Clinical results of and patient satisfaction with cervical laminoplasty for considerable cord compression with only slight myelopathy

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Received: 10 December 2010 / Revised: 1 July 2011 / Accepted: 9 October 2011 / Published online: 18 October 2011
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Abstract

Purpose There is no established consensus on the indications for surgery in patients with considerable cord compression but only slight myelopathy. The purpose of this study is to stimulate discussion about the indications for surgery in these patients.

Methods The records of consecutive patients who underwent cervical laminoplasty (CLP) during 3.5 years were reviewed. Those patients whose pre-operative Japanese Orthopaedic Association score (JOA score, maximum 17) for cervical myelopathy was 16 points or more, indicating that they had very slight myelopathy, were selected. The postoperative JOA scores of these patients were checked via a chart review, and they were sent a survey asking about their degree of satisfaction with the results of surgery.

Results Of 143 patients who underwent CLP, 14 presented with a preoperative JOA score of 16 or more. No patients showed a postoperative deterioration in JOA score. Nine patients complained of pre-operative hand numbness and this symptom disappeared postoperatively in seven cases. Most patients were satisfied with the results of the surgery: “very satisfied” in 11 cases and none selected “slightly dissatisfied” or “very dissatisfied”.

Conclusions We believe that surgery can rescue well-informed and deliberately selected patients with only slight myelopathy, because their symptoms improve and they are freed from persistent anxiety.

Keywords Cervical spondylotic myelopathy · Ossification of posterior longitudinal ligament · Cervical laminoplasty · Surgical indication · Patient satisfaction

Introduction

There is no established consensus on the indications for surgery in patients with considerable cord compression but only slight myelopathy. The myelopathy may progress with time and become irreversible, and the surgical results and satisfaction of patients with late-stage myelopathy are usually poor [1, 2]. However, surgery is always accompanied by the risk of major and minor complications, which should not be ignored. Furthermore, some patients may do well with conservative treatment [3]. We should weigh the former against the latter, taking into consideration many factors such as age, activity, general condition, understanding, psychological status and social background of the patients, dynamic factors, the severity of cord compression, and the intramedullary high signal intensity on T2 weighted MR images, and our own surgical skill and experience. However, we often waver between conservative treatment and surgery. Two recent review papers on cervical spondylotic myelopathy (CSM) [1, 2] and the Japanese Orthopaedic Association (JOA) guidelines for cervical ossification of posterior longitudinal ligament (OPLL) recommend conservative treatment for patients with mild myelopathy. In contrast, some neurosurgeons aggressively perform prophylactic surgery for those with cord compression and few symptoms.

Cervical laminoplasty (CLP) is a very popular technique for treating cervical myelopathy in our country, which has a higher incidence than Western countries of patients with developmental canal stenosis necessitating a wide range of

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decompression. This technique is well established and the reported complication rates are acceptable, but some problems such as axial symptoms or C5 palsy have not been fully resolved [4–6]. The long term results of this technique is satisfactory, with the preservation of the enlarged cervical canal area and the maintenance of JOA scores for cervical myelopathy (JOA score, Table 1, maximum score 17 points) [7].

Table 1 Criteria for evaluation of the severity of cervical myelopathy (JOA^a score)

I. Motor function	
A. Upper limbs, hands and fingers	
0	= Unable to feed oneself with any cutlery
1	= Able to feed oneself with a spoon but not with chopsticks; writing is impossible
2	= Able to feed oneself with chopsticks, though awkwardly; writing is possible but not practical
3	= Slightly clumsy use of chopsticks; writing is clumsy but practical
4	= Normal
B. Upper limbs, shoulder and elbow joints	
–2	= Manual muscle testing of deltoid or biceps muscles ≤ 2
–1	= Manual muscle testing of deltoid or biceps muscles = 3
–0.5	= Manual muscle testing of deltoid or biceps muscles = 4
0	= Manual muscle testing of deltoid or biceps muscles = 5
C. Lower limbs	
0	= Chairbound or bedridden
0.5	= Able to stand but unable to walk
1	= Requires walking aids
1.5	= Walks unaided but with difficulty
2	= Needs support when going up and down stairs
2.5	= Needs support when going down stairs
3	= Capable of fast walking but with some difficulty
4	= Normal
II. Sensory function	
A. Upper limbs	
0	= Complete sensory loss
0.5	= Severe sensory loss
1	= Mild sensory loss
1.5	= Subjective numbness without sensory loss
2	= Normal
B. Trunk, same as A	
C. Lower limbs, same as A	
III. Bladder function	
0	= Retention and/or incontinence
1	= Sense of retention and/or incomplete continence
2	= Retardation and/or pollakiuria
3	= Normal

^a The Japanese Orthopaedic Association

In the present study, we retrospectively investigated through a chart review and survey the clinical results and satisfaction of the patients who underwent CLP despite having only slight myelopathy. We focused on CLP because it is the one of the most popular and established technique, by which we have treated many patients. The purpose of this study is to stimulate discussion about the indications for surgery rather than to draw a conclusion.

