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Outcome of Skip Laminectomy Versus Classic Laminectomy in Surgical Treatment of Multi-Level Cervical Spondylotic Myelopathy

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Abstract

Background: Optimal surgical strategy for managing multilevel cervical myelopathy is still a matter of controversy. Skip laminectomy and laminectomy are specific cervical approaches for treatment of multi-level cervical spondylotic myelopathy.

Aim of Study: This study is to thoroughly compare between both approaches regarding clinical results and complications.

Aim of Study: To evaluate the role of skip laminectomy in tearing patients with multi-level cervical spondylotic myelopathy.

Material and Methods: This study was conducted in Mansoura University Hospital 2018-2021 on 40 patients 23 males and 17 females with mean age 59 years with multi-level CSM Were operated using Posterior cervical approach, 20 cases operated using laminectomy procedure (group A) and the other 20 cases were operated using skip laminectomy procedure (group B). We compared the data of both group regarding the clinical results and complications.

Results: Comparison between group A&B shows that group B showed less postoperative neck pain, less affection of ROM, less loss of cervical lordosis, less blood loss and less operative time. Also the rate of complications is less in group A.

Conclusion: Although the clinical outcome of both procedures showed no significant difference that can give absolute superiority to any of these approaches but skip laminectomy is less destructive with better postoperative course and shorter hospital stay. On the other hand it is more lengthy procedure which needs special skills and learning curve.

Key Words: *Cervical – Myelopathy – Skip – Laminectomy.*

Introduction

OPTIMAL surgical strategy for managing multilevel cervical myelopathy is still a matter of controversy. Anterior surgery has the advantage directly removing the majority of compressive of the cervical spine bony osteophytes, herniated discs and calcified ligaments. Anterior approach will also decrease the postoperative pain due to muscle sparing dissection, and its capability of cord decompression in patients with kyphotic deformity. As we know when myelopathy is caused by one or two levels, the anterior approach is preferred by most of surgeons. However, when more than two levels are approached, the higher rate of complications associated with anterior approache spescialy fusion related concerns detected with long strut grafts needed when we do multilevel corpectomies, make suegeons prefer to take the posterior approach **[4].**

Posterior approaches, such as laminectomy, laminoplasty, and laminectomy and lateral mass fixation, have stood the test of time and their advantages are well known. Posterior approaches are technically less demanding and shorter procedures to perform than anteriorapproaches, especially in multilevel significant cervical canal stenosis with or without OPLL that requires resection. Through posterior approach we avoid technical difficulties encountered during graft carpentry to regain the anterior column contour. Also, posterior approach permits rapid decompression of multiplelevels more than that with anterior approaches. This may be crucial in dealing with old aged debilitated patents who need a rapid safe less sophisticated approaches. On the other hand laminoplasty can permit cord decompression without fusion and is considered a motion preserving procedure **[5].**

The first description of Skip laminectomy which is considered a novel technique was by Shiraishi **[9].**

The philosophy of this technique is who to reach maximum decompression of neurological structures with preservation of as much as we can muscules insertion to the spinous processes. This will lead

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to preservation of posterior neck extensor musculature compared to classic posterior approaches as laminectomy and as we all know these muscles are crucial in cervical stability which is crucial as these muscles plays an important role in maintaining cervical spine stability.

Despite having many surgical strategies for treating cervical spondylotic myelopathy there is still absence of solid consensus about the best approach for it management. So we decided to compare between posterior cervical laminectomy and skip laminectomy in this study.

Patients and Methods

This prospective study was conducted in Neurosurgery Department, Mansoura University Hospital from 2018 to 2021 on twenty patients divided into two groups 10 patients in each group all of them were presented with cervical spondylotic myelopathy. The first group underwent decompression through posterior laminectomy according to the stenotic levels and the second group underwent skip laminectomy. We used the same technique described by Shiraishi and his colleagues.

Detailed history taking including personal history, onset and progression of patient complaints and symptoms suggesting motor, sensory or sphincteric deficits. A modified MRC scale was used to assess the motor power of the affected limbs. Also we assessed muscle tone and tendon reflexes to detect signs of cord affection. We performed Sensory examination following dermatomal distribution.

X-ray, MSCT-scan and MRI of cervical spine were done to all our patients to detect the etiology, extent and level of spinal cord compression. Spinalcord ischemia and signal changes were also documented. Cervical alignment and deformity were evaluated and analyzed.

