

# Posterior microlaminoforaminotomy for cervical disc herniation

## Leczenie dyskopatii szyjnej drogą mikrolaminoforaminotomii tylnej

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### Abstract

**Background and purpose:** Posterior microlaminoforaminotomy is a surgical treatment option for lateral cervical disc herniation. This approach avoids injury of vital structures lying in front of the cervical spine and preserves mobility of the treated spinal segment. The authors present the outcome of 20 patients operated on using this method.

**Material and methods:** Retrospective analysis was performed on 20 consecutive patients operated on in the years 2005–2009. Posterior microlaminoforaminotomy was used in patients with unilateral cervical radiculopathy resulting from lateral disc herniation. Osteophytes coexisted in 12 cases. The presenting symptoms were: radicular pain (20 patients), paraesthesias (19), neck pain (17), dermatomal sensory loss (11) and motor deficit (9 patients). All operations were performed at a single level (C5/C6 in 8 cases, C6/C7 in 10 cases, C7/Th1 in 2 cases).

**Results:** The herniated disc was removed in 19 cases; nerve root decompression was performed in 1 patient. Osteophytes were additionally excised in 4 cases. Significant relief of radicular pain was achieved in all cases early after surgery. Transient improvement with unsatisfactory late outcome was observed in 1 patient. Satisfactory late outcome (according to Odom's criteria) was obtained in 95% (18/19) of patients. Complete or marked improvement of radicular pain was observed in 95% (18/19), neck pain in 94% (16/17), sensory loss in 82% (9/11) and motor deficit in 78% (7/9). There was no case of spinal instability or secondary operation due to recurrence with a mean follow-up period of 22 months.

**Conclusions:** Posterior microlaminoforaminotomy is safe and effective. Coexistence of osteophytes does not limit use of this

### Streszczenie

**Wstęp i cel pracy:** Mikrolaminoforaminotomia tylna jest stosowana w przypadku bocznie wypadniętego krążka międzykręgowego w odcinku szyjnym kręgosłupa. Dzięki temu dostępowi unika się ryzyka uszkodzenia struktur leżących do przodu od kręgosłupa, powikłań zależnych od implantu oraz zachowuje funkcję ruchową na operowanym poziomie. Celem pracy jest prezentacja wyników leczenia 20 chorych operowanych tą metodą.

**Materiał i metody:** Analizą retrospektywną objęto 20 kolejnych chorych operowanych w latach 2005–2009. Do operacji kwalifikowano chorych z jednostronną radikulopatią z bocznie wypadniętym sekwestrem dyskowym. Osteofitoza współistniała u 12 chorych. Przed operacją ból korzeniowy stwierdzono u 20, parestezje u 19, bóle karku u 17, zaburzenia czucia u 11, a niedowład u 9 chorych. U wszystkich pacjentów zabieg był wykonany na jednym poziomie (C5/C6 w 8 przypadkach, C6/C7 w 10 przypadkach, C7/Th1 w 2 przypadkach).

**Wyniki:** W czasie operacji usunięto wpadnięty sekwestr dyskowy u 19 pacjentów, u jednego wykonano odbarczenie korzenia. U 4 dodatkowo usunięto osteofity. Do czasu wypisu uzyskano wyraźne zmniejszenie bólów korzeniowych u wszystkich chorych. W jednym przypadku poprawa była przejściowa, z niezadowolającym odległym wynikiem leczenia. Satysfakcjonujący odległy wynik (zgodnie z kryteriami Odoma) uzyskano w 95% (18/19), w tym w przypadku współistnienia osteofity w 92% (11/12). Ustąpienie lub znaczne zmniejszenie bólów korzeniowych obserwowano w 95% (18/19), bólów karku w 94% (16/17), zaburzeń czucia w 82% (9/11) i niedowładu w 78% (7/9). W obserwacji

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technique. The risk of herniation recurrence and spinal instability is very low. The minimal invasiveness of this method allows faster return to normal life activities.

