



## Influence of Prior Cervical Surgery on Surgical Outcome of Endoscopic Posterior Cervical Foraminotomy for Osseous Foraminal Stenosis

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■ **BACKGROUND:** Posterior cervical foraminotomy is a valuable option as a treatment for cervical radiculopathy caused by osseous foraminal stenosis. Here the authors present their technique and results in a series of patients with and without previous surgery.

■ **METHODS:** Forty-five patients suffering from cervical osseous foraminal stenosis were operated on via a microendoscopic posterior approach with the EasyGO system. All procedures were video recorded and afterwards retrospectively analyzed. The primary evaluation criterion was prior surgery or no prior surgery. Additionally, postoperative outcome according to Odom's criteria and Neck Disability Index (NDI), reoperation rate, and complications was considered.

■ **RESULTS:** The 45 patients of this study showed an overall clinical success rate of 84%. There was no emergency stopping of any endoscopic procedure. Twenty patients (44.4%) had no and 25 patients (55.6%) had previous cervical surgery. In patients without previous surgery, the clinical success rate was 95.2%; NDI was 12%; and 100% of patients reported reduction of their preoperative arm pain and motor recovery. In patients with previous surgery, the clinical success rate was 75%. NDI was 24%. Most patients (91.7%) reported reduction of their preoperative arm pain, and 66.7% reported recovery of motor strength.

■ **CONCLUSION:** This retrospective analysis shows that microendoscopic posterior cervical foraminotomy is a successful option in the treatment of osseous cervical foraminal stenosis. Nevertheless, clinical success in patients with previous surgery is much lower compared

with patients without previous surgery. Thus, a more thorough clinical workup is recommended to identify the patients who are not going to benefit before subsequent surgical procedures.

### INTRODUCTION

In the 1940s Scoville and Frykholm described the posterior cervical foraminotomy for the first time.<sup>1,2</sup> At that time the technique of posterior cervical foraminotomy was a big step forward, leaving traditional surgical techniques such as laminectomy. However, detaching the paraspinal muscles can lead to severe collateral tissue trauma and can come along with postoperative complications like axial neck pain, shoulder pain, loss of lordosis, or even spinal instability.<sup>3,4</sup> Also, direct access to the cervical disk and vertebral body is obstructed by the spinal cord in such a posterior approach. In the late 1950s, Smith and Robinson and later Cloward presented the anterior cervical discectomy and fusion (ACDF), which became the gold standard for treatment of most degenerative cervical disk disease while the posterior approach became more and more obsolete over time.<sup>5,6</sup> More recently, disadvantages of the ACDF like loss of motion due to fusion, approach-related morbidity, graft-related complications, and adjacent segment disease led to a rediscovery of the posterior approach.<sup>7</sup> Many studies have demonstrated that posterior cervical foraminotomy is a safe and effective technique for the treatment of cervical radiculopathy, especially caused by soft lateral disk herniation.<sup>8-16</sup> Endoscopic techniques have been introduced to the lumbar spine in the 1990s and provide comparable results with standard microsurgical discectomy with the advantage of less tissue and muscular trauma.<sup>17</sup> The use of an endoscopic

#### Key words

- Cervical spine
- Endoscopic technique
- Minimally invasive technique
- Osseous foraminal stenosis
- Posterior cervical foraminotomy
- Previous surgery

#### Abbreviations and Acronyms

- ACCF:** Anterior cervical corpectomy and fusion  
**ACDF:** Anterior cervical discectomy and fusion  
**ACDF + PS:** Anterior cervical discectomy and fusion with plate stabilization  
**CT:** Computed tomography  
**MRI:** Magnetic resonance imaging

**NDI:** Neck Disability Index

**PSI:** Patient Satisfaction Index

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visualization technique in combination 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, several studies have demonstrated that endoscopic- and microscopic-assisted tubular posterior cervical foraminotomy obtain equivalent results compared with standard open technique for the treatment for cervical radiculopathy due to lateral disk herniation.<sup>8,9,18-20</sup> However, there are few reports about the effectiveness of minimally invasive cervical foraminotomy for cervical radiculopathy due to neural foraminal stenosis and especially via the use of microendoscopic techniques.<sup>9,11,18,20-25</sup> Detailed information about patients and their medical history regarding previous cervical spine surgery and reoperation rate are almost never reported.<sup>23,25</sup> The purpose of this article is to report results of clinical and functional outcome after endoscopic posterior cervical foraminotomy for single and multilevel osseous foraminal stenosis in patients with and without a history of previous cervical spine surgery.

