Tubular Diskectomy vs Conventional Microdiskectomy for the Treatment of Lumbar Disk-Related Sciatica: Cost Utility Analysis Alongside a Double-Blind Randomized Controlled Trial

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BACKGROUND: Conventional microdiskectomy is the most frequently performed surgery for patients with sciatica caused by lumbar disk herniation. Transmuscular tubular diskectomy has been introduced to increase the rate of recovery, although evidence of its efficacy is lacking.

OBJECTIVE: To determine whether a favorable cost-effectiveness for tubular diskectomy compared with conventional microdiskectomy is attained.

METHODS: Cost utility analysis was performed alongside a double-blind randomized controlled trial conducted among 325 patients with lumbar disk related sciatica lasting >6 to 8 weeks at 7 Dutch hospitals comparing tubular diskectomy with conventional microdiskectomy. Main outcome measures were quality-adjusted life-years at 1 year and societal costs, estimated from patient reported utilities (US and Netherlands EuroQol, Short Form Health Survey-6D, and Visual Analog Scale) and diaries on costs (health care, patient costs, and productivity).

RESULTS: Quality-adjusted life-years during all 4 quarters and according to all utility measures were not statistically different between tubular diskectomy and conventional microdiskectomy (difference for US EuroQol, −0.012; 95% confidence interval, −0.046 to 0.021). From the healthcare perspective, tubular diskectomy resulted in nonsignificantly higher costs (difference US $460; 95% confidence interval, −243 to 1163). From the societal perspective, a nonsignificant difference of US $1491 (95% confidence interval, −1335 to 4318) in favor of conventional microdiskectomy was found. The nonsignificant differences in costs and quality-adjusted life-years in favor of conventional microdiskectomy result in a low probability that tubular diskectomy is more cost-effective than conventional microdiskectomy.

CONCLUSION: Tubular diskectomy is unlikely to be cost-effective compared with conventional microdiskectomy.

KEY WORDS: Cost utility, (Lumbar) disk herniation, Microdiskectomy, Randomized controlled trial, Sciatica, Tubular diskectomy

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ABBREVIATIONS: QALY, quality-adjusted life-year; **VAS,** Visual Analog Scale

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Unilateral transflaval microdiskectomy is the most frequently performed surgical procedure for patients with lumbar disk–related sciatica.[1] Transmuscular tubular diskectomy has been introduced with the idea of reducing postoperative back pain and providing faster mobilization and resumption of daily activities with potentially a faster rate of recovery. However, scientific evidence of superiority of minimally invasive techniques is lacking. In a double-blind randomized controlled trial, we compared the effectiveness of tubular diskectomy with conventional microdiskectomy.[2-4] This trial showed similar rates of recovery and functional outcome during the first 2 years after surgery, although patients treated with tubular diskectomy reported significantly more leg pain and back pain.[3,4]

Previous randomized trials comparing tubular diskectomy and conventional microdiskectomy did not focus on an economic evaluation.[5-9] We therefore performed a cost utility analysis of the data from our randomized controlled trial, comparing quality-adjusted life-years (QALYs) with societal costs at 1 year, to determine whether, given this similar effectiveness, a favorable cost-effectiveness for tubular diskectomy is attained.

METHODS

Patients with sciatica caused by lumbar disk herniation participated in a multicenter double-blind randomized controlled trial comparing tubular diskectomy with conventional microdiskectomy. Details of the study protocol have been published previously.[2] The Medical Ethics committees of 7 participating general hospitals in the Netherlands approved the study, and all participants gave written informed consent.

A total sample size of 300 patients was calculated to detect at least a 4-point difference in the Roland Disability Questionnaire for Sciatica.[10] Between January 2005 and October 2006, 325 patients were enrolled. The baseline characteristics of both groups were similar.[3,4]

Patients and Treatment

Eligible patients between 18 and 70 years of age presented with sciatica lasting >6 to 8 weeks and radiologically confirmed disk herniation with distinct nerve root compression. Patients with small contained disk herniations with doubtful nerve root compression were excluded. Moreover, patients with cauda equina syndrome, previous spinal surgery at the same disk level, spondylolisthesis, central canal stenosis, pregnancy, severe somatic or psychiatric diseases, inadequate knowledge of the Dutch language, or emigration planned within 1 year of inclusion were also excluded.

