Cervical Spine Lateral Approach to Manage Myelo-Radiculopathy: Lessons Learned from 20 Years Experience

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ABSTRACT

OBJECTIVE: The authors describe the rationale for choosing a lateral approach to the cervical spine for the management of spondylotic myelo-radiculopathy; the surgical technique as well as its advantages, disadvantages, complications and pitfalls are discussed along with a critical review of their experience accumulated during the last two decades.

MATERIAL AND METHODS: A lateral approach to the cervical spine may be indicated to treat spondylotic myelo-radiculopathy when there is predominant anterior compression, and either spine straightening or kyphosis but no vertebral instability.

RESULTS: By using a lateral approach it is possible to easily reach and visualize the lateral aspect of the cervical spine and the vertebral artery; in this way the lateral part of the affected intervertebral disc(s), uncovertebral joint(s), vertebral body/bodies and posterior longitudinal ligament can be removed as needed to decompress nerve root(s) and/or spinal cord.

CONCLUSION: Multilevel cervical oblique vertebrectomy and/or lateral foraminotomy allow wide nervous structures decompression; at the same time, optimal stability and physiological spinal motion are maintained.

KEY WORDS: Cervical spine, Discectomy, Lateral foraminotomy, Myelopathy, Oblique corpectomy, Vertebral artery

INTRODUCTION

Cervical spondylotic myelopathy (CSM) and cervical spondylotic radiculopathy (CSR) are classically approached by anterior single or multiple disc space decompression (1, 25), multilevel corpectomy (21), laminectomy (7, 14-16, 20, 22, 32), and laminoplasty (6, 17-19, 23, 24, 27, 33); more recently, techniques using lateral multiple oblique vertebrectomy (MOV) and/or foraminotomy (2-5, 8-12, 26) have been increasingly used. In general, the preferred techniques in cases where three or more levels are affected remain either an anterior multi-level corpectomy or the posterior route such as laminectomy, open door laminoplasty and posterior foraminotomy. The best management remains still controversial; the authors consider the cervical spine lateral approach a valid and safe option to treat such pathologies as it provides very good clinical results and maintains long term spinal stability. The goal of this paper is to further and critically present the idea and rationale of the cervical spine lateral approach with its advantages, disadvantages, complications and pitfalls in a critical review containing about 20 years’ experience.
Technique indication

The proposed technique is generally indicated in cases of predominantly anterior compression especially if associated with either straight or kyphotic spine in the absence of instability. In cases of both anterior and posterior compression, the posterior way is probably the best choice as long as cervical lordosis remains preserved.

It is very rare for the spinal cord to necessitate anterior and posterior decompression.

Inclusion - Exclusion Criteria

Inclusion

- clinical evidence of cervical myelopathy and/or radiculopathy.
- cervical CT-MRI scan evidence of single/multiple level nerve roots and/or spinal cord compression, mainly anterolateral and/or myelopathy.
- evidence of neutral or kyphotic cervical alignment in the lateral cervical plain x-ray as well as absence of instability documented by cervical dynamic x-ray.

Exclusion

- soft disc herniation documented with MRI within 6 months (only for MOV)
- presence of preoperative anterolisthesis > 2 mm between any two contiguous vertebral bodies.

Surgical Technique

Principles

The technique has already been described and reported by the authors (2- 5, 8-13). The idea and rationale of the present technique is based on the evidence that anterolateral compression of the cervical spine and nerve roots, may be best managed by an anterolateral approach because it provides direct exposure of the abnormal area. The described technique is a variation of the Verbiest technique (28-31). The senior author's experience began in 1989 by studying the approach on cadaver specimens; initially, the anterolateral approach was employed to treat only severe nerve root compression. Only cervical foraminotomies were therefore completed. When it was felt that reasonable dexterity was gained, then more complex cases were planned and the first oblique vertebrectomies completed in 1992. Ultimately this approach has become a routine in our Department for the treatment of spondylotic radiculopathy or myelopathy (2-5, 8-13). Generally the anterolateral aspect of the cervical spine is approached from the most symptomatic side. If symptoms are bilateral, the side with the larger osteophytes or disc herniation is chosen. If there is no predominant side either clinically or radiologically, the approach chosen is on the side of the smaller vertebral artery (VA). The idea and rationale is that is easier and safer when the artery is under vision and control.

