The Effect of Cervical Laminoplasty and Laminectomy on the Cobb Angle in the Treatment of Cervical Spondylotic Myelopathy

Emir Kaan İzci[1], Mahmut Sertdemir[2], Fatih Keskin[3]
[1]Konya City Hospital, Orcid:0000-0002-7713-4643
(Corresponding Author)
ekaanizci@hotmail.com
[2]Konya City Hospital, 0000-0002-3659-5646
mahmutsertdemir25@gmail.com
[3]Meram Medicine faculty, 0000-0001-9398-8908
drfatihk@yahoo.com

Abstract
Treating Cervical Spondylotic Myelopathy (CSM) has always been a complicated procedure for surgeons. The most utilized procedures for treating CSM included laminectomy with fusion (LF) and cervical laminoplasty (LP). Both these procedures are found to be favourable in this regard. The present retrospective study was conducted to determine the impact of LP and LF on the Cobb angle of the patients while treating CSM. For this purpose, 52 patients who underwent LP or LF were selected and divided into groups based on the procedure they went through: LP group (26 patients with a mean age of 60.11 years) and LF group (26 patients with a mean age of 63.83 years). For this study, both pre and postoperative clinical and radiographic outcomes for both groups were determined. The clinical outcomes included recovery rates, VAS and mJOA scores, whereas the main parameters for determining the radiographic outcomes were Cobb angle (C2-C7), diameter and area. The values of *p* for VAS, mJOA scores, diameter (mm) and area (mm^2) were found to be ≤ 0.05, showing significant outcomes, while the value of *p* in the context of Cobb angle (C2-C7) for the LP group was found to be 0.044 and that of LF group was 0.308. So LP had a significant impact on the Cobb angle. However, in preoperative axial pain, the most suitable procedure is LF.

Keywords*: Cervical Laminoplasty; Cobb Angle; Cervical Spondylotic Myelopathy; Laminectomy; mJOA Score; Recovery Rate; VAS score.*

Tob Regul Sci.™ 2022; 8(1): 4158-4170
DOI: doi.org/10.18001/TRS.8.1.312

1. Introduction

A chronic medical illness known as cervical spondylotic myelopathy (CSM) is typically linked to intervertebral disc degeneration. The most prevalent kind of spinal cord deterioration in elderly patients is cervical spondylotic myelopathy, which is brought on by growing spinal canal constriction and consequent nerve root entrapment. Surgery is typically recommended when non-surgical therapy fails to control a patient's CSM (Lopez et al., 2021). Anterior cervical decompression and fusion for multilayer CSM is a challenging treatment that could result in a lengthy recovery period, and comorbidities include trigeminal nerve palsy, internal graft displacement, and swallowing disorders. The basic prevertebral surgical approaches for treating CSM are laminoplasty (LP) and

laminectomy with fusion (LF), with or without fusion, to eliminate compression factors, create sufficient space for the chord, and decompress the brain stem. (Mehdi et al., 2016).

The vertebral column's bones, or spinal vertebrae, which make up the skeletal ceiling of the spinal canal, include the lamina. The spinal cord and nerves are contained in this passageway. As we age, the spine will deteriorate, which might result in a herniated disc or bone projections that constrict the spinal canal (spinal stenosis). As a result, the spine and spinal nerve roots are compressed, causing pain, tingling, or weakening (C. Chen et al., 2020). Spinal surgery can be required if a patient has neurological issues that are significant or getting worse over time. In a cervical laminectomy, the lamina is taken out. The spinal canal is widened, relieving strain on the spinal cord. The durability and stability of the spine could be harmed by eliminating the lamina. This could result in a malformation or worsening pain. A laminoplasty is a choice. Rather than eliminating the vertebrae, this spinal fusion repositions the lamina to open up the spinal canal. Using a tiny metal plate and screws, the lamina is propped open (Keskin, 2021).

Laminectomy was once considered the gold standard procedure for CSM, typically accompanied by further fusion. Nevertheless, this method has several drawbacks, including post-LC kyphosis, segmental instability, and ensuing cerebral degeneration, which results in a shortened prescription. After laminoplasty, the ligament flavum still covers the brain stem and posterior laminar bone. The benefits of laminoplasty include reducing instabilities, controlling dura narrowing from extradural scar formation, maintaining mobility, and preventing problems associated with fusion (G. Chen et al., 2020). Nonetheless, patients with CSM, >13° of kyphosis, and significant neck pain should not have LP. Even though LP has various drawbacks, such as issues with the spinal canal being reclosed, hinge fractures, more demanding operational specifications, and potential cervical cord injuries, LP has increasingly gained the acceptance of more surgeons. Both surgical methods are regarded as successful in treating CSM because they relieve the brain stem by widening the spinal canal (Zhao et al., 2021). When precise parameters are selected, the anterior and posterior operations can produce equal therapeutic benefits in the treatment of CSM. Despite the absence of discernible contrast between the two techniques in the recovery rate of cognitive performance, comorbidities and reoperation rates are more significant in anterior procedures (Zhang et al., 2019).

The current research aims to evaluate the safety and technical effectiveness of cervical laminoplasty and laminectomy in MCSM patients by determining their complications and clinical outcomes. This aim is achieved by fulfilling the following objectives:

- To determine the pre and postoperative clinical outcomes of LP group using the visual analog score (VAS), modified Japanese Orthopaedic Association (mJOA) score and cervical lorosis Cobb's angle.
- To investigate the pre and postoperative clinical outcomes of LF group using the visual analog score (VAS), modified Japanese Orthopaedic Association (mJOA) score and cervical lordosis Cobb's angle.
- To observe radiographs for LP and LF groups presenting the spinal cord area and the antero-posterior diameter.

Among the posterior techniques, Laminotomy involves only partial lamina removal, making it ineffective for treating multilevel cervical spondylitis myelopathy (MCSM). Whereas both expansive cervical laminoplasty (ECLP) and traditional extensive laminectomy have been employed to treat MCSM, ECLP has disadvantages such as surgery-related axis symptoms and cervical lordosis loss. In contrast, traditional laminectomy is poor at preserving the range of neck motion (ROM) (Li et al., 2015). Since the musculature of the posterior extensor plays an essential role in transient cervical performance, on the other hand, removing these muscles might result in surgical side effects, including axial discomfort, cervical imbalance, and even lumbar lordosis (Nori et al., 2017).

