Operative Results of Laminoplasty in Multilevel Cervical Spondylosis with Myelopathy: A Comparison of Two Surgical Techniques

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Objective: *To compare the surgical results of two unilateral open-door cervical laminoplasty in patients with multilevel cervical spondylosis with myelopathy (CSM) or ossification of posterior longitudinal ligament (OPLL) in Songklanagarind Hospital.*

Material and Method: *This was a cohort study between January 2007 and December 2009. Thirty-eight patients were categorized into two groups of two periods. The Itoh and Tsuji laminoplasty technique (spinous process laminar elevation spacer) was performed in the first group. In the second group, the modified Hirabayashi laminoplasty technique (secured suture to elevated laminar with facet joint) was performed. All patients were followed up for at least 18 months. Demographic data, physical examination, postoperative Nurick score, JOA score, and recovery rate were collected.*

Results: *All patients experienced improvement of neurological symptoms, Nurick score, JOA score, and recovery rate. There were no postoperative complications such as C5 nerve root palsy or neck pain. There were no statistically significant differences in all outcomes between the two surgical laminoplasty techniques. However, the modified Hirabayashi laminoplasty technique had significantly less operative blood loss ($p = 0.005$) and a shorter operative time than the Itoh and Tsuji technique.*

Conclusion: *There were no statistically significant differences in the surgical results of either technique, while the modified Hirabayashi technique had less operative time and blood loss. This suggests that the modified Hirabayashi technique is the technique of choice.*

Keywords: *Cervical spondylosis with myelopathy, Cervical laminoplasty*

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Cervical spondylosis with myelopathy (CSM) or ossification of posterior longitudinal ligament (OPLL) has been found in the middle-aged and elderly people. They developed severe disabilities in daily activities such as writing, using a spoon, walking in a wide based gait, and in some cases, they cannot control their bowel and bladder functions[1,2]. The slow progressive compression of the cervical spinal cord leads to degeneration of the spinal cord, a poor clinical outcome and a low rate of response to conservative treatment[3]. Anterior surgical approach[4] with multiple cervical disectomy or corpectomy with fusion disturbed of cervical motion by long fusion. A number of posterior decompression techniques have been developed. Laminectomy with or without fusion[4] is the first surgical procedure but results in a poor long term clinical outcome and there are complications following the procedure such as post-operative kyphosis or axial instability which are difficult to manage. Laminoplasty was first described in 1973 and gained popularity for the treatment of cervical myelopathy. A number of surgical techniques have been developed. The Hirabayashi technique[5] is the classic open-door laminoplasty that maintains the elevated lamina with a secured suture to the contra-lateral soft tissue. The Itoh and Tsuji technique[6] maintains an elevated lamina with a spinous process spacer with suturing to the lateral mass. Both laminoplasty techniques showed good surgical results in the previous studies. However, disadvantages are

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post-operative neck pain or neurological deficit, *e.g.* C5 palsy[7-9]. In present study, the Hirabayashi technique was modified to secure a suture to the lateral mass for stability and strength for maintenance of laminar elevation rather than a secured suture to the soft tissue. However, no previous study has directly compared the results of the Itoh and Tsuji technique and a modified Hirabayashi technique. The study aimed to compare the results of the two surgical techniques of laminoplasty in treatment of patients with CSM in Songklanagarind Hospital.

Material and Method

Permission of the study was granted by the Ethic Committee, Faculty of Medicine, Prince of Songkla University. Between January 2007 and December 2009, forty-one cases of CSM were initially enrolled into the present study, whereas thirty-eight were follow-up (25 men and 13 women). The subjects were categorized into two different periods. The first group of 18 clients was surgically performed through the Itoh and Tsuji technique[6] (spinous process spacer laminoplasty). The second group of 20 clients was intervened with the modified Hirabayashi technique[5] (maintain laminar elevation with secured suture with lateral mass). The demographic data, as well as the clinical status, physical examination, and magnetic resonance imaging of at least 18-month follow-up information, were assessed.

Surgical technique

The patient was in the prone position and the head was supported on a head ring with eye protection. A midline incision over C3 to 7 was made, and the ligamentum nuchae ligament was separated laterally to expose the spinous process of C3 to 6 or C3 to 7. High-speed blur was used to create complete laminotomy on one side and incomplete laminotomy on the contralateral site. In the modified Hirabayashi technique (Fig. 1), the lamina was elevated and secured with nylon wiring to the ipsilateral lateral mass after drilling a small hole for maintaining an elevated lamina. In the Itoh and Tsuji technique (Fig. 2), the spinous process was resected and prepared for use as a spacer at the open-door site of laminoplasty, and then secured with a nylon suture passing from the facet, bone graft, and lamina.

