Clinical Outcomes of Microendoscopic Foraminotomy and Decompression in the Cervical Spine

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Key words
- Foraminotomy
- Microendoscopic
- Microendoscopic decompression
- Microendoscopic diskectomy
- Minimally invasive surgery
- Spine surgery

Abbreviations and Acronyms
CMED: Cervical microendoscopic diskectomy
CMEF: Cervical microendoscopic foraminotomy
NDI: Neck disability index
VASA: Visual analog scale for the arm
VASN: Visual analog scale for the neck

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OBJECTIVE: **Few reports have addressed long-term outcomes, as well as the safety and efficacy of the cervical microendoscopic foraminotomy (CMEF) and cervical microendoscopic diskectomy (CMED) procedures used in modern spine practice to treat degenerative disease of the cervical spine. Accordingly, we present long-term outcomes from a cohort of patients treated for foraminal stenosis or disk herniation with the CMEF or CMED procedure, respectively.**

METHODS: **A total of 38 patients were included in the study, with a mean follow-up of 24.47 ± 12.84 months. Patients were monitored prospectively with questionnaires consisting of a visual analog scale for the neck (VASN) and arm (VASA), and a neck disability index (NDI) form. Operative time, estimated blood loss, and hospitalization stay also were collected. Data were analyzed with Microsoft Office Excel 2007.**

RESULTS: **The mean 1 year follow-up scores all showed statistically significant improvements: NDI ($P = 0.0019$), VASN ($P = 0.0017$), VASA ($P \leq 0.0001$). Similar results were seen at 2-year follow-up: NDI ($P = 0.0011$), VASN ($P = 0.0022$), and VASA ($P \leq 0.0001$); and at 3- to 6-year follow-up: NDI ($P = 0.0015$), VASN ($P = 0.0200$), and VASA ($P = 0.0034$). The average operation time, hospitalization stay, and estimated blood loss were 154.27 ± 26.79 minutes, 21.22 ± 14.23 hours, and 27.92 mL, respectively. There were no statistically significant differences when patients were compared by age (over 50 vs. under 50), operative level (above C6 vs. below C6), or sex. One complication was reported in this study consisting of duratomy, which required no further intervention.**

CONCLUSION: **Posterior CMEF and CMED are safe and effective procedures for minimally invasive decompression in the cervical spine.**

INTRODUCTION

Traditional methods for the treatment of cervical degenerative disk disease and myeloradiculopathy include both anterior and posterior approaches (6, 7, 12). Each may provide specific advantages depending upon the patient-specific pathology. The open anterior approach involves a complete diskectomy and fusion, which places a restraint on cervical spinal motion and accelerates the development of adjacent-level degenerative disease (6, 7, 13, 16, 17, 23). The open posterior approach avoids many of the complications associated with anterior access and spinal fusion; however, this technique requires extensive subperiosteal dissection of the paraspinal musculature. We believe this to be a large contributing factor to the postoperative cervical muscular pain and spasms and prolonged postoperative recovery observed with this procedure.

During the last decade, minimally invasive approaches have been developed to achieve comparable results to the more traditional procedures (10, 11, 28). Cervical microendoscopic foraminotomy (CMEF) and cervical microendoscopic diskectomy (CMED) are two minimally invasive posterior procedures developed for the treatment of foraminal stenosis and posterolateral disk herniation, respectively (10, 28). The advantage of these procedures is their ability to circumvent the requirement for anterior access to the spinal column and need for spinal fusion, while also limiting the approach-related morbidity found in the open posterior approaches. Initial studies have shown that compared with the open procedures, the minimally invasive approaches are associated with a reduction in intraoperative blood loss, tissue damage, length of hospitalization, postoperative pain, and infection rate (1, 3, 8, 9, 14, 19, 22, 24, 29, 30, 34).

In this study, we present long-term outcomes from a cohort of patients treated by a single spinal neurosurgeon (R.G.F.) who performed CMEF and CMED procedures for decompression in the cervical spine. Our results serve to supplement early initial short-term outcomes seen with these procedures and data gained from smaller cohorts of patients. The current available literature contains few significant prospective or retrospective studies evaluating the efficacy of these techniques. In this report, we seek to substantiate the efficacy and safety of these techniques as well as highlight critical attributes.

MATERIALS AND METHODS

Medical records were obtained from patients operated on for foraminal stenosis or posterolateral disk herniation in the cervical spine between October 2002 and March 2011. Cervical decompression was accomplished by the use of the CMEF or CMED procedure. All patients in this study were operated on by a single established spinal neurosurgeon (R.G.F) and were followed for an average of 24.47 ± 12.84 months (range, 8–61 months) with prospectively collected questionnaires used for data analysis. Patients were excluded from the study for having incomplete questionnaires preoperatively or lacking questionnaires from a minimum of 8 months postoperatively. Among 103 consecutively treated patients, 65 were eliminated on the basis of the exclusion criteria; 38 patients remained for the study. Data were collected from 25 patients treated with a CMEF procedure and 13 patients treated with a CMED procedure (Table 1).