**Key words:** cervical disc herniation, radiculopathy, posterior laminoforaminotomy, treatment outcome.

## Introduction

Currently, posterior approaches are rarely used in the treatment of cervical disc herniation. The most prevalent surgical modality involves an anterior approach with a complete discectomy and subsequent fusion with an interbody implant. The anterior approach is well recognized among spine surgeons and, perhaps because of that, its invasiveness and possible complications have been disregarded. Still, in lateral disc herniations or degenerative foraminal stenosis with unilateral radiculopathy, a posterior approach might be successfully implemented [1]. The posterior laminoforaminotomy described by Spurling and Scoville in 1944 [2] is worth recalling then, particularly in the face of the development of minimally invasive techniques that can exploit this approach [3]. A posterior microlaminoforaminotomy is a minimally invasive technique that avoids risk of injury to the vital structures situated anterior to the cervical spine as well as implant-related complications as they are not used. Preservation of spine motility within the operated segment is another major benefit of the posterior approach. The aim of the following paper is to present the outcome of 20 consecutive cases treated with this method in the Department of Neurosurgery of Warsaw Medical University.

## Material and methods

### Patients and symptoms

A retrospective analysis of 20 consecutive cases treated for a cervical disc disease with posterior microlaminoforaminotomy between 2005 and 2009 was performed. Our cohort included 11 women and

trwającej średnio 22 miesiące nie było przypadków niestabilności kręgosłupa ani reoperacji z powodu nawrotowej dyskopatii.

**Wnioski:** Mikrolaminoforaminotomia tylna jest bezpieczna i skuteczna w przypadku bocznie wypadniętego dysku. Współistnienie osteofitów nie stanowi ograniczenia dla tej metody. Ryzyko dyskopatii nawrotowej i niestabilności jest bardzo małe. Minimalna inwazyjność dostępu pozwala na szybki powrót do normalnej aktywności.

**Słowa kluczowe:** dyskopatia szyjna, radikulopatia, laminoforaminotomia tylna, wyniki leczenia.

9 men aged 32 to 64 years (mean age: 47). The symptomatic period varied from less than 1 month in 4 cases, from 1 to 3 months in 11 cases, 4 to 6 months in 4 cases, up to 36 months in 1 case (mean: 4 months). In 75% of cases the symptomatic period was no longer than 3 months. All 20 patients had strong, unilateral radicular pain prior to surgery, 19 had radicular paresthesias and 17 had neck pain. Neurological deficits were less prevalent: sensory deficits were present in 11 patients, paresis in 9, and muscle wasting within the area innervated by the compressed root in 2 patients (Table 1).

Magnetic resonance imaging (MRI) revealed lateral disc herniation in 13 patients, centrolateral in 6 cases (with the predominant part of the sequester in the lateral recess) and intraforaminal sequester in 1 patient. All of the patients had single level surgery, C5/C6 in 8 cases, C6/C7 in 10 cases and C7/Th1 in 2 cases. Thirteen of the patients had right-side and 7 left-side approach. Preoperative MRI or X-rays revealed osteophyte coexistence at the herniation level in 12 patients.

### Qualification criteria and surgical technique

Patients with a relatively short record of a strong, unilateral radicular pain of the upper extremity (often with coexisting neurological deficits) and the presence of disc sequester with lateral (lateral recess or intervertebral foramen) or centrolateral disc herniations with the predominant part of the sequester in the lateral recess on MRI were qualified for the surgery (Fig. 1). The presence of osteophytes at the level of disc herniation did not preclude patient qualification in the case of a short pain record along with the presence of 'fresh' herniated disc sequester observed on MRI (assuming

that coexisting degenerative changes are not responsible for the present symptoms, i.e. their removal is not one of the surgical aims). A full correlation between dermatomal symptoms' representations along with contingent neurological deficits and the level of disc herniation on MRI was essential for qualification for this type of procedure. Patients with radiological and/or clinical signs of cervical myelopathy were not operated on via a posterior approach.

Surgery was performed under general anaesthesia, usually in the sitting position (18 patients), rarely in the prone position (2 patients). A short linear incision over the spinous processes, either median or paramedian 2 cm off midline (approx. 5 cm), was performed. Subsequent to nuchal fascia dissection, muscles were detached from the spinous processes and vertebral arches until facet joints were visualized. At this stage, proper localization was confirmed with X-rays. High-speed drill and operating microscope were used to perform micro-laminoforaminotomy, approx. 1 cm wide, comprising the lateral parts of adjacent arches and median parts of respective articular facets (1/3 to 1/2 of a given facet). Following ligamentum flavum removal, the lateral part of the dural sac along with the nerve root origin was envisaged and the venous plexus adjacent to the root within the intervertebral foramen was cauterized. Motor and sensory parts of the root were mandatorily identified within the intervertebral foramen prior to disc removal. Since a disc sequester was usually accessible from the root axilla, drilling off the upper, medial part of the pedicle below the intervertebral foramen allowed access to the herniation without additional nerve root retraction. The disc sequester was subsequently dissected via a nerve root axilla approach exclusive of nucleus pulposus removal from the intervertebral space. If nerve root modelling on an osteophyte was still present after disc removal, it was removed with a diamond drill. Integuments were subsequently closed in layers. Cervical collar was used only in selected cases with severe neck pain.

