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An Overview on Treatment of Cervical Spondylosis

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Abstract:

Cervical spondylosis refers to the age-related degenerative changes of the cervical spine, including intervertebral disc degeneration, osteophyte (bone spur) formation, ligament thickening, and facet joint arthritis. These changes are common in individuals over the age of 40 and may lead to a spectrum of clinical symptoms depending on the structures affected. Patients with cervical spondylosis may be asymptomatic or present with symptoms such as neck pain, stiffness, radiculopathy (nerve root compression), or cervical myelopathy (spinal cord compression). Myelopathy is considered the most serious complication and can result in significant functional impairment, including gait disturbances, hand clumsiness, and even bowel or bladder dysfunction. Cervical spondylosis is a progressive degenerative condition that can lead to significant morbidity if not appropriately managed. Early recognition and a tailored treatment approach—ranging from conservative management to surgical intervention—are essential for optimal outcomes and quality of life in affected individuals.

Keywords: Cervical spondylosis, conservative management, cervical myelopathy.

Introduction:

The true natural history of cervical spondylotic (CS) is difficult to discern. The disease process progresses in a variable and unpredictable manner. Often there is stepwise deterioration of neurologic function, with periods of stable symptoms followed by decline. The clinical course may wax and wane over a period of years. Sensory symptoms may be transient, but motor symptoms tend to persist and progress **(1).**

CS may present with variable clinical findings depending on the levels affected and involvement of the neural foramina and long tracts. A variety of neurological symptoms and signs may be present **(2).**

The treatment of cervical spondylosis is by conservative treatment in the beginning by medical treatment and physiotherapy and if there is no response surgical treatment is considered in the form of decompression procedures to relieve the cord compression **(3).**

1. Non-operative Conservative treatment:

The conservative treatment is by observation, physiotherapy and lifestyle modifications.

Indications:

1. Mild disease with no functional impairment.

- Function is a more important determinant for surgery than physical exam finding (**4).**

2. Patients who are poor candidates for surgery:

- **Modalities:**

Medications such as (non-steroidal anti-inflammatory drugs, gabapentin or pregabalin) and physical therapy for neck strengthening, balance, and gait training. Watching the patients carefully for progression by

follow up examinations every six to twelve weeks initially and then every six months if the neurological deficit is not progressed **(4).**

3. Surgical treatment:

Surgical decompression, restoration of lordosis and stabilization. This can be done if there is significant functional impairment. There are many forms of cord decompression procedures that can be done by anterior or posterior approaches that allow for cord decompression. Appropriate procedure depends on cervical alignment, number of stenotic levels and location of compression (either from anterior or posterior) **(3).**

Surgical treatment procedures are:

1. Anterior decompression:

Indications of anterior decompression:

1. Mainstay of treatment in most patients with single or two level disc diseases.
2. Fixed cervical kyphosis of > 10 degrees, anterior procedure can correct kyphosis.
3. Pathology is anterior (soft discs and disc osteophytes complexes). **(3)**

1. Anterior cervical discectomy and fusion (ACDF).
2. Anterior median cervical corpectomy and fusion (ACCF).
3. Oblique corpectomy **(3).**

2. Posterior decompression:

Indications of posterior decompression:

Multilevel compression with kyphosis of < 10 degrees **(5).**

Contraindications:

Fixed kyphosis of > 10 degrees is a contraindication to posterior decompression because this will not adequately decompress spinal cord as it is "bowstringing" anterior **(5).**

