A Transtubular Microsurgical Approach to Treat Lateral Cervical Disc Herniation

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OBJECTIVE: **Different surgical options are available to treat radicular pain syndromes of the cervical spine. Use of the posterior approach for foraminotomy and sequestrectomy (Frykholm) fusion can be avoided, but neck pain affects the postoperative course. This retrospective study compares the classical Frykholm approach and the transtubular microsurgical approach for foraminotomy.**

METHODS: **From 2004 to 2012, 40 patients fulfilled the inclusion criteria and were enrolled into this retrospective study. The classical Frykholm approach was performed on 25 affected levels. The transtubular microsurgical approach was used on 19 affected levels. Endpoints were neck pain, radicular pain, surgery time, duration of hospital stay, and long-term outcomes.**

RESULTS: **For the transtubular microsurgical approach and the classical Frykholm approach, the mean surgery time was 77.65 $\pm$ 23 minutes and 104 $\pm$ 27.59 minutes ($P = 0.003$), respectively. Radicular pain improved in all patients regardless of the technical approach. Significant differences were observed in neck pain on the first postoperative day ($P = 0.003$) and at discharge ($P = 0.006$), resulting in a shorter hospital stay of 4.82 days $\pm$ 2.1 for the transtubular microsurgical approach in comparison with 7.43 days $\pm$ 3.2 for the Frykholm approach ($P = 0.005$). According to the criteria of Odom, the rate of an excellent or good outcome was 97.5% (67.5% excellent and 30% good), without any differences between the compared approaches.**

CONCLUSION: **The transtubular microsurgical approach shows advantages regarding postoperative neck pain, surgery time, and hospital stay with a trend towards an earlier return to work.**

INTRODUCTION

In 1951, Frykholm et al.[1] briefly described a surgical technique to remove lateral cervical disc herniation through a dorsal approach. They reported excellent or good clinical results in more than 90% of the treated patients. Henderson et al.[2] confirmed Frykholm's findings in 1983 in the largest ever-published series of 846 dorsal foraminotomies.

Nevertheless, because of the ubiquitous opportunities (medial and lateral disc herniation), the anterior approach became more and more popular in subsequent decades with the disadvantage of fusion but with the advantage of avoiding the detachment of the neck muscles and resulting neck pain.[3] Jagannathan et al.[4,5] reported equivalent outcomes for both approaches but could not show any statistical differences during extended follow-up; however, the disadvantage of neck pain, mainly in the early postoperative phase, remains.

To reduce approach-related morbidity, minimally invasive approaches have become popular in the last decade. The benefits already have been demonstrated for the treatment of lumbar stenosis and disc herniation[6-9]; however, only a few publications have reported the results of minimally invasive approaches for the cervical spine. The purpose of the present study was to review our series of posterior cervical procedures for disc herniation and stenosis and to evaluate the benefits of the minimally invasive transtubular approach.

METHODS

Patients

Each patient was treated in our institution between 2004 and 2012 and provided informed written consent. In accordance with local and institutional laws and data-protection regulations, no approval by the local ethics committee was necessary for this study. Patient data, including demographics, clinical presentation, imaging, surgical treatment, and postoperative results, were analyzed retrospectively. The following inclusion criteria were

Key words
- Cervical disc herniation
- Foraminotomy
- Minimally invasive
- Radiculopathy
- Transtubular microsurgical approach

Abbreviations and Acronyms
VAS: Visual analog scale

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defined for the study: (1) unilateral cervical radiculopathy; (2) corresponding imaging findings with lateral cervical soft disc herniation, hard disc disease (spondylosis with bony stenosis) or mixed disease; (3) absence of medial protrusion, clinical or radiologic signs of myelopathy, or instability; and (4) did not respond to conservative treatment, including periradicular infiltration therapy.

Preoperative diagnostics included a neurologic examination, magnetic resonance imaging, dynamic x-ray images, and computed tomography with tri-axial reconstruction. Forty patients met the inclusion criteria and were enrolled into this retrospective analysis; all underwent surgery through the posterior route to treat a symptomatic cervical radiculopathy. The classical technique described by Frykholm was performed in 23 patients in the first years of the study, whereas 17 patients underwent a transtubular microsurgical approach in the last 4 years. Because of the retrospective design of the study, the selection of the approach was determined only by the time of surgery. After the introduction of the tubular-assisted approach in our hospital in 2008, we performed all dorsal foraminotomies through this approach. No other criteria influenced the selection of the approach.