Materials and methods

The records of consecutive patients who underwent CLP to treat myelopathy between April 2006 and September 2009 were reviewed. CLP was generally performed for patients with cervical spinal canal stenosis ranging across three or more intervertebral discs and with lordotic or straight alignment. In all cases, one of the spinal surgeons in our hospital decided on and performed the surgery. Exclusion criteria were CLP shortly after spinal cord injury, previous cervical surgery and concomitant foraminotomy or fusion. The patients' pre-operative JOA scores were reviewed. The patients whose pre-operative JOA score was 16 points or more were selected. A JOA score of 16 or more indicates very slight if any myelopathy, and was selected as the threshold because considering only extreme cases makes the purpose of the present study clearer. Further, the complaints of most of these patients were only numbness or sensory disturbance of the hands. This made the group homogenous and made the interpretation of the results simpler. The postoperative JOA scores of these patients were checked through a chart review and they were sent a survey asking about pre-operative symptoms, symptoms at the time of response, why they underwent surgery, and their degree of satisfaction with the result (Table 2).

Before surgery, all patients were well informed about the possibility of worsening of their symptoms with ageing, their irreversibility, the effects and limitations of the conservative treatments, the risks of the operation including very rare major complications such as mortality or permanent quadriplegia and more popular complications such as axial symptoms or C5 palsy, and the limitations of the surgery. The merits and demerits of both conservative and surgical treatment were thoroughly explained. We sometimes took a lot of time if the patients and their family had many questions. Only patients, who and whose family essentially understood the above explanation, became candidates for operation. After discussion, the final decision was made by the patients and their families.

The precise technique for CLP and its postoperative care has been described elsewhere [8]. Briefly, the technique was conventional double-door laminoplasty, except that suture anchors instead of interlaminar spacers were used to

Table 2 Survey sheet

Question 1: Select your pre-operative symptoms (multiple selections are allowed)

- 0: None
- 1: Nuchal and shoulder pain or stiffness
- 2: Numbness in the hand
- 3: Clumsiness of the hand
- 4: Numbness in the lower limbs
- 5: Difficulty in walking
- 6: Disturbance of urination
- 7: Others

Question 2: Select your postoperative symptoms (multiple selections are allowed)

- 0: None
- 1: Nuchal and shoulder pain or stiffness
- 2: Numbness in the hand
- 3: Clumsiness of the hand
- 4: Numbness in the lower limbs
- 5: Difficulty in walking
- 6: Disturbance of urination
- 7: Others

Question 3: Why did you decide to undergo the operation (multiple selections are allowed)?

- 1: Because my activities of daily living were disturbed by the symptoms, although they were slight, and I wanted to improve them by undergoing the operation
- 2: Because the doctors (including those at previous hospitals) recommended the operation
- 3: Because I wanted to avoid being disabled in the future
- 4: Because I hated to live with anxiety about the future
- 5: Others

Question 4: Are you satisfied with the results of the surgery (one selection)?

- 1: Very satisfied
- 2: Slightly satisfied
- 3: Neither satisfied nor dissatisfied
- 4: Slightly dissatisfied
- 5: Very dissatisfied

Free comments

keep the split laminae open. The bilateral muscles attached to the C2 and/or C7 spinous processes were preserved as far as possible. Patients wore a soft collar for about two weeks after surgery.

Results

The total number of patients who fulfilled the selection criteria was 146. However, the pre-operative JOA scores of three patients were not available, resulting in 143 patients (89 males and 54 females) being selected. Their mean age

Fig. 1 Distribution of pre-operative JOA scores of the patients who underwent CLP. Black bars indicate the patients whose pre-operative JOA score was 16 or more

was 66.6 years (33–92 years). The diagnosis was CSM in 120 patients and OPLL in 23 patients. The mean pre-operative JOA score was 10.9 points and its distribution in these patients is shown in Fig. 1.