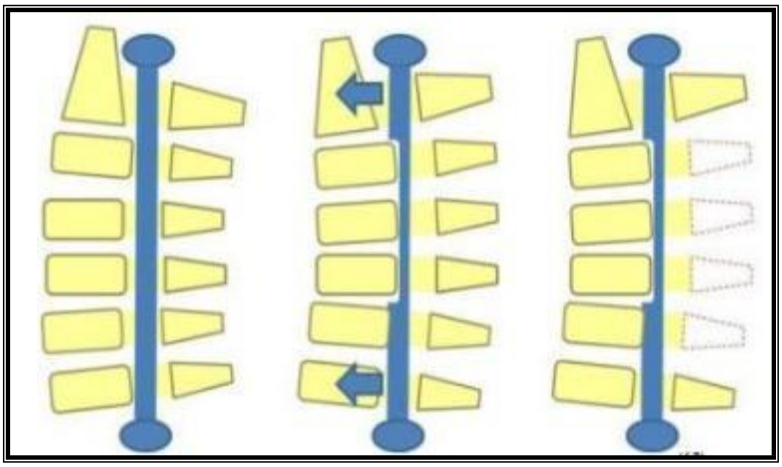

Fig. (1): Cervical alignment and posterior decompression **(6).**

The idea of posterior decompression:

A range of posterior surgical procedures exist, including laminectomy, laminoplasty, and laminectomy with posterior fusion. Until the 1960ˈˈs the traditional way to decompress the cervical spine in spondylotic

patients was via a dorsal approach and a decompressive laminectomy. This surgery effectively enlarges the spinal canal area, allowing the spinal cord to drift away from ventral compression, so The posterior approach relies on decompression through both direct removal of offending posterior structures and indirectly, through spinal cord translation posteriorly, however, while doing this it also may destabilize the dorsal structures and can lead to progressive kyphotic deformity **(5).**

The advantages of the posterior approaches over the anterior:

Posterior based operations such as laminectomy, laminectomy and fusion, and laminoplasty possess their own distinct set of advantages. First, because an indirect decompression is performed, posterior surgeries are generally technically easier operations to perform than anterior corpectomies, particularly in multilevel patients with severe stenosis or OPLL that requires resection. Accordingly, all challenges associated with graft carpentry to reconstruct the anterior column are avoided. Second, posterior decompression allows the surgeon to rapidly decompress multilple segments more quickly than is possible with a multilevel anterior decompression. This may be critical in treating debilitated patients who need a quick decompressive procedure. Third, motion-preserving posterior operations like laminectomy allow cord decompression without necessitating fusion and its attendant complications. Fourth, because fusion is not routinely necessary with some posterior approaches like laminectomy, laminectomy allows decompression of segments at future risk in one operation without substantially increasing patient morbidity **(5).**

Laminoplasty.

1. Laminectomy with fusion.
2. Laminectomy without fusion.

1. Laminepalsty:

Laminoplasty describes the process of increasing the space available for the spinal cord by reconstruction of the laminar arch via a posterior approach **(7).**

There are many techniques that are all similar in that they expand the cervical canal and preserve some or all of the posterior elements. Modifications on where the cuts in the lamina or spinous processes are made and how the canal is kept open have been developed. Newer techniques, such as the use of ceramic spacers and titanium mini-plates have been proposed, which may decrease the surgical time and improve the safety of the procedure **(7)**.

Laminoplasty was developed to widen the spinal canal dimensions without permanently removing the dorsal elements of the cervical spine. The retained dorsal elements should aid in the prevention of muscle scarring to the dura (i.e., result in less cervical and head pain after surgery) and potentially reduce the incidence of postoperative instability. Cervical motion is theoretically preserved **(7, 8).**

In 1968, Dr. Yoshihito Kirita devised a sophisticated technique of laminectomy, in which the laminae were thinned and divided at the mid line by a high-speed drill and then removed. Being safe and effective, Kirita‟s technique brought remarkable progress in the surgical management of cervical compressive myelopathy **(7, 8).**

However, postoperative kyphosis, vulnerability of the unprotected spinal cord, and formation of a laminectomy membrane still remained as unsolved problems due to the total removal of the posterior supporting structures **(8).**

In 1973, Dr. Susumu Hattori and Oyama devised an expansive Z- laminoplasty, in which the spinal canal was reconstructed by the preservation of the laminae, to address such problems **(8).**

