case would be revisited should they successfully stop smoking with two documented negative urine cotinine checks. Twenty-two patients (22%) were deemed likely to benefit from additional physical therapy and were recommended PT before consideration of surgery. Six patients (6%) were deemed candidates for epidural steroid injection before surgical consideration and two patients (2%) were deemed a candidate for vertebroplasty rather than surgery. Notably, the absence of physical therapy or ESI were not contraindications for surgery, and eight patients (8%), all of whom had spondylolisthesis, who had not had physical therapy previously were deemed

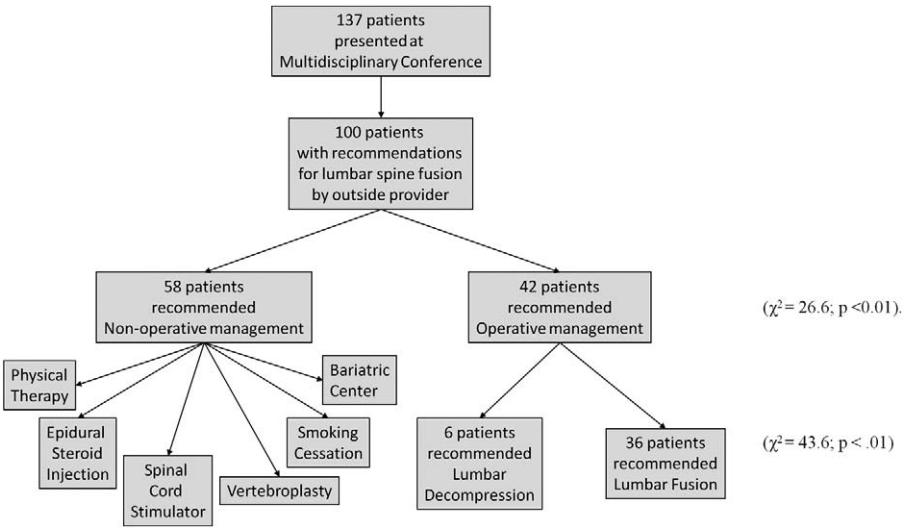

Figure 1. Summary of patient selection, conference decision, and final treatment paradigm.

surgical candidates as the physiatrists and physical therapists felt that they would not benefit from PT and would therefore be better served by surgical treatment. These rationales for recommending nonsurgical management are summarized in Table 3.

There was no statistically significant difference between the patients who underwent surgery and those who were recommended not to undergo surgery with respect to age, sex, race, or home state (Table 1). We also observed no statistically significant difference in the BMI between the two groups (nonsurgical group 31.2 ± 6.3, surgical group 30.9 ± 2.3; $P > .05$; 2-tailed t-test with unequal variance). However, smoking status showed a significant difference between the two groups (nonsurgical group 16.7% smokers; surgical group 0% smokers; $P < .05$; one-tailed t test with unequal variance). We did not observe a statistically significant difference in the occurrence of any comorbidities between the two groups.

Of the 42 patients who underwent surgery, we found that 16 patients (28%) underwent a different procedure after multidisciplinary discussion than that previously recommended by the outside surgeon (Figure 2). Only 18 patients underwent lumbar posterolateral fusion without interbody, compared with 84 patients who had been recommended a lumbar posterolateral fusion by an outside surgeon ($\chi^2 = 43.6$; $P < .01$). Fourteen patients underwent lumbar interbody fusion compared with 16 patients who had been previously recommended the same ($\chi^2 = 0.79.6$; $P > .05$) and six patients who had been recommended lumbar fusion underwent simple decompressive procedures (laminectomy in five cases and foraminotomy in one case; $\chi^2 = 5.37$; $P < .05$). These data are summarized in Figure 3. We found a 0% 30-day and 90-day complication rate and a 0% 90-day readmission rate for the operative patients in this series.

DISCUSSION

The utilization of spinal fusion for degenerative spinal disease in the United States has increased tremendously in the past several decades.[17] Along with skyrocketing utilization rates for spine surgery, the total cost of spine surgery increased 790% between 1998 and 2008, far outpacing the cost increases associated with any other medical procedure.[18] Over the decade between 1990 and 2000, the cost

TABLE 2. Number of Patients Deemed Operative and Nonoperative by the Outside Spine Surgeon and the Virginia Mason Medical Center Multidisciplinary Spine Conference

	Operative	Nonoperative
Outside surgeon	100	0
Conference	42	58

Note: Of the 50 patients we identified for the study, the multidisciplinary conference recommended that 29 patients (58%) should not undergo any spine surgery ($\chi^2 = 26.6$; $P < 0.01$).