Catamnestic data were collected during follow-up visits in the outpatient clinic, from ambulatory charts and via a questionnaire performed by the phone in October 2009. Eventually we managed to assemble reliable data for a long-term outcome assessment in 19 patients. The follow-up period varied from 3 to 42 months and averaged 22 months. Outcome was appraised based on Odom's criteria [4].

**Table 1.** Studied patients, their symptoms and MRI findings

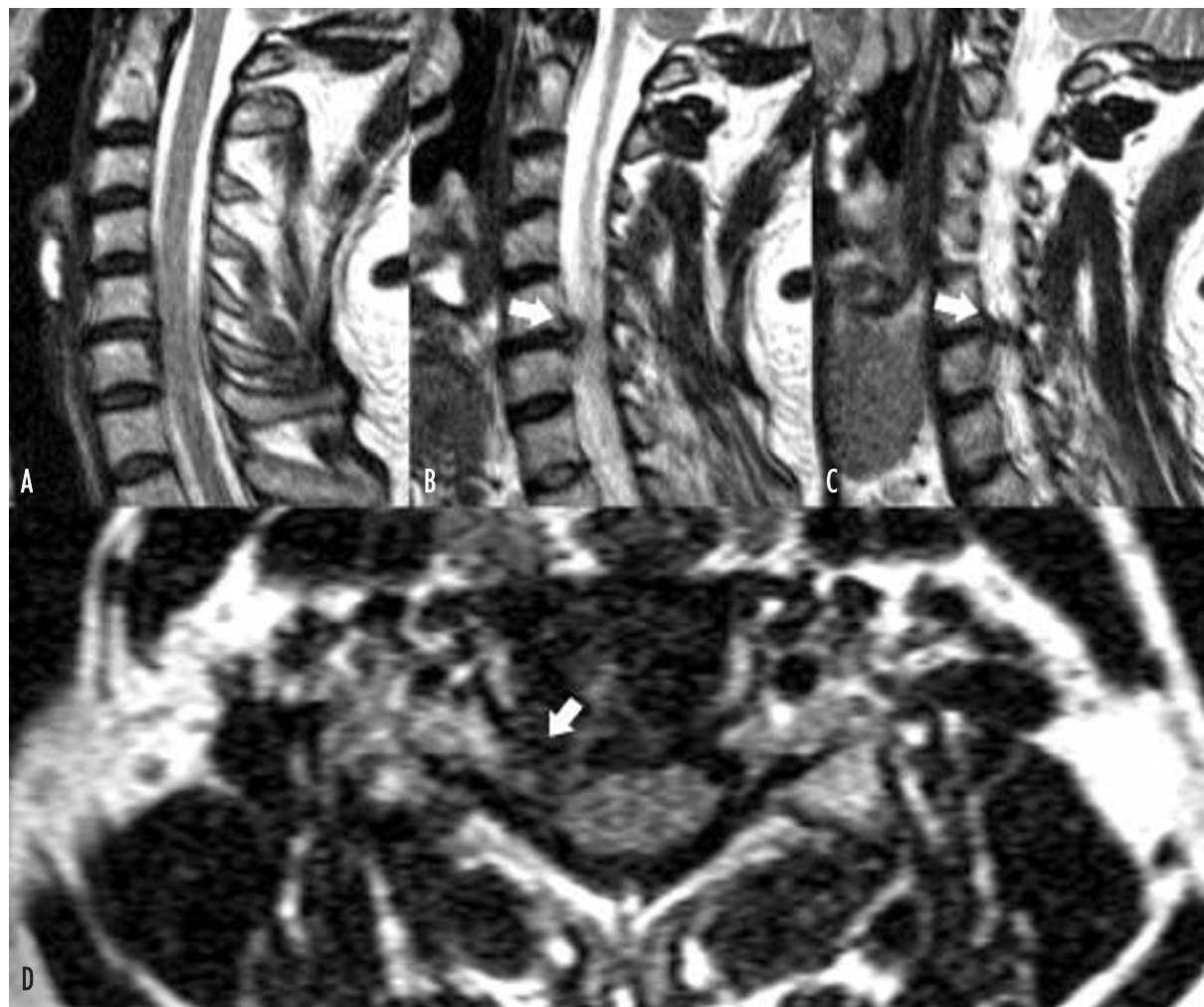
Gender	
Female	11 (55%)
Male	9 (45%)
Age, years; range (mean)	32-64 (47)
Duration of symptoms, months; mean	
< 1 month, n (%)	4 (20%)
1-3 months, n (%)	11 (55%)
4-6 months, n (%)	4 (20%)
> 6 months, n (%)	1 (5%)
Symptoms	
Radicular pain	20 (100%)
Neck pain	17 (85%)
Paraesthesias	19 (95%)
Dermatomal sensory loss	11 (55%)
Motor deficit	9 (45%)
Muscle atrophy	2 (10%)
MRI findings	
Lateral herniation	13 (65%)
Centrolateral herniation*	6 (30%)
Foraminal herniation	1 (5%)
Concomitant osteophytosis	12 (60%)
Level of disc herniation	
C5/C6	8 (40%)
C6/C7	10 (50%)
C7/Th1	2 (10%)

