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Original Article

A Study of the Clinical Outcome of Laminoplasty for Cervical Compressive Myelopathy
研究椎管擴大手術對頸脊髓壓迫症的臨床結果

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ABSTRACT

Purpose: To evaluate the prognostic factors that affect the surgical outcome of laminoplasty in patients with cervical compressive myelopathy.
Methods: This is a retrospective review of 43 cases of multi-level cervical compressive myelopathy treated operatively with expansive laminoplasty (Itoh surgical technique), from June 1989 to August 2008. The mean follow-up duration was 7 years. The Japanese Orthopaedic Association score, Hirabayashi recovery rate and improvement of Pavlov's ratio were used to assess the clinical results after laminoplasty.
Results: The mean Japanese Orthopaedic Association score improved from 9.7 to 13.7 points after laminoplasty ($p < 0.001$), with 65.1% excellent or good results. The Pavlov ratio improved from 0.71 to 0.9 after operation ($p < 0.001$). Excellent or good surgical outcome is demonstrated in patients aged <70 years.
Conclusion: Laminoplasty is a viable surgical option for patients with three or more levelsofcervical cord compression. Patients youngerthan 70 years predict a favourable surgical outcome.

中 文 摘 要

目的：評估那些預後因素能影響患有頸脊髓壓迫症的病人進行椎管擴大術的手術結果。
方法：本研究回顧分析了43個患有多節段頸脊髓壓迫症的病人，在1989年六月到2008年八月期間，接受了椎管擴大手術(Itoh伊藤外科技術)。平均隨訪時期為七年。使用了日本骨科學會（JOA）評分，平林(Hirabayashi)康復率和頸椎椎管/椎體矢狀徑的比值(巴夫諾夫比值Pavlov's ratio)來評定椎管擴大手術的術後臨床結果。
結果：接受了椎管擴大手術的病患者，日本骨科學會評分之平均分從9.7分提高到13.7分($p < 0.001$)。優良或良好的手術結果達65.1%。此外，巴夫諾夫比值在手術後也從0.71提高到0.9($p < 0.001$)。年齡小於70歲的病患者能顯現出優良或良好的手術結果。
結論：椎管擴大術是一個適用於三或多於三節段頸脊髓壓迫症病患者的外科手術。病人年齡小於70歲有良好的術後臨床結果。

Introduction

Since Hirabayashi first reported the results of expansive laminoplasty by using single hinge door, this technique has become the treatment of choice for cervical compressive myelopathy (CCM) involving three or more levels.[1] Laminoplasty is commonly used to manage cervical myelopathy resulting from cervical spondylotic myelopathy, ossification of the posterior longitudinal ligament, and diffuse idiopathic skeletal hyperostosis.[2–6] Cervical laminoplasty avoids anterior approach related morbidity and graft-related complications that associate with anterior cervical surgery.[7–11] In the literature many different surgical modifications were introduced with the aim of preventing fall back of the raised bone flap after single hinge door laminoplasty. The use of rib allograft, sutures, bone blocks and stainless steel wiring, and recently titanium plates have been advocated.[12–16]

The objective of this study is to review the operative results of the patients in our centre and to evaluate various prognostic factors.

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Materials and methods

From June 1989 to August 2008, 51 patients with CCM had laminoplasty performed in our centre. Eight patients died of unrelated medical causes and were unable to complete 2 years follow-up. Thus, a total of 43 patients were recruited. The average age of patients was 65.3 (range 37–88) years. The male to female ratio was 28 to 15. The mean duration of symptoms was 10.6 (range 1–46) months. The mean follow-up was 7 years (range 26 months to 16 years). All patients with CCM had their diagnosis confirmed by clinical examination and magnetic resonance imaging (MRI) study. Laminoplasties were performed when there werethree or more levels of cervical stenosis.

Surgical technique

We used Itoh's modification of Hirabayashi single door hinge laminoplasty, whichapplied interposing bone graft and stainless steel wiring to prevent fall back of the laminar bone flap.[13] A midline posterior incision was used with patients laid in prone position. Paraspinal muscles were dissected and stripped to expose the facet joints. The number of laminae raised was based on the number of compressed segments, determined preoperatively by clinical examination and MRI studies. The side of open door was determined by the side with more neurological deficits. The adequacy of spinal decompression was confirmed by observing cord pulsation intraoperatively.