Surgical procedure:

This study performed our procedure under general anesthesia. Classic prone position was used with head in flexion position and fixed with pins. We used fluoroscopy images to detect the targeted levels also with intraoperative localization.

The patients in the first group underwent classic full posterior cervical laminectomy from C3 to C6 for adequate decompression.

The patients in the second group underwent skip laminectomy procedure. In this group we did posterior midline skin incision then we divided the nuchal fascia. Then we identified the plane in between right and left deep extensor muscles at the targeted levelswe used a retractor to spread interspinous space, through this we can expose the superiorpart of each lamina and ligamentum flavum at each interspinous space.

By using this less invasive mauver we depended on the fact that tendinous attachments to the superior parts of the laminae in cervical vertebrae are deficient and they have strong attachment sinferiorly. This can help us to identify superior and inferiorborders of C4 and C6 spinous processes then we can split them longitudinally. The spinous processes are split through their posterior arch by a high speed drill preserving the attached semispinalis cervicis and multifidus muscles. Then these muscles are laterally retracted to identify the laminae of C4 and C6. This retraction should not exceed the limits of the medial part of the capsule of the facet joint.

By this technique we can preserve spinous processes and posterior arches and the attached musclesat levels of C3, C5 and C7. Then C4 lamina istypically detached in a traditional manner, then we excised superior part of C5 and ligamentum flavum excision at C3–4 and C4–5. The proximal portion of ligamentum flavum at C3–4 is removed from C3 lamina anterior part using a Kerrison rongeur orcurved curette.

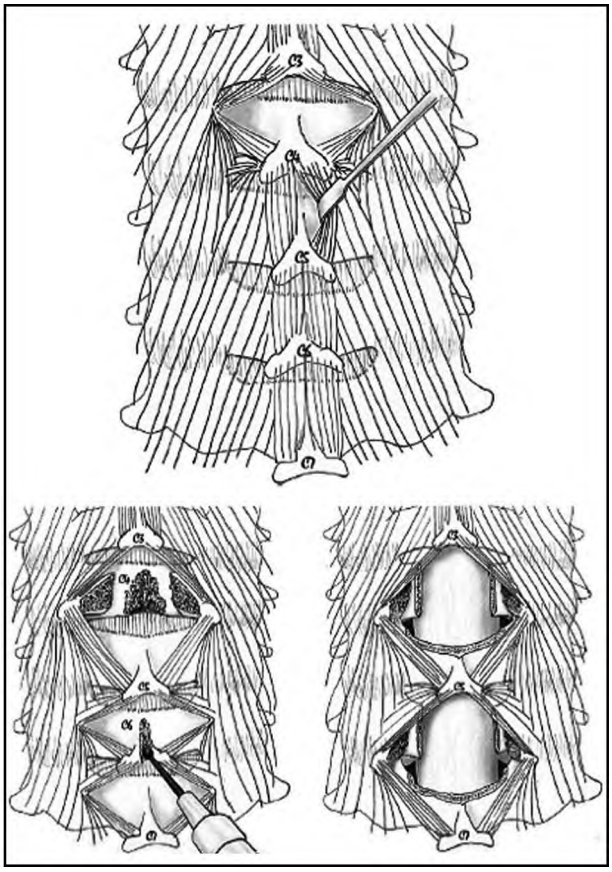

Fig. (1): Drawing showing interval between midline and right and left extensor muscles at each interspinous space (Top). C4 spinous process is vertically splitted keeping attachments of the muscles and C6 lamina is also splittedby a high speed drill (Bottom Left). Four level decompression is done (Bottom Right). Taken from Shiraishi **[9]**.