MRI – magnetic resonance imaging

\*Lateral herniations with small posteromedial components without significant spinal cord compression in the midline

## Results

Herniated disc sequesters were removed during surgery in 19 patients; in 4 patients osteophytes modelling the nerve root were resected additionally. In 2 cases intraoperative complications occurred: in 1 case a disc sequester could not be found, and only a root decompression was performed; in the other one substantial venous bleeding from the epidural plexus in the intervertebral foramen hindered operative field orientation. This patient underwent surgery in a prone position. Yet another patient required elective extension of laminoforaminotomy with broad C7 arch removal due to a massive sequester of C6/C7 that migrated toward the C7 body and jammed simultaneously in 2 intervertebral foramina C6/C7 and C7/Th1 (Fig. 2). Postoperative complications



**Fig. 1.** (B, C, D) Lateral disc herniation at C5/C6 level, without significant spondylotic alterations. Herniated disc occupies lateral recess (white arrows) without spinal cord compression in the midline (A)

occurred in 2 patients – 1 of them had slight, transient paresis of flexors of fingers I and II and another 1 presented with a small region of hypoesthesia over the thumb.

Duration of the surgical procedure typically varied from 2 to 2.5 hours. Most of the patients were discharged 1 to 2 days after the surgery. Patients with more pronounced local postoperative pain or those with more distant residence were discharged within a week.

Prior to discharge, complete or nearly complete resolution of radicular pain in all of the patients was achieved, even in a case with root decompression alone. Neck pain outbreaks or its aggravation was transiently seen in 6 patients during the postoperative period. They lasted from a few days to up to 3 months after surgery. Only 1 patient used a cervical collar for a few days. Nine

patients had control X-rays of the cervical spine (including patients with transient postoperative neck pain); none of them showed any signs of instability.

Satisfactory long-term outcome (Odom I or II) has been achieved in 18 (95%) out of 19 patients with available catamnestic data. A single patient, whose data were not available, was discharged home in a very good condition with no neurological deficits (Table 2). Only 1 patient after a short, transient improvement presented with recurrent radicular symptoms on top of the small region of hypoesthesia over the thumb since surgery (Odom group IV). Control X-rays and MRI ruled out spinal instability or recurrent discopathy as a source of the symptoms.

Long-term assessment of the symptoms proved that radicular pain disappeared or significantly diminished





**Fig. 2.** Lateral disc herniation at C6/C7 level descending to C7/Th1 level (B, white arrows). The main mass of disc herniation occupies the lateral recess (C, transverse view, white arrow), while the posteromedial part is minimal, without spinal cord compression (A, sagittal view)

in 18 out of 19 and neck pain in 16 out of 17 patients. Similarly, dysaesthesias diminished or vanished in 9 out of 11 and paresis in 7 out of 9 patients (Table 3).

