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Title: Surgery for thoracic myelopathy caused by ossification of the ligamentum flavum

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Keywords: coexistent spinal lesion; ossification of the ligamentum flavum; surgical treatment; thoracic myelopathy

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Manuscript Region of Origin:

Abstract: Background. Ossification of the ligamentum flavum (OLF) overlying the lower thoracic spine frequently produces myelopathy. This study analyzed the postoperative outcomes following decompressive laminectomy for thoracic OLF.

Methods. We retrospectively studied 13 patients (10 male, 3 female; mean age, 58 years; range, 39 to 69). The mean follow-up duration was 66 months (range, 21 to 107). All patients had undergone decompressive laminectomy and excision of the OLF. The clinical course was evaluated according to the Frankel grading system and JOA scores. The number of vertebral segments demonstrating OLF, the most frequent level of thoracic cord involvement, and spine lesions coexisting with OLF were determined by magnetic resonance imaging (MRI).

Results. By the Frankel system, 7 of 13 patients improved by one grade while the others, classified as grade D, were unchanged after surgery. Utilizing the JOA score, the functional improvement was excellent in 3 patients, good in 4, fair in 2, and unchanged in 4. The number of vertebral segments demonstrating OLF included 4 levels in 2 patients, 3 levels in 2 patients, 2 levels in 5 patients, and 1 level in 4 patients. OLF occurred most frequently at the T10/T11 level. Tandem cervical and lumbar lesions were present in 6 patients.

Conclusions. Decompressive laminectomy for excision of OLF resulted in clinical improvement utilizing the Frankel grading system in 7 of 13 patients. In myelopathy patients with OLF, preoperative MRI of the entire spine is necessary because other coexisting spinal lesions may be present.

December 23, 2006

Dr. James I. Ausman
Editor-in-Chief
SURGICAL NEUROLOGY Editorial Office

Ms. Ref. No.: SUN-D-06-00610R2

Title: Surgery for thoracic myelopathy caused by ossification of the ligamentum flavum

Dear Dr. Ausman,

Thank you very much for your e-mail of December 8, 2006 in which you passed reviewers' comments on our manuscript entitled "Surgery for thoracic myelopathy caused by ossification of the ligamentum flavum".

I am returning herewith the above revised according to your letter of reviewer's comments. We are enclosing a revised manuscript.

I look forward to hearing from you.

Sincerely yours,

Hiroki Hirabayashi, M.D.

Response to reviewers letter

Our incorporation of the reviewer's suggestion is follows:

Reviewers' comments:

Reviewer #1: To the Authors

This paper has been reduced to a short technical note. However, I think that much basic editing is still needed. I have gone through the technical note sentence by sentence below and have offered what I think would constitute an acceptable rewrite/alternative. You should go through my recommendations and accept as many as you agree with. This technical note needs the basic editing offered below and still contains interesting material regarding the management of thoracic OYL.

Response: We have reorganized and revised our abstract and manuscript everything carefully according to the reviewer's recommendations.

Specific recommendations: There are many places in the abstract that require articles

Abstract:

I would break the first sentence into two separate sentences.

Line 2..produces myelopathy. PERIOD

I would omit the latter part of this sentence as it is redundant with the last one;

Therefore don't add:

Laminectomy is the most commonly performed surgical procedure for OLF.

Rather, go with the last sentence [line 3]This study analyzed the postoperative outcomes following decompressive laminectomy for thoracic OLF.

Methods. Second line;

The mean follow-up duration was.

Results; second line and second sentence. Utilizing the JOA score, the functional improvement was excellent in 3 patients.

Line 3; The number of vertebral segments exhibiting OLF included: 4 levels in 2 patients, 3 levels in 12 patients, ..OLF occurred most frequently at the T10/T11 level. Tandem cervical and lumbar lesions were present in 6 patients.

Response: Reviewer's comment shows "3 levels in 12 patients". However, as this is a study of 13 patients, "3 level in 2 patients" is correct.