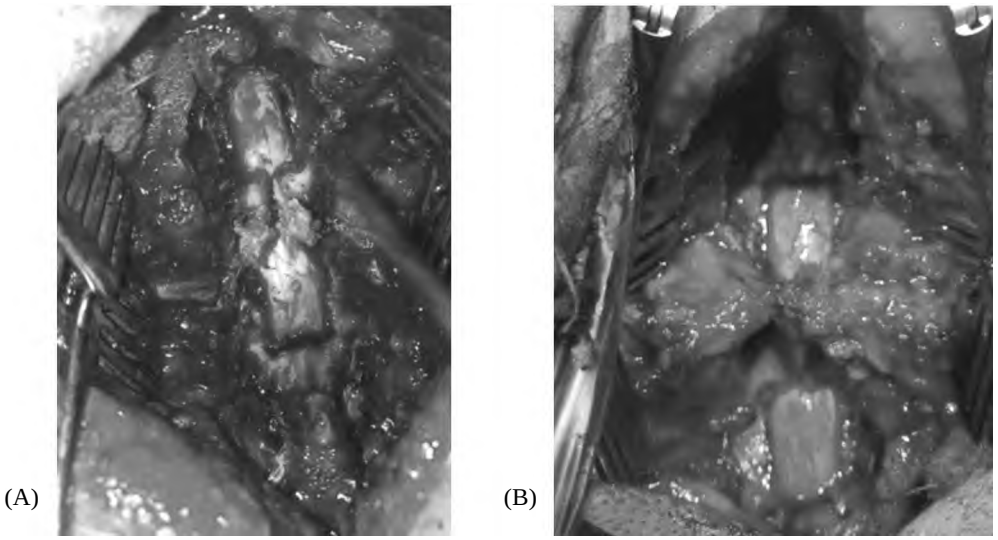

Fig. (2): Intraoperative finding (A) Nearly four levels decompression through two levels laminectomy (B) Muscles approximation to the spinous process.

Then we repeat this procedure at C5–6 and C6–7. This leads to spinal cord decompression at four levels between C3–4 and C6–7 through excision of alternate laminae such as C4 and C6 while keeping the C3, C5 and C7 posterior arches and attached muscles. Then were-approximated Split parts of the spinous processes using a stout suture followed by anatomical closure so all layers and Philadelphia neck collar of a suitable size was used for immobilization four weeks after surgery **[9]**.

MRI cervical spine was done for all our patients to detect adequate cord decompression and postoperative changes. We included our patients in dedicated rehabilitation physiotherapeutic program especially those who were presented with neurological deficits. We followed-up our patients regularly thirty days after surgery then every three months for at least twelve months.

Results

The collected data was analyzed using Statistical package for Social Science (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.). Student *t*-test was used to assess the statistical significance of the difference between two study group means. Mann Whitney Test (U test) was used to assess the statistical significance of the difference of a non-parametric variable between two study groups. Chi-Square test was used to examine the relationship between two qualitative variables. Paired sample *t*-test was used to assess changes in parametric parameters over time. Wilcoxon Test was used to assess the statistical significance of the difference of a non-parametric variable between two study periods. *p*-value less than 0.05 is considered statically significant.

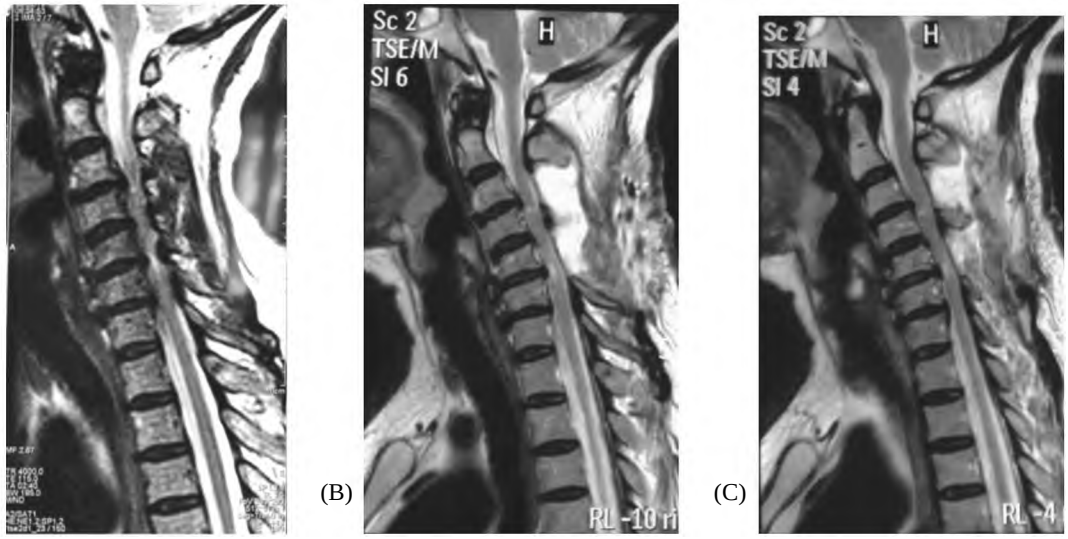

Fig. (3): (A) Preoperative MRI cervical region showing cervical canal stenosis with cord Malacia (B,C) Follow-up MRI showing adequate decompression by skip laminectomy technique.