The influence of various factors such as direction of herniation, coexistence of osteophytes or the extent of operation on outcome was analysed (Table 4). No sig-

nificant differences between subgroups were found; coexistence of osteophytes did not significantly influenced outcome. It is worth mentioning, though, that the best outcome was achieved in the subgroup of patients with lateral or foraminal disc herniation without coexisting osteophytes (Odom I - 86%).

**Table 2.** Late outcomes according to Odom's criteria [4]

Outcome according to Odom's criteria	Brief description of functional status	No. of patients
Odom I (excellent)	without complaints related to cervical spine, without need for medication, return to previous work	11
Odom II (good)	temporary discomfort related to cervical spine that needs medication without interference with work	7
Odom III (satisfactory)	subjective improvement but demanding permanent medication with substantial physical activity limitations	0
Odom IV (poor)	lack of improvement or deterioration in comparison with preoperative status	1*

\*No spinal instability or herniation recurrence in the control X-ray and MRI of cervical spine

**Table 3.** Late outcomes with respect to different symptoms

Symptoms with complete or marked improvement	Proportion of patients (%)
Radicular pain	18/19 (95%)
Neck pain	16/17 (94%)
Sensory loss	9/11 (82%)
Motor deficit	7/9 (78%)

A fraction of patients with satisfactory outcome still had residual symptoms that included neck pain in 2 patients and residual radicular pain in 2 patients. In 1 of the patients, radicular pain subsided, while neurological deficits (hypoesthesia and paresis) prevailed. Importantly, this patient had the shortest follow-up (less than 6 months). In a long-term follow-up 1 of the patients presented with contralateral pain from the operated segment while another 1 showed ipsilateral recurrent radicular pain. In both cases, control MRI provided no indications for reoperation and physiotherapy was introduced. Out of 19 patients with catamnestic data available, 15 patients resumed their prior occupation. One of the patients, currently retired, continues rehabilitation (3 months post op, Odom II), 1 patient is unemployed, 1 is still on sick leave due to another ill-

ness (lumbar disc disease); only 1 patient did not return to work due to unsatisfactory outcome. In summary, out of 17 patients who were professionally active prior to the disease only 1 (6%) did not resume his employment because of unsatisfactory outcome. Sick absenteeism varied from 1 week to 1 year in the group of patients who resumed professional activities and 11 out of 15 (73%) patients resumed work within 3 months.

## Discussion

Most patients with cervical discopathy have been treated via an anterior approach since it was described by Cloward and Smith and Robinson in the 1950s [5,6]. Meanwhile, the idea of a posterior approach in the treatment of cervical discopathy is more than a decade older. Spurling and Scoville described a posterolateral approach to laterally herniated discs in the cervical spine in 1944, although owing to limited indications this approach has never become as popular as the anterior approach [2]. During the last decade, however, it has grown to be more popular again as a result of its low invasiveness.

Posterior microlaminoforaminotomy is less invasive than an anterior approach, which requires crossing of