TABLE 3. Reasons for the recommendation of Nonoperative Management by the Virginia Mason Medical Center Multidisciplinary Spine Conference

	Number of Patients	Percentage
Misdiagnosis by outside surgeon	6	6
Morbid obesity (BMI > 40)	10	10
Active smoking	10	10
Likely to benefit from additional physical therapy	22	22
Likely to benefit from ESI	6	6

BMI indicates body mass index; ESI, epidural steroid injections.

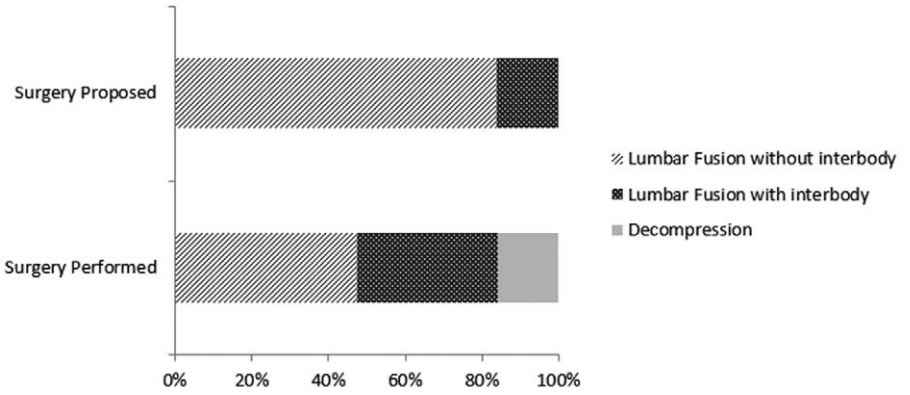

Figure 2. The distribution of surgeries proposed by outside spine surgeons (surgery proposed) and the surgeries performed at Virginia Mason Medical Center on the operative patient group. Only 18 patients underwent lumbar posterolateral fusion without interbody compared with 84 patients who had been recommended a lumbar posterolateral fusion by an outside surgeon ($\chi^2 = 43.6$; $P < .01$). Fourteen patients underwent lumbar interbody fusion compared with 16 patients who had been previously recommended the same ($\chi^2 = 0.79.6$; $P > .05$) and six patients who had been recommended lumbar fusion underwent simple decompressive procedures (laminectomy in five cases and foraminotomy in one case; $\chi^2 = 5.37$; $P < .05$).

of total knee replacement increased a little over 200%[19] whereas the cost of dialysis has increased only 40% over that same period.[20] The ever increasing costs and utilization of spine surgery without a concurrent increase in positive outcomes calls the cost effectiveness and quality of spine surgery into question. Value has been defined as the ratio of outcome to cost, often defined as quality-adjusted-life-years (QALYs) gained per dollar. Cost-effectiveness between interventions can be compared according to cost per QALY gained. Dialysis costs between $25,000 and $50,000 per QALY[21] and is considered the gold standard by which to benchmark other healthcare interventions.[22] Total hip arthroplasty costs $4600 per QALY gained[23] whereas recent studies have shown that lumbar fusion may cost over $200,000 per QALY gained.[24–26]

In the face of escalating costs, value can be maintained by improving patient outcomes for a particular intervention. Unfortunately for lumbar fusion, numerous studies have shown that spinal fusion for low back pain is associated with stable or worse disability and return to work[27,28] and that these outcomes may be even poorer in older patients and patients with more comorbidities,[29] making its value proposition questionable. Lumbar fusion surgery does provide improvement for particular subsets of patients,[30–37] and therefore the challenge lies in distinguishing those patients who are likely to see improvement after operative treatment from those who are best served by nonoperative management, including physical therapy, chiropractic care, or behavioral modification.

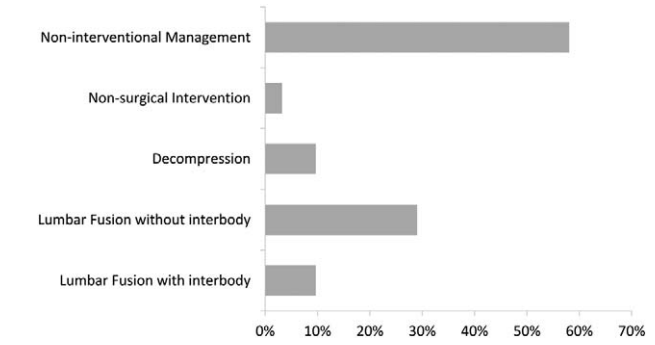

Figure 3. Final management approach at Virginia Mason Medical Center for patients who were recommended a lumbar posterolateral fusion by an outside institution spine surgeon.