However, this technique did not prevail because it was technically demanding and time-consuming. Dr. Kiyoshi Hirabayashi used a modifcation of Kirita‟s method, in which the spinal cord was decompressed by

making bony gutters at both lamina–facet junctions followed by en-bloc resection of the laminae. The idea of open-door laminoplasty evolved when Hirabayashi noted that the pulsation of the dural tube was present when he lifted one side of the laminae, indicating that sufficient decompression was obtained without totally removing the laminae. In 1977, he performed the first case of the procedure, which he named -expansive open-door laminoplasty‖ (ELAP). In this procedure, only the ventral cortex in one side of the gutter was penetrated, leaving that in the other side, which serves as the hinge, intact **(8).**

Since then, the concept of laminoplasty gained wide spread acceptance in Japan, and the advent of double-door laminoplasty by Kurokawa followed **(8).**

These two techniques have formed the base that enabled the development of many modified procedures, and the concept of laminoplasty has spread worldwide. Although ELAP is not a radical decompression surgery that directly removes anterior pathological structures, such as protruded disks, osteophytes, and ossified ligaments, it has a total decompression effect induced by the dorsal shift of the spinal cord as long as cervical alignment is maintained in lordosis **(8).**

Its possible complications such as This procedure has not been widely accepted because of the technical difficulties of the operation, related to the thinning of the entire laminae to perform a Z-plasty at each level, leading to long operative times, and high blood loss **(9).**

2. Laminectomy with fusion:

Laminectomy with posterior fusion can be added. Currently, fusion in association with laminectomy is typically performed with lateral mass screws. Autologous bone graft from the iliac crest is generally recommended to enhance fusion rates, but successful outcomes have been noted with the use of local auto graft bone only **(10).**

The indications of laminectomy with fusion are:

Axial neck pain as it is preferred in multilevel myelopathic patients with significant neck pain (e.g., from facet arthropathy), if one aim of surgery is to control the spondylotic neck pain with fusion. Preservation of sagittal alignment; because laminectomy and fusion better preserves sagittal alignment than does laminoplasty, it may also be preferred in patients who are not too kyphotic to be decompressed posteriorly (e.g., neutral to slightly kyphotic alignment). It limits repetitive microtrauma and instability; as the fusion may limit repetitive micro-trauma to a healing cord and also prevent the development of instability which has been associated with poorer neurologic outcomes **(10).**