The mean age for both groups was similar, with classic laminectomy group having a mean age of 60.75 years and skip laminectomy group having a mean age of 61.6 years. The proportion of males and females was also similar between the groups. The duration of symptoms before intervention was comparable, with a mean of 3.7 months for the classic laminectomy group and 4 months for the skip laminectomy group. None of these differences reached statistical significance, as indicated by the *p*-values above 0.05.

Skip laminectomy showed longer operative time and shorter hospital when compared to classic laminectomy group (p=0.007, 0.028 respectively). The proportions of blood transfusion, complications, wound infection, and neurological deterioration were similar between the two groups, with none of these differences being statistically significant.

Both interventions had significant improvement after treatment in terms of VAS score, JAO score, and range of movement (p<0.001 for each).

The skip laminectomy group demonstrated better outcomes in terms of VAS score, JAO score, and range of movement after the intervention (p<0.001, =0.001, 0.003 respectively).

Muscle atrophy was not found in any patient before treatment, while after intervention did not differ significantly between study arms (p=0.077).

Muscle atrophy showed a significantly higher proportion after intervention in the classic laminectomy group (p=0.008), while in skip laminectomy group, the difference was not statistically significant.

Table (1): Comparison between studied groups regarding baseline data.

	Classic laminectomy N=20	Skip laminectomy N=20	*p*
Age (years):			
Mean ± SD	60.75±7.45	61.6±4.55	0.666
Median (min-max)	61.5 (49-72)	62 (52-69)	
Males:			
N (%)	12 (60.0%)	11 (55.0%)	0.749
Females:			
N (%)	8 (40.0%)	9 (45.0%)	
Duration of symptoms (months):			
Mean ± SD	3.7±3.3	4±2.5	0.542
Median (min-max)	1.9 (0.5-9)	3.5 (0.5-9)	

SD: Standard deviation. min: Minimum. max: Maximum.

Table (2): Comparison between studied groups regarding operative and post operative parameters.

	Classic laminectomy N=20	Skip laminectomy N=20	*p*
Operative time (minutes):			
Mean ± SD	101.8±16.8	115±12.4	0.007
Median (min-max)	100 (80-140)	115 (95-140)	
Hospital stay (days):			
Mean ± SD	2.4±1.2	1.7±1	0.028
Median (min-max)	2 (1-6)	1.5 (1-5)	
Blood transfusion:			
N (%)	1 (5.0%)	1 (5.0%)	1
Complications:			
N (%)	3 (15.0%)	2 (10.0%)	1
Wound infection:			
N (%)	2 (10.0%)	1 (5.0%)	0.834
Neurological deterioration:			
N (%)	1 (5.0%)	1 (5.0%)	

SD: Standard deviation. min: Minimum. max: Maximum.

Table (3): Comparison between studied groups regarding VAS, JAO, range of movement and muscle atrophy before and after intervention.

	Classic laminectomy N=20	Skip laminectomy N=20	p_1
VAS Score:			
Before intervention:			
Mean ± SD	6±0.8	5.9±0.7	0.716
Median (min-max)	6 (5-7)	6 (5-7)	
After intervention:			
Mean ± SD	2.3±0.5	1.4±0.5	<0.001
Median (min-max)	2 (2-3)	1 (1-2)	
p_2	<0.001	<0.001	
JAO score:			
Before intervention:			
Mean ± SD	10±1.3	10.4±1.4	0.389
Median (min-max)	9 (9-12)	10.5 (9-13)	
After intervention:			
Mean ± SD	12.8±1.1	14.3±1.3	0.001
Median (min-max)	13 (11-14)	14.5 (12-16)	
p_2	<0.001	<0.001	
Range of movement:			
Before intervention:			
Mean ± SD	42.9±6.1	42.1±5.8	0.653
Median (min-max)	43 (33-55)	42 (33-52)	
After intervention:			
Mean ± SD	35.9±6.1	30.1±5.8	0.003
Median (min-max)	36 (26-48)	30 (21-40)	
p_2	<0.001	<0.001	
Muscle Atrophy:			
Before intervention:			
N (%)	0 (0%)	0 (0%)	–
After intervention:			
N (%)	8 (40.0%)	3 (15.0%)	0.077
p_2	0.008	0.250	

SD: Standard deviation. min: Minimum. max:, Maximum.
p1: Comparison between Classic and skip laminectomy.
p2: Comparison between before and after intervention.