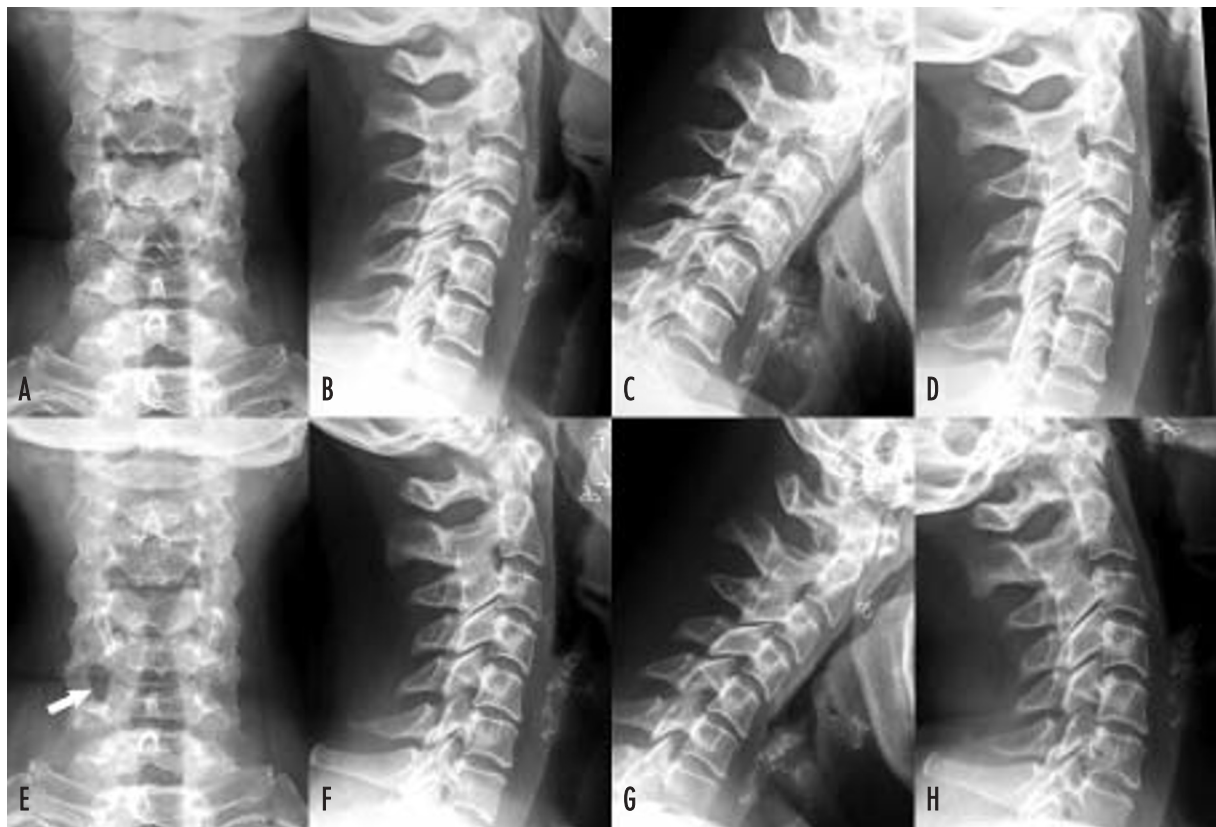
**Table 4.** Late outcomes in different subgroups of patients

	Odom I	Odom II	Odom IV	Satisfactory outcome (Odom I + II)	Differences between groups
Pure lateral or foraminal herniation	9 (64%)	4	1	13/14 (93%)	$p = 0.91^*$
Centrolateral herniation	3 (50%)	3	–	6/6 (100%)	
Disc herniation with concomitant osteophytosis	6 (50%)***	5	1	11/12 (92%)	$p = 0.41^*$
Disc herniation without osteophytosis	6 (75%)***	2	–	8/8 (100%)	
Pure lateral or foraminal herniation without osteophytosis	6 (86%)	1	–	7/7 (100%)	
Removal of soft disc herniation and osteophytes	2 (50%)	1	1	3/4 (75%)	
Removal of soft disc herniation without osteophytes	4 (50%)	4	–	8/8 (100%)	

a number of important structures such as the oesophagus, large vessels or recurrent laryngeal nerve – all of them are at risk of potential injury during surgery. Furthermore, anterior discectomy involves elective removal of the entire disc and usually anterior cage implantation and spondylodesis. This way we discretionarily achieve fusion of a functional segment of the spine which, in consequence, puts adjacent levels at risk of an overload that arises from compensatory movements. Conversely, in the course of the posterior approach only spinal muscles are dissected and small parts of vertebral arches and facets are removed, which neither significantly affects spinal stability nor requires internal spinal fusion or a cervical collar postoperatively. The aim of this particular approach is solely to remove a disc sequester. The residue of the disc remains untouched within the intervertebral space and maintains its function. Overall together, spinal motility is not significantly impaired at the level of surgery since the functions of both – the

facet as well as the disc – are preserved (Fig. 3). This enables shorter in-hospital stay and a shorter sick absenteeism period, and, on top of that, the whole procedure is less expensive as no implants are required. In our opinion microlaminoforaminotomy fulfils contemporary requirements for minimally invasive surgery. Most of the patients can quickly resume their professional activities – in our series 2 patients returned to work as soon as a week after surgery.

Over the last decade spine access techniques (mainly to the lumbar spine) have been expanded by the use of endoscopes or dilators that enable an intermuscular approach. These systems might also be successfully used in the posterior approach to the cervical spine [3]. It appears that intermuscular dilators are less traumatic than a typical subperiosteal muscle detachment, which in turn can reduce postoperative pain and allow faster recovery [7].