2. Review of Literature

Multilevel cervical spondylitis myelopathy (MCSM) is a condition that frequently has a protracted course, causes significant cervical spine degeneration, and advances quickly. LF's benefits are considered sufficient for cervical spine decompression and partial physiological curvature restoration (Zhou et al., 2018). Nevertheless, in comparison to LF, LP might also accomplish an adequate decompression and even preserve the entire posterior structure and cervical motion, enhancing preoperative postoperative patient quality of life and expediting early rehabilitation.

A study by Lee et al. (2021) evaluated the demographic and management of cervical spondylosis. The most frequent clinical manifestations were myeloradiculopathy characteristics, and the most impacted levels were C5-C7. One-third of patients got laminectomy alone, and the remaining two-thirds received laminectomy plus foraminotomy. They ranged in age from 38 to 82, were made up of 14 men and 11 women, affected men somewhat more than women, and were more likely to live in remote than metropolitan regions. With C5-C7 being the most damaging levels, myeloradiculopathy characteristics were the most frequently seen exhibiting ones. In addition to necessary studies, including radiographic evaluations, a comprehensive checkup and neurological evaluation were conducted (Wang et al., 2020). Each patient underwent surgery, with laminectomy and foraminotomy used to treat 17 patients (68%) and foraminotomy alone to manage the remainder of 8 patients (32%). The complaints of more than half of the individuals exhibited some recovery, whereas more than 28% of patients saw substantial improvement. Despite this, 20% of patients did not see a difference in their symptom severity; nevertheless, the research did not detect any apparent deterioration.

Although commonly utilized in posterior cervical spine surgery, laminectomy and laminoplasty still have significant side effects. A study by Yu et al. (2019), sought to evaluate the medical outcomes of open-door laminoplasty (ODLP) and microscope-assisted extensor muscle-preserving laminectomy (MA-EMPL) for multilevel cervical spondylitis myelopathy (MCSM). Twenty patients with MCSM had MA-EMPL as part of a prospective trial, while twenty-four patients with MCSM got ODLP (control). Radiographic measurements and outcome measures, such as VAS and Japanese Orthopedic Association (JOA) scores, were used to assess technical efficacy. Consequences from surgery were recorded to evaluate technical competence. Apart from ROM in the ODLP sample, preoperative postoperative cervical curvature score and range of neck motion (ROM) were not profoundly impacted. At the last follow-up, the postoperative postoperative JOA scores and VAS in both categories improved (Yeh et al., 2020). An efficient, secure, and least intrusive technique for treating MCSM is MA-EMPL. When contrasted to ODLP, MA-EMPL has the benefit of reducing perioperative excessive bleeding, hospitalization, postoperatively VAS, and axial symptoms while preserving postoperative postoperative range of motion.

In one research (He et al., 2020), laminectomy and fusion (LF) and laminoplasty (LP) were compared for multilevel cervical spondylitis myelopathy (MCSM) with enhanced signal intensity (ISI) on T2-weighted imaging (T2WI). In this prospective observational analysis, researchers examined 52 patients who had undergone laminoplasty and had MCSM with ISI on T2WI (LP group). The VAS assessment, the physical and mental component scores (PCS and MCS) of the Short-Form 36 (SF-36), the extended and flexing ranges of motion (ROMs), and the Japanese Orthopedic Association (JOA) score were all registered. The operative time was much longer in the LF group than in the LP category. The JOA score, VAS score, and SF-36 (PCS and MCS) ratings were all considerably more excellent across both categories at the most recent follow-up. Both groups experienced a reduction in extension and flexion ranges of motion. However, the LP group fared noticeably better than the LF group. The ultimate follow-up showed comparable therapeutic outcomes in both groups. The LF group saw a greater risk of complications.

In one study (Qihua et al., 2018), for patients with multilevel cervical spondylitis myelopathy, a meta-analysis evaluating the effects of conserving or correcting the posterior deep extensor insertion to C2 in laminoplasty was performed (MCSM). Researchers used several internet resources to look for significant findings. The main indicators comprised the Japanese Orthopedic Association (JOA) scores before and after surgery, the JOA extraction efficiency, the pace of muscle atrophy, the preoperative and postoperativepostoperative range of motion (ROM), the ROM decrease rate, and the prevalence of axial pain. Among the categories, there was no significant statistical difference in bleeding, preoperative and postoperative postoperative JOA scores, or JOA recovery rate.

3. Materials and Methods

For the present retrospective study, the data of about 52 patients were viewed who were diagnosed with CSM integrating C3-6. These patients experienced surgery of the posterior cervical, including laminectomy with fusion (LF) or laminoplasty (LP). These surgeries were carried out at Meram Medicine Faculty in Turkiye between January 2015 and June 2020.

3.1 Inclusion and Exclusion Criteria

The patients suffering from compression of the spinal cord, spinal stenosis and MSC were more likely to undergo posterior surgery. In contrast, the patients with fixed kyphosis were not included in this study as no posterior surgery was recommended. In this context, the patients with cervical kyphosis/ cervical instability with K-line, which was negatively modified, were also not involved as no LP procedure could be performed on them.

For this study, the patients were classified into two groups which included:

a) LP group: It includes the patients who had open-door laminoplasty. This group included 24 patients (figures 2 and 3).
b) LF group: It includes the patients who had laminectomy with fusion. This group included 24 patients (figures 4 and 5).

On the first day after the operation, all operated participants were mobilized and were recommended to utilize a cervical collar for at least four weeks after the operation. Therefore, the clinical outcomes were determined before the surgery and at the last follow-up using the "modified Japanese Orthopaedic Association" (mJOA) scale. The recovery rate was also determined by using the following formula (Hirabayashi et al., 1981):

$$recovery\ rate\ (\%) = \frac{[postoperative\ score - preoperative\ score]}{[full\ score(18) - preoperative\ score]} \times 100$$

The surgical procedure's success could be evaluated by using this formula. In this case, a 75% recovery rate is considered excellent. For assessing pain, a visual analogue scale (VAS) was used. It ranged from 0 (stating no pain) to 10 (stating severe pain). At the same time, cervical MRI, cervical radiography, cervical CT and radiographic examinations of flexion-extension lateral were also determined pre and post-surgery. The axial CT scans were used to measure the spinal cord area and anterior-posterior diameter at C4-C5 levels. In contrast, the cervical lordosis Cobb angle was analyzed using the lateral cervical radiograph, as shown in figures 1, 2, 3, 4, 5 and 6. The complications such as C5 palsy and axial pain were determined in both groups, and the average follow-up frame was stated to be 20 months (ranging from 12 to 30 months).