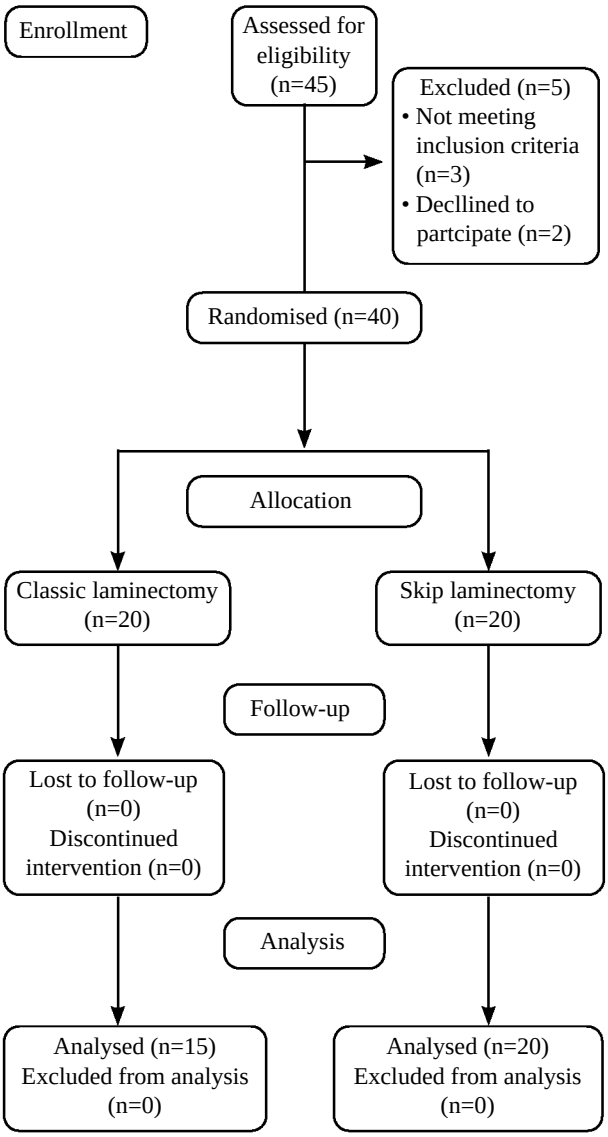

Fig. (4): Consort chart.

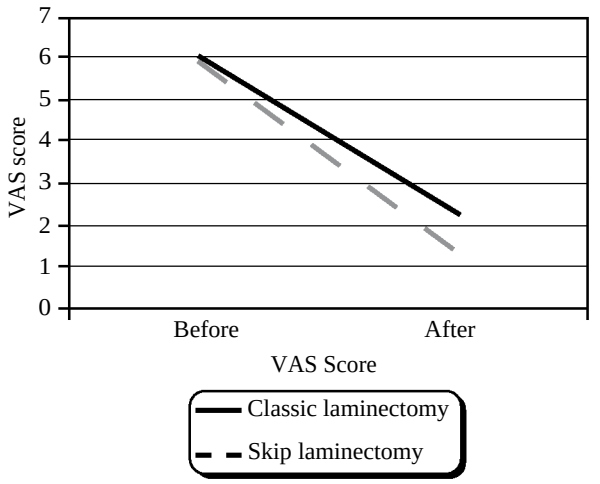

Fig. (5): VAS score before & after classic and skip laminectomy.

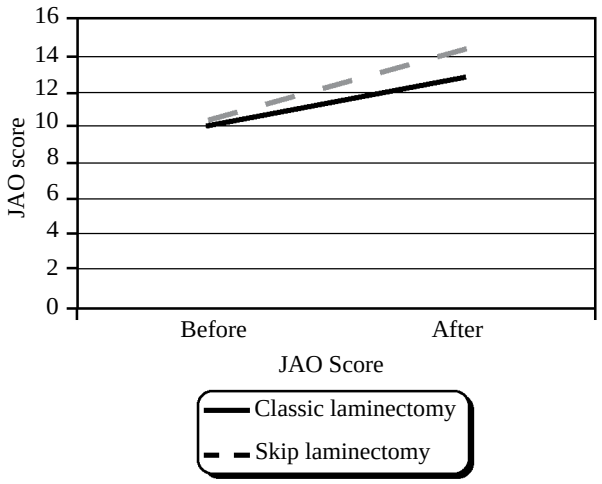

Fig. (6): JAO score before & after classic and skip laminectomy.