Patient positioning and exposure: The patient is positioned supine, with the head slightly extended and rotated to the contralateral side. A longitudinal skin incision is made along the medial border of the sternocleidomastoid (SCM) muscle at the level of the vertebral bodies to be exposed. The incision may extend to the mastoid tip to expose C2-3 and to the sternal notch to expose C7-T1. The subcutaneous tissue and the platysma muscle are incised along with the skin incision. The natural space between the SCM muscle and the internal jugular vein is opened by sharp dissection (Figure 1A, B). The SCM muscle is retracted laterally, while the great vessels, trachea, and oesophagus are kept undissected medially and protected by a blunt retractor. There is always a variable amount of fat in the depth of this space. This fatty sheath surrounds the accessory nerve, which must be identified when the C2-C3 and the C3-C4 levels need to be exposed. At that point, the transverse processes can be easily palpated and then visually identified. The transverse processes are covered by the prevertebral muscles. Under the aponeurosis of the longus colli muscle, the sympathetic chain must be recognized. The aponeurosis is divided longitudinally, medial to the sympathetic chain; both the aponeurosis and the sympathetic chain are then retracted laterally (Figure 1A, B). The longus colli muscle is divided along the transverse processes and vertebral bodies at the decided levels and then retracted away from the field. Care must be taken to ensure that the VA is not entering the transverse foramen at an abnormally high level (C5, C4, or even C3); in this case, the artery is running before the transverse processes and may be injured during the longus colli muscle division. At that point, the transverse processes and the lateral aspect of the vertebral bodies are clearly exposed (Figure 2A-C).

Foraminotomy: The intervertebral foramen is opened by removing the anterior part of the transverse
foramen with a Kerrison rongeur after it is identified via subperiosteal dissection; this manoeuvre helps with additional lateral VA mobilization by creating a plane between the lateral aspect of the uncovertebral joint and the medial border of the VA. Once both structures are separated, the hypertrophied uncovertebral joint can be safely removed with a drill and/or rongeurs. In this way, the cervical nerve root can be completely decompressed from its dural origin up to the VA lateral border.

**Oblique Corpectomy:** After radiological identification of the correct level, we start the corpectomy, using a cutting drill, on the bodies on both sides of the disc. We keep the direction of the drill parallel to the endplate; the corpectomy continues until the cortical bone of the posterior aspect of the body is found. The pieces of bone and disc remaining in between are then removed. Next, the drilling is extended obliquely toward the opposite side: it is very important to start with a vertical trench just medial to the VA and then to move obliquely so as to reduce, as much as possible, the extent of bone resection (Figure 3A,B, Figure 4). The intervertebral discs are incised and removed up to the posterior margin of vertebral body. At this stage the vertebral body is drilled obliquely from the lateral side toward the opposite posterolateral corner. More than half of the vertebral body is preserved creating a convex-shaped posterior aspect (Figure 4). Next, drilling is turned towards a point of the posterior aspect of the vertebral body, which has been precisely located on the preoperative computed tomographic (CT) scan. It is located at the limits of the osteophytes and often corresponds to the junction between the body and the opposite pedicle.
Posterior Longitudinal Ligament Resection: The posterior longitudinal ligament must then be at least opened longitudinally and as much as possible removed to ensure that optimal cord decompression has been obtained.

Advantages of the Technique

The present procedure provides the followings advantages:

1) wide anterolateral decompression of the spinal canal and foramen at single or multiple level (multiple levels to decompress is not a limitation).

