Endoscopic Posterior Cervical Foraminotomy as a Treatment for Osseous Foraminal Stenosis

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BACKGROUND: **Posterior cervical foraminotomy is a valuable treatment option for cervical radiculopathy. Here the authors present their technique and results in the treatment of a series of patients suffering from osseous foraminal stenosis.**

METHODS: **Forty-three patients suffering from cervical osseous foraminal stenosis were operated on via a posterior approach with the EasyGO endoscopic system. Decompression was performed in 1 segment in 31 patients, in 2 segments in 11 patients, and in 3 segments in 1 patient. Bilateral decompression was performed in 4 cases. Twenty-four (55.8%) patients had been subjected to previous spine surgery. All procedures were video recorded and afterwards retrospectively analyzed. In addition, particular reference was given to previous cervical spine surgery, postoperative outcome, reoperation rate, and complications.**

RESULTS: **The endoscopic system was easy to handle intraoperatively in all procedures. No emergency stopping was required. Forty-one patients reported improved and/or even no remaining pain postoperatively (95%).**
Thirty-five patients (81.4%) regained full motor strength. Clinical success rate with respect to Odom's criteria reached 39 patients (90.7%). One reoperation was needed due to postoperative hematoma (2.3%). One patient suffered from transient worsening of his preoperative paresis (2.3%). Neither dural tear nor nerve root injury was observed. Reoperation rate due to degenerative changes was 18.6% (8 of 43 patients).

CONCLUSIONS: **This retrospective analysis shows that posterior endoscopic decompression is a successful option in the treatment of osseous cervical foraminal stenosis.**

INTRODUCTION

The posterior cervical foraminotomy was first described by Scoville in 1945 and later further modified by Frykholm. For the first time, the nerve root was decompressed in a series of patients with cervical radiculopathy through partial resection of the medial margin of the facet joint.[1,2] This technique represented a big step ahead for dorsal decompression of the cervical spine at that time.

However, posterior approaches had and have the disadvantage of detaching the extensor cervical muscles from the laminae and spinous processes. Detaching of the paraspinal muscles can lead to severe collateral damage to the muscles and can come along with postoperative complications like axial neck pain, shoulder pain, loss of lordosis, or even spinal instability.[3,4] Nonetheless, the problem of the dorsal approach with the spinal cord being in the way for optimal access at the pathology was eluded through the introduction of the anterior approach to the cervical spine (anterior cervical diskectomy and fusion [ACDF]) by Smith and Robinson and by Cloward in the 1950s.[5,6] The anterior approach represented the gold standard in the treatment of cervical disk prolapse and cervical stenosis for decades while the posterior approach became more and more obsolete over time.

Recognition of ACDF's disadvantages such as loss of motion due to bony fusion, approach-related morbidity, graft-related complications, and adjacent segment disease led to a widespread movement for rediscovering the posterior approach.[7] Meanwhile, a multitude of studies have demonstrated that open

Key words
- Cervical spine
- EasyGO system
- Endoscopy
- Minimally invasive technique
- Osseous foraminal stenosis
- Posterior cervical foraminotomy

Abbreviations and Acronyms
ACDF: Anterior cervical diskectomy and fusion
SD: Standard deviation

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microsurgical posterior foraminotomy is an effective treatment for cervical radiculopathy.[8-16] Also, the iatrogenic approach-related trauma can be reduced by application of new minimally invasive endoscopic techniques.

There is still no consensus about the ideal surgical approach for the treatment of cervical radiculopathy till today. Endoscopic lumbar diskectomy has been shown to obtain comparable results with standard microsurgical diskectomy with the advantage of less muscular trauma and thereby less postoperative back pain.[17] The technique of using endoscopic visualization with a tubular system can also be applied to the cervical spine. It enables surgeons to perform minimally invasive posterior foraminotomy for lateral disk prolapse or foraminal stenosis. In the past decade, equivalent results from tubular posterior cervical foraminotomy compared with standard open technique have been reported in the treatment for cervical radiculopathy due to lateral disk herniation.[8,9,18-20]

However, only a few studies that investigated the effectiveness of minimally invasive cervical foraminotomy for cervical radiculopathy have included patients with foraminal stenosis.[9,11,18,20-24] The number of studies that used an endoscopic technique is even smaller.[11,20,22,24] A detailed description about the entity of foraminal stenosis among those studies is not available. The purpose of this article is to report results of clinical and functional outcomes after endoscopic posterior cervical foraminotomy for single and multilevel osseous foraminal stenosis.