Randomization into tubular diskectomy or conventional microdiskectomy was performed in the operating room after induction of anesthesia by opening a sealed envelope. Details of the treatment can be found elsewhere.[2] Conventional microdiskectomy was performed after subperiosteal dissection and retraction of the ipsilateral paravertebral muscles. The herniated disk was removed by the unilateral transflaval approach with the aid of a headlight loupe or microscope magnification, depending on the surgeon's preference. In case of tubular diskectomy, the skin was retracted laterally, and the guidewire and sequential dilators (METRx, Medtronic) were placed at the inferior margin of the lamina under fluoroscopic control. A 14- to 18-mm working channel was introduced over the final dilator and attached to the table. The herniated disk was removed through the tubular retractor with microscopic magnification. For blinding purposes, an equally small midline incision was made in both procedures (25-30 mm), and patients and researchers were kept blinded to the allocated treatment during the follow-up period of 1 year.

Utilities and QALYs

Utilities represent the valuation of the quality of life of the patients on a scale from 0 (as bad as death) to 1 (perfect health). Patients described their quality of life using the EuroQol classification system (EQ-5D), from which we calculated utilities for the United States and the Netherlands.[11,12] Similarly, patients reported their quality of life using the SF-36, from which we calculated the SF-6D utilities.[13] Both EQ-5D and SF-6D provide societal valuation, which is preferred for economic evaluations from the societal perspective. We also obtained valuations by the patients themselves using the Visual Analog Scale (VAS), ranging from 0 (worst imaginable health) to 100 (perfect health). We transformed the values to a utility scale[14] using the power transformation $1 - (1 - VAS/100)^{1.61}$.

We obtained measurements for EQ-5D and VAS at intake, randomization, and 2, 4, 6, 8, 12, 26, 38, and 52 weeks after randomization. SF-36 measurements were obtained less often: at intake and 4, 8, 26, and 52 weeks after randomization. For the EQ-5D, SF-36, and VAS measurements, 6%, 6%, and 8%, respectively, of the items were missing. From the area under the utility curves, we calculated the average utility during each separate quarter of the year after randomization and during the entire year (QALYs).

Costs

We estimated the costs from the societal perspective during a follow-up period of 1 year. Because of the 1-year time horizon, costs were not discounted. Costs were converted into 2008 price levels by use of the general Dutch consumer price index.[15] Costs were translated from Euros into US dollars by use of the purchasing power parity (0.873).[16]

Using cost diaries, patients reported admissions to hospital, visits (specialists, general practitioner, physical therapy, and alternative health care), home care, paid domestic help, informal care, drugs and aids, and out-of-pocket expenses as result of sciatica, as well as hours of absenteeism from work.

At the follow-up examinations by the research nurse at 4, 8, 26, and 52 weeks after randomization, the research nurse collected and went through the diary with the patient. All patients completed the first diary. Of the following diaries, 4%, 5%, and 10%, respectively, were missing.

A microcost approach was used to estimate the cost of the 2 surgical procedures. The costs of the operating room (staff, operating room, equipment, and overhead), specific operating equipment, and consumables were considered. Costs of anesthesia and use of awakening room use were assumed to be equal for both procedures and therefore omitted. To calculate the cost of operating room, the time of surgery was registered for each patient. Cost for 1-minute use of the operating room was obtained from each participating hospital. The mean cost per minute of US $15 was increased by the personnel costs of 1 neurosurgeon and 1 anesthetist (US $4.04).[17] Costs of specific operating equipment of US $20 and US $6 for tubular diskectomy and conventional microdiskectomy, respectively, were calculated on the basis of initial purchasing prices of the instruments, their yearly use and depreciation, and maintenance and interest costs. Costs of disposables amount to US $111 and US $85 per surgery for tubular diskectomy and conventional microdiskectomy, respectively.

For other healthcare resources, we used Dutch standard prices designed to represent societal costs and to standardize economic evaluations.[17,18] Healthcare costs are reported, including the patients' time and travel costs.

We valued the reported hours of absenteeism from work during the first year follow-up period according to the friction cost method using a friction period of 22 weeks[17] at standard productivity costs of US $38 per hour for women and US $48 per hour for men.

Analysis

All analyses followed the intention-to-treat principle. All statistical analyses were conducted with Stata 9.2 (Stata Corp, College Station, Texas).

To reduce possible bias caused by missing data, we used multiple imputation by chained equations, with 5 iterations for the switching regression model.[19] For each missing utility measure or cost measure, an imputation regression model was used that included age, sex, body mass index, randomization group, patient's reported functional disability measured by the modified Roland Disability Questionnaire for Sciatica,[20] VAS for leg pain and back pain, duration of complaints, and all (other) utility measures and costs measures at all moments. Group differences in QALYs and costs were statistically analyzed with a standard *t* test for unequal variance.