Conclusion; give the number. Decompressive laminectomy for excision of OLF resulted in clinical improvement utilizing the Frankel grading system in 7 of 13 patients..

Response: According to reviewer's suggestion, we have omit "LSCS" from Abbreviation list and changed MRI: Magnetic Resonance Imaging to MR: Magnetic Resonance.

Introduction.

Line 1 : I would suggest. OLF frequently contributes to either cervical or thoracolumbar spinal cord compression [1, 4].

Line 2:

Both MR and CT studies document that OLF, located posterolaterally in the spinal canal, contribute to significant epidural thoracic cord compression.

This study focuses on the neurological outcome following laminectomy for resection of OLF in the thoracolumbar spine.

M and M

First line; Laminectomies were performed in 13 consecutive patients with thoracic myelopathy attributed to OLF and stenosis [table 1].

Line 2 Preoperative patients underwent MR and myelography/ M-CT studies of the entire spine along with MEPs to demonstrate the levels of symptomatic OLF and identify tandem spinal lesions.

Line 5 The majority of decompressions focused on the T10/T11 levels. Postoperatively, patients were followed an average of 66 months, and their neurological improvement was rated utilizing the Frankel grading system and JOA scores.

Results

Seven patients improved 1 Frankel grade following laminectomy, while 6 demonstrated

no improvement [table 2]. JOA scores increased postoperatively in 11 of 13 patients [mean preoperative.]. One of the 13 patients, a 63 year old female [case 8], became transiently paraplegic following a T3-T4 laminectomy. Despite the lack of cord compression, focal edema, or hematoma formation on the postoperative MR study.. Tandem lesions included OPLL [3-cervical, 1 thoracic], CSM [1 patient [and LSCS[this should be spelled out not abbreviated]. Prior to thoracic decompressions, 3 patients underwent cervical decompressions [laminectomies] for OLF [table 2].

Response: Prior to thoracic decompression, 2 patients underwent cervical decompression and 1 patient underwent lumbar decompression (See Table 2). Thus I would like to put an acceptable sentence: Prior to thoracic decompressions, 3 patients underwent cervical or lumbar decompressive surgeries (Table 2).

Discussion; Line 2; Tandem spinal lesions were diagnosed based on MR, Myelography/Myelo-CT, and MEP studies. Omit the third line. Keep the fourth line.

Abbreviations list

CSM: Cervical Spondylotic Myelopathy

CT: Computed Tomography

JOA: Japanese Orthopedic Association

MEP: Motor Evoked Potential

MR: Magnetic Resonance

OLF: Ossification of the Ligamentum Flavum

OPLL: Ossification of the Posterior Longitudinal Ligament

Surgery for thoracic myelopathy caused by ossification of the ligamentum flavum

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Abstract

Background. Ossification of the ligamentum flavum (OLF) overlying the lower thoracic spine frequently produces myelopathy. This study analyzed the postoperative outcomes following decompressive laminectomy for thoracic OLF.

Methods. We retrospectively studied 13 patients (10 male, 3 female; mean age, 58 years; range, 39 to 69). The mean follow-up duration was 66 months (range, 21 to 107).

All patients had undergone decompressive laminectomy and excision of the OLF. The clinical course was evaluated according to the Frankel grading system and JOA scores. The number of vertebral segments demonstrating OLF, the most frequent level of thoracic cord involvement, and spine lesions coexisting with OLF were determined by magnetic resonance imaging (MRI).

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1. Introduction

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2. Material and Methods

Laminectomies were performed in 13 consecutive patients with thoracic myelopathy attributed to OLF and stenosis (Table 1). Preoperative patients underwent MR and Myelography/Myelo-CT studies of the entire spine along with MEPs to demonstrate the levels of symptomatic OLF and identify tandem spinal lesions. The majority of decompressions focused on the T10/T11 levels. Postoperatively, patients were followed an average of 66 months, and their neurological improvement was rated utilizing the Frankel grading system and JOA scores [3].