2) Easy access to any level including the upper ones (C2-C3, C3-C4)

3) kyphotic change is not a contraindication as long as vertebral stability is preserved.

4) there is no need for bone grafting and/or instrumentation making the technique also very suitable for elderly people and heavy smokers.

5) the lateral approach, by using a different path when compared to the standard anterior approach, offers an excellent visual alternative as the field between the SCM muscle and the internal jugular vein is opened. This is particularly desirable in cases of recurrence after previous anterior surgery, because there is no need to mobilize tedious postoperative scar tissue.

6) Safer horizontal drilling

Disadvantages of the Technique

The present procedure has the followings disadvantages:

1) bilateral radiculopathy may not be treated in a single-staged procedure; in these cases, an anterior midline approach remains of choice.

2) in cases where delayed contralateral radiculopathy appears, selective microsurgical nerve root decompression may be advocated although we suggest spine stabilization/fusion.

3) the anterolateral technique, by exposing multiple anatomical critical structures, is a procedure with a steep learning curve. Good knowledge of VA anatomy and its possible variations is essential. However, surgeons should not be discouraged by initial difficulties and should keep in mind that
after having performed the procedure 10 times, the operative time will be substantially reduced.

4) stretch and potential damage of XI nerve (when exposing C2-C3 level), and Horner’s syndrome (when approaching C4-C7) are well known but rare complications.

5) kyphosis, if present, is not corrected by the technique.

Clinical experience

Since 1989, we have completed 478 procedures using this technique. Analysis of our experience allows the following considerations: at a mean follow-up of 102 months (range 9 to 192 months), a global recovery rate of 87.6% was recorded for CSM using the following formula:

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\text{Recovery rate (\%)} = \left( \frac{\text{postop mJOA score} - \text{preop mJOA score}}{\text{17 - preop mJOA score}} \right) \times 100
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and a global recovery rate of 95% for CSR using a score obtained by multiplying the intensity (VAS scale 0 - 10) and the duration scores, ranging in this way, from 0 to 100.

The cervical lateral approach for CSM and/or CSR can be extended on as many levels as required and the number of levels is not considered a limit for this procedure. A total of 862 levels were decompressed in 478 patients (C2-C3 in 33 cases, C3-C4 in 115, C4-C5 in 178, C5-C6 in 284, C6-C7 in 121, C7-T1 in 9). Oblique vertebrectomy was performed at one level in 220 patients, two levels in 118, three levels in 85, four levels in 29, and five levels in 7.

The mean operation time was 129 minutes (range 92 to 183 minutes); mean intraoperative estimated blood loss was 68 ml (range 28 to 280) and the mean hospitalization time 6 days (range 2 to 14 days).

The lateral foraminotomy and the oblique corpectomy technique, by preserving over 50% of the vertebral body and preserving two of the three columns, do not compromise spinal stability so that bone grafts or instrumental arthrodesis are not necessary (5). Patient selection for these procedures is crucial; all patients with clear spine instability (slippage >2 mm between at 2 adjacent vertebral bodies on dynamic x-ray) and/or with a preoperative fixed listhesis >2 mm were therefore excluded. Delayed stabilization became necessary only for three patients (less than 1%). The first developed a disc herniation, the second had a non-recognized congenital bone malformation, and the third developed segmental instability at a level above the treated levels. Aside from these three patients, a change in the spinal curvature of more than 5 degrees was never observed postoperatively at the level of the surgical decompression, regardless of the preoperative spinal curvature.