Base-case cost utility analysis compared societal costs at 1 year and QALYs at 1 year on the basis of the US EQ-5D. Sensitivity analyses were carried out on the use of different utility measures (Dutch EQ-5D, SF-6D, or VAS) and on the perspective (societal or healthcare perspective).

Depending on the willingness to pay for obtained effectiveness, a strategy is cost-effective compared with an alternative strategy if it has a better net benefit (willingness to pay × QALYs − costs). Given the statistical uncertainty of differences between costs and QALYs, cost-effectiveness acceptability curves graph the probability that a strategy is cost-effective as a function of willingness to pay, ie, $CEA(WTP) = \Phi(NB(WTP)/S_{NB})$, where WTP is the willingness to pay for a QALY and NB is net benefit.[21]

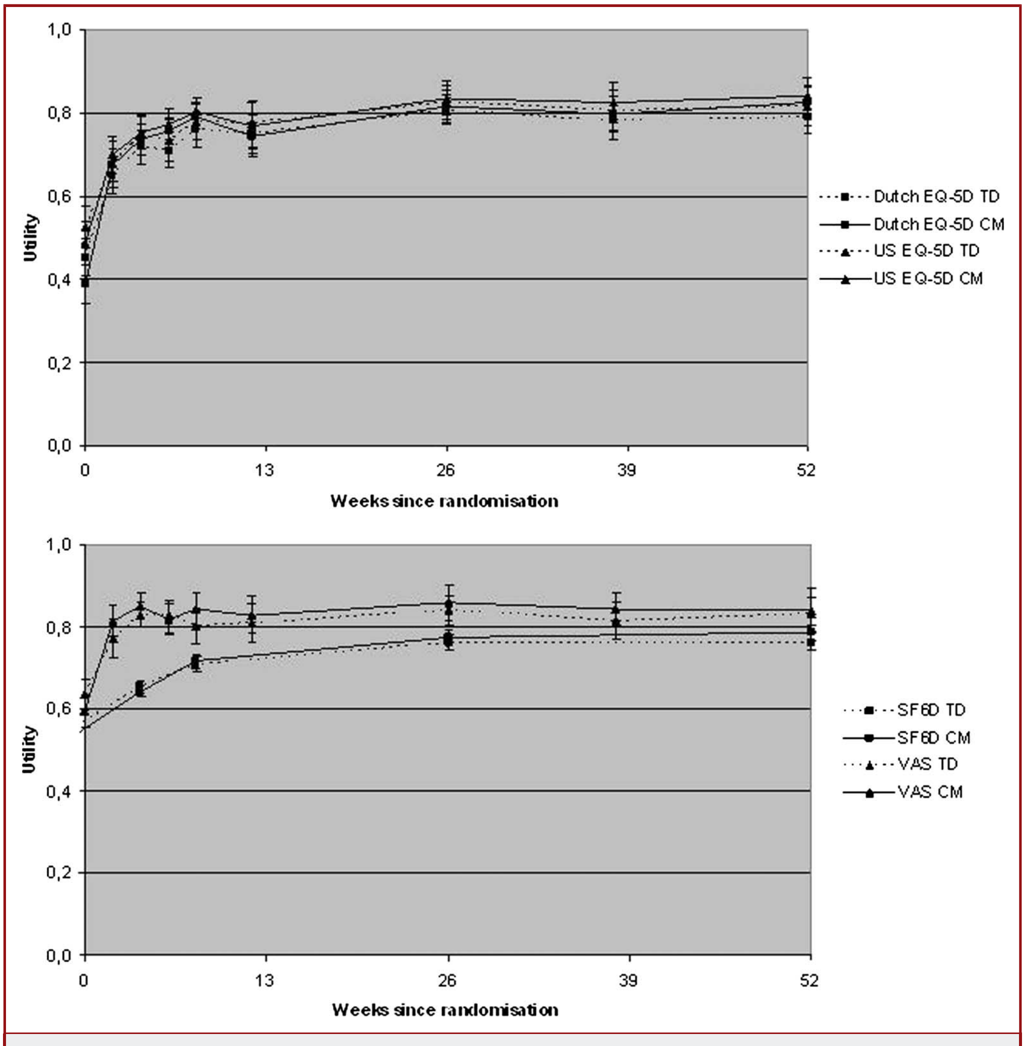

FIGURE 1. *Utilities according to US and Dutch EQ-5D, SF-6D, and Visual Analog Scale (VAS) after tubular diskectomy (TD) and conventional microdiskectomy (CM).*

RESULTS

Utilities and QALYs

The valuation of quality of life measured by the different utility measures (EQ-5D, SF-6D, and VAS) was consistently similar for patients who underwent conventional microdiskectomy and patients who underwent tubular diskectomy (Figure 1).