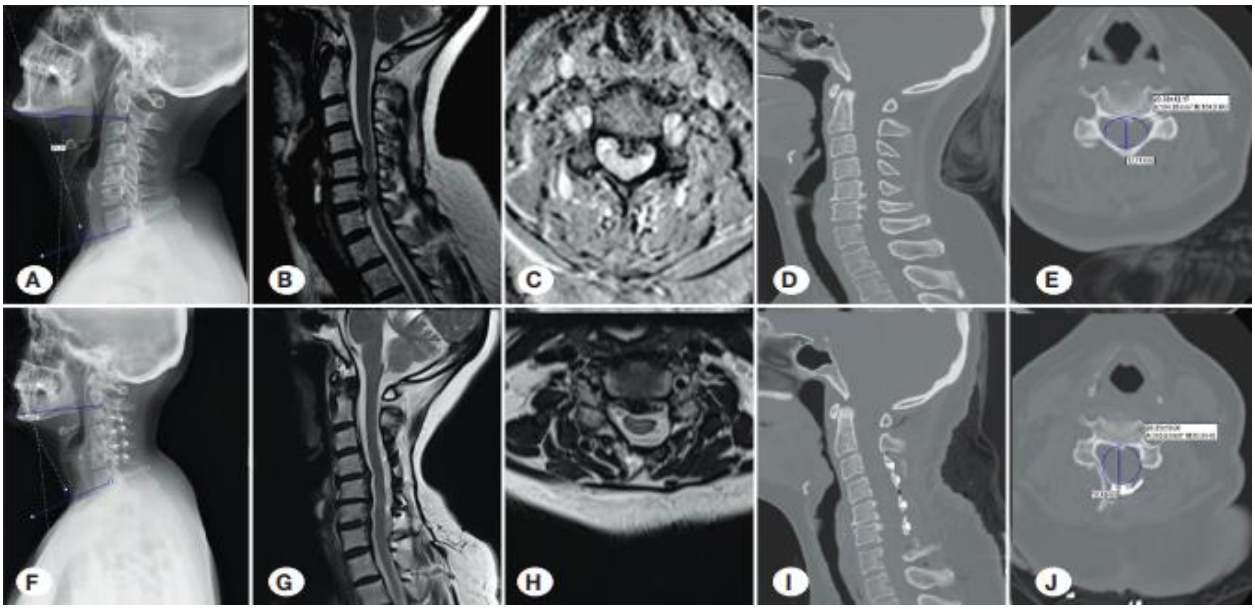

Figure 1. (A) Preoperative radiograph of lateral cervical presenting C2-C7 Cobb angle; (B) Axial; (C) MRI presenting compression of the spinal cord; (D) Axial; (E) CT scan presenting compression of the spinal cord; (F) Cobb angle (C2-C7) postoperative; (G) Axial; (H) MRI scans post-LP; (I) Axial and (J) postoperative sagittal

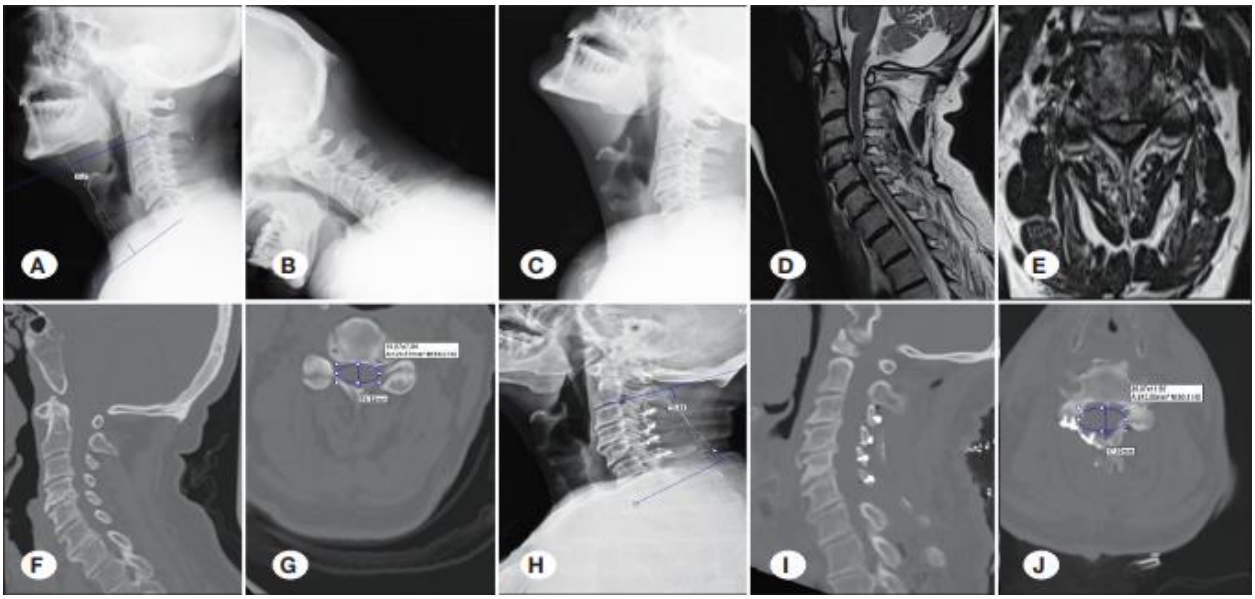

Figure 2. Preoperative radiographs (A) flexion; (B) extension; (C) preoperative sagittal; (D) axial; (E) CT and MRI sagittal; (F) axial; (G) CT scans postoperative; (H) lateral radiogram; (I) CT scan; sagittal and (J) CT scan; axial