The lateral approach (2, 3, 5, 8-13, 26) differs substantially from the anterolateral approach as it leads directly to the lateral aspect of the vertebral body and the transverse process which are covered by the prevertebral muscles. When dividing the prevertebral muscles, it should be kept in mind the importance to identify and preserve the sympathetic chain running under the aponeurosis. In general, a postoperative Horner’s syndrome (HS) may develop after manipulation of the sympathetic nerve but it is mild and transient if the main trunk of the sympathetic nerve is preserved. A transient HS was observed in 14 patients (3%), as a consequence of manipulation of the sympathetic nerve; in almost all of them, symptoms markedly resolved within 3 months with less than 1% (4 cases) retaining permanent impairment. The majority of HS cases (9 cases) occurred in the first 3 years of our practice. Horner’s syndrome can occur and constitutes a disadvantage of the technique but it is a matter of fact that its incidence decreases significantly with increasing experience. In our experience, HS is almost always temporary, if careful identification and gentle retraction without dissection of the sympathetic chain is performed. We don’t agree with other authors, such as Rocchi et al. (26), who have proposed dissection of the sympathetic chain to avoid its functional damage. Similarly when exposing above C3, the accessory nerve must be retracted as gently as possible and kept protected by a fat pad around it. Morbidity resulting from the dissection of the accessory nerve is very unlikely and eventually minimal and never occurred in our experience. With the described approach, the VA has to be controlled but not mobilized. VA direct visualization allows safe drilling of the postero-lateral corner of the vertebral body and the control of the distal nerve root. Preservation of the periosteal sheath around the VA prevents troublesome venous bleeding from the perivertebral venous plexus. Care must be taken to identify any abnormal course of the VA, especially entry of the VA into the transverse canal at an abnormally
high level, which may be the C5, C4, or even C3 level (4); this could be easily achieved by carefully examining a standard preoperative MRI and/or MRA.

Practical pearls offered by the authors while performing this technique include the placement of the suction device in front of the VA and…?? to provide its protection in case of inadvertent sliding during drilling. The operative microscope should also be set obliquely (to have an oblique view) during the oblique corpectomy to avoid the natural tendency to drill bone inadvertently and unnecessarily in a horizontal plane, thus compromising spine stability; this represents the first surgical pitfall. Another problem is represented by the absence of an anatomic landmark to define where the horizontal drilling should be stopped; this constitutes the second pitfall and to solve it we determined the extension of drilling on the preoperative computed tomographic scan. In general the limits of the osteophytes set the length of bone drilling and, very often, correspond to the junction between the body and the opposite pedicle.

The distance between the contralateral pedicle and the medial border of the ipsilateral VA is measured on the preoperative computed tomographic scan, or as we recently started to do, by using the navigation guide as it is very reliable. This distance can be verified during surgery to check the adequacy of the decompression in the horizontal plane. In the majority of cases, the distance varies between 22 and 28 mm. Neither cerebrospinal fluid leakage (0%), nor infections (0%), nor C5 deficit or dysphagia/dysphonia were observed in our series. We have no clear explanation about why these complications were not encountered; they may be related to the absence of any distraction during the procedure and the possibility for the surgeon to follow the cervical spinal root at the foramen. Since this technique does not require medial traction, the trachea and esophagus are barely touched by holding a hand blade (a self-retaining retractor is never used). In any case we would like to stress that this approach is initially a demanding procedure and the learning curve may be long for some. In the authors' experience it is enough to perform the procedure few times in the cadaver lab and, for the first few times, to be assisted by an experienced surgeon. We also would like to stress that good knowledge of VA anatomy and its variations is essential to perform this operation; needless to say, careful analysis of preoperative imaging is crucial.

CONCLUSIONS

Although multilevel oblique corpectomy and/or simple foraminotomy via a lateral approach remains a rather demanding technique with a substantial learning curve, we believe it is a valid alternative for the management of multisegmental cervical spondylosis. Good knowledge of VA variations is essential and careful analysis of preoperative imaging is mandatory. This technique does not compromise stability, as much as anterior approaches do; the incidence of early and late postoperative complications is lower and bone grafting is not necessary, allowing it to be used in patients with a low fusion rate as in the elderly, diabetics and/or heavy smokers. It also permits early patient mobilization with no postoperative immobilization. As often is the case, optimal results rely on scrupulous selection of patients and preservation of cervical spine stability.

REFERENCES


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