The QALYs during all 4 quarters and according to all utility measures were also not statistically different between both groups (Table 1). The difference in QALYs according to the US EQ-5D was −0.012 (95% confidence interval, −0.046 to 0.021); for the Dutch EQ-5D, −0.014 (95% confidence interval, −0.056 to 0.029); for the SF-6D, −0.11 (95% confidence interval, −0.037 to 0.014); and for the VAS, −0.021 (95% confidence interval, −0.058 to 0.016).

Healthcare Costs

The average costs of initial surgery, including the initial hospital admission, were US $226 (95% confidence interval, 43 to 409) higher per patient for tubular diskectomy compared with conventional microdiskectomy (see Table 1, Supplemental Content 1, http://links.lww.com/NEU/A397, for a detailed overview of costs of tubular diskectomy and conventional microdiskectomy per patient). Because of a lower reoperation rate after conventional microdiskectomy, the average costs of reoperation per patient were lower (US $27), although not significantly (95% confidence interval, −208 to 263). Combined with other hospital costs (other hospital admissions and specialist contacts) and healthcare costs outside the hospital (physiotherapy, general practitioner care, alternative care, home care, drugs, and aids), a nonsignificant difference of US $460 (95% confidence interval, −243 to 1163) was found for the total healthcare costs with higher costs for tubular diskectomy (Table 2).

Societal Costs

In the nonhealthcare costs, consisting mainly of productivity costs but also including domestic help, informal care, and out-of-pocket expenses, no significant differences were found. The total nonhealthcare costs after tubular diskectomy were higher than after conventional microdiskectomy with a nonsignificant difference of US $1032 (95% confidence interval, −1494 to 3557). Because the societal cost is the sum of the healthcare and nonhealthcare costs, these costs also showed a nonsignificant difference (US $1491; 95% confidence interval, −1335 to 4318) in favor of conventional microdiskectomy.

TABLE 1. Utility and Quality of Life Years After Tubular Diskectomy and Conventional Microdiskectomy[a]

Measure	Tubular Microdiskectomy (n = 166)	Conventional Microdiskectomy (n = 159)	Difference	P^b
US EQ-5D				
First quarter	0.730	0.742	−0.012	
Second quarter	0.801	0.804	−0.003	
Third quarter	0.816	0.829	−0.014	
Fourth quarter	0.812	0.834	−0.022	
QALYs	0.790 (0.16)	0.802 (0.15)	−0.012	.47
NL EQ-5D				
First quarter	0.702	0.718	−0.016	
Second quarter	0.781	0.782	−0.001	
Third quarter	0.794	0.805	−0.012	
Fourth quarter	0.787	0.813	−0.026	
QALYs	0.766 (0.20)	0.779 (0.19)	−0.014	.53
SF-6D				
First quarter	0.680	0.680	−0.000	
Second quarter	0.754	0.766	−0.012	
Third quarter	0.762	0.776	−0.015	
Fourth quarter	0.762	0.782	−0.020	
QALYs	0.739 (0.10)	0.751 (0.11)	−0.011	.37
Visual Analog Scale				
First quarter	0.790	0.811	−0.022	
Second quarter	0.824	0.844	−0.020	
Third quarter	0.825	0.849	−0.024	
Fourth quarter	0.823	0.840	−0.018	
QALYs	0.815 (0.16)	0.836 (0.15)	−0.021	.26

[a]QALY, quality-adjusted life-year. Values are means (standard deviations).
[b]*t* test for unequal variance.