Fourteen patients had a pre-operative JOA score of 16 or more (9.7%, 11 males and three females) (Fig. 1, Table 3). Four patients had the maximum JOA score of 17. Seven patients complained of numbness in the hands without sensory disturbance, resulting in a JOA score of 16.5. The JOA score of the remaining three patients was 16: two patients complained of mild sensory loss in the hands and one patient complained only of being unable to fully extend the fingers of the left hand. Although some patients complained of clumsiness of the hand or numbness pre- and/or postoperatively, they were allocated the maximum score when the clumsiness was not objectively detectable or the subjective numbness was occasional. The mean age of patients with a JOA score of 16 or more was 51.9 years (35–67 years), while that of the remainder was 68.2 years. The mean age of the patients with a JOA score of 12 or less (a widely accepted indication for CLP) was 70.9 years. Of the 14 patients with a JOA score of 16 or more, nine were diagnosed with CSM and five with OPLL. Eleven were referred patients. Two of the non-referred patients came to us asking for a second opinion because in a previous hospital they were strongly recommended to undergo surgery in spite of their mild symptoms.

Plain radiograms and MRI of all the patients demonstrated considerable cervical spinal canal stenosis without remarkable instability. Dural tube compression at three or more levels and spinal cord deformity were observed on MRI in all cases. Disappearance of the cerebrospinal fluid signal on T2 weighted MRI was observed in all but one patient (case 11, Fig. 2). Three patients demonstrated the intramedullary high signal intensity on T2 weighted MR images.

Table 3 Details of the patients undergoing CLP with pre-operative JOA score of 16 or more

Case	Age (years)	Pre-operative JOA score	Postoperative JOA score (at final FU)	Postoperative term of survey (months)	Pre-operative symptoms (Q1)	Present symptoms (Q2)	Decision (Q3)	Satisfaction (Q4)	Range of CLP
1	56	16.5	17	38	2	None	4	1	C2–6, T3, 4
2	58	16.5	16.5	26	2	2	1, 3	1	C2–6
3	54	16.5	17	25	1, 2, 3, 5	None	1	1	C2–7
4	61	17	17	14	1	None	3, 4	1	C3–7
5	64	16.5	17	12	2	1	2, 3	1	C3–7
6	35	16	17	12	1, 2, 3	1, 3	4	1	C3–T2
7	35	16	16	12	2	1, 2	1	1	C3–6
8	56	16	16.5	12	1, 2	1, 2	1, 2	3	C3–7
9	40	16.5	17	12	2	1	2, 4	1	C2–7
10	40	17	17	12	7	1, 7	5	3	C1–T1
11	40	16.5	17	12	1, 2, 5	1, 4	3, 4	1	C3–7
12	61	17	17	12	1	1	2, 4	2	C2–7
13	67	17	17	12	None	1	2, 4	1	C3–7
14	60	16.5	17	10	1, 2	None	3, 4, 5	1	C1–7

Numbers in the columns from Q1 to Q4 correspond to the selection numbers in the survey (Table 2)

CLP cervical laminoplasty, JOA Japanese Orthopaedic Association, FU follow up, Q1–Q4 question number in the survey

Fig. 2 Pre-operative T2 weighted sagittal MRI (a) and axial MRI at C4/5 (b) of case 11. Dural tube compression and spinal cord deformity are apparent, but the cerebrospinal fluid signal was barely detectable on both sagittal and axial images. No intramedullary high signal intensity was observed on T2 weighted MR images

The final JOA score was obtained at least 10 months postoperatively in all cases. The survey was retrieved from all patients (response rate 100%), and the mean postoperative follow-up at response was 15.8 months (10–38 months). The demographic data and the survey results for these 14 patients are shown in Table 3. The final JOA scores of these patients were all 16 or more, and none showed deterioration in the JOA score after surgery. Four patients pre-operatively and 11 postoperatively had the maximum score. Nine patients complained of numbness in the hand pre-operatively, which was the most common symptom. This symptom disappeared postoperatively in seven cases. Seven patients pre-operatively and nine

postoperatively complained of axial symptoms such as nuchal or shoulder pain or stiffness. Five patients complained postoperatively of de novo axial symptoms. In four of them, the symptom was mild and the activity of daily living was not disturbed. Only one patient complained of moderate shoulder stiffness, which affected his activity. However, none required sick leave or analgesics for the axial symptoms. On the other hand, axial symptoms disappeared postoperatively in three patients.