As clinicians, we bring our own biases into the treatment plan for patients, and therefore may exhibit heuristic tendencies that drive us towards particular interventions or requests for advanced imaging. A recent study comparing the rate of recommendation for surgery for patients with nonurgent lumbar spine conditions demonstrated that requiring a single visit to a physiatrist decreased surgery rates by 25%.[11] Interestingly, the percentage of fusion procedures within the surgical population increased in this study, suggesting that patients with milder conditions improved with nonoperative management, leaving only the patients with more profound degenerative conditions such as spondylolisthesis or scoliosis to be treated surgically. Studies within the Canadian Health System have demonstrated similar effects,[12,13] noting that patients referred to a dedicated spine pathway that included physiatry experienced less overall MRI utilization when still selecting appropriate surgical candidates for operative intervention. Subsequent analysis from the same group demonstrated that a formalized spine pathway led to improvement in appropriate referrals to spine surgeons, selecting for those patients with the most severe leg pain but without nonspecific back pain who were most likely to benefit from surgery.[12,13] Even visits with other surgeons appear able to reduce the rate of unnecessary surgery, suggesting that this effect isn't solely related to nonsurgeons limiting or denying surgical care options.[38,39] In both of these studies, a second opinion surgeon visit led to a recommendation against surgery in 45% to 50% of patients, and a recommendation for a less invasive procedure amongst many of the remainder.

The use of multidisciplinary conferences is common within cancer care, and in some cases is required for accreditation by specialty societies.[40] These conferences can serve as a forum to discuss difficult cases, but especially in community settings are primarily aimed at helping to standardize care and prevent "outlier" events.[41] This improvement in care is accomplished primarily through a discussion

of particular patients by a group of experts from differing fields, and capitalizes on what has been called the "wisdom of the crowd."[42] We propose that our multidisciplinary spine conference serves the same function as a tumor board: to review a patient's history, examination, and imaging and determine a plan of care that has input from the varied specialties involved in the care of this condition. This concept has been utilized routinely throughout many aspects of medical care, but has not yet become a standard of care for the treatment of low back pain, although recent statewide and insurance plan initiatives have proposed the use of such conferences and pathways to help guide patients towards appropriate care.[11,16] The Robert Bree Collaborative established by the Washington State Legislature, for example, has recently published a lumbar fusion guideline that includes a requirement for "Formal consultation with collaborative team led by board certified physiatrist to confirm appropriateness, adequacy, completeness, and active participation in nonsurgical therapy and need for lumbar fusion" as part of its documentation of failure of nonsurgical management.[16] We expect other organizations nationally to follow suit in the face of escalating cost and decreasing value.

We find in our series a statistically significant reduction in spine surgery performed with the advent of a multidisciplinary conference. Compared with the decisions of outside spine surgeons, we had a 58% decrease in spine surgery recommendations, with patients undergoing nonsurgical management more frequently with our multidisciplinary team in the balance. Although the recommendation for surgery may be variable amongst surgeons and perhaps related to "aggressiveness" or greater belief in the benefit of surgery for treatment of nonspecific low back pain, the decrease in surgery recommendations from our conference cannot fully be explained by an unwillingness to pursue surgical intervention. In our series, two patients had a faulty diagnosis of lumbar pathology and would not have benefited from a lumbar fusion to treat symptoms arising from their degenerative hip arthritis. Although a large subset of patients were steered towards nonoperative measures, conference members were fully willing to recommend surgery, in fact recommending forgoing any nonoperative management in 10% of patients with clear surgical indications and significant disability.

Although a subset of patients who had an initial recommendation for lumbar fusion eventually underwent a nonfusion procedure after presentation at conference, in other patients eventually undergoing surgery a different fusion procedure was utilized. We saw an increase in the number of surgical procedures involving a lumbar interbody fusion device. This increase is primarily related to our use of lateral interbody fusion for adjacent level failure in the setting of a prior fusion. The external opinions for these patients typically involved a revision of the previous fusion with an extension by one or two levels, which does require a fairly extensive exposure made more difficult by the presence of scarring and the potential need to remove or replace a portion of the pre-existing hardware. We instead pursued a lateral minimally invasive approach at the affected level only in these patients with stabilization through a lateral plate. This approach allows one to avoid the previous posterior site and has been described in the literature with good result.[43,44]