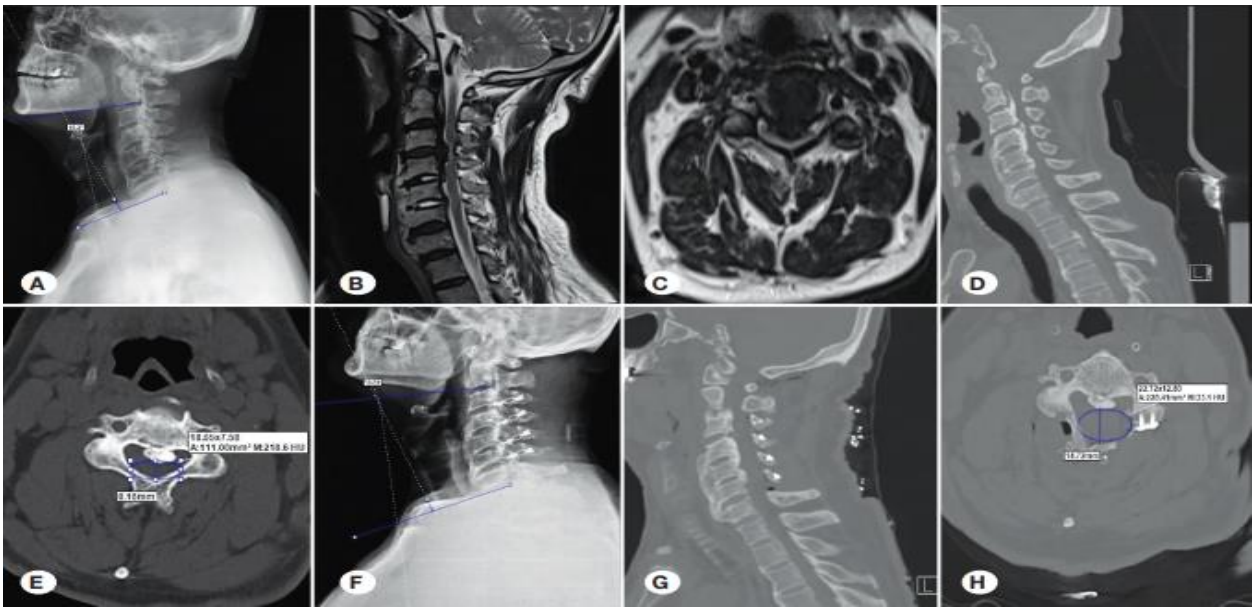

Figure 3. A preoperative radiograph (LP) (A) MRI; (B) MRI, sagittal; (C) MRI, axial; (D) CT, sagittal; (E) CT, axial; (F) CT; (G) CT, sagittal and (H) CT, axial

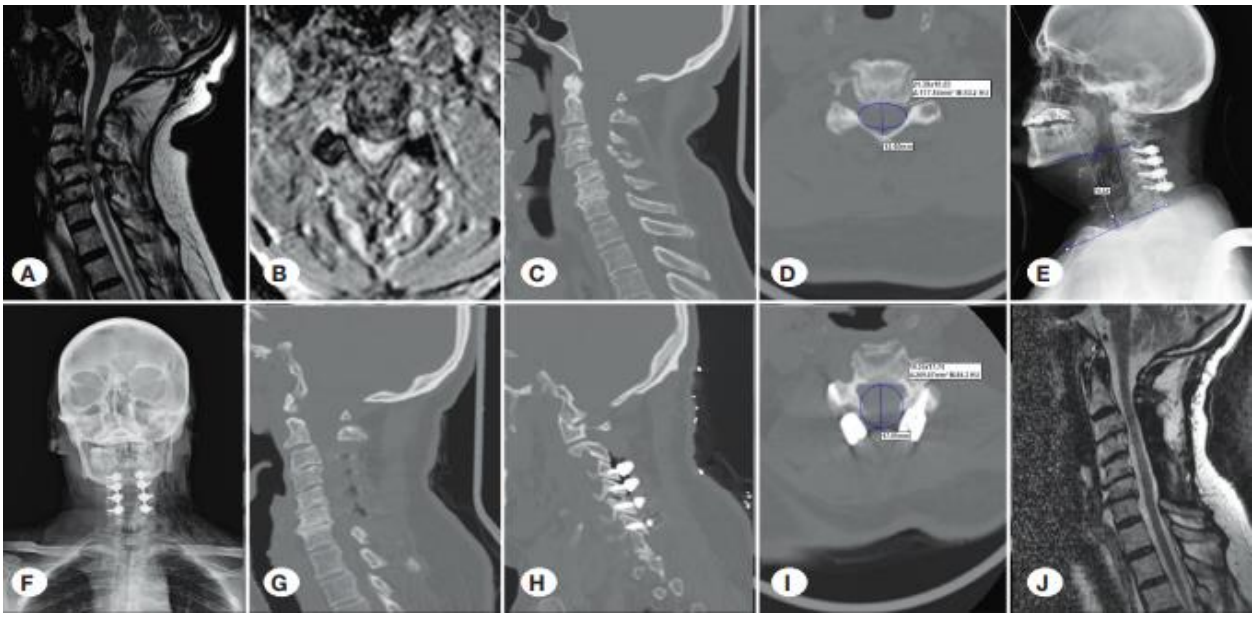

Figure 4. T2W MRI, preoperative (A) MRI, sagittal; (B) MRI, axial; (C) CT, sagittal; (D) CT, axial; (E) postoperative radiograph, lateral; (F) postoperative radiograph, anteroposterior; (G) CT, sagittal; (H) CT, sagittal; (I) CT, axial and (J) C3-C6 LF