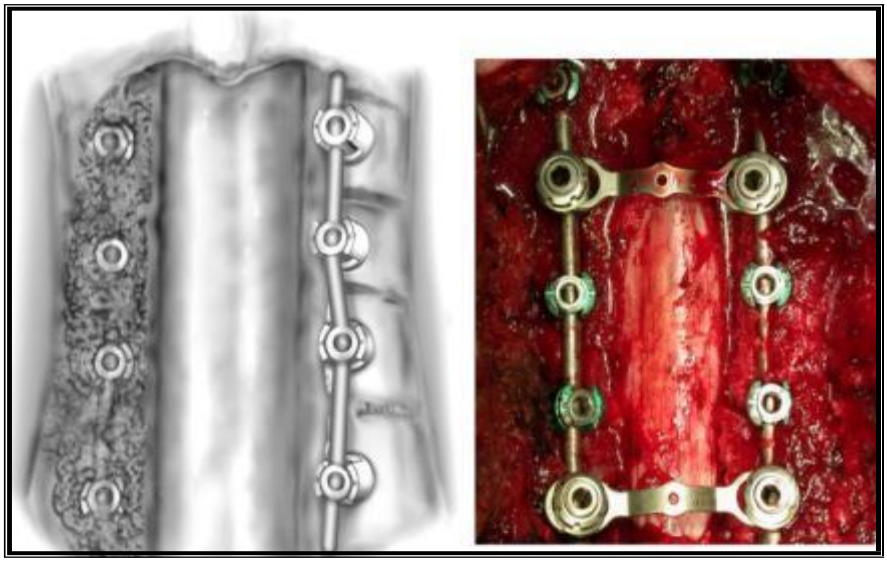

Fig. (2): Laminectomy with fusion **(11).**

Its possible complications such as New postoperative neurologic deficits following PCF was found to occur in about 8.5% of patients . The most common deficit is C5 palsy, which manifests as weakness of the deltoid and/or biceps brachii muscles, with or without concomitant shoulder pain and sensory deficits. Even though about 96% of patients with minor palsies and 71% with severe palsies fully recover eventually, this is a dreaded complication due to its significant impact to the patient's quality of life, and its highly variable time to recovery. One study has estimated time to recovery ranging from 48 hours to 41 months.

The main complications of lateral mass screw insertion are injury to the adjacent nerve roots, the vertebral arteries and screw fixation failure **(12, 13).**

3. Surgical treatment of CS by laminectomy without fusion:

Laminectomy without fusion is the most common approach to decompression for multilevel myelopathy **(3).**

- **History of laminectomy without fusion:**

Cervical laminectomy has long been the treatment for multilevel cervical spondylosis. It permits adequate decompression of the cervical spinal cord and is safe and easily performed. Potential adverse outcomes after cervical laminectomy. **(7, 8).**

In the early fifties, all surgical procedures of the cervical spine were performed using a posterior approach. Anterior approaches were initially avoided for fear of damage to vital structures, such as the esophagus, carotid artery, jugular vein and vagal nerve. Decompressive surgery of the spinal cord and radices was performed through large posterior incisions and consisted of laminectomies or hemilaminectomies with or without opening of the dura, sometimes cutting the ligamentum denticulate **(14)**.

- **Indications:**

A cervical laminectomy is indicated for the patients with cervical spinal stenosis, which is a narrowing of the spinal canal. Stenosis may be caused by a number of degenerative spine conditions, including wear and tear on the bones, discs, and ligaments.

A narrow spinal canal can compress the spinal cord and surrounding nerves. Compression may irritate a spinal nerve or nerves, causing radiculopathy (pain, weakness, numbness, or tingling in one limb). Compression of the spinal cord itself can damage its delicate tissues and cause myelopathy (pain, weakness, numbness, or tingling in both arms or legs, difficulty walking, and/or loss of bowel or bladder control).

A laminectomy decompresses the spinal cord and spinal nerves. It is generally effective when performed in patients who have an identifiable compression resulting in radiculopathy or myelopathy.

Before surgery is considered, nonoperative measures like physical therapy and pain medications may be tried. These measures provide effective relief in many cases. But when other treatment plans do not provide relief, and a problem exists that can be surgically corrected, surgery is often the treatment of choice. Surgery is also typically required for cases in which the spinal cord is compressed and multi- level **such as.**

1. Ossification of the posterior longitudinal ligament (OPLL) **(15).**
2. Multi-level cervical spondylosis (more than 3 levels) **(15).**

- **Contraindications:**

1- Cervical kyphosis: more than 10 degrees is a contraindication to posterior decompression because the posterior decompression will not adequately decompress spinal cord as it is "bowstringing" anterior, as there is less room for posterior drift of the cord. So, it is possible to perform laminoplasty in a straightened spine, but a lordotic posture is preferred.

2- Severe axial neck pain: is a relative contraindication and these patients should be fused because they have facets pain that is decreased and improved if these facets are fused.

3- Spinal pathologies, which are best treated by an anterior approach (i.e., cervical disc disease or traumatic vertebral body fracture with canal compression).

4- Ossification of the ligamentum flavum (OLF).

5- Epidural fibrosis.

6- Instability of the affected segment.

