Semin Spine Surg 28 (2016) 75–79

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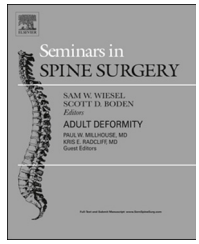

Seminars in cervical disc herniation: Posterior cervical foraminotomy—Indications, technical nuances, and a review of outcomes

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ABSTRACT

Posterior cervical foraminotomy for the treatment of symptomatic cervical disc herniation is a well-established and effective procedure providing long-lasting relief of radicular pain. Many patients will have partial to complete resolution of radicular symptoms without any surgical treatment, (Carette and Fehlings, 2005[1]) and it is therefore reasonable to provide a trial of nonsurgical management in the absence of weakness, or pain causing significant disability. Attention to technique and anatomy is essential in limiting morbidity, which can include focal motor neuropathy and pain. Guidance for treatment of cervical radiculopathy with a posterolateral soft disc compression corresponding to the symptomatic level is through class III studies.

1. Introduction

Posterior cervical foraminotomy for the treatment of symptomatic cervical disc herniation is a well-established and effective procedure providing long-lasting relief of radicular symptoms.[2,3] However, the management of cervical radiculopathy is widely debated. Many patients will have partial to complete resolution of radiculopathic symptoms without any surgical treatment,[1] and it is therefore reasonable to provide a trial of nonsurgical management in the absence of weakness or intractable pain.

Spurling and Scoville[4] implicated a posterolateral cervical disc as the underlying etiology of shoulder and arm pain as early as 1953. This was followed shortly by the earliest series for posterior surgical foraminotmy and nerve root decompression by way of disk fragment removal in 1966 by Scoville and Whitcomb.[5] In the following 10 years, multiple reported series demonstrate a high rate of clinical success with a posterior cervical foraminotomy, citing a low complication rate, low morbidity, low rate of disk recurrence, and a low need for reoperation.[6–10]

Aside from the posterior approach, proponents of the ventral approach cite an ease in disc exposure, decreased postoperative patient discomfort, and an overall wider exposure of the pathology.[11] However, biomechanical studies have shown that fusion of the relatively mobile levels of C3–C7 result in increased forces on adjacent levels, placing patients at an estimated 25% risk for symptomatic adjacent segment disease in the first 10 years after fusion, which can significantly impact quality of life and require additional treatment and possible surgery.[12,13] Additionally, one has to consider the risks of graft subsidence, hardware failure, and

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http://dx.doi.org/10.1053/j.semss.2015.11.011
1040-7383/

pseudarthrosis associated with anterior cervical discectomy and fusion, none of which are risks of a posterior foraminotomy.[11]

2. Technique

The posterior cervical foraminotomy has not significantly changed over the last 50 years.[5] The patient is turned prone after intubation with the head slightly flexed and held by a Mayfield pin headrest. Intraoperative monitoring of motor-evoked potentials and EMG is obtained, if the surgeon chooses to utilize. The shoulders are taped under slight traction to aid in visualization. Affected levels of interest are localized by plain radiographs or fluoroscopically to limit incision size. A midline incision and a unilateral subperiosteal dissection is performed, with care to stay midline in the avascular ligamentum nuchae to avoid the vascular cervical spinal musculature, which causes tremendous pain and increases the risk of intraoperative bleeding. After exposure of two adjacent spinous processes, lateral radiography is obtained to confirm the level of surgery. The localization of the level can be difficult with patients that have shingled and degenerative joints and facets. Further subperiosteal dissection is performed to expose the lamina and facet joint. The lateral inferior edge of the rostral lamina and adjacent medial facet are then removed with a high-speed burr [e.g., Anspach™ 1.8 mm fluted matchstick burr (Synthes Inc., West Chester, PA)], with or without the aid of an operative microscope depending on surgeon preference.[14] Drilling is continued until an eggshell thickness is obtained with care to limit the extent of facetectomy. A 1 mm kerrison then aids to resect cortical bone and the ligamentum below. The axilla of the nerve root is exposed through careful bipolar cautery of the epidural venous plexus without nerve root or thecal sac retraction. Careful inspection will often show the ventral and dorsal nerve roots. Webb et al.[14] argue that further decompression can be safely obtained if needed, by resection of the superomedial edge of the caudal pedicle. After sufficient exposure of the annulus is obtained, an annulotomy is performed with a No. 15 blade and finally compressive disc fragments can be carefully removed. Care must be used to assure that the ventral nerve roots are not displaced and displayed by the underlying disc herniation.

3. Patient selection

Like most neurosurgical spine procedures, posterior cervical foraminotomies require careful patient selection. The posterior cervical foraminotomy is an approach that certainly has the potential for excellent patient outcomes. However, patient selection is arguably the most important factor in determining whether this procedure is truly indicated.

Henderson et al.[15] reported perhaps one of the largest and earliest cohorts of patients carefully selected to receive a posterior cervical foraminotomy. In this series, 736 patients received the aforementioned procedure for isolated cervical radiculopathy. Of note, the authors also emphasize that their practice was comprised of a patient population that is generally middle-class, insured, employed at the time of operation, and usually motivated to return to work and activity—yet there was no difference in elective operations versus those for compensation/liability. By exclusively utilizing this approach for patients with straightforward cervical radiculopathy, the authors conclude they were able to achieve durable outcomes, with a recurrence rate, requiring reoperation, of 3.3%. Radicular pain was relieved in 96% of patients, and motor deficits were relieved in 98% of patients.

The majority of evidence for posterior cervical foraminotomies are class III studies. Davis[16] long-term outcomes of 170 patients with cervical herniated discs managed by the posterior approach are presented in the largest single surgeon series to date. The author of this study interviewed and examined all of the patients, finding 91% of them with unilateral upper extremity radicular pain. On motor examination, 94% of patients were documented to have a focal motor weakness in the arm or hand preoperatively and 74% of patients with correlative sensory deficits. Finally, an operation was performed where neuroradiologic studies confirmed foraminal stenosis from a soft disc herniation. From his series of patients, he was able to identify the following as negatively influencing outcomes: strenuous occupation, workers' compensation, legal claims, radiculopathy due to a hard disc, and persistent paresthesias in the fingers and/or hand postoperatively.

Operative approaches to the spine are best formulated by taking patient symptoms, physical examination findings, and neuroradiologic findings into equal consideration. By selecting the apropriate patients, the neurosurgeon is able to see optimal patient outcomes with minimizing operative risk. Pre-operative counseling should also emphasize a patient's true neurologic symptoms, such as radicular pain and any associated motor as sensory deficits, as true indications for surgery and potential targets for relief.

4. Recent surgical case series

Posterior cervical foraminotomies for soft disc herniations in more recent publications (Table) have been shown to successfully match the high clinical success of earlier reports with reported symptomatic relief of up 98% of patients with evidence of radiculopathy.[2,13,15,17–20]

4.1. *Reoperation*

More recently, Bydon et al.[35] retrospectively reviewed a series of 151 patients undergoing posterior cervical foraminotomy. The series highlights perioperative variables that led to reoperation. Presenting symptoms in this group of 151 patients included neck pain in 42.4%, motor deficit about 50%, and sensory deficits in 39% of patients. All patients had symptoms consistent with radiculopathy. Disc herniation, osteophyte, complex osteophyte–disc herniation, and spondylosis were neuroradiologic findings that justified posterior cervical foramintoromy in this series. Interestingly, patients with pre-operative neck pain had the highest rates of revision surgery and shorter duration of time before repeat surgery after the initial posterior cervical foraminotomy.