TABLE 2. Mean Healthcare Costs and Societal Cost Per Patient After Tubular Diskectomy and Conventional Microdiskectomy During the First Year[a]

	Tubular Diskectomy (n = 166)		Conventional Microdiskectomy (n = 159)		Difference	
	Volume	Costs, US $	Volume	Costs, US $	Costs, US $	P[b]
Surgery						
Surgery, with admission to hospital		2908 (877)		2682 (805)	226	.02
Repeat surgery	10	312 (968)	7	284 (1179)	27	.82
Postsurgery hospital costs						
Other admissions to hospital	18	190	16	221	−32	.82
Neurologist[c]	0.4	61	0.2	24	37	.06
Neurosurgeon[c]	1.5	179	1.2	148	27	.24
Other specialists	66	274	60	188	86	.06
Other healthcare costs						
Physical therapy						
First quarter	95	560	90	562	−3	
Second quarter	61	324	55	352	−29	
Third quarter	54	228	43	177	51	
Fourth quarter	47	231	33	166	64	
Total physical therapy costs (SD)	95	1342 (1335)	91	1258 (1349)	84	.61
General practitioner[c]	2.5	78	2.5	72	−6	.81
Alternative care	17	64	17	43	11	.64
Home care[d]	0.3	6	0.1	3	4	.39
Drugs	71	70	64	77	7	.84
Aids	24	56	27	69	−13	.61
Total healthcare costs (SD)		5529 (3020)		5070 (3375)	460	.20
Nonhealthcare costs						
Paid domestic help[d]	9	177	3.1	83	94	.24
Informal care[d]	25	289	32	375	−86	.43
Out of pocket expenses	19	157	19	194	−37	.79
Productivity costs (friction costs)						
First quarter	137	6067	145	6449	−382	
Second quarter	54	2377	48	2146	231	
Third quarter	31	1381	16	700	681	
Fourth quarter	20	880	8	351	529	
Total productivity costs (SD)	243	10 705 (11068)	217	9646 (10131)	1060	.38
Total nonhealthcare costs (SD)		11 329 (11390)		10 297 (10740)	1032	.42
Total societal costs						
First quarter		10 355		10 384	−25	
Second quarter		2983		2808	153	
Third quarter		2025		1301	632	
Fourth quarter		1494		874	541	
Total societal costs (SD)		16 858 (12 759)		15 367 (12 165)	1302	.30

[a]Volumes are percentages of patients who made costs for that item unless stated otherwise.
[b]*t* test for unequal variance corrected for nonresponse with multiple imputation.
[c]Number of visits.
[d]Number of hours.

Cost Utility Analysis

Although no statistically significant differences were found in societal costs and QALYs between tubular diskectomy and conventional microdiskectomy over the first year, the estimated nonsignificant differences in costs and QALYs were all in favor of conventional microdiskectomy. This results in a low probability that tubular diskectomy is more cost-effective than conventional microdiskectomy. For varying levels of the willingness-to-pay threshold, the probability that tubular microdiskectomy is more cost-effective is relatively stable between 15% and 22% (Figure 2). With other utility measures, the probability of being cost-effective remains in favor of conventional microdiskectomy. In addition, from the healthcare perspective, tubular diskectomy is not preferred over conventional microdiskectomy (Figure 2).