**Fig. 3.** (A, B, C, D) Functional X-ray examination of cervical spine before surgery. (E, F, G, H) Functional X-ray after surgery. E – Site of partial articular processes resection (white arrow). In comparison with preoperative X-ray (C, D), greater movement range is seen, without instability (G, H). Cervical lordosis: reduction before (B), and improvement after procedure (F)

## Outcome

Long-term satisfactory outcome has been achieved in 95% of patients. Similarly, high effectiveness was accomplished with respect to particular symptoms of discopathy (retreat or significant reduction of radicular pain in 95%, neck pain in 94%, dysaesthesias in 82% and paresis in 78%). None of the patients required subsequent surgery for recurrent discopathy or spinal instability and most of them returned to their previous occupations within 3 months post op; only 1 patient still does not work due to unsatisfactory outcome. In their series of 2032 cases, Roberts and Collias reported a satisfactory outcome in 96% of cases [8]. Other published series, including those with long-term follow-up periods, usually report a satisfactory outcome in more than 90% of patients [9-11].

The small numbers of patients in particular subgroups of our cohort preclude detailed analysis of outcome relative to coexisting osteophytes or precise locations of herniated sequesters. Nonetheless, it is worth mentioning that all of the subgroups had a high percentage of satisfactory outcomes. Small differences (statistically not significant) were present when very good outcomes were compared. The best results were obtained in patients with solely lateral or intraforaminal sequesters without osteophytes (Odom I – 86%). Similar results were reported in other published series in cases with ‘soft discs’ or degenerative stenosis in the lateral recess [9,12]. Moreover, a recent meta-analysis published in *Journal of Neurosurgery: Spine* in 2009 recommends posterior laminoforaminotomy as a viable treatment option in patients with cervical radiculopathy attributable to soft discs or spondylosis with degenerative stenosis in the lateral recess (recommendations were verified by the Joint Guidelines Committee of the American Association of Neurological Surgeons/Congress of Neurological Surgeons). The effectiveness of the method and its advantage of preserving spinal motility at the level operated on have been particularly stressed [1].

Similarly, no far-reaching conclusions can be drawn concerning whether additional osteophyte removal is necessary after free sequester extraction. In our series results were comparably good for both subgroups. This assessment is even further complicated by the fact that the decision to remove an osteophyte was based exclusively on the performing neurosurgeons’ impression that the osteophyte was large enough to model the nerve root despite the sequester extraction. This means that ‘larger’ osteophytes in the surgeon’s judgment were removed

while the ‘smaller’ ones were left untouched. Nonetheless, extraction of the disc mass is essential and usually sufficient for nerve root decompression. Bone opening itself cannot be neglected for it provides posterior nerve root decompression [12]. A good example is the patient whose sequester could not be localized and removed, yet he reported improvement after surgery.

## Spinal stability after surgery

Infringement of the capsule or a facet itself might theoretically result in neck pain and cervical spine instability. Some advocate a cervical collar for a few weeks after surgery in order to reduce neck pain in the early postoperative period [7]. In our group, 6 patients in their catamnestic questionnaire confirmed recurrent neck pain, usually mild and well tolerated, though. Only 1 patient required a cervical collar for a few days in order to reduce his ailment. None of our patients showed any signs of spinal instability postoperatively. What is noteworthy, however, is the fact that 16 out of 17 patients in the long-term follow-up reported either a retreat or significant reduction of neck pain that was present preoperatively. To sum up, in our opinion postoperative neck pain and spinal instability are marginal problems. Jagannathan in his series reported only 1 patient (0.6%) who required surgery for instability and another 7 patients (4%) with radiological signs of instability with no clinical sequelae during at least 5 years of follow-up [11]. Nonetheless, one should stress the importance of certain rules of this procedure – facet resection should not exceed half of its width [13]. To facilitate that, it is of value to identify a lateral edge of an intervertebral facet at the early stage of muscle dissection so as to avoid an overtly extensive resection.