The reason why the patients underwent the operation showed no particular trends. The most common reason was “because I hated living with anxiety about the future”, selected by eight of the 14 patients, followed by “because the doctors recommended surgery” and “because I wanted to avoid being disabled in the future” (five votes each), then “because I wanted to improve my slight symptoms” (four votes). Four of five patients who selected “because the doctors recommended surgery” had been recommended to undergo surgery by their previous doctors.

Most of the patients were satisfied with the results of the surgery, that is, “very satisfied” in 11 cases, “slightly satisfied” in one, and “neither satisfied nor dissatisfied” in two. There were no patients who selected “slightly dissatisfied” or “very dissatisfied”. The main reasons for their satisfaction, which were identified from patients’ free comments made in the survey, were “my symptoms were improved” and “I can live without anxiety about palsy”. One patient who selected “neither satisfied nor dissatisfied” (case 10) commented “I recommend the operation to patients in the same situation as me to prevent worsening of

their symptoms”. One patient (case 3) was very satisfied because after surgery he was able to play the violin as he used to. Before the operation, he was sometimes unable to move his fingers dexterously while playing the violin, although he had no difficulty in daily living and his pre-operative upper extremity motor function score was the maximum (four points).

Case presentation (case 11)

A 40-year-old man was referred to us to treat an osteoid osteoma in the left L2 superior articular process. His only complaint was low back pain and he was classified as a non-referred patient. However, he had a history of transient quadriplegia after jumping from a height, at which time the cervical spinal canal stenosis was identified. At that time, the quadriplegia disappeared completely after several days of emergency admission in another hospital. Plain lateral radiograms of his cervical spine demonstrated a straight alignment with an anterior–posterior distance of the spinal canal of 10–12 mm, and MRI demonstrated spinal canal stenosis with considerable cord compression from C3/4 to C6/7 (Fig. 2). Although he had slight numbness on the ulnar side of both hands, no sensory disturbance was observed. The reflexes of his upper extremities were within normal limits, but bilateral patellar tendon reflexes were exaggerated. No pathological reflex was observed. Manual

muscle testing of the four extremities demonstrated no muscle weakness. His JOA score was 16.5 points. We did not recommend surgery, although we presented it as one of the options. We advised him to give up his hobby of driving in car races to prevent possible irreversible quadriplegia caused by a car accident.

After the successful resection of the lumbar osteoid osteoma, he decided to undergo CLP. He did not want to give up car racing, partly because it was closely related to his job of running a tyre shop. He underwent CLP from C3 to C7 (double-door laminoplasty from C4 to C6 with concomitant resection of distal lamina of C3 and proximal lamina of C7) (Fig. 3). His postoperative course was uneventful.

At 1 year after operation, the numbness in his hands had disappeared. Although he complained of occasional nuchal pain and stiffness (which he had also complained of pre-operatively), he returned to his work and car racing with peace of mind. He chose “very satisfied” in the survey, and commented that he was happy, without anxiety about the future.

Discussion

The natural history of CSM or OPLL is not well known. Symptoms are often stable, at least in the short term, and only a modest number of patients improve while a significant minority eventually deteriorates. Worsening can occur in a gradual and stepwise progressive fashion. However, there are patients who present with sudden irreversible quadriplegia caused by minor trauma, although this is rare. However, the clinical course of an individual patient is difficult to predict [1]. Even MRI cannot reliably predict who will benefit from surgery and who will not. It is generally believed that the predictive factors for a good surgical outcome may include shorter duration of disease and milder neuroimaging [1, 2], suggesting that early or prophylactic surgery for myelopathy may be effective. However, we should remember that surgery is always accompanied by the possibility of major and minor complications [4], which makes the indications for surgery in patients with considerable cord compression but slight myelopathy controversial.

In two recent review papers on CSM, the authors recommended a careful observation for asymptomatic or mildly myelopathic patients [1, 2]. These recommendations, however, were drawn from statistical analysis of mostly middle-term follow-up of such patients. In the present study, some of the patients who underwent surgery focused on the possible irreversible worsening of their symptoms rather than the risks of the operation. The mean age of the patients who underwent surgery was 16 years

Fig. 3 Postoperative T2 weighted sagittal MRI of case 11 two weeks after surgery. The dural tube was successfully decompressed from C3/4 to C6/7

younger than those patients whose pre-operative JOA score was less than 16 points. This may reflect the patients' concern about the remainder of their life: we should remember that it is very important for some patients, particularly young patients, to live without anxiety about the future. Another reason may be that the JOA score would be higher in younger patients than in older patients with the same grade of myelopathy because of a better ability to compensate in younger patients.