3. Results

Seven patients improved 1 Frankel grade following laminectomy, while 6

demonstrated no improvement (Table 2). JOA scores increased postoperatively in 11 of 13 patients (mean preoperative 5.2 to mean postoperative 7.6: mean JOA recovery rate 46%). One of the 13 patients, a 63 year-old female (case 8) became transiently paraplegic following a T3-T4 laminectomy, despite a lack of cord compression, focal edema, or hematoma formation on the postoperative MR study to account for this new deficit. Tandem lesions included OPLL (3-cervical, 1-thoracic), CSM (1 patient), and Lumbar Spinal Canal Stenosis (2 patients). Prior to thoracic decompressions, 3 patients underwent cervical or lumbar decompressive surgeries (Table 2).

4. Discussion

Multilevel thoracic OLF most often includes the T10/T11 levels, as in this series, and may be adequately managed with thoracic laminectomy alone. Tandem spinal lesions were diagnosed based on MR, Myelography/Myelo-CT, and MEP studies. In this series, thoracic laminectomy resulted in neurological improvement of one Frankel grade in 7 of 13 individuals and was followed by improvement of JOA score in most patients.

References

[1] Hanakita J, Suwa H, Ohta F, et al. Neuroradiological examination of thoracic radiculomyelopathy due to ossification of the ligamentum flavum. *Neuroradiology* 1990;32:38-42.

[2] Miyakoshi N, Shimada Y, Suzuki T, et al. Factors related to long-term outcome after decompressive surgery for ossification of the ligamentum flavum of the thoracic spine. *J Neurosurg* 2003;99:251-6.

[3] Ohnishi K, Miyamoto K, Kanamori Y, et al. Anterior decompression and fusion for multiple thoracic disc herniation. *J Bone Joint Surg [Br]* 2005;87B:356-60.

[4] Shiokawa K, Hanakita J, Suwa H, et al. Clinical analysis and prognostic study of ossified ligamentum flavum of the thoracic spine. *J Neurosurg* 2001;94:221-6.

Figure Legends

Fig. 1. MRI (A) and CT myelographic images (B, C) in a representative case of OLF involving T8/9 to T10/11 in a 59-year-old man (case 1). Preoperative T2- weighted (A) MRI, and axial CT myelography (B and C) show OLF at T10 (B) and T10/11 (C). No other coexistent spinal lesion was associated with OLF in this patient. Decompression was achieved, and the neurologic deficit showed improvement after surgery (see Table 2).

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Table 1 Summary of study patients

Patient			Follow up
No.	Age / Sex	Spinal levels of OLF	(months)
1	59/M	T8/9, T9/10,T10/11	107
2	61/M	T9/10, T10/11, T11/12	86
3	58/M	T10/11	79
4	64/M	T11/12	73
5	56/M	T9/10, T10/11	64
6	39/M	T9/10, T10/11, T11/12, T12/L1	61
7	54/M	T5/6, T7/8, T11/12, T12/L1	46
8	63/F	T3/4	33
9	66/M	T10/11	34
10	66/M	T10/11, T11/12	21
11	69/M	T10/11, T11/12	90
12	47/F	T3/4, T4/5	97
13	48/F	T4/5, T10/11	69

Table 2 Clinical outcomes

Patient No.	Frankel grade		JOA score		Recovery rate (%)	Final result	Spinal diseases coexisting with OLF
	Pre-op	Post-op	Pre-op	Post-op			
1	D	E	7	10	75	Excellent	Cervical OPLL
2	C	D	5	6	17	Unchanged	LSCS
3	D	D	5	7	33	Fair	CSM (decompressed)
4	D	D	6	9	60	Good	Cervical OPLL (decompressed)
5	C	D	2	7	56	Good	
6	C	D	5	9	67	Good	LSCS (decompressed)
7	D	D	7	7	0	Unchanged	
8	D	D	4	4	0	Unchanged	
9	C	D	3	4	13	Unchanged	
10	D	E	6	10	80	Good	
11	D	E	9	11	100	Excellent	Cervical OPLL
12	D	D	4	6	29	Fair	Thoracic OPLL
13	D	D	5	9	67	Good	

Fig. 1.