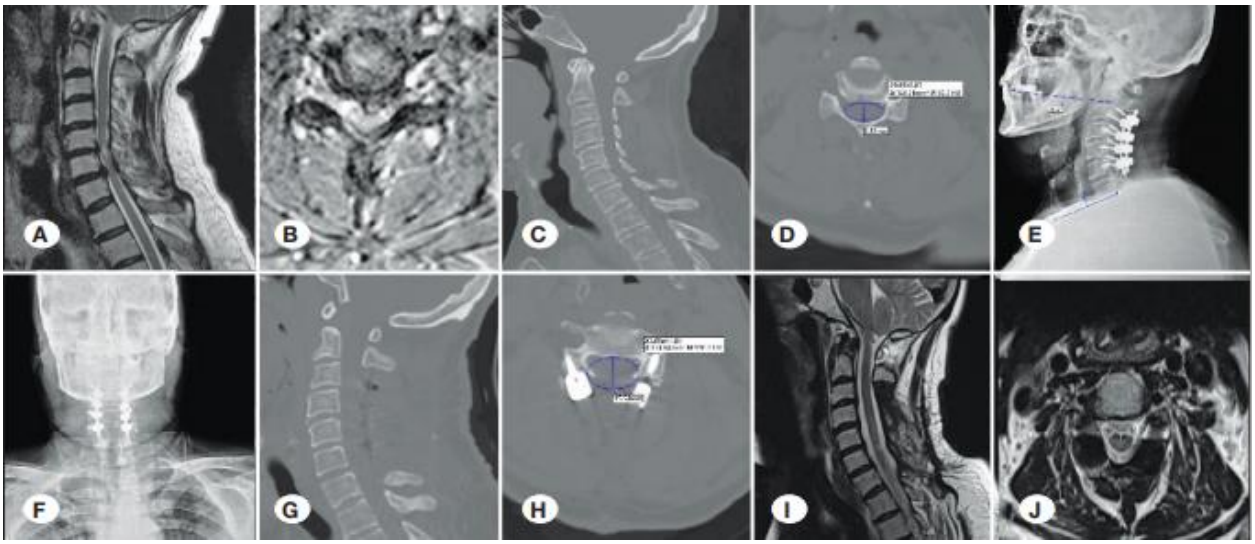

Figure 5. Snake eye appearance in preoperative stage and spinal cord narrowing in T2W (A) MRI, sagittal; (B) MRI, axial; (C) CT, sagittal; (D) CT, axial; (E) Direct radiograph, lateral (postoperative); (F) Direct radiograph, anteroposterior (postoperative); (G) CT, sagittal; (H) CT, axial; (I) T2W MRI, sagittal and (J) T2W MRI, axial.

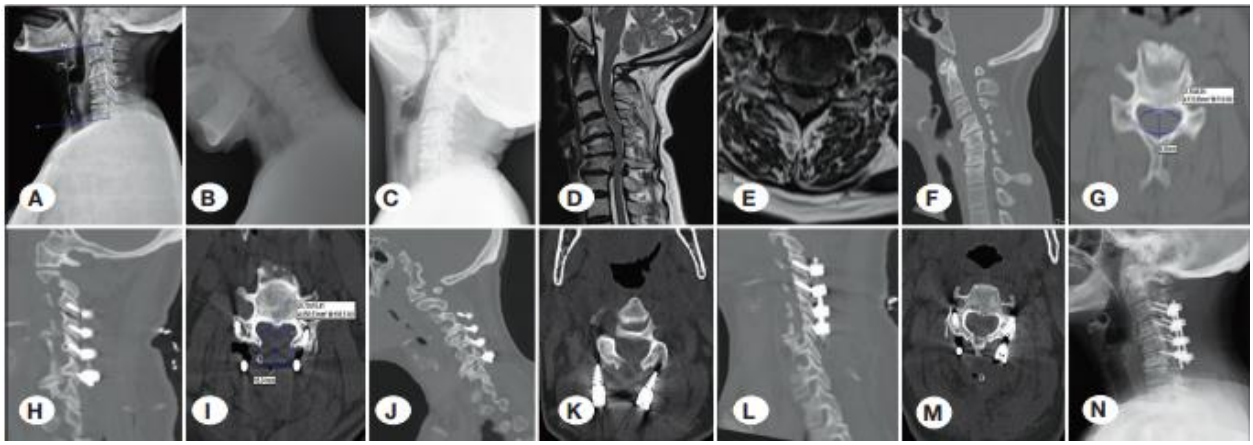

Figure 6. Preoperative radiographs (lateral cervical) (A) flexion; (B) extension (C) preoperative MRI (flexible kyphosis); (D) MRI, sagittal; (E) MRI, axial; (F) CT, sagittal; (G) CT, axial; (H) CT, sagittal; (I) CT, axial; (J) LF, sagittal; (K) LF, axial; (L) CT, sagittal (traffic accident of patient after one month of LF); (M) CT, axial and (N) x-ray, lateral

3.2 Ethical Concerns

For this study, the ethical considerations associated with the institute were considered. The study was approved by KTO Karatay University (52839). All the volunteers were guided regarding the purpose of the present study, and their written consents were acknowledged. Experienced surgeons performed the surgeries.

3.3 Surgical Procedure

General anaesthesia was given to all patients; they were horizontally positioned and fixed via slight flexion. A midline skin incision was made in the cervical, and detachment of paravertebral muscles from the spinous processes was done to observe the lateral and laminae masses. Fluoroscopy was used to determine cervical levels, and every process was carried out within four levels from C3 to C6. In the context of target levels, the interspinous ligaments were detached from their inferior and superior ends, and finally, the retention of supraspinal ligaments

was observed. In the case of the LP group, a full-thickness gutter was drilled using automated high-speed burrs at the junction of the laminae and articular procedures on the symptoms' dominant side, whereas, in the context of the contralateral hinge site, a partial-thickness gutter was formed. Later on, at the open side, the laminae were raised towards the hinge side, stating a picture of a greenstick fracture. The open lamina was maintained by placing a mini-plate in every four levels. Almost in six patients, C7 arcocristectomy was carried out. Whereas, in the case of the LF group, flavectomy, as well as laminectomy, were carried out medial to pedicles at C3-C4-C5-C6. The Magerl technique was used to insert polyaxial screw-rods via lateral masses. As a result of this, the cervical spine is stabilized. The C-arm fluoroscopy was used for checking screw locations during surgery.

3.4 Data Analysis

For the present study, statistical analysis was conducted using the "Statistical Package for Social Sciences" (SPSS) software, 20. The "Mann-Whitney U-test" was used to compare the two independent groups. Therefore, the "Wilcoxon signed-rank test" was used for comparing pre and postoperative variables, including diameter, area, mJOA and Cobb angle. The value of $p \leq 0.05$ was stated to be significant.

4. Results

For this study, 52 patients with MCSM were treated with LF or LP. 79% (41) of these patients were male, and 21% (11) were female. The male: female was found to be 3.73:1 whereas, the mean age of the LF group was 63.83 years, and it ranged from 36 to 73 years, including 20 male patients and six female patients whereas, the mean age for the LP group was 60.11 years ranging from 42 to 75 years. This group includes 21 male patients and five female patients. These demographics are presented in table 1. The difference in gender distribution of the formulated two groups was not significant, and the value of p was greater than 0.05.