MATERIAL AND METHODS

Patient Population

The cohort consists of 43 consecutive patients with osseous cervical foraminal stenosis treated with endoscopic posterior cervical foraminotomy at the Department of Neurosurgery, Saarland University Medical Center and Saarland University Faculty of Medicine, Homburg/Saar, Germany between 2011 and 2014. All procedures were performed with the EasyGO endoscopic system (Karl Storz company, Tuttlingen, Germany). Inclusion criteria for this retrospective study were a complete set of preoperative and postoperative patient records and video recordings of the procedure. Patients with central compression of the myelon, instability, and soft lateral disk herniation were not included in the study. A telephone interview was conducted to complete a standardized questionnaire as final follow-up before preparation of this manuscript.

The standardized questionnaire assessed Neck Disability Index (NDI) and the functional outcome according to Modified Odom's Criteria (Table 1).[25,26] "Excellent" and "good" results were defined as clinical success.

Table 1. Modified Odom's Criteria

Grading	Definition
Excellent	All preoperative symptoms and abnormal findings improved.
Good	Minimal persistence of preoperative symptoms (neck tenderness only, otherwise no symptoms). Abnormal findings improved.
Fair	Definite relief of some preoperative symptoms. Other symptoms slightly improved (residual root irritation with transient pain).
Poor	Symptoms and signs unchanged or worse.

Surgical Equipment

All procedures were performed with the EasyGO spine system (KARL STORZ GmbH & Co. KG, Tuttlingen, Germany). The endoscopic equipment consisted of a 30° Hopkins Forward-Oblique telescope that was 9.5 cm in length, an H3-Z Full HD Camera Head, and a Xenon Nova 300 cold light fountain. The intraoperative image was transmitted on a 26″ HD Flat Screen. All intraoperative data were recorded via AIDA compact NEO data archiving system (KARL STORZ GmbH & Co. KG). For a detailed description of the spine system, please refer elsewhere.[17]

Surgical Technique

After the induction of the status of general endotracheal anaesthesia, the patients were placed in prone position. The head was fixed in a 3-point Mayfield head holder with an elevated position and slightly inclined. To reduce intraoperative bleeding from epidural blood vessels, we kept the surgical field above heart level. The affected segment was identified by lateral fluoroscopy. Frequently the shoulders of the patient had to be pulled down and fixed by using medical duct tape for surgical field exposure on lateral radiograph. In single-level surgery, a straight approach from the skin incision to the neuroforamen was performed. In 2-level surgery, the skin incision was made halfway between the 2 affected segments (Figure 1A). In the rare case of a 3-level surgery, the skin incision was made in a straight trajectory to the middle segment. It was made craniocaudal about 2 cm lateral to the midline. After the skin incision, the muscle fascia was punctured and the muscles were subsequently dilated with the various dilators. The tip of each dilator was always in firm contact with the vertebral arch or the facet joint, respectively (Figure 1B). Then the selected work sheath was introduced. The whole application of the dilators and the working sheath was done under lateral fluoroscopy control. After introduction of the trocar, it was connected to the holder and thereby fixed to the surgical field (Figure 1C). In most cases, the 30° endoscope was introduced lateral pointing to the midline (Figure 1D) and bimanual microsurgical techniques could be applied (Figure 1E). An example of endoscopic posterior cervical foraminotomy is shown on Video 1.

Video available at WORLDNEUROSURGERY.org

After removal of some remnant soft tissue (Figure 2A), the lamina and facet joint were exposed (Figure 2B). The medial third of the facet joint was thinned with a diamond drill (Figure 2C) before the ligamentum flavum (Figure 2D) was resected. Through this technique the lateral section of the dural sac with its outgoing nerve root was depicted (Figure 2E). The nerve root was decompressed from medial to lateral far into the neuroforamen (Figure 2F). To control the intraoperative bleeding coagulation in a gentle fashion, compression by sponges and cotton or a combination of both techniques with additional application of surgical hemostatic agents for hemostasis was used. After