Our article does have some limitations. Although we show superior early outcomes in the patients who did undergo surgery, with a 0% 30-day and 90-day complication rate, long-term outcomes are unknown in this set of patients. We also do not have information on the patients who were recommended a nonsurgical option, and some of them may have returned to their initial surgeon for treatment. Long-term follow up will ultimately be essential to demonstrating the true utility of this multidisciplinary conference in improving the value of care delivered to all patients with spinal disorders. We intend to follow this cohort of patients and subsequent patients longitudinally to test our current hypothesis that we are indeed delivering care of superior value to not only patients who undergo surgery but also to those who are treated nonoperatively.

In examining our limitations, it is also important to discuss the selection criteria for patient presentation at our multidisciplinary conference and for inclusion in this study. Every patient who was proposed to undergo any lumbar fusion at our institution or had been recommended a lumbar fusion procedure at an outside institution before consultation at our institution was presented at our multidisciplinary conference. No patient underwent a lumbar spinal fusion at our institution without prior presentation at the multidisciplinary conference during the study period. Other patients with lumbar spinal pathology were presented at the discretion of the consulting surgeon, physiatrist, or pain specialist. These selection criteria were specifically designed to capture all patients who would undergo lumbar fusion and ensure that they met the stringent criteria we have identified in the methods. However, we do lose a number of patients who underwent lumbar decompressions and discectomies who proceeded to surgery without such prior multidisciplinary evaluation. It is possible that some of these patients who underwent decompressive procedures without evaluation in the multidisciplinary conference may have had a different recommendation had they been presented at the conference. This is a limitation that we will address in future cohorts, where we have begun a more inclusive selection process.

Furthermore, in this study, we specifically examine patients presenting at our institution for a second opinion after having been recommended a lumbar fusion elsewhere. There is a real potential for the introduction of selection bias here as patients who never underwent outside evaluation are not included. Our study was designed specifically to compare surgical opinions made in isolation *versus* surgical opinions made in the context of multidisciplinary evaluation. We felt this was the most objective way of making such a comparison. However, further larger scale studies will be needed to assess the magnitude of the effect of such selection bias. This is our reason for designating this study a pilot study, as noted in the title.

Ultimately, we do feel that our findings are likely to be generalizable to patients undergoing lumbar fusion, and that

a multidisciplinary conference developed at other institutions on the basis of the Bree criteria or other similar evidence-based criteria would likely have similar findings to ours. Further larger scale evaluations will be necessary to corroborate this hypothesis.

CONCLUSION

We specifically demonstrate in this study that multidisciplinary evaluation can alter the treatment recommendations for patients with lumbar spinal pathology. Isolated surgical decision making may result in suboptimal treatment recommendations. Specifically, a rigorous multidisciplinary conference can decrease the utilization of spine surgery in patients who may have questionable benefit from surgical treatment. In an era where overutilization of spine surgery has led to a decline in the value of care delivered, such methods may provide appropriate care, ultimately improving the value of spine care by removing or reducing the cost of surgery by improving clinical patient outcomes. Furthermore, this can also limit patients' unnecessary exposure to surgical complications when the benefits may be uncertain. Importantly, this represents a tremendous opportunity for providers to take the lead in establishing appropriateness standards to increase the value of spine surgery for patients, purchasers, and health plans alike. Although surgeons and medical centers may initially be concerned with lost revenue from cancelled surgeries, better planning can be made when conferences are held well in advance of a planned surgery. Finally, we feel that the long-term benefits of establishing higher value sustainable spine care will unquestionably be beneficial to all involved. We urge surgeons and nonsurgical clinicians who treat lumbar degenerative conditions to work together to develop the infrastructure necessary to support multidisciplinary approaches to spine care.

➢ Key Points

- ❑ In this observational cohort study, we find that the multidisciplinary discussion of patients with degenerative lumbar spine disease among surgeons and nonsurgical providers leads to a 58% decreased utilization of lumbar spinal fusion.
- ❑ Multidisciplinary conference discussion also led to a statistically significant decrease in the invasiveness of surgical procedures.
- ❑ Multidisciplinary approaches will be essential to optimizing operative and nonoperative care for patients with degenerative lumbar spine disease and may ultimately lead to a decrease in the overutilization of lumbar fusion.