7- Previous posterior cervical surgery **(15)**

- **Surgical Instruments needed:**

The use of the usual instruments for cervical laminectomy suffice such as scalpel to open the skin ,diathermy for opening the sheath of ms ,scissors , bipolar for hemostasis

* Bone currete fiber handle

* Bone nibller double action angular

* Cobbs Elevator

* Disc Forceps Straight

* Disc Forceps Up

* Disc Forceps Down

* Dura Elevator

* Kerrison Bone Punch 2 mm

* Kerrison Bone Punch 3 mm

* Kerrison Bone Punch 4 mm

* Kerrison Bone Punch 5 mm

* McDonald Retractor

* Mastoid Retractor Self Retaining

* Nerve Root Retractor Straight

* Nerve Root Retractor Angled 45Degree

* Nerve Root Retractor Angled 90 a fine-tipped Kerrison rongeur make the removal of the ligamentum flavum safe and easy. **(16)**

- **Positioning of the Patient:**

The patient's hair is shaved up to the inferior margin of the occiput. The patient is placed in the prone position on the surgical table. Sponge pads are placed underneath the bilateral shoulders and iliac crests to relieve excessive pressure on the chest and abdomen. The head is securely fixed with a Mayfield fixator that is firmly attached to the surgical table. Both knees are bent at the right angle, and the lower legs are firmly fixed to shin supports attached perpendicular to the surgical table. Then, the table is tilted cranially upward at an angle of 20 to 30 degrees (A reverse Trendelenburg position) to reduce venous congestion.

The neck is slightly flexed to open the interspinous spaces and to bring the posterior aspect of the neck parallel to the horizontal plane. After the patient is positioned, the shoulders are taped down. A radiopaque skin

marker may be used to estimate incision length, but C2 and C7 spinous processes are prominent and provide a good estimate of incision length (Fig. 3) **(16)**.

Fig. (3): Intraoperative photograph of the prone position for laminoplasty procedure. **(17)**

- **Approach:**

The external occipital protuberance (Inion) and the spinous processes of C2 and C7 serve as landmarks of the midline. Make a straight midline incision of appropriate length, usually from C2 to C7, and follow the central plane along the nuchal ligament down to the spinous processes. Be sure to always stay in the midline because a careful midline dissection through the nuchal ligament minimizes muscular bleeding. Retraction of the skin and subcutaneous tissues bilaterally with Gelpi or Adson retractors helps clarify the midline. Identify the prominent C6 or C7 spinous process first, then proceed cranially so as not to miss the midline **(Fig. 4) (16).**

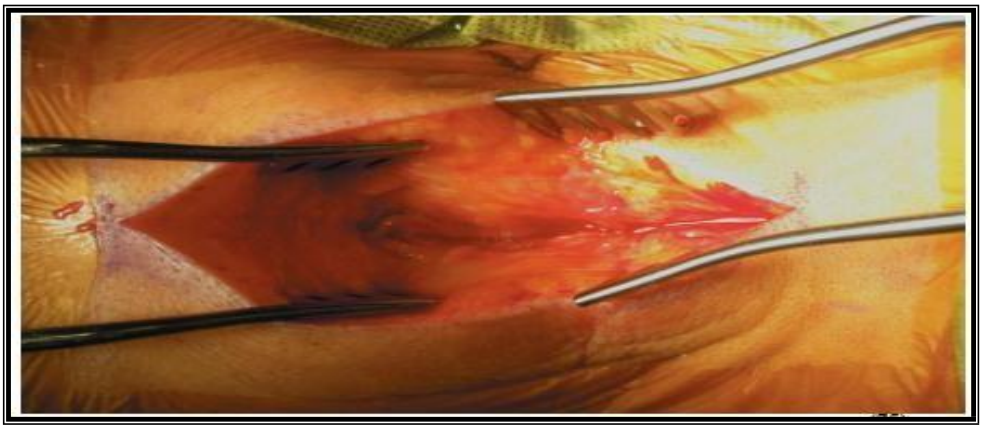

Fig. (4): Posterior approach to cervical laminoplasty **(17).**

- **Lamina Exposure:**

Expose the tips of the spinous processes with a cautery, then strip the bilateral paracervical muscles from the lateral aspects of the spinous process and the laminae with a small Cobb elevator or a cautery, taking care not to violate the facet joint capsules **(16).**