The surgical indications consisted of cervical foraminal stenosis and lateralized cervical disk herniation (Table 2). Centrally located disk herniations and osteophytes were excluded from this approach, and received either anterior cervical diskectomy and fusion or anterior cervical corpectomy and fusion. See Figure 1 for an illustrative case. All patients failed to improve after receiving a minimum of 6 weeks of conservative management. Initial radiologic and clinical investigations were performed on all patients. In the clinical evaluations, their history, physical examination, and preoperative clinical questionnaires were documented. The questionnaires included a visual analog scale for their neck (VASN) and arm (VASA), and a neck disability index (NDI) form. The radiological investigations included an anteroposterior, lateral, and dynamic view X-ray imaging as well as noncontrast magnetic resonance imaging and/or computed tomography studies. Any patient demonstrating cervical instability, centrally located disk herniation, or multisegment central stenosis was declared inappropriate for this approach.

Table 1. Number of Patients Treated with the Indicated Surgical Procedure

Procedure	Number of Patients
CMEF	25
CMED	13

CMEF, cervical microendoscopic foraminotomy; CMED, cervical microendoscopic diskectomy.

Table 2. Number of Patients Treated for Each Surgical Indication

Surgical Indication	Number of Patients
Foraminal stenosis	25
Disk herniation	13

Intraoperative data were collected, including the operation time and estimated blood loss as well as time of hospitalization. Postoperatively, all patients were assessed clinically along with questionnaires, which were documented. The questionnaires used were identical to those in the preoperative evaluation and included a VASN, VASA, and NDI form. A computed tomography of the cervical spine was obtained postoperatively on all patients. All complications both intraoperatively and postoperatively were documented. In general, most patients were admitted to the hospital the day of surgery and discharged within 24 hours after their operation. Individual patient length of stay is variable depending on their degree of postoperative pain and functional dependence. Postoperative questionnaires were collected at 6 weeks, 3 months, 6 months, and annually postoperation.

The data were collected prospectively using Microsoft Office Excel 2007 and reviewed retrospectively. Data are expressed as a mean ± SD with categorical variation expressed as a percentage. A t-Test was used for statistical calculations of repeated measures using Microsoft Office Excel 2007.

Surgical Procedure

Under general endotracheal anesthesia, the patient is placed in a sitting position with a Mayfield head holder. A 2-cm stab incision is made ipsilateral at the level of the pathological lesion approximately 1 cm off midline. After confirmation of level, the skin, subcutaneous tissue, and fascia is opened in layers. Blunt dissection is performed with Metz scissors to safely delineate the cervical lateral mass before dilation. A series of dilators is then passed to separate the soft tissues in the neck followed by an 18-mm tubular retractor. The dilators are then removed and the retractor is locked in position at the junction of the lamina and lateral mass. The endoscope is then introduced to the working channel and locked in place. Bovie and/or bipolar cautery are used to remove any remaining muscle and soft tissue overlying the lateral mass and facet. After adequate visualization of the bone, a small straight curette is used to delicately detach the ligamentum flavum from the inferior edge of the lamina, and a Kerrison punch is used to begin the laminotomy.

Angled curette is then used to extend the exposure beneath the lamina and

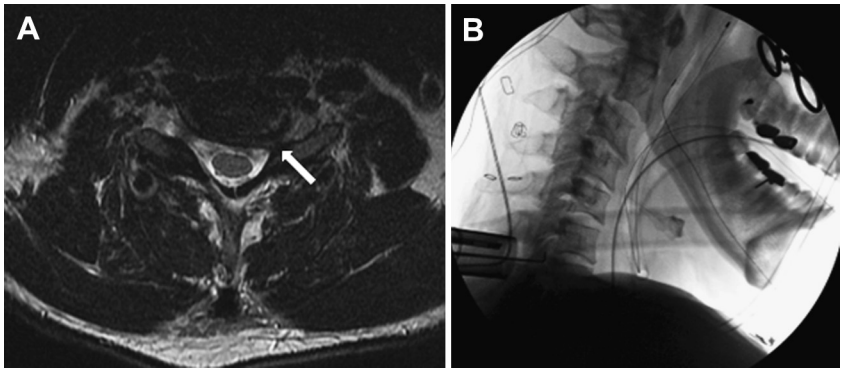

Figure 1. Example case showing a 57-year-old patient with persistent left C7 motor and sensory radiculopathy with both lateral recess and proximal foraminal stenosis secondary to a C6/C7 disk herniation as shown in (**A**; *arrow* indicates foraminal stenosis). The patient is illustrative of a typical candidate for the procedure and was successfully treated with a left-sided C6/C7 CMED. Intraoperative localization is shown in (**B**).