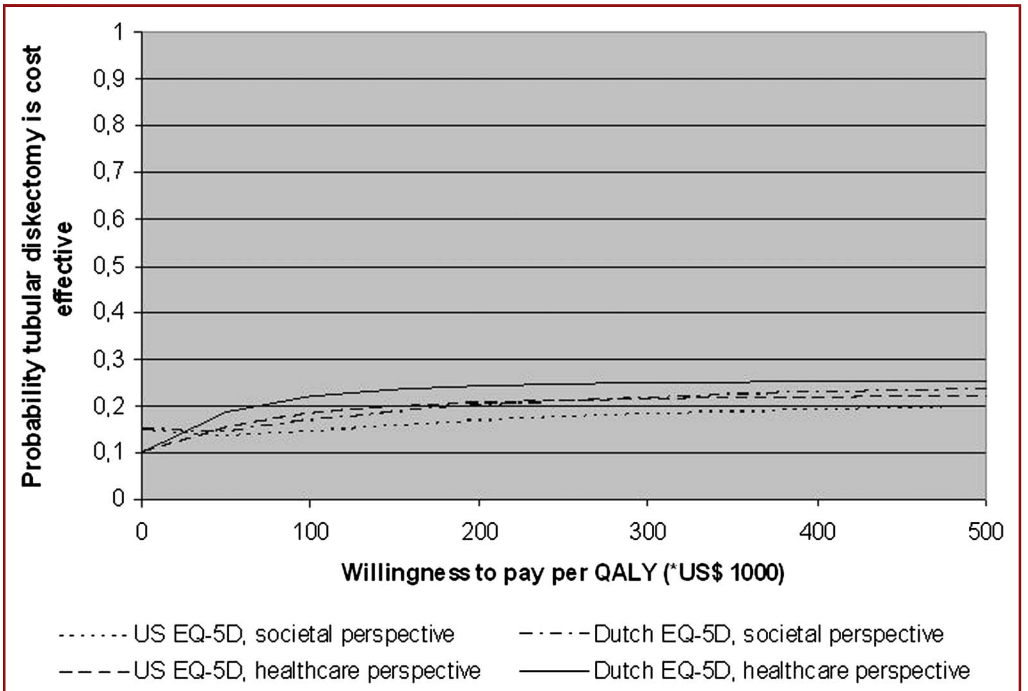

FIGURE 2. *Cost-effectiveness acceptability curves for tubular diskectomy compared with conventional microdiskectomy. QALY, quality-adjusted life-year.*

DISCUSSION

The present double-blind randomized controlled trial of patients with herniated disk–related sciatica compared tubular diskectomy with conventional microdiskectomy.[2-4] The trial showed similar rates of recovery and functional outcome, although patients treated with tubular diskectomy had less favorable results of leg pain and back pain during the first 2 years after surgery.[4]

In the economic evaluation, we studied whether, given this similar effectiveness, a favorable cost utility of tubular diskectomy was attained. The expected reduction in postoperative back pain, faster mobilization, and quicker resumption of daily activities with consequent faster rate of recovery after tubular diskectomy were not reflected by the utility measures; the utility measures reported are similar for both groups. The difference in mean healthcare costs was estimated at US $460, at a disadvantage for tubular diskectomy. This nonsignificant difference consisted mostly of the difference in surgery costs, including tubular retractors, instruments, and surgery time. The assumed faster resumption of daily activities beforehand was reflected by a lower absenteeism in the first quarter in the tubular diskectomy group. However, after this initial lower absenteeism after tubular diskectomy, the difference in absenteeism during the rest of the year was in favor of conventional microdiskectomy, most likely related to the patients' perceived recovery. As a result, the nonhealthcare costs are also higher after tubular diskectomy (US $1032). In addition, the difference in societal costs, which are the sum of healthcare and nonhealthcare costs, of US $1491 is also not statistically significant. However, the nonsignificant differences in QALYs and costs in favor of conventional microdiskectomy result in the conclusion that tubular microdiskectomy is unlikely to be cost-effective compared with conventional microdiskectomy, regardless of the economic threshold per QALY.

The study has several limitations. First, other settings may differ from the 7 general hospitals in the Dutch setting included in this study. Translating the results to other settings should be done with caution. Second, the duration of the economic evaluation is limited to 1 year. The differences between both treatment groups in utility, as measured by the EQ-5D and SF-6D, and in costs of physical therapy and productivity seem to increase during the year. However, additional linear regression analyses of these variables against time (in quarters) and treatment group show no systematic trend in the difference between both treatment groups. Therefore, we expect that a longer follow-up will not alter our conclusions. Furthermore, a longer time horizon would have reduced the statistical power, and the clinical evaluation showed no differences beyond the first years.[3,4]

In this study, we used costs of surgery instead of hospital prices. In the Dutch funding system, individual hospitals set diagnosis-treatment prices for lumbar disk surgery to facilitate competition and price containment. However, prices do not bear a consistent relation to costs. Surgery may be profitable (prices greater than costs) or subsidized by other services (prices less than costs).

Using the average hospital prices of the participating hospitals for both treatments resulted in a larger difference in mean surgery costs between the 2 treatments of US $892, with tubular diskectomy the more expensive treatment. So, regardless of the use of costs or prices, the conclusion holds that tubular diskectomy is not likely to be cost-effective compared with conventional microdiskectomy.

Disclosure

This study was funded by the Dutch Health Care Insurance Board. Trial registration information—URL: www.isrctn.org. Identifier: ISRCTN51857546. The authors have no personal financial or institutional interest in any of the drugs, materials, or devices described in this article.

REFERENCES

1. Arts MP, Peul WC, Koes BW, Thomeer RT. Management of sciatica due to lumbar disc herniation in the Netherlands: a survey among spine surgeons. *J Neurosurg Spine*. 2008;9(1):32-39.
2. Arts MP, Peul WC, Brand R, Koes BW, Thomeer RT. Cost-effectiveness of microendoscopic discectomy versus conventional open discectomy in the treatment of lumbar disc herniation: a prospective randomised controlled trial [ISRCTN 51857546]. *BMC Musculoskelet Disord*. 2006;7(1):42.
3. Arts MP, Brand R, van den Akker ME, Koes BW, Bartels RH, Peul WC. Tubular diskectomy vs conventional microdiskectomy for sciatica: a randomized controlled trial. *JAMA*. 2009;302(2):149-158.
4. Arts MP, Brand R, van den Akker ME, et al. Tubular discectomy versus conventional microdiscectomy for the treatment of lumbar disc herniation: two year results of a double-blinded randomised controlled trial [published online ahead of print February 26, 2011]. *Neurosurgery*. doi: 10.1227/NEU.0b013e318214a98c.
5. Huang TJ, Hsu RW, Li YY, Cheng CC. Less systemic cytokine response in patients following microendoscopic versus open lumbar discectomy. *J Orthop Res*. 2005;23(2):406-411.
6. Sasaoka R, Nakamura H, Konishi S, et al. Objective assessment of reduced invasiveness in MED compared with conventional one-level laminotomy. *Eur Spine J*. 2006;15(5):577-582.
7. Righesso O, Falavigna A, Avanzi O. Comparison of open discectomy with microendoscopic discectomy in lumbar disc herniations: results of a randomized controlled trial. *Neurosurgery*. 2007;61(3):545-549.
8. Ryang YM, Oertel MF, Mayfrank L, Gilsbach JM, Rohde V. Standard open microdiscectomy versus minimal access trocar microdiscectomy: results of a prospective randomized study. *Neurosurgery*. 2008;62(1):174-181.
9. Brock M, Kunkel P, Papavero L. Lumbar microdiscectomy: subperiosteal versus transmuscular approach and influence on the early postoperative analgesic consumption. *Eur Spine J*. 2008;17(4):518-522.
10. Patrick DL, Deyo RA, Atlas SJ, Singer DE, Chapin A, Keller RB. Assessing health-related quality of life in patients with sciatica. *Spine*. 1995;20(17):1899-1908.
11. Lamers LM, Stalmeier PF, McDonnell J, Krabbe PF, van Busschbach JJ. Measuring the quality of life in economic evaluations: the Dutch EQ-5D tariff [in Dutch]. *Ned Tijdschr Geneeskd*. 2005;149(28):1574-1578.
12. Dolan P. Modeling valuations for EuroQol health states. *Med Care*. 1997;35(11):1095-1108.
13. Brazier JE, Roberts J. The estimation of a preference-based measure of health from the SF-12. *Med Care*. 2004;42(9):851-859.
14. Stiggelbout AM, Eijkemans MJ, Kiebert GM, Kievit J, Leer JW, De Haes HJ. The "utility" of the visual analog scale in medical decision making and technology assessment: is it an alternative to the time trade-off? *Int J Technol Assess Health Care*. Spring. 1996;12(2):291-298.
15. Statistic Netherlands. Consumer price index. July 17, 2008. Available at: www.cbs.nl.
16. Organisation for Economic Co-operation and Development. *Purchasing Power Parities*. Available at: http//www.oecd.org. Accessed September 23, 2010.
17. Oostenbrink JB, Koopmanschap MA, Rutten FF. Standardisation of costs: the Dutch Manual for Costing in economic evaluations. *Pharmacoeconomics*. 2002;20(7):443-454.
18. Dutch Health Insurance Executive Board. *Pharmacotherapeutic compass [In Dutch]*. Amstelveen, the Netherlands: Health Insurance Board, 2008.
19. van Buuren S, Boshuizen HC, Knook DL. Multiple imputation of missing blood pressure covariates in survival analysis. *Stat Med*. 1999;18(6):681-694.
20. Gommans IHB, Koes BW, Tulder MW van. Validity and responsiveness of the Dutch Roland Disability Questionnaire [In Dutch]. *Ned Tijdschr Fysiother*. 1997;107:28-33.
21. Zethraeus N, Johannesson M, Jonsson B, Lothgren M, Tambour M. Advantages of using the net-benefit approach for analysing uncertainty in economic evaluation studies. *Pharmacoeconomics*. 2003;21(1):39-48.

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COMMENTS

Whereas minimal-access spine surgery as a potential less invasive alternative to standard macrosurgical and microsurgical approaches is gaining increasing importance in the treatment of lumbar disk disease,[1] data are lacking on whether spine surgery by a less invasive access is more cost-effective than conventional microdiskectomy. Therefore, Dr van den Akker and colleagues have conducted a multicenter trial on 325 patients with symptomatic lumbar disk herniation to analyze and compare cost utility between 2 different surgical approaches using either a so-called minimally invasive tubular system or a conventional retractor system. The authors reported on the same patient cohort and expanded the results of their previously published articles.[2-4] In contrast to existing studies primarily comparing clinical data and outcome of standard open microdiskectomy and minimal-access tubular or trocar microdiskectomy,[1-4] the novel aspects of the present work lie particularly in the determination and comparison of costs and utility using these different operative techniques by cost utility analysis alongside the randomized controlled trial. Surprisingly, compared with patients treated with conventional diskectomy, patients treated with tubular diskectomy showed similar rates of recovery and functional outcome in the clinical evaluation[1-4] and nonsignificant differences in healthcare and societal costs in the economic analysis even in favor of conventional microdiskectomy. A salient strength of the present study is its prospective double-blind randomized controlled character, the strict inclusion and exclusion criteria, the extensively analyzed data, and the large series of patients with comparable baseline characteristics. However, corresponding to the multicenter character of the study, various surgeons at 7 hospitals, possibly with different surgical expertise and skills, have performed the interventions, which might bias the data. The fact that the tubular diskectomy technique is known to be associated with a steep learning curve and to be more demanding for the surgeon than standard microdiskectomy for herniated disk[1] might also have influenced the study results. In addition, although a longer time horizon would have reduced the statistical power and the clinical evaluation showed no differences beyond the first year as summarized by van den Akker et al, the relatively short follow-up interval of 12 months makes definite conclusions difficult. Especially for the determination of recurrences and postoperative development of symptomatic epidural adhesions and scar tissue formation with its potentially associated economic impact, an extended follow-up interval would be desirable. Finally, as mentioned by the authors themselves, the present study is based on a Dutch patient cohort, and generalizing or translating the results of the study to other settings should be done with caution.

Despite these limitations, the present article is an important and well-done addition to the field of spine surgery and economical management of lumbar disk disease.

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1. Ryang YM, Oertel MF, Mayfrank L, Gilsbach JM, Rohde V. Standard open microdiscectomy versus minimal access trocar microdiscectomy: results of a prospective randomized study. *Neurosurgery*. 2008;62(1):174-182.
2. Arts MP, Brand R, van den Akker ME, et al. Tubular discectomy versus conventional microdiscectomy for the treatment of lumbar disc herniation: two-year results of a double-blind randomised controlled trial [published online ahead of print February 26, 2011]. *Neurosurgery*. doi: 10.1227/NEU.0b013e318214a98c.
3. Arts MP, Brand R, van den Akker ME, et al. Tubular diskectomy vs conventional microdiskectomy for sciatica: a randomized controlled trial. *JAMA*. 2009;302(2):149-158.
4. Arts MP, Peul WC, Brand R, Koes BW, Thomeer RT. Cost-effectiveness of microendoscopic discectomy versus conventional open discectomy in the treatment of lumbar disc herniation: a prospective randomised controlled trial [ISRCTN51857546]. *BMC Musculoskelet Disord*. 2006;7:42.

Van den Akker et al present the results of an economic evaluation of tubular diskectomy vs conventional microdiskectomy for sciatica that was conducted in parallel to a randomized trial. The primary analysis of the randomized trial demonstrated that tubular diskectomy was not associated with any significant improvement in the Roland-Morris Disability Questionnaire score compared with conventional microdiskectomy, with secondary analyses showing that tubular diskectomy was associated with poorer patient self-reported leg pain, back pain, and recovery.[1] The present study adds to these findings by revealing no significant difference in quality-of-life outcome or costs between these 2 procedures at 1 year. Methodologically, this is a very high-quality study, and the authors are to be congratulated for this. Given the results of the original randomized trial, the present results are not surprising, but they do add a further dimension to the interpretation of their overall findings. The main limitations of this study have been acknowledged: The follow-up is relatively short and, importantly, their study reflects the costs incurred in a specific setting (7 general hospitals in the Netherlands) and using standard Dutch cost estimates. Therefore, this study will have less applicability in settings where individual costs might be relatively different from those used in the study. Nevertheless, this is an important and high-quality addition to the literature.

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1. Arts MP, Brand R, van den Akker ME, et al. Tubular diskectomy vs conventional microdiskectomy for sciatica: a randomized controlled trial. *JAMA*. 2009;302(2):149-158.