References

1. Castel LD, et al. Spine and pain clinics serving North Carolina patients with back and neck pain: what do they do, and are they multidisciplinary? *Spine (Phila Pa 1976)* 2009;34 (6):615–22.
2. Vora RN, et al. Work-related chronic low back pain-return-to-work outcomes after referral to interventional pain and spine clinics. *Spine (Phila Pa 1976)* 2012;37 (20):E1282–9.
3. Barrett PH, et al. Treatment decisions about lumbar herniated disk in a shared decision-making program. *Jt Comm J Qual Improv* 2002;28 (5):211–9.
4. Boss EF, et al. Shared decision making and choice for elective surgical care: a systematic review. *Otolaryngol Head Neck Surg* 2016;154 (3):405–20.
5. Jones LE, et al. Shared decision-making in back pain consultations: an illusion or reality? *Eur Spine J* 2014;23 (Suppl 1):S13–9.
6. Kim HJ, et al. Factors influencing the surgical decision for the treatment of degenerative lumbar stenosis in a preference-based shared decision-making process. *Eur Spine J* 2015;24 (2):339–47.
7. Weinstein JN. The missing piece: embracing shared decision making to reform health care. *Spine (Phila Pa 1976)* 2000;25 (1):1–4.
8. Kearing S, Berg SZ, Lurie JD. Can decision support help patients with spinal stenosis make a treatment choice? A prospective study assessing the impact of a patient decision aid and health coaching. *Spine (Phila Pa 1976)* 2016;41 (7):563–7.
9. Sethi RK, Pong RP, Leveque JC, et al. The Seattle Spine Team approach to adult deformity surgery: a systems-based approach to perioperative care and subsequent reduction in perioperative complication rates. *Spine Deformity* 2014;2 (2):95–103.
10. Halpin RJ, et al. Standardizing care for high-risk patients in spine surgery: the Northwestern high-risk spine protocol. *Spine (Phila Pa 1976)* 2010;35 (25):2232–8.
11. Fox J, et al. The effect of required physiatrist consultation on surgery rates for back pain. *Spine (Phila Pa 1976)* 2013;38 (3):E178–84.
12. Kindrachuk DR, Fourney DR. Spine surgery referrals redirected through a multidisciplinary care pathway: effects of nonsurgeon triage including MRI utilization. *J Neurosurg Spine* 2014;20 (1):87–92.
13. Wilgenbusch CS, Wu AS, Fourney DR. Triage of spine surgery referrals through a multidisciplinary care pathway: a value-based comparison with conventional referral processes. *Spine (Phila Pa 1976)* 2014;39 (22 Suppl 1):S129–35.
14. Rasmussen C, et al. Rates of lumbar disc surgery before and after implementation of multidisciplinary nonsurgical spine clinics. *Spine (Phila Pa 1976)* 2005;30 (21):2469–73.
15. Martin BI, et al. How do coverage policies influence practice patterns, safety, and cost of initial lumbar fusion surgery? A population-based comparison of workers' compensation systems. *Spine J* 2014;14 (7):1237–46.
16. Available from: http://www.breecollaborative.org/.
17. Davis H. Increasing rates of cervical and lumbar spine surgery in the United States, 1979–1990. *Spine (Phila Pa 1976)* 1994;19 (10):1117–23; discussion 1123-4.
18. Rajaee SS, et al. Spinal fusion in the United States: analysis of trends from 1998 to 2008. *Spine (Phila Pa 1976)* 2012;37 (1):67–76.
19. Mehrotra C, et al. Trends in total knee replacement surgeries and implications for public health, 1990–2000. *Public Health Rep* 2005;120 (3):278–82.
20. Lysaght MJ. Maintenance dialysis population dynamics: current trends and long-term implications. *J Am Soc Nephrol* 2002;13 (Suppl 1):S37–40.
21. Neumann PJ, Cohen JT, Weinstein MC. Updating cost-effectiveness—the curious resilience of the $50,000-per-QALY threshold. *N Engl J Med* 2014;371 (9):796–7.
22. Lee CP, Chertow GM, Zenios SA. An empiric estimate of the value of life: updating the renal dialysis cost-effectiveness standard. *Value Health* 2009;12 (1):80–7.
23. Chang RW, Pellisier JM, Hazen GB. A cost-effectiveness analysis of total hip arthroplasty for osteoarthritis of the hip. *JAMA* 1996;275 (11):858–65.
24. Carreon LY, Anderson PA, Traynelis VC, et al. Cost-effectiveness of single-level anterior cervical discectomy and fusion five years after surgery. *Spine (Phila Pa 1976)* 2013;38 (6):471–5.