Another point to note in the present study is that some people were happy after surgery because their slight symptoms (numbness in the hands in most cases) were relieved. Conservative treatment is usually recommended for patients with mild myelopathy, not because the symptoms improve with conservative treatment but because in most cases the symptoms do not deteriorate for a long time. Some patients, however, want to completely remove their slight symptoms even at the risk of surgery. For patients with apparent myelopathy, we usually explain that numbness is one of the symptoms least likely to disappear after surgery. However, in spite of repeated pre-operative explanations, some patients, in particular those with the intramedullary high signal intensity on T2 weighted MR images, complained of residual numbness after surgery even though other symptoms improved. In general, only a small percentage of patients experience complete recovery of numbness, so it was surprising that numbness disappeared in seven of nine patients in the present study. Further, one patient was pleased because he was again able to play the violin as he used to. In this series, we can recall another patient of 56 years old with a pre-operative JOA score of 15 who was very satisfied with his surgery for the same reason. One patient (case 6) was also satisfied because his finger extension improved postoperatively. We should note that a slight symptom, even if of little importance from our standpoint, might be a major problem for patients, in particular younger patients.

These results may raise questions about the surgeon's refusal to operate on patients simply because the patients do not present with apparent myelopathy. However, we should note with caution that the number of patients who complained of axial symptoms increased postoperatively, although the symptoms did not markedly disturb the patients' daily lives. We have used a conventional technique for CLP although several less invasive techniques have been recommended to reduce axial symptoms [9]. Although this is not the focus of the present paper, refined techniques may reduce the number of patients with de novo axial symptoms. However, four of five patients who presented with de novo axial symptoms after operation were very satisfied. This may demonstrate that freedom from anxiety and improvement of slight neurological symptoms

are much more important for them than the presence of mild axial symptoms.

We want to stress that we are by no means radical surgeons. We believe that thoughtless expansion of the indications for CLP should be strictly avoided. The proportion of patients in our series who were operated on in spite of their high JOA score may be felt to be too high. However, our hospital is a university hospital, and many of the patients were referred to us asking for a final decision when their previous surgeons hesitated to operate. If these surgeons did not have doubts, they would not have recommended their patients to come to us, because CLP is one of the most popular surgical techniques in our country. In addition, we should stress that many of the referred patients chose to be treated conservatively after our explanations of their myelopathy and the risks/benefits of CLP, although to present the exact number of these is impossible.

In the present study, we show the clinical results and the satisfaction of the patients who underwent CLP despite their slight symptoms. Their clinical results were good and their satisfaction was high. It would be impossible to draw a scientific conclusion based on the results of the present study because the number of the patients is small, the follow-up was short, conservatively treated patients were not followed or compared, and the patients' satisfaction was closely related to not only clinical results but also their understanding and philosophy. However, our results may stimulate discussion concerning the indications for CLP in such patients, in particular for young, active, intelligent patients, against the prevailing opinion. We should keep several points in mind as a basis for the discussion. First, all the information about the natural course of the disease, the effects and limitations of conservative treatments and in particular about major and minor complications of surgery that may result in permanent sequelae, should be given to the patients, although some of these are not well known. Second, we should understand that patients' high satisfaction does not always justify surgery. Usually advanced age and better postoperative health status were significantly associated with higher satisfaction [10, 11]. Although our patients were young, their postoperative health status was high with few sequelae, probably as a result of the early surgery, and this may have heightened their satisfaction. However, patient satisfaction is subjective and is easily affected by the surgeons' pre-operative explanation. We should try to keep a scientifically neutral position and always be careful not to mislead the patient.

Nevertheless, we believe that some selected patients are actually rescued by undergoing surgery, because their symptoms, although slight, improve and they are freed from persistent anxiety. Our endeavours to reduce the complication rate of surgery may widen the indications of CLP for these patients. However, we should be careful and

modest in draw a conclusion, because long-term results of cervical laminoplasty more than 20 or 30 years are not fully known. Further, we should attempt to scientifically determine the natural course of cervical myelopathy, the long-term prognosis of conservative treatment and the probability of irreversible palsy caused by minor trauma, to provide more precise information to these patients. Lastly, we should always caution ourselves not to expand thoughtlessly the indications for surgery.

Acknowledgment This study was supported by a grant from the Japanese Ministry of Health, Labour and Welfare.

Conflict of interest The authors certify that no actual or potential conflict of interest in relation to this article exists.

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