Table 1: Patients' demographics according to the formulated groups

	Laminoplasty (LP) group	**Laminectomy with fusion (LF) group**
Total no. of observations (N)	26	26
Gender		
Male	21	20
Female	5	6
Average age (years)	60.11	63.83

4.1 Clinical Outcomes

Clinical outcomes are presented in table 2, showing that mJOA scores were significant for both LP and LF groups, as the value of p was less than 0.05 for both groups. The preoperative mJOA scores for LP and LF groups were 11.45 ± 1.26 and 10.14 ± 1.87, while the postoperative mJOA scores for LP and LF groups were 15.26 ± 0.86 and 14.91 ± 1.22, and the recovery rate of these groups was recorded to be 58.25% and 60.75%. The preoperative and postoperative VAS scores for the LP group were 4.7 ± 2.1 and 2.1 ± 1.1. Therefore, axial pain in the neck was observed in patients treated with laminoplasty. In about one month, the pain subsided.

Table 2. Clinical outcomes

	LP Group	**LF Group**
mJOA score		
Preoperative	11.45 ± 1.26	10.14 ± 1.87
Postoperative	15.26 ± 0.86	14.91 ± 1.22
p-value	**< 0.0001**	**< 0.0001**
Recovery rate	58.25%	60.75%
VAS score		
Preoperative	4.7 ± 2.1	4.7 ± 2.1
Postoperative	2.1 ± 1.1	7.2 ± 2.5
p-value	**< 0.0001**	**< 0.0001**

4.2 Radiographic Outcomes

The widening of the diameter of the spinal canal was ensured postoperatively. The radiographic outcomes for the present study are presented in table 3. The pre and postoperative mean values of the spinal canal's mean anterio-posterior at C4-C5 were found to be 156.18 ± 32.92 and 273.58 ± 50.31 for the LP group. In contrast, the pre and postoperative mean values of the spinal canal's mean anterio-posterior at C4-C5 were found to be 147.41 ± 11.28 and 266.07 ± 27.02 for the LF group. Thus the increase in diameter was significant for both LF and LP groups, as the value of *p* was less than 0.05. The preoperative values of Cobb angles for LP and LF groups were16.21 ± 6.35° and 14.38 ± 5.33° while the postoperative values of Cobb angles for LP and LF groups were 14.44 ± 4.51° and 15.11 ± 6.20°. However, a significant association was seen between the Cobb angle and LP group as the value of p was 0.044, while in the LF group, the value of *p* was 0.308, which was greater than 0.05, so no significant relationship was observed. Therefore, both groups observed a significant improvement in the context of the Cobb angle (CCAI). The recorded pre and operative diameter (mm) for the LP group were 10.56 ± 1.58 and 16.43 ± 1.51, while that of the LF group was 10.58 ± 0.94 and 16.37 ± 1.14. This also showed a significant correlation ($p \leq 0.05$)

In about seven cases, postoperative complications were observed, which integrated axial pain. One patient treated with LF went through a traffic accident and had to go through another operation just two months after the initial surgery, as shown in figure 6. However, C5 palsy was only determined in two patients treated with LF and one treated with LP. In this regard as such, no permanent complications were observed. Non-steroidal anti-inflammatory drugs (NSAIDs) were used to treat such patients' pain. C5 palsy was found to be recovered almost three months after the operation. Bed rest was recommended for treating the leakage of cerebrospinal fluid.

Table 3. Radiographic outcomes

	LP Group	**LF group**
$C_2 – C_7$ Cobb angle (°)		
Preoperative	16.21 ± 6.35°	14.38 ± 5.33°
Postoperative	14.44 ± 4.51°	15.11 ± 6.20°
p-value	**0.044**	0.308
CCAI	-1.76	+0.72
Diameter (mm)		
Preoperative	10.56 ± 1.58	10.58 ± 0.94

Postoperative	16.43 ± 1.51	16.37 ± 1.14
p-value	**< 0.0001**	**< 0.0001**
Area (mm^2)		
Preoperative	156.18 ± 32.92	147.41 ± 11.28
Postoperative	273.58 ± 50.31	266.07 ± 27.02
p-value	**< 0.0001**	**< 0.0001**

5. Discussion

In the current retrospective study, around 52 individuals with a CSM incorporating C3-6 diagnosis had their data evaluated. The posterior cervical surgery performed on those patients included laminectomy with fusion (LF) or laminoplasty (LP). The procedures were performed between January 2015 and June 2020 at the Meram Medicine Faculty. Patients with MSC, spinal stenosis, or spinal cord compression were more inclined to require posterior surgery. However, since no posterior surgery was advised for individuals with fixed kyphosis, they did not participate in this research. The findings of the current study stated that both techniques i.e., laminectomy with fusion (LF) and laminoplasty (LP), are significantly related to cervical spondylotic myelopathy (CSM) and are considered effective treatments. In severe pain, laminectomy with fusion (LF) is preferable and more effective. The Laminoplasty group is significantly related to the Cobb angle, and laminectomy with fusion is related non-significantly to cobb angle.

Although posterior cervical surgery seeks to decompress the spinal cord, reinstate sagittal posture, and stabilize the spine, it is the treatment of preference for multilevel (including more than three levels) cervical spondylotic myelopathy. Sagittal curvature, the region of the compressive pathology, and the number of levels implicated influence the therapeutic strategy (Fehlings et al., 2017). Either laminoplasty or laminectomy with fusion are dependable, efficient, and well-liked posterior surgical techniques that can readily offer significant segment decompression. Although posterior cervical surgery seeks to decompress the spinal cord, reinstate sagittal posture, and stabilize the spine, it is the treatment of preference for multilevel (including more than three levels) cervical spondylotic myelopathy. Sagittal curvature, the region of the compressive pathology, and the number of levels implicated are variables that influence the therapeutic strategy. Either laminoplasty or laminectomy with fusion is regarded as dependable, efficient, and well-liked posterior surgical techniques that can readily offer significant segment decompression.