## MATERIAL AND METHODS

### Patient Population

The cohort consists of 45 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 2016. All procedures were performed with the EasyGO endoscopic system (KARL STORZ, Tuttlingen, Germany). Inclusion criteria for this retrospective study were 1) complete set of preoperative and postoperative patient records and 2) video recordings of the procedure. A telephone interview was conducted to complete a standardized questionnaire as final follow-up before preparation of this manuscript.

The standardized questionnaire assessed patient satisfaction (PSI) via a modified subitem of the North American Spine Society outcome questionnaire, Neck Disability Index (NDI), and functional outcome according to Modified Odom's Criteria (Table 1).<sup>26-28</sup> Clinical success was defined as excellent and good.

Preoperative magnetic resonance imaging (MRI) and computed tomography (CT) were analyzed with special focus on the sagittal alignment of the cervical spine. Positive values higher than

5° were considered to be indicative of cervical lordosis. Values between -5° and +5° were indicative of cervical rectification, and values below 5° indicated cervical kyphosis.

### Patient Characteristics

The authors divided the 45 patients in 2 groups:

Group 1 consisted of twenty (44.4%) patients who were operated at the cervical spine for the first time via microendoscopic posterior cervical foraminotomy.

Group 2 consisted of twenty-five (55.6%) patients who had undergone a cervical procedure due to degenerative conditions before microendoscopic posterior cervical foraminotomy.

### Surgical Equipment and Technique

All procedures were performed with the EasyGO spine system (KARL STORZ). The endoscopic equipment consisted of a 30° Hopkins Forward-Oblique telescope with 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). For a detailed description of the spine system and surgical technique for microendoscopic posterior cervical foraminotomy, please refer elsewhere.<sup>17,25</sup>

### Statistical Analysis

The SPSS statistical software package (SPSS, Inc., Chicago, Illinois, USA) was used for statistical analysis of the data. The Mann-Whitney-U test, 2-sided Fisher exact test, and Fisher-Freeman-Halton exact test were selected for analysis. A P value of <0.05 was assumed sufficient to indicate statistical significance.

## RESULTS

A total number of 45 patients met the inclusion criteria of this retrospective study. The primary indication for surgery was radicular pain resistant to conservative treatment and/or a radicular neurologic deficit.

Forty-three patients had a preoperative CT scan and 35 had preoperative MRI. Thirty-three patients received MRI and CT scans before surgery. Preoperative imaging and intraoperative finding revealed the diagnosis of an osseous foraminal stenosis in all cases.

Twenty-eight patients were male (62.2%), and 17 were female (37.8%). The mean age at surgery was 55.6 years (range 29–82 years). Thirty-three patients had a single-level procedure, 11 patients had a 2-level procedure, and 1 patient had a 3-level procedure. Forty-one procedures were done unilaterally. In 4 procedures a bilaterally foraminotomy was performed. A total of 62 endoscopic foraminotomies in 45 patients had been performed in total. A detailed presentation of all operated level is given in Table 2. Twenty-five patients had previous cervical spine surgery. Among those, 11 had ACDF, 7 had ACDF with plate stabilization (ACDF+PS), 2 had anterior cervical disk replacement, 2 had anterior cervical corpectomy and fusion (ACCF), and 3 had undergone posterior cervical foraminotomy. The mean follow-up was 27.7 months (range 3.1–48.4).

**Table 1.** Modified Odom's Criteria

Odom's Criteria	
Excellent	No complaints referable to cervical disease, able to carry on daily occupations without impairment
Good	Intermittent discomfort, related to cervical disease, but not significantly interfering with work
Satisfactory	Subjective improvement, but physical activities significantly limited
Poor	No improvement, or worse as compared with the condition before operation

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