

Economic Analysis of Hydrosurgical Decompression In Microdiscectomy

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Summary

An economic model has been developed to assess the impact of the SpineJet Hydrosurgery System on the utilization of medical resources. Clinical data, peer reviewed journal articles, and expert opinion were used to formulate the model. Analysis shows that the cost of the SpineJet MicroResector device (\$1,125 per procedure) is more than offset by the cost savings afforded by its use. Using data from the Hardenbrook and White cohort study, a net benefit of \$2,114 per patient was achieved. Additional economic benefit may be achieved when longer-term savings are considered.

Background

Microdiscectomy is the most frequently performed procedure for spine surgeons in the U.S. Over 300,000 of these procedures are performed each year yielding a range of outcomes and complications for patients and correspondingly varying costs for the payers. Concerns have been documented about the overall rate of success of this common procedure estimated to be about 75 to 80%¹ and the substantial costs associated with poor outcomes². In a large outpatient surgery study, microdiscectomy produced 82.1% good or excellent results³. In these studies, recurrent herniations leading to reoperation were a frequent occurrence. Other complications of discectomy include epidural fibrosis resulting in recurrent pain without reherniation, and CSF leaks due to incidental durotomy.

The SpineJet MicroResector instruments were designed specifically to enable surgeons to perform microdiscectomies more efficiently, with smaller annulotomies and less nerve root manipulation. The clinical advantages are fewer reherniations, less recurrence of radicular pain as a result of less epidural fibrosis, and potentially fewer surgical complications. The hospital benefits from a significant reduction in procedure time (17.3 minutes). The payer benefits from lower total costs.

Methods

An economic model was formulated that accounts for costs and offsets in the index hospitalization, including the cost of reherniations, reoperations, and treating recurrent radicular pain in the absence of reherniation. A sensitivity analysis was performed to show how the economic outcomes would shift based on changes to the assumptions in the models.

Data

The data used for the analysis was derived from three sources: clinical data reported by users of the SpineJet Hydrosurgery System, peer reviewed journal articles, and expert opinion. The primary source is a comparison of two cohorts⁴, one including 27 patients who had a discectomy using the SpineJet MicroResector, and 34 patients who had a conventional microdiscectomy. The procedures were performed by two board-certified surgeons at the same institution. Recurrence of sciatica with or without reherniation was tracked as the primary driver of additional costs beyond the initial hospitalization. Tables 1 and 2 describe the complication data utilized to build the cases analyzed in the models. Total first-year costs of the two procedures were calculated from actual discectomy reimbursed cost data supplied by the Minnesota-based HealthEast hospital group. The base procedure cost is a weighted average of the payment rates for commercial insurers, Medicare, Medicaid and workers compensation. The procedure cost for the SpineJet-assisted microdiscectomy is the base cost for microdiscectomy plus \$1125, the cost of the SpineJet disposable tool, and less \$865, the savings that results from the 17.3 minutes reduction in procedure time.

Table 1 Failure Rates Conventional Microdiscectomy		
Failure Cause	Frequency-Hardenbrook- White Study ⁴	Frequency Medical Literature
Reherniation	17.6%	10.3% ⁵ - 14.5% ⁶
Recurrent radicular pain in the absence of reherniation	20.6%	10.2% ⁷ - 11.7% ⁵

Table 2 Failure Rates SpineJet MicroResector ³	
Failure Cause	Frequency
Reherniation	0%
Reoperation	0%
Recurrent radicular pain in the absence of reherniation	4%

Table 3 Procedure Costs for Study Cohorts	
Cohort	Cost
Microdiscectomy Procedure	\$9,160 ⁸
Microdiscectomy + SpineJet	\$9,420

Table 4 Cost Implications of Complications	
Cost Category	Cost
MRI (required if reherniation or recurrent radicular pain)	\$650
Reoperation (30 minutes longer than index procedure)	\$10,660
Pain Management (2 months for reherniation)	\$400
Pain Management (6 months for recurrent radicular pain)	\$1,200

Results

Costs and offsets can be analyzed by examining the cost of the SpineJet MicroResector versus the actual savings in the microdiscectomy plus SpineJet MicroResector group (provided by reduced complications and failures see tables 1 and 2).