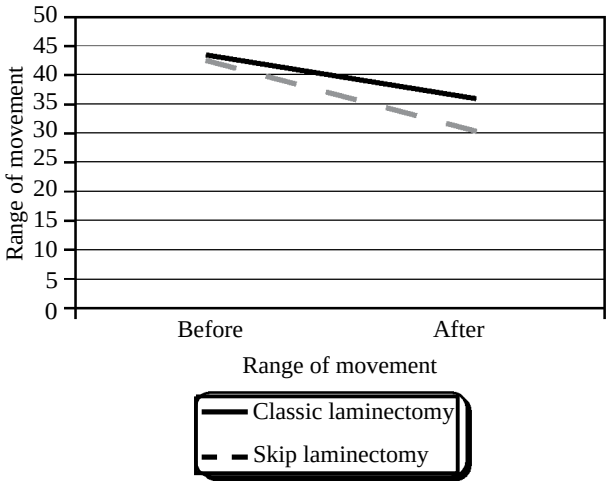

Fig. (7): ROM before and after classic and skip laminectomy.

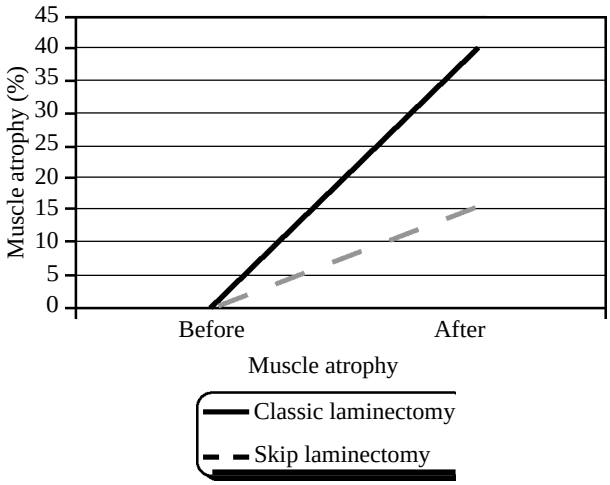

Fig. (8): Percent of muscle atrophy before and after classic and skip laminectomy.

Discussion

In 1928 Stookey firstly described Cervical myelopathy in a patient with cord compression due to cartilaginous particle of a degenerated disc fragment.

However, in 1952 Brain established the association between myelopathy and cervical spondylosis **[2].**

Many authors define Cervical spondylosis as the most important etiology of myelopathy and spinal cord pathology. However animal and cadavericresearches also assumed crucial role of malalignment of the cervical spine in causing myelopathy through cord affection **[8].**

Farley et al., assumed that cord tension is greater in cases of kyphosis. Shimizu et al., found that there is a highly positive relation between the significance of kyphosis and the extent of flattening of the cervical cord, which cause to deficient blood supply, and subsequently demyelination and cord Malacia in an animal research. These researches emphasize crucial role of sagittal balance and alignment in the patients with mylopathy caused by cervical spondylotic changes or as known (CSM) **[3].**

James et al., in their work to compare between traditional cervical laminectomy (LAMT) and skip cervical laminectomy (skip LAMT) found no statically significant results in patients clinical outcomes, intraoperative and postoperative complications in both groups. They also assumed that the patients who underwent Skip laminectomy techniques had shorter hospital but it was not statistically significant and this matches with results in our study **[6].**