Fig. (5): Lamina exposure **(17).**

- **Laminectomy without fusion techniques:**

During a laminectomy, the lamina is removed. In addition, the spinous process may be removed or trimmed to open the spinal canal and give your neurosurgeon access to the spinal cord and nerve roots. A cervical laminectomy may include a partial or complete discectomy. Sometimes a herniated disc encroaches into the spinal canal and presses on the spinal cord and nerve roots.

Thickening of this ligament can cause it to buckle and press on the spinal cord and nerve roots.

Fig. (6): Posterior approach to cervical laminectomy

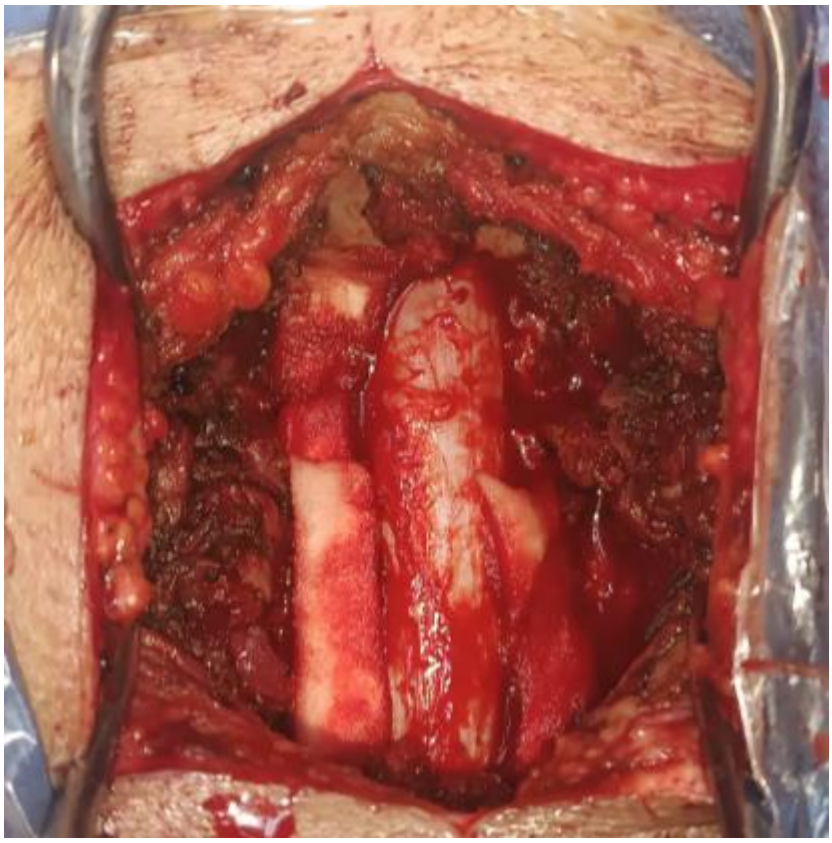

Fig. (7): Ligamentum flavum is removed

- **Postoperative care:**

The patient is encouraged to ambulate the next day without any external support, and to start gentle range-of motion (ROM) neck exercise on the third day. Patients can be discharged within a week or even earlier. The patient is encouraged to return to the work after 3 to 4 weeks. Vigorous activities including manual labor and sports are permitted after 3 months, depending on the patient's neurologic status **(18).**

- **Aims of Laminectomy without fusion:**

The aims of laminectomy without fusion are to decompress (take pressure off) the spinal cord and nerve roots , to secure spinal stability, and to spare the protective function of the spine. Preservation of mobility of the spine is not exactly the aim of this procedure for multiple-level involvement**.** There is a pre-requisite for assuring a successful laminectomy. The spine must be non-kyphotic. In a lordotic spine a backward shift of the spinal cord is expected to ensure enough space between anterior osteophytes and the spinal cord. The utmost shift of the spinal cord, visualized postoperatively in CT- myelography, is sometimes beyond 5 mm at the apex of physiological lordosis **(19).**

The purpose of a laminectomy is to decompress (take pressure off) the spinal cord and nerve roots.