Based on the complication rates observed in the Hardenbrook and White study, \$3,239 savings are realized as a result of the superior efficiency, safety and effectiveness of the SpineJet HydroSurgery System, more than offsetting the \$1,125 device cost. Thus the total expected economic benefit from using the SpineJet HydroSurgery System for decompression in microdiscectomy is \$2,114 per surgery. When compared to the complication rates documented in the literature (see table 1), \$1,323 savings are expected with the use of the SpineJet HydroSurgery System, more than offsetting the \$1,125 device cost and providing a \$198 net economic benefit.

Table 5 Costs and Savings: Comparison of Cohorts	
Category	(Cost) Savings per Surgery
Cost of SpineJet	(\$1,125)
Reduction in OR time	\$865
Reduction in reherniations: no MRI, pain management, or reoperations	\$2,061
Reduction in recurrent radicular pain in the absence of reherniation: no MRI or pain management	\$313
Net economic benefit when using the SpineJet MicroResector	\$2,114

Table 6 Costs and Savings: Comparison to Literature	
Category	(Cost) Savings per Surgery
Cost of SpineJet MicroResector	(\$1,125)
Reduction in reherniations: no MRI, pain management, reoperations	\$1,206
Reduction in recurrent radicular pain in the absence of reherniation: no MRI and pain management	\$117
Net economic benefit when using the SpineJet MicroResector	\$198

Sensitivity Analysis

In order to assess the sensitivity of the cost savings if more modest reductions in complications are achieved, we performed a sensitivity analysis using lower values of key parameters to recalculate costs and offsets. Savings that reverse as a result of small changes to any parameter would need to be evaluated carefully for an institution's particular cost profile. Savings that withstand variation in more than one dimension can be considered more predictable.

Table 7 reflects the impact on the components of the cost savings when the assumptions underlying the estimates are varied. The sensitivity analysis shows that even when the most sensitive variable is set to the lowest expected value a positive economic benefit can be anticipated from using the SpineJet HydroSurgery System for decompression in microdiscectomy.

Table 7 Range of Savings from Modest Reductions In Complications & Failure Rates		
Category	Range of Absolute Rate Reduction	Range of Savings per Surgery
Reherniation with reoperation	7% - 11%	\$820 - \$1288
Recurrent radicular pain in the absence of reherniation	6% - 12%	\$111 - \$222

Discussion

The Hardenbrook & White cohort study demonstrated impressive reductions in microdiscectomy complications with the use of the SpineJet MicroResector. This translated into a significant cost benefit of \$2114 per surgery. Because the cohorts are small and the follow-up is only one year, this data must be considered preliminary. However, even with smaller reductions in complications, the use of the SpineJet may be cost effective. This is consistent with the analysis of Cauthen et al which concluded that surgical technologies that improve outcomes of discectomy by 50% would be cost neutral at \$971². Additional benefits may also be derived from Hydrosurgical decompression in microdiscectomy. Shorter procedure times should result in fewer surgical site infections. Neither cohort had any surgical site infections, but a relationship to the length of surgery has been observed in other studies^{9,10}. Similarly, back pain from annular damage during the procedure should be reduced with the SpineJet technique.

Finally, Mochida has observed that there is less post-discectomy degenerative back pain when the central nucleus is preserved¹¹. Hydrosurgical decompression removes only posterior nucleus, from the immediate vicinity of the herniation. The procedure may have a lower rate of disc collapse and resulting degenerative back pain on long-term follow-up.

Each type of complication reduction would contribute to additional cost savings. A randomized trial of SpineJet Hydrosurgical microdiscectomy versus conventional microdiscectomy is warranted to further elucidate the relative cost effectiveness of the two methods.

References

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Notes

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