25. Meyer SA, Mummaneni PV. Cost-effectiveness of transforaminal lumbar interbody fusion. *J Neurosurg Spine* 2011;15 (2):136–7; discussion 137.
26. Mummaneni PV, Whitmore RG, Curran JN, et al. Cost-effectiveness of lumbar discectomy and single-level fusion for spondylolisthesis: experience with the NeuroPoint-SD registry. *Neurosurg Focus* 2014;36 (6):E3.
27. Hedlund R, Johansson C, Hägg O, et al. The long-term outcome of lumbar fusion in the Swedish lumbar spine study. *Spine J* 2016;16 (5):579–87.
28. Nguyen TH, Randolph DC, Talmage J, et al. Long-term outcomes of lumbar fusion among workers' compensation subjects: a historical cohort study. *Spine (Phila Pa 1976)* 2011;36 (4):320–31.
29. Lingutla KK, Pollock R, Benomran E, et al. Outcome of lumbar spinal fusion surgery in obese patients: a systematic review and meta-analysis. *Bone Joint J* 2015;97-B:1395–404.
30. Asghar FA, Hilibrand AS. The impact of the Spine Patient Outcomes Research Trial (SPORT) results on orthopedic practice. *J Am Acad Orthop Surg* 2012;20 (3):160–6.
31. Birkmeyer NJ, Weinstein JN, Tosteson AN, et al. Design of the Spine Patient outcomes Research Trial (SPORT). *Spine (Phila Pa 1976)* 2002;27 (12):1361–72.
32. Hart RA. The Spine Patient Outcomes Research Trial (SPORT): a continuing return on investment: commentary on an article by Jeffrey A. Rihn, MD, et al.: "The influence of obesity on the outcome of treatment of lumbar disc herniation. analysis of the Spine Patient Outcomes Research Trial (SPORT)". *J Bone Joint Surg Am* 2013;95 (1):e5.
33. Levin PE. The impact of the Spine Patient Outcome Research Trial (SPORT) results on orthopedic practice. *J Am Acad Orthop Surg* 2012;20 (6):331; author reply 331-2.
34. Lurie JD, Tosteson TD, Tosteson A, et al. Long-term outcomes of lumbar spinal stenosis: eight-year results of the Spine Patient Outcomes Research Trial (SPORT). *Spine (Phila Pa 1976)* 2015;40(2):63–76.
35. North American Spine Society Board of Directors. Spine Patient Outcome Research Trial (SPORT): multi-center randomized clinical trial of surgical and nonsurgical approaches to the treatment of low back pain. *Spine J* 2003;3 (6):417–9.
36. Park DK, An HS, Lurie JD, et al. Does multilevel lumbar stenosis lead to poorer outcomes? A subanalysis of the Spine Patient Outcomes Research Trial (SPORT) lumbar stenosis study. *Spine (Phila Pa 1976)* 2010;35 (4):439–46.
37. Weinstein JN, Tosteson AN, Tosteson TD, et al. The SPORT value compass: do the extra costs of undergoing spine surgery produce better health benefits? *Med Care* 2014;52(12): 1055–63.
38. Gamache FW. The value of "another" opinion for spinal surgery: A prospective 14-month study of one surgeon's experience. *Surg Neurol Int* 2012;3 (Suppl 5):S350–4.
39. Vialle E. Second opinion in spine surgery: a Brazilian perspective. *Eur J Orthop Surg Traumatol* 2015;25 (Suppl 1):S3–6.
40. Winchester DP. The United States' national accreditation program for breast centers: a model for excellence in breast disease evaluation and management. *Chin Clin Oncol* 2016;5 (3):31.
41. Gross GE. The role of the tumor board in a community hospital. *CA Cancer J Clin* 1987;37 (2):88–92.
42. Surowiecki, J. The wisdom of crowds: why the many are smarter than the few and how collective wisdom shapes business, economies, societies, and nations. 1st ed. 2004, New York: Doubleday:. xxi, 296 p.
43. Palejwala SK, Sheen WA, Walter CM, et al. Minimally invasive lateral transpsoas interbody fusion using a stand-alone construct for the treatment of adjacent segment disease of the lumbar spine: review of the literature and report of three cases. *Clin Neurol Neurosurg* 2014;124:90–6.
44. Wang MY, Vasudevan R, Mindea SA. Minimally invasive lateral interbody fusion for the treatment of rostral adjacent-segment lumbar degenerative stenosis without supplemental pedicle screw fixation. *J Neurosurg Spine* 2014;21(6):861–6.