Advantages of laminectomy without fusion:

1. Decompression of the spinal cord without removal of spondylotic protrusion impinging on the neural tissue. Removal of the osteo- cartilaginous protrusions encroaching on the already compromised neural tissue is known to be the most hazardous part of the operative procedure when surgeons use the anterior approach for CS.
2. Decompress of spinal canal and nerve roots without much loss of spinal stability. When the spinal cord has suffered myelomalacia secondary to sustained spondylotic compression, instability may be the major

cause of worsening after decompressive laminectomy, particularly if it is associated with epidural adhesions (post laminectomy membrane**).**

3. Anterior surgery for CS and OPLL often demands more careful and meticulous haemostasis. But haemostasis is not much of a problem with laminectomy**. (8)**

Complications:

1. Wound complications:

There is a large incidence of wound complications and poor healing presumably due to the increased tension created by the mass effect of elevating the posterior structures. It is for this reason that it is commonly that the more pronounced spinous processes are debulked prior to wound closure **(20).**

Any time surgery is performed, there is a risk of infection. However, infections occur in less than 1% of spinal surgeries. An infection can be in the skin incision only, or it can spread deeper to involve the areas around the spinal cord and the vertebrae. A wound infection that involves only the skin incision is considered a "superficial" infection. It is less serious and easier to treat than the deeper infection. Surgeons take every precaution to prevent infections. You will probably be given antibiotics right before surgery - especially if bone graft, metal screws, or plates will be used for your surgery. This is to help reduce the risk of infection **(21).**

If the surgical wound becomes red, hot, and swollen and does not heal, it may be infected. Infections will usually cause increasing pain. You may run a fever and have shaking chills. The wound may ooze clear liquid or yellow pus. The wound drainage may smell bad **(21).**

2. Nerve root palsy (specifically C5):

A motor dominant C5 root palsy may result after laminectomy in 5–11% of cases. This usually occurs on postoperative day two or three and is not commonly seen immediately postoperatively. C5 is most often involved, although C6, C7, and rarely C8 root palsies have been described. It begins with deltoid weakness and shoulder pain. These motor root palsies are not a unique to laminectomy .

This complication has also been reported after laminectomy and fusion or anterior decompression and fusion procedures for the same pathology **(22).**

The reason for C5 palsy is unknown, but it is likely caused by the course of the nerve through its foramen (which is straight and short) and traction on the nerve as the cord migrates dorsally. Other series have attributed postoperative C5 palsy to intraoperative nerve root trauma **(20).**

In post laminectomy patients evaluated with CT myelograms who showed a mean posterior drift of 3mm at the level of C5 there was a mechanical tethering of the nerve root in the foramina which put the C5 root under stretch and cause the palsy, though this theory does not fully explain why C5 palsy may occur after an anterior decompression as well **(23)**.

The pain may be controlled with physical therapy and non steroidal anti- inflammatory drugs. The motor palsy usually recovers to normal or near normal within 12 months after surgery **(20).**

3. Axial neck pain:

Patients may complain of axial neck pain after laminectomy . Its true incidence is unknown because it is not consistently reported in the literature. It may be a result of the surgical manipulation and dissection around the facet joints. The pain usually begins shortly after surgery, but usually resolves within one year **(24).**

The exact etiology for the postoperative neck pain is unclear, but may be related to stiffening of the facet joints, denervation and injury to the nuchal musculature. A new onset midline neck pain is relatively rare, although persistence or amplification of preoperative axial pain is common. Thus, laminectomy without fusion is ideally suited to the patient with little to no axial pain **(24).**