Shiraishi et al., in their comparative study cleared that only 1 (2%) of the patient who underwent skip LAMT showed newly experienced axial neck pain, while 33 patients (66%) managed through laminoplasty technique (LAMP) showed newly discovered or progression of their axial neck pain. The overall percentage of cervical extens or musclesatrophy in patients underwent skip LAMT was 13%, while it was 59.9% in those underwent LAM. C5 paresis was detected in Three patients (5.7%) the LAMP group, while this complication wasn't encountered in the skip LAMT group. The neck range of movement (ROM) Postoperatively was better in Skip LAMT, in comparison to LAMP (p<0.05). This study showed that Skip LAMT technique was found to be less destructive with more preservation of extensor muscles with wide decompression and less bone removalin comparison to LAMP. This clearly demonstrate that skip LAMT is an effective technique for spinal cord decompression while being less invasive with lower postoperative complications than conventional LAMT and LAMP. Sivaraman et al., in their work concluded better postoperative range of movement, shorter operative time, less blood loss and significant reduction of axial neck pain in persons who were treated by skip laminectomy in comparison to traditional laminectomy. However the degree of neurological structures decompression in the two procedures was nearly equal. Yukawa et al., in their research concluded that there was no significant statistical difference as regards, axial neck pain and patient satisfaction, operative invasiveness between skip LAMT and LAMP **[1].**

In the absence of solid consensus about the ideal approach to manage moderate and event mildcases of myelopathy due to cervical spondylosis or as known (CSM) are still considered a debatable condition. Some surgeons prefer to remove the compressing elements to prevent significant cord compression and irreversible damage due to traumatic events or repetitive cord trauma during routine daily activity. However, the accurate prediction of this progression lacks solid guidelines to identifyexactly for whom and when surgical interference

isvalid in this group of candidates. Many reports showed favorable outcome after surgical management but these reports are mostly retrospective with short period of follow-up. There is a great need of high-quality researches to creating a comprehensive management strategies for these patients **[7].**

Conclusion:

Although the clinical outcome of both procedures showed no significant difference that can give absolute superiority to any of these approaches but skip laminectomy is less destructive with better postoperative course and shorter hospital stay. On the other hand it is more lengthy procedure which needs special skills and learning curve.

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نتائج استئصال الصفيحة الفقريه التخطيية مقابل استئصال الصفيحة الفقرية الكلاسيكيه فى العلاج الجراحى لاعتلال النخاع الفقارى العنقى متعدد المستويات

لا تزال الإستراتيجية الجراحية المثلى لإدارة اعتلال النخاع الفقارى العنقى متعدد المستويات موضع جدل. يعد استئصال الصفيحة الفقرية واستئصال الصفيحة الفقرية من الأساليب المحددة لعنق الرحم لعلاج اعتلال النخاع الفقارى العنقى متعدد المستويات.

الهدف من هذه الدراسة هو إجراء مقارنة شاملة بين كلا النهجين فيما يتعلق بالنتائج والمضاعفات السريرية تهدف الدراسة الى تقييم دور استئصال الصفيحة الفقرية التخطيية فى تمزق المرضى الذين يعانون من اعتلال النخاع الفقارى العنقى متعدد المستويات أجريت هذه الدراسة فى مستشفى جامعة المنصورة ٢٠١٨–٢٠٢١ على ٤٠ مريضاً ٢٣ ذكر و ١٧ أنثى بمتوسط عمر ٥٩ سنة مع ضيق شوكى متعدد المستويات وتم إجراء العمليات الجراحية باستخدام نهج جراحى خلفى، ٢٠ حالة تم إجراء عملية استئصال الصفيحة الفقرية (المجموعة أ) والأخرى ٢٠ حالة تم إجراء العمليات الجراحية باستخدام عملية استئصال الصفيحة الفقرية (المجموعة ب). قمنا بمقارنة بيانات كلا المجموعتين فيما يتعلق بالنتائج والمضاعفات السريرية تظهر المقارنة بين المجموعة ب وآ أن المجموعة ب أظهرت آلامًا أقل فى الرقبة بعد العملية الجراحية، وتأثرًا أقل بالمدى الحركى وفقدانًا أقل لقعس الفقرات، وفقدانًا أقل للدم ووقتًا أقل للعملية الجراحية. كما أن نسبة المضاعفات أقل فى المجموعة أعلى الرغم من أن النتائج السريرية لكلا الإجراءين لم تظهر أى فرق كبير يمكن أن يعطى تفوقًا مطلقًا لأى من هذه الأساليب، إلا أن تخطى استئصال الصفيحة الفقرية يكون أقل تدميراً مع مسار أفضل بعد العملية الجراحية وإقامة أقصر فى المستشفى. ومن ناحية أخرى، فهو إجراء أطول ويحتاج إلى مهارات خاصة ومنحنى تعليمى.