## Recurrent discopathy

As emphasized previously, during this procedure only a herniated sequester is removed. Intuitively, with the judgment based mainly on the habit of complete disc removal during the anterior procedure one could expect a high incidence of recurrent discopathies. Meanwhile, in our series we had only 1 case (5%) of discopathy progression at the level operated on previously, which was confirmed by control MRI with recurrent radicular pain opposite to the side operated on (physiotherapy was subsequently recommended with no indications for reoperation). Recurrent radiculopathy, ipsilateral to previous surgery, was found in 2 patients; 1 of them showed



rapid recurrence in the early postoperative period (Odom IV), and the other one had a late recurrence 2 years after surgery (Odom II, patient still active professionally). None of them showed any signs of recurrent discopathy on control MRI. Clinical outcome was attributed to non-compliance with the postoperative physiotherapy recommendations. So far, none of our patients has required reoperation for recurrent discopathy. Only 1 out of 2032 patients in Roberts and Collias' series required reoperation [14]. Other large series estimated the risk of recurrent radiculopathy that would require reoperation at 3-6% [9,15].

### Analysis of indications and limitations of the procedure

One should emphasize that posterior microlaminoforaminotomy can be safely implemented in a selected group of patients. The aim of the procedure is strictly defined – to eliminate a compression on a single nerve root via a minimally invasive approach. Accordingly, an 'ideal candidate' for posterior microlaminoforaminotomy has a short history of unilateral radiculopathy and a laterally herniated sequester without any other signs or symptoms of discopathy or degenerative changes [16]. On the other hand, our results prove that coexistence of degenerative changes or a small 'central' component of the herniated sequester does not limit this method under the condition that clinical symptoms arise from a compression on a single nerve root.

Frequently, these patients have coexisting degenerative changes at the given as well as other levels without previous clinical representations that do not require surgical treatment. The question arises, however, whether in such a case one should expand the procedure, i.e. remove a whole disc with osteophytes via the anterior approach with subsequent fusion in order to achieve radical protection of a patient against possible future clinical sequelae, or instead treat only the current cause of the symptoms. The presented results suggest that the risk of disease progression or recurrent discopathy at the treated level is low enough to substantiate a minimally invasive approach.

It is obvious that aforementioned patients could be treated with a classic anterior approach. Other approaches for similarly located discs, such as anterior foraminotomy or transvertebral foraminotomy, have been developed as well [17-19]. These approaches aim at minimization of invasiveness of a given procedure in comparison to the typical anterior discectomy with a yield of a widely known access direction. During ante-

rior foraminotomy, similarly to a posterior one, only a herniated sequester and/or osteophytes that compress a nerve root are removed, not an entire disc from the intervertebral space. Still, anterior foraminotomy does not avoid typical risks of anterior approach that are related to the direction of access. Moreover, Hacker in his series reports that 30% of the patients required further surgery [20]. Advantages of this approach include better access to the osteophytes on the posterolateral surface of the vertebrae in comparison to the posterior approach, where an exiting nerve root limits access to the osteophytes that wrap around the edges of vertebral bodies. Given that, an anterior foraminotomy might be a rational choice for cases in which degenerative changes prevail over a soft, herniated disc.

### Technical comments on the approach

Posterior microlaminoforaminotomy might be performed in a sitting or a prone position. In our opinion the sitting position provides better spine configuration and a view of the operated region. Additional advantages include less venous bleeding (lower venous pressure) and better outflow of blood and irrigating fluid from the operative field, which improves the surgeon's orientation in the operative field and accelerates the surgery. Importantly, venous bleeding from the epidural plexus in the intervertebral foramen can be a significant obstacle during this procedure [13]. In our series we encountered bothersome bleeding that impaired orientation in the operative field in only 1 patient out of 2 operated on in a prone position. No such problems were noticed in any of the 18 patients operated on in a sitting position. A major disadvantage of a sitting position lies in the extension of time necessary for preparation; the risk of air emboli during cervical spine surgery is very low, though. Henderson et al. did not report a single case of air emboli in their series of 846 operations performed in the sitting position [9].

### Conclusions

1. Posterior microlaminoforaminotomy is a safe, relatively simple and effective treatment modality in cases with unilateral radicular pain that arises from disc herniation with a predominant compression in the lateral recess.
2. Coexistence of osteophytes does not limit the use of this method.

3. The risk of recurrent discopathy and spinal instability after surgery is very low.
4. This technique fulfils the requirements of minimally invasive surgery and does not require any implants, which makes the whole procedure cheaper and allows a quick return to preoperative occupation as well as normal life activities.

## Disclosure

Authors report no conflict of interest.

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