Bone grafts harvested from C7 and/or T1 spinal process were used to interpose the open hinge side to prevent fall back of the laminar bone flap. The bone graft was then secured and fixed by fine wire loops (Figure 1). The open hinge was also secured by Ethibond sutures to prevent laminar bone spring back.

Postoperatively,the patients wore Philadelphia neck collars for protection for 6 to 8 weeks. After that period, they were referred to physiotherapy for neck exercises. All patients had regular follow-up at the spine clinic.

Assessment

The patients' characteristics including age, gender, symptom duration, and pathology were documented. Japanese Orthopaedics Association (JOA) scores (Table 1)and X-raysof the cervical spine were recorded and studiedduring every outpatient visit.

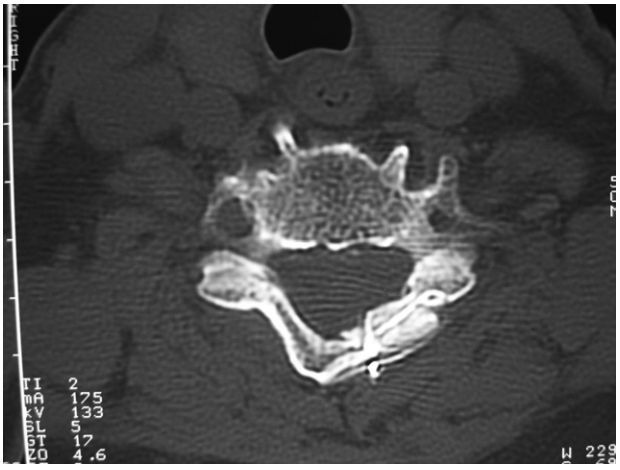

Figure 1. Computed tomography scan showed widening of the spinal canal after the laminoplasty with Itoh's method.

Table 1
Functional scoring system for cervical myelopathy proposed by the Japanese Orthopaedic Association (JOA; 0–17 points)

Parameter	Score
Motor dysfunction of the upper extremity	
Unable to feed oneself	0
Unable to handle chopsticks, able to eat with a spoon	1
Able to eat with chopsticks but has difficulty	2
Independently eating with chopsticks but awkward	3
Normal	4
Motor dysfunction of the lower extremity	
Unable to walk	0
Need cane or aid on flat floor	1
Need cane or aid on stairs	2
Able to walk without cane or aid, but limited	3
Normal	4
Sensory deficit	
Upper extremity	
Severe sensory loss or pain	0
Mild sensory loss	1
None	2
Lower extremity	
Severe sensory loss or pain	0
Mild sensory loss	1
None	2
Trunk	
Severe sensory loss or pain	0
Mild sensory loss	1
None	2
Sphincter dysfunction	
Unable to void	0
Marked difficulty in micturition (retention, strangury)	1
Difficulty in micturition	2
None	3

The light touch sensation was tested by using a small wooden stick. The functional improvement was expressed by Hirabayashi recovery rate percentage. The functional results were rated as 'excellent', 'good', 'fair', 'unchanged', and 'worse' according to percentage of recovery rate (Table 2).

Abnormal neurological signs detected clinically were classified into early and late signs according to criteria in Table 3. Pavlov's ratio was measured preoperatively and postoperatively with the lateral cervical spine plain radiographs (Figure 2). Signal changes were studied with T2 MR images preoperatively.

Wilcoxon signed rank test was used to compare the change in Pavlov's ratio and JOA score before and afterthe laminoplasty. Pearson correlation test was used to determine the correlation between various prognostic factors (gender, age, symptom duration, neurological signs, Pavlov's ratio, and MRI signal changes) and good/excellent recovery rate. All data analysis was performed using SPSS (Windows version 12.0; SPSS Inc, Chicago, IL, USA).

Results

Out of the 43 cases of CCM, there were 29 cervical spondylotic myelopathies, 11 ossifications of the posterior longitudinal

Table 2
Determine the recovery rate by Hirabayashi recovery rate percentage (RR %)

$$\text{RR \%} = \frac{(\text{Postop JOA score} - \text{Preop JOA score})}{17 - \text{Preop JOA score}} \times 100$$

Functional recovery based on RR %:

Excellent	RR 75–100%
Good	RR 50–74%
Fair	RR 25–49%
Unchanged	RR 0–24%
Worse	RR < 0%