Lee et al. (2016) stated that patients with straight lordosis may acquire kyphosis after laminoplasty. The present analysis revealed that the C2-C7 Cobb angle increased in the LF group but decreased in the LP group. The primary score was used in the present study to assess neurological function; post-surgery, a substantial improvement was seen in either group. Additionally, the two groups mJOA neurological function recovery rates were comparable. As a result, both procedures were regarded as effective because they sufficiently widened the spinal canals. If there are neutral or flexion-extension lateral radiographic indications of instability or mild to severe preoperative axial neck pain, posterior laminectomy with fusion may be recommended. C5 palsy and axial neck pain, particularly following laminoplasty, comprise the most prevalent post-operative consequences linked to posterior cervical surgery for CSM. Laminoplasty can prevent pain from getting worse by carefully selecting individuals with low preoperative axial discomfort and the proper cervical curvature (Stephens et al., 2017).

Tsuji et al. (2017) restricted the laminar opening angle to 53.5° to minimize spinal slippage. A study was conducted to look into the factors related to C5 palsy using multivariable analysis and an emphasis on radiological characteristics. The increased prevalence of C5 palsy was highly associated with the larger postoperative space anterior to the spinal cord, which was connected to the open lamina angle. Yuan et al. (2019) performed research.

According to a meta-analysis, most of the clinical results for LF and LP surgical treatments of multilevel CSM are comparable. Nevertheless, it was discovered that LP was preferable to LF in terms of problems related to nerve palsy. This needs additional validation and research in randomized, longitudinal trials with larger sample sizes.

Two frequently used techniques for the management of cervical spondylotic myelopathy are laminoplasty and laminectomy with fusion. The optimal surgical procedure is still under debate. Blizzard et al. (2017) stated that in terms of maintaining the cervical range of motion, shortening the hospital stay, and lowering costs, laminoplasty might be preferable to laminectomy with fusion. Although laminoplasty clinical outcome scores were essentially equivalent to laminectomy with fusion, the relevance of these variations is still uncertain. After surgery, the JOA, SF-12, and VAS ratings improved similarly in the two cohorts. In none of the cohorts did the cervical sagittal alignment dramatically affect. Range of motion reduced in both cohorts, but it did so more noticeably following laminectomy with fusion. Infection and C5 nerve root palsy were both cohorts' most frequent side effects. C5 nerve root palsy and other problems were more common after laminectomy with fusion. Laminoplasty resulted in substantially lower average hospital costs and time in the hospital.

Lin et al. (2019) indicated that laminoplasty and posterior laminectomy with instrumented fusion were both shown to be effective treatments for MCSM. Nevertheless, laminoplasty looked to provide a more extensive range of motion (ROM), reduced rates of general complications and C5 palsy, quicker surgery, and less blood loss. To further support their findings, well-designed, randomized controlled trials in the future are still required. Laminoplasty and posterior laminectomy with instrumented fusion are two standard procedures used to treat multilevel cervical spondylotic myelopathy (MCSM). The best surgical technique is the subject of intense debate. These researchers assessed laminectomy with instrumented fusion and laminoplasty for the treatment of MCSM in order to compare medical outcomes and safety.

6. Implications

This research study will effectively improve the literature on comparing LF and LP procedures in the context of treating CSM. This study mainly focuses on the impact of these procedures on the Cobb angle, which has not been thoroughly discussed in past studies, so this study will provide effective empirical evidence for future studies in this regard. This study can also encourage different healthcare professionals to focus on the quality of life of CSM patients. This will encourage effective and essential surgical procedures in different hospitals to treat CSM. This will also be beneficial in formulating an effective follow-up plan for patients undergoing different surgical procedures. In this regard, healthcare professionals such as doctors, nurses and hospital management will play an essential role. Better recommended prescriptions for treating postoperative pain will also be encouraged by various surgeons. Thus, the present study will not only be efficient in improving the theoretical view of the LF and LP procedures in treating CSM, but it will also provide different practical and effective implications to improve the postoperative outcomes of the procedures.

7. Limitations

This research had a number of drawbacks. Firstly, even though identical inclusion criteria were applied to both groups, the retrospective study design may have resulted in selection bias. Furthermore, the patient's routines, profession, and comorbidities were overlooked. Hence, more prospective studies with bigger sample sizes should be conducted to get more convincing outcomes.

8. Conclusion

This study has shown that while treating patients with multilevel cervical spondylotic myelopathy, both posterior surgical interventions and laminectomy with fusion—were equally efficient in enhancing neurological functioning.

Laminectomy with fusion is superior to laminoplasty in individuals with significant axial discomfort. Nonetheless, laminectomy with fusion (apart from OPLL) should not be the preferred treatment in a mobile spine due to severe neck movement restrictions and patient-related quality of life impairments. The preferred treatment approach should be laminoplasty if there is no kyphotic deformity.

References

[1]. Blizzard, D. J., Caputo, A. M., Sheets, C. Z., Klement, M. R., Michael, K. W., Isaacs, R. E., & Brown, C. R. (2017). Laminoplasty versus laminectomy with fusion for the treatment of spondylotic cervical myelopathy: short-term follow-up. European Spine Journal, 26(1), 85-93.

[2]. Chen, C., Li, J., Liao, Z., Gao, Y., Shao, Z., & Yang, C. (2020). C3 laminectomy combined with modified unilateral laminoplasty and in situ reconstruction of the midline structures maintained cervical sagittal balance: a retrospective matched-pair case-control study. The Spine Journal, 20(9), 1403-1412.

[3]. Chen, G., Liu, X., Chen, N., Chen, B., Zou, X., Wei, F., & Liu, S. (2020). Ten-year surgical outcomes and prognostic factors for French-door laminoplasty in the treatment of multilevel cervical spondylotic myelopathy. BioMed research international, 2020.

[4]. Fehlings, M. G., Santaguida, C., Tetreault, L., Arnold, P., Barbagallo, G., Defino, H., . . . Kopjar, B. (2017). Laminectomy and fusion versus laminoplasty for the treatment of degenerative cervical myelopathy: results from the AOSpine North America and International prospective multicenter studies. The spine journal, 17(1), 102-108.

[5]. He, X., Zhang, J. N., Liu, T. J., & Hao, D. J. (2020). Is laminectomy and fusion the better choice than laminoplasty for multilevel cervical myelopathy with signal changes on magnetic resonance imaging? A comparison of two posterior surgeries. BMC Musculoskeletal Disorders, 21(1), 1-9.