4. Spinal cord injury:

Any time you operate on the spine, there is some risk of injuring the spinal cord. This can lead to serious injuries to the nerves or the covering of the spinal cord - the dura. The spinal cord is a column of nerves that connects your brain with the rest of your body, allowing you to control your movements. The nerve fibers in your spinal cord branch off to form pairs of nerve roots that travel through the small openings (foramina) between your vertebrae. The nerves in each area of the spinal cord connect to specific parts of your body. Damage to the spinal cord can cause paralysis in certain areas and not others, depending on which spinal nerves are affected **(25).**

5. Loss of motion:

Even when a laminoplasty is performed, loss of motion typically does occur. The cause may be multi factorial but may be related to facet joint injury with spontaneous fusion or alterations in tissue elasticity after an extensive posterior exposure. Prolonged postoperative immobilization may contribute to the problem **(26).**

In a long term study of open door laminoplasty, **Wada et al. (27)** reported 27% loss of range of motion (37.1 degree preoperative to 27.1 degree postoperative) in patients who were immobilized in a collar for only three weeks, compared with a 71% loss of motion (40.2 degree preoperative to 11.6 degree postoperative) in those who were immobilized for 2~3 months. In general, about 30% loss of preoperative range of motion can be expected in the C2-7 motion arc, even with early mobilization.

6. Progression of OPLL:

In patients with severe OPLL and dural deficiencies, laminectomy without fusion provides a safer, easier solution to decompression than does anterior corpectomy. However, because the OPLL is not resected with laminoplasty, the potential remains for growth and expansion of OPLL over time. In most cases, symptomatic regrowth at the decompressed levels is unlikely because the canal diameter is made so large that a modest amount of OPLL expansion will not cause recurrent stenosis. But if the OPLL expands longitudinally to include previously undecompressed adjacent segments, symptomatic cord compression may occur. This scenario is more likely in younger patients with significant OPLL, and thus consideration should be given at the initial laminoplasty to prophylactically decompress segments adjacent to the limits of the OPLL, particularly the more cephalad area. For example, if such a patient has a large mass of OPLL arising at C4, with stenosis distal to C4 but not involving C3-4, one might still consider decompressing C3 prophylactically **(28).**

Outcome:

1. Neurologic:

Most studies report outcome based on visual analogue score (VAS) for neck pain and brachialgia examination motor power. Reported results include mean preoperative and postoperative scores for all patients, and a calculated rate of recovery is provided **(29).**

The range of recovery is likely related to the degree of preoperative myelopathy and not the specific surgical procedure **(29).**

2. Cervical alignment:

In general, no specific laminectomy without fusion technique has been able to prevent the development of some degree of kyphosis after surgery. Moreover, no laminectomy without fusion technique is effective for the restoration of lordosis in an already kyphotic spine. The range of worsening of spinal alignment, not necessarily kyphosis, has been reported to range from 22% to 53%. The incidence of development of kyphosis has been reported to range from 2% to 4**% (30).**

3. Range of motion:

Cervical ROM has been reported to decrease from 17% to 50%. The clinical prevalence of this decreased ROM is controversial. In long- term follow-up studies, there is a clear trend towards a decrease in cervical ROM **(26).**

Hyun et al. (26) reported a significant rate of spontaneous facet fusion in their patients whom they monitored for at least 10 years after laminectomy **.**

Long-term outcome:

There are studies that have reported long-term outcome after laminectomy . **Miyazaki et al. (31)** observed that improved neurologic status was maintained at a mean of 12 years after surgery. **Kawai et al. (32)** reported 10-year follow-up after laminectomy without fusion and found patients with CSM were stable after surgery, whereas those with OPLL demonstrated some late deterioration.

Only 20% of those patients operated upon for OPLL demonstrated late worsening. It appears that OPLL may progress despite laminectomy. In general, improvement after laminectomy without fusion is stable, even up to 10 years after surgery **(33)**.

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