Philadelphia collars were applied for 2 months post-operative. Isometric neck exercises began after the pain subsided. The patients were followed-up at 1, 3, 6, 12, and 18 months post-operatively.

Pre- and post-operative Nurick score[10], Japanese Orthopedic Association (JOA) score for cervical myelopathy, recovery rate[10], intraoperative blood loss, operative time, and post-operative axial neck pain at the twelfth and eighteenth months were collected. The Chi-square test was used for categorical outcomes, paired t-test for continuous data and unpaired t-test was used to compare between two methods. A p-value of less than 0.05 was considered significant difference.

Results

The mean age was 56.7 years old. There were no statistically significant differences among the demographic data between both groups, in term of sex, current smoking, alcohol drinking, axial neck pain, radiculopathy, myelopathy, duration of symptoms & conservative management, and underlying diseases, as well as the clinical findings of Hoffman sign, inverted radial reflex, L'hermitte, Spurling test, axial pain, scapulohumeral reflex, myelopathic gait, and paresthesia.

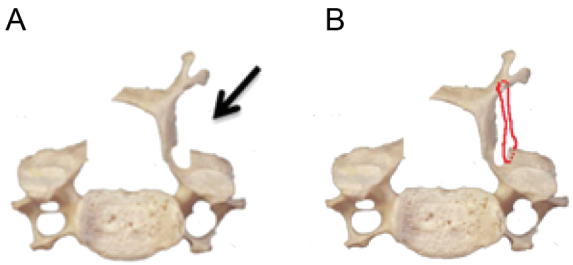

Fig. 1 Modified Hibarayashi's technique, the lamina was elevated (A) to the contralateral osteotomy site and a nylon suture was passed through the gutter of the lamina (the black arrow) to secure the lateral mass (B) after drilling a small hole

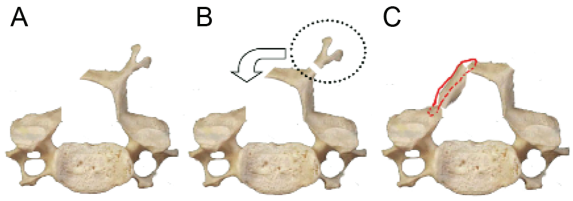

Fig. 2 Itoh and Tsuji's technique, the lamina was elevated (A) and the spinous process was split (B) and shaped to a size of about 8 mm thickness and placed at the osteotomy site and secured with nylon suture from the lateral mass, spinous process and lamina (C)

Table 1. Distribution of postoperative Nurick /JOA score and recovery rate among Itoh

	Itoh and Tsuji technique (n = 18) Nurick/JOA score	Modified Hirabayashi technique (n = 20) Nurick/JOA score	p-value Nurick/JOA score	Recovery rate (%) for JOA score (group 1/group 2)	p-value
Pre-operative	2.82/11.17	2.80/11.55	0.921/0.406	-	-
Post-operative					
1 month	2.82/13.11	2.85/12.85	0.914/0.559	31.74/23.10	0.218
3 months	2.35/14.00	2.40/14.10	0.854/0.814	48.08/48.40	0.960
6 months	1.82/14.00	2.10/14.25	0.300/0.599	49.23/49.70	0.945
12 months	1.76/14.41	2.15/14.60	0.163/0.651	56.67/56.35	0.954
18 months	1.82/14.76	2.10/14.80	0.089/0.926	58.90/59.60	0.877

The mean operative time was less in group 2 (203.0 $\pm$ 38.4 minutes) compared with group 1 (305.88 $\pm$ 46.1 minutes), but there was no statistically significant difference. The mean intraoperative blood loss was less in group 2 (189.70 $\pm$ 69.68 ml) and was statistically significant ($p < 0.05$) compared with group 1 (240.00 $\pm$ 45.18 ml). There was no post-operative C5 nerve root palsy in either group.

The surgical outcome was assessed by Nurick score, JOA score, and recovery rate by Hirabayashi method, as demonstrated in Table 1. There was no statistical difference between both surgical intervention groups.

Discussion

Currently cervical laminoplasty has been a standard and popular posterior surgