Use of a tubular retractor system in microscopic lumbar discectomy: 1 year prospective results in 135 patients

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Object. Application of minimally invasive techniques to lumbar disc surgery has led to the development of the Microscopic Endoscopic Tubular Retractor System (METRx-MD). A prospective evaluation of results and complications was undertaken.

Methods. One hundred thirty-five patients underwent surgery in which the METRx-MD system was used; most procedures were performed on an outpatient basis, and general anesthesia was induced in all cases. All patients were followed prospectively. Outcomes were measured using a visual analog scale (VAS), the Oswestry Disability Index (ODI), and the Short Form-36 (SF-36) questionnaires. Follow-up data were collected by an outside company, which also tabulated the data.

Data were collected in 129 of 135 patients. Improvement was seen on the VAS (Scores 7–2), ODI (Scores 57–16), and SF-36 scales (bodily pain Scores 20–60). Patient satisfaction with results was 94% and with office services 88%. Thirty-six percent of patients returned to work at 0 to 2 weeks, 38% at 3 to 5 weeks, and 25% at 5 to 26 weeks. Hospital charges decreased by \$2395 (18%).

The mean operative time was 66 minutes, and the mean blood loss was 22 ml. Complications included one superficial wound infection, one discitis, three durotomies, and three cases of excessive bleeding (> 100 ml). There were five reoperations: four for recurrent disc herniations, (two ipsilateral and two contralateral to the index site) and one for spinal stenosis contralateral to the index site.

Conclusions. Minimally invasive surgery in which the METRx-MD system is used is clinically effective and cost effective. Patient satisfaction was high. A mean per case cost savings of \$2395 was realized. Complications rates were comparable with those associated with traditional microdiscectomy procedures.

KEY WORDS • lumbar herniated disc • microdiscectomy • minimally invasive surgery • outpatient surgery • operative microscope

Low-back pain is a serious public health problem resulting in estimated direct and indirect costs of up to \$3 billion.⁹ It is often the result of lumbar disc disease.^{13,14} The natural history of herniated lumbar discs is one of spontaneous regression.¹⁹ A variety of modalities have been shown to be effective in the conservative management of acute low-back pain.²¹ Weber²² has shown that surgery yielded better results than conservative care at 1 year posttreatment but that after 4 years this difference was no longer statistically significant. Nonetheless, 185,000 patients underwent surgical intervention in 1990 in the United States, and the rate escalated 40% between 1979 and 1990.⁴

In 1934, Mixter and Barr¹² first reported the surgical treatment of patients with lumbar herniated discs by undertaking laminectomy and discectomy. Caspar² in 1977 and Williams²³ in 1978 reported refinements in approach

with the use of a microsurgical technique. Increasingly, minimally invasive techniques have been applied to spinal surgery,^{11,16,20} many of which have suffered from the inability to allow direct visualization of the pathological entity and the neural elements, thereby limiting their application and effectiveness. In 1997, Foley and Smith⁸ introduced MED. The original MED instrumentation set was modified to improve compatibility with the operative microscope with the METRx-MD system (Medtronic Sofamor Danek, Memphis, TN).

CLINICAL MATERIAL AND METHODS

The procedure involving placement of the METRx-MD system is similar to the MED that has been previously described in detail.^{5,8} Briefly, a paramedian muscle-splitting approach is facilitated by dilation of the paraspinous muscles with sequential dilators (Fig. 1). Visualization is then achieved using tubular retractors of various diameters and lengths. Special instruments, which have been optimized for use with the tubular retractors and the microscope, mirror those instruments commonly used for microdiscectomy. The major difference between METRx-

Abbreviations used in this paper: LOS = length of hospital stay; MED = microendoscopic discectomy; METRx-MD = Microscope Endoscopic Tubular Retractor System–Microdiscectomy; ODI = Oswestry Disability Index; SF-36 = Short Form–36; VAS = visual analog scale.

Fig. 1. Paramedian muscle splitting approach with tubular retractor in place. Figure reproduced with permission of Medtronic Sofamor Danek.

MD and MED is the use of the microscope, in the former, and the endoscope, in the latter, for intraoperative visualization.

Microendoscopic discectomy involving the METRx-MD system was performed in 135 consecutive patients for lumbar herniated nucleus pulposi. During the study period, all elective surgeries performed by the author for virgin herniated nucleus pulposi were conducted using this method. All operations were planned as outpatient procedures involving the induction of general anesthesia. Preoperatively patients received dexamethasone (20 mg) and antibiotic agents. The microscope was used with a prototype METRx instrument set, until the availability of the production set. All procedures were performed with patients in the prone position, positioned on a Wilson frame. At the conclusion of the procedure 80 mg Depomedrol was injected epidurally at the operative site unless a durotomy had occurred. Bupivacaine 0.25% with 1:200,000 epinephrine (10 ml) was infiltrated into the local tissues. The incision was closed in layers by using Vicryl (Johnson & Johnson/Ethicon, Somerville, NJ) followed by Steri-strips (3M Corporation, St. Paul, MN) and a bioocclusive dressing or, more recently, Dermabond (Johnson & Johnson) on the skin edge. The patients were encouraged to use ice postoperatively and were given only oral analgesic medication (usually hydrocodone). They were observed in the outpatient center and discharged to home after they were ambulatory and had voided.

All patients completed a consent form, Patient Questionnaire-A form, and an SF-36 form prior to surgery. Office follow-up visits were conducted at 2 weeks, 6 weeks, and 3 months. Office follow up was extended when clinically indicated. Patients received questionnaires by mail from PhDx Systems, Inc. (Albuquerque, NM), at 6 weeks, 6 months, and 1 year postoperatively. Materials included a follow-up Patient Questionnaire-B form and an SF-36 form. Individuals at PhDx Systems tabulated the data, and the results were mailed to the operating surgeon quarterly. The data presented at this time are those obtained by the author at 1 year follow up and constitute his experience as part of an ongoing 12-site cooperative study.

RESULTS

One hundred thirty-five consecutive patients underwent discectomies involving placement of the METRx-MD system. Data were collected in 129 (96%) of these patients. There were equal numbers of male and female patients, whose mean age was 42 years. Nonsmokers comprised 88% of the group. Workers' compensation was being received by 9%, and 5% were involved in liability cases. Four patients suffered significant comorbid medical conditions. The mean length of symptoms prior to surgery was 25.5 weeks. Conservative care included pain management in 78%, bedrest in 67%, physical therapy in 51%, epidural steroid therapy in 46%, and chiropractic care in 32%.

The disc herniation was contained in 56% and extruded in 44% of cases. Disc sizes ranged from 5 to 30 mm (Fig. 2). The most common location of the herniation was at the level of the intervertebral disc space; however, several large cephalad and caudally migrated fragments were removed. The caudally located fragments were often found in the axilla of the nerve root. The mean operative time was 66 minutes, and the mean blood loss was 22 ml. Intraoperative complications included three durotomies that were not primarily repaired but covered with gelfoam. These patients were not given epidural steroid agents and were admitted for 48 hours of bedrest. No delayed cerebrospinal fluid leaks or pseudomenigeoceles developed. Excessive bleeding, arbitrarily defined as greater than 100 ml, occurred in three patients.

Postoperative complications included one case of superficial wound infection, which resolved after local wound care and oral antibiotic therapy, and one case of discitis in which the patient presented with increasing back pain and required readmission; the latter resolved after a course of antibiotic therapy. Four patients required reoperation for recurrent disc herniations (the first underwent standard microdiscectomy and the last three underwent surgery involving the METRx-MD system). Two of the reherniations occurred at the same level and on the same side, and two occurred at the same level but on the contralateral

Fig. 2. Pre-and postoperative sagittal and axial magnetic resonance images of L5-S1 herniated nucleus pulposus. Figure reproduced with permission of Medtronic Sofamor Danek.

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side. One patient required reoperation for a contralateral spinal stenosis causing new contralateral pain. No neural injuries occurred.

The surgeon recorded data concerning the presence of back pain, radicular pain, motor deficit, reflex deficit, sensory deficit, and bowel/bladder dysfunction preoperatively and at the 2-, 6-, and 12-week office visits. Back pain was present in 99% of patients preoperatively and in 62% at 12 weeks postoperatively; radicular pain in 99 and 37%, respectively; motor deficit in 65 and 16%, respectively; reflex deficit in 48 and 33%, respectively; and sensory deficit in 54 and 20%, respectively. Preoperatively bowel/bladder dysfunction was demonstrated in two patients, in both of whom, it resolved by the 2-week visit. Back pain at the 12-week follow-up visit was improved in 97%, worsened in 1%, and unchanged in 2%; radicular pain at 12 weeks was improved in 98%, worsened in 1%, and unchanged in 1%; and sensory deficit at 12 weeks was improved in 99% and unchanged in 1%.

The patients reported results to PhDx by mail surveys at 6 weeks, 6 months, and 1 year postoperatively. With regard to back pain, the mean pain discomfort scores measured on a VAS at 0, 7, 42, 182, and 365 days postoperatively were 6.2 (125 cases), 1.5 (46 cases), 2.1 (90 cases), 2.3 (84 cases), and 2.2 (72 cases), respectively. With regard to leg pain, the mean VAS pain scores were 7.3 (125 cases), 1.4 (51 cases), 1.9 (96 cases), 1.5 (84 cases), and 1.9 (73 cases), respectively. The ODI scores recorded during the same intervals for back pain were 53.8 (127 cases), 13.1 (51 cases), 19.3 (95 cases), 19.0 (87 cases), and 19.4 (73 cases), respectively; for leg pain they were 60.6 (124 cases), 12.8 (51 cases), 16 (95 cases), 13.4 (86 cases), and 13.3 (74 cases), respectively. The SF-36 physical health component subscale scores at 0, 42, 182, and 365 days postoperatively were 28.2 (123 cases), 39.6 (96 cases), 45.6 (84 cases), and 45.4 (73 cases), respectively. The SF-36 role limitations—physical subscale scores at the same intervals were 5.8 (125 cases), 32.2 (97 cases), 64.9 (87 cases), and 65.2 (74 cases), respectively. The SF-36 mental health component subscale scores at the same intervals were 46.2 (123 cases), 53 (96 cases), 54.0 (84 cases), and 53.2 (73 cases), respectively.

Patient satisfaction with physician, hospital, and office services, as reported to PhDx, was scored on a scale from 0 to 100 (with 0 being poor to 100 being excellent). Satisfaction with services ranged from 93.4 to 76.9 (mean 88.3). Patient satisfaction with results at 2, 6, 26, and 52 weeks as reflected by answers to the question, "...all things considered, they would have the surgery again for the same condition," was 96.2% (52 cases), 94.9% (97 cases), 93.4% (87 cases), and 93.9% (74 cases), respectively.

Return-to-work times were tabulated for those patients who were previously employed. The percentage of patients returning to work was 48.9% (22 cases) at 1 week, 78.8% (63 cases) at 6 weeks, 94.4% (67 cases) at 6 months, and 93.1% (54 cases) at 1 year. Return-to-work time was tabulated only for those patients who supplied a valid return-to-work date. Mean return-to-work time was 32.1 days. The percentage of patients returning to work at various intervals was 8.9% in less than 1 week, 26.6% in 1 to 2 weeks, 38% in 3 to 5 weeks, 25.3% in 6 weeks to 6 months, and 1.3% in 6 months to 1 year.

Hospital charges averaged \$10,877 for METRx-MD-treated disc herniation procedures. Disc herniations treated by inpatient microdiscectomy, during the same time period, were associated with a mean hospital charge of \$13,272. The former represented a mean savings of \$2395 per case, or 18%. The mean LOS for a METRx-MD-treated patient was 1 day (1 day was arbitrarily assigned for an outpatient procedure). The mean LOS for a microdiscectomy-treated patient was 2 days. No consideration was given to charges for admission of the three patients with dural tears or readmission for patients requiring reoperation.

DISCUSSION

Minimally invasive techniques in all areas of surgery have gained momentum in recent years. Spinal surgery has been no exception. Unfortunately, minimally invasive techniques have often been equated with minimally effective procedures. The procedure involving METRx-MD instrumentation and technique is an attempt to allow for a standard familiar microsurgical discectomy to be performed using standard microsurgical techniques via a minimally invasive approach. This is in keeping with the 1986 statement on the role of microdiscectomy in relation to standard discectomy in which Hudgins wrote, "My concept of micro-lumbar discectomy is that it consists of the ability to do all the surgical maneuvers of standard partial hemilaminectomy that have stood the test of time, but through a much smaller incision."¹⁰

It is important that the complication rate associated with the METRx-MD lumbar discectomy is comparable with that in standard microdiscectomy series. In our current series there was a 0.8% wound infection rate, a 0.80% discitis rate, and a 2.33% durotomy rate. These rates compared favorably with those reported by Williams²³ (0, 0, and 0%, respectively), Ebling, et al.,⁶ (3.3, 0.8, and 3.9%, respectively), Caspar, et al.,³ (0.7, 0.7, and 6.7%, respectively), and Pappas, et al.,¹⁷ (7.2, 0.5, and 1%, respectively). Our reoperation rate was 4%. This included two reherniations at the same level and same side, two reherniations at the same level and contralateral side, and one reoperation for a contralateral spinal stenosis. The aforementioned authors reported reoperation rates of 14, 5.5, 5.7, and 3%, respectively.

The success rates are in general quite high with all surgical procedures for herniated lumbar discs.¹⁸ Williams,²³ Ebling, et al.,⁶ Caspar, et al.,³ and Findlay, et al.,⁷ have reported success rates ranging from 73 to 86%. In our series 93.9% of patients answered affirmatively to the questions, "All things considered, I would have the surgery again." The VAS scores for low-back pain decreased from a mean of 6.2 prior to surgery to 2.2 1 year after surgery. The VAS scores for leg pain decreased from 7.3 to 1.9 over the same period. The SF-36 physical health component subscale score improved from 28.2 preoperatively to 45.4 1 year postoperatively. The mean SF-36 role limitation—physical score improved from 5.8 to 65.2 during the same interval.

Another measure of success is reflected by the patient's ability to return to previous employment. Bookwalter, et al.,¹ reported that 40% of their patients returned to work in

fewer than 5 weeks. Caspar, et al.,³ reported a mean return-to-work time of 18.6 weeks, and Foley and Smith⁸ reported a mean return-to-work time of 17.6 days. Our return-to-work time of 32 days is comparable with these series.

One of the driving forces behind minimally invasive surgery is economics. Less invasiveness often equates with shorter LOS, reduced morbidity, and quicker convalescence. This should result in greater cost effectiveness. Bookwalter, et al.,¹ reported a 91% success rate at performing standard microdiscectomies on an outpatient basis. They achieved a cost savings of 27%. In 1994, Newman¹⁵ reported on 74 patients who underwent outpatient microdiscectomies. He achieved a cost savings of 31%. In comparing our series of outpatient METRx-MD-treated patients undergoing lumbar discectomies with a concurrent group treated as inpatients, the mean hospital charges decreased from \$13,272 to \$10,877, realizing a net savings of \$2395.

CONCLUSIONS

Minimally invasive surgery in which METRx-MD instrumentation is used is a clinically and cost-effective treatment for lumbar herniated discs. Results and complications were comparable with those associated with standard microdiscectomy techniques. Patient satisfaction was high (93.9%), and a mean cost savings of \$2395 was realized.

Disclosure

Sylvain Palmer, M.D., acts as a consultant for Medtronic Sofamor Danek, which provided technical and financial support.

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Manuscript received June 17, 2002.

Accepted in final form July 3, 2002.

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