Surgical Technique

The patients were placed in a prone Concorde position with their head fixed in a Mayfield head clamp after the induction of general anesthesia. The affected level was identified by fluoroscopy. A midline incision was used for the classical Frykholm approach, and then the paravertebral muscles were detached from the ligamentum nuchae and the spinous processes, exposing the laminae and the medial part of the facet joint. A paramedian skin incision was made for the transtubular microsurgical approach. After sharp perforation of the muscle fascia, the initial dilatator was inserted at an angle of 10–20° toward the midline (Spotlight; DePuy Spine, Raynham, Massachusetts, USA). Dilation was completed with a second and third dilatator, and a tubular retractor with a diameter of 18 mm and length ranging from 40 to 70 mm was inserted and connected to the table-mounted flexible arm. The transtubular procedure is illustrated in Figures 1 and 2.

The subsequent microsurgical technique was in both study arms the same as that reported by Frykholm.[1] Exposure was limited to the foraminal pathology with the maximum extent of a hemifacetectomy to avoid secondary instability. Then, the nerve root was exposed routinely through the axilla of the nerve and the herniated disc fragments were removed.

Postoperative Management and Endpoints of the Study

All patients received the same postoperative pain medication with 3× 1000 mg paracetamol per day and additional medication on demand. The endpoints of the study were skin incision, surgery time, the course of postoperative pain (separated into radicular and neck pain), the postoperative use of analgesics, duration of hospital stay, and clinical outcome. Clinical outcome was classified according to the modified Odom criteria at the last individual contact with the patients.[10] The need for analgesic medication was analyzed during the first 5 postoperative days. According to the classification of the World Health Organization, each day was scored as followed: class 1 (nonopioids) 0.5 points, class 2 (nonopioids and a weak opioid) 1 point, and class 3 (nonopioids and strong opioids) 1.5 points. To evaluate the patient's satisfaction, we asked the patients to fill out a simple questionnaire as to whether they would choose the same procedure and surgical technique again and whether they would recommend this surgical approach to other patients with similar symptoms and pathologies. Additionally, we asked the patient about how long it took to return to work after surgery.

Both data sets were obtained retrospectively. Some data were extracted from the chart review or were collected routinely in a database (prospective data). Motor grade was classified according to the British Medical Research Council Score.[11] For the quantification of pain, we used the simple visual analog scale (VAS) preoperatively, on the first postoperative day, at discharge, and after 6 weeks. Dynamic x-ray images were acquired 6 weeks after surgery to rule out instability.

Data Analysis

SPSS Statistics 21 (IBM Corporation, Somers, New York, USA) was used to perform χ^2 tests (Pearson, Kendall-Tau, Spearman) and one-way analysis of variance, in which $P < 0.05$ and $P < 0.01$ were considered significant and highly significant, respectively. Graphs were created by SPSS.

RESULTS

Patient Data

A total of 40 patients (21 [47.5%] male and 19 [52.5%] female) with 44 treated levels were enrolled into this retrospective analysis. The mean age was 50 ± 12.6 years (range, 26.8–72.8). Patient collective was divided into 2 groups: 23 patients (group 1) underwent the classical Frykholm approach, and 17 patients (group 2) underwent the described transtubular microsurgical approach. No significant difference in symptom duration or the characteristics of symptoms could be found (Tables 1-4). The most frequently operated level was C6/7 with 24 cases (54.6%), followed by 10 procedures at C5/6 (27.3%), 3 at C4/5 (6.8%), 3 at C7/T1 (6.8%), and 2 at C3/4 (4.5%), respectively. Pathology was classified as soft, mixed, and hard disc diseases on the basis of imaging findings. In 14 patients (35%), the pathology was classified as soft disc disease, in 14 patients (35.0%) as hard disc disease, and in 12 patients (30.0%) as mixed disc disease. For the Frykholm group, who had more soft disc diseases, additional sequestrectomy was performed significantly more often than in the transtubular group ($P = 0.018$). Table 1 shows the pathology-related parameters according to the approach used. Patients treated by the transtubular technique had a shorter time of surgery ($P = 0.003$), smaller skin incision ($P = 0.001$), and a shortened hospital stay ($P = 0.005$) (Table 2).

Pain Outcome

The VAS was used to measure the relationship between radiating and neck pain. Independently of the surgical technique, preoperative radicular pain was predominant in all patients, whereas postoperatively the dominance changed to neck pain. Compared with the Frykholm approach, the transtubular-treated group complained of significantly less postoperative neck pain (first day $P = 0.003$, at discharge $P = 0.006$). Within 6 weeks, the differences diminished. The VAS for radicular pain showed no significant differences between the 2 groups (Tables 3 and 4, Figure 3).