[6]. Hirabayashi, K., Miyakawa, J., Satomi, K., Maruyama, T., & Wakano, K. (1981). Operative results and postoperative progression of ossification among patients with ossification of cervical posterior longitudinal ligament. Spine, 6(4), 354-364.

[7]. Keskin, F. (2021). The Effects Of PosterIor SurgIcal Approach On CervIcal AlIgnment In The Treatment Of CervIcal SpondylotIc Myelopathy. Selcuk Medical Journal, 37(1), 32-38.

[8]. Lee, C. K., Shin, D. A., Yi, S., Kim, K. N., Shin, H. C., & Ha, Y. (2016). Correlation between cervical spine sagittal alignment and clinical outcome after cervical laminoplasty for ossification of the posterior longitudinal ligament. Journal of Neurosurgery: Spine, 24(1), 100-107.

[9]. Lee, J. J., Kim, H. C., Jeon, H. S., An, S. B., Kim, T. W., Shin, D. A., . . . Nagoshi, N. (2021). Laminectomy with instrumented fusion vs. laminoplasty in the surgical treatment of cervical ossification of the posterior longitudinal ligament: A multicenter retrospective study. Journal of Clinical Neuroscience, 94, 271-280.

[10]. Li, Z., Xue, Y., He, D., Tang, Y., Ding, H., Wang, Y., . . . Zhao, Y. (2015). Extensive laminectomy for multilevel cervical stenosis with ligamentum flavum hypertrophy: more than 10 years follow-up. European Spine Journal, 24(8), 1605-1612.

[11]. Lin, X., Cai, J., Qin, C., Yang, Q., & Xiao, Z. (2019). Comparison of clinical outcomes and safety between laminectomy with instrumented fusion versus laminoplasty for the treatment of multilevel cervical spondylotic myelopathy. Medicine (Baltimore), 98(8), e14651. https://doi.org/10.1097/md.0000000000014651

[12]. Lopez, W. Y., Goh, B. C., Upadhyaya, S., Ziino, C., Georgakas, P. J., Gupta, A., . . . Schwab, J. H. (2021). Laminoplasty—an underutilized procedure for cervical spondylotic myelopathy. The Spine Journal, 21(4), 571-577.

[13]. Mehdi, S. K., Alentado, V. J., Lee, B. S., Mroz, T. E., Benzel, E. C., & Steinmetz, M. P. (2016). Comparison of clinical outcomes in decompression and fusion versus decompression only in patients with ossification of the posterior longitudinal ligament: a meta-analysis. Neurosurgical Focus, 40(6), E9.

[14]. Nori, S., Iwanami, A., Yasuda, A., Nagoshi, N., Fujita, N., Hikata, T., . . . Momoshima, S. (2017). Risk factor analysis of kyphotic malalignment after cervical intramedullary tumor resection in adults. Journal of Neurosurgery: Spine, 27(5), 518-527.

[15]. Qihua, Q., Yan, C., Zemin, L., Hao, H., Junxuan, M., Wei, G., . . . Xuenong, Z. (2018). Modified Laminoplasty Preserving the Posterior Deep Extensor Insertion into C2 Improves Clinical and Radiologic Results Compared with Conventional Laminoplasty: A Meta-Analysis. World Neurosurgery, 111, 157-165. https://doi.org/https://doi.org/10.1016/j.wneu.2017.12.098

[16]. Stephens, B. F., Rhee, J. M., Neustein, T. M., & Arceo, R. (2017). Laminoplasty does not lead to worsening axial neck pain in the properly selected patient with cervical myelopathy. Spine, 42(24), 1844-1850.

[17]. Tsuji, T., Matsumoto, M., Nakamura, M., Ishii, K., Fujita, N., Chiba, K., & Watanabe, K. (2017). Factors associated with postoperative C5 palsy after expansive open-door laminoplasty: retrospective cohort study using multivariable analysis. European Spine Journal, 26(9), 2410-2416.

[18]. Wang, W.-x., Zhao, Y.-b., Lu, X.-d., Zhao, X.-f., Jin, Y.-z., Chen, X.-w., . . . Zhao, B. (2020). Influence of extending expansive open-door laminoplasty to C1 and C2 on cervical sagittal parameters. BMC Musculoskeletal Disorders, 21(1), 1-10.

[19]. Yeh, K.-T., Chen, H., Lee, R.-P., Yu, T.-C., Peng, C.-H., Liu, K.-L., . . . Wu, W.-T. (2020). Two surgical strategies for treating multilevel cervical spondylotic myelopathy combined with kyphotic deformity. Medicine, 99(7).

[20]. Yu, Z., He, D., Xiong, J., Pan, Z., Feng, L., Xu, J., . . . Phan, K. (2019). Extensor muscle-preserving laminectomy in treating multilevel cervical spondylotic myelopathy compared with laminoplasty. Annals of Translational Medicine, 7(18).

[21]. Yuan, X., Wei, C., Xu, W., Gan, X., Cao, S., & Luo, J. (2019). Comparison of laminectomy and fusion vs laminoplasty in the treatment of multilevel cervical spondylotic myelopathy: a meta-analysis. Medicine, 98(13).

[22]. Zhang, J., Liu, H., Bou, E. H., Jiang, W., Zhou, F., He, F., . . . Liu, T. (2019). Comparative study between anterior cervical discectomy and fusion with ROI-C cage and laminoplasty for multilevel cervical spondylotic myelopathy without spinal stenosis. World Neurosurgery, 121, e917-e924.

[23]. Zhao, H., Ren, R., Ma, W., Xu, S., Peng, L., Zhong, Z., & Zheng, Y. (2021). Comparison of Laminoplasty vs. Laminectomy for Cervical Spondylotic Myelopathy: A Systematic Review and Meta-Analysis. Front Surg, 8, 790593. https://doi.org/10.3389/fsurg.2021.790593

[24]. Zhou, W., Tang, J., Fan, J., & Yin, G. (2018). The effect of intramedullary signal intensity in MRI on the therapeutic efficacy of posterior cervical decompression laminectomy with internal fixation and fusion for multi-level cervical spondylotic myelopathy: a retrospective cohort study. Acta Orthop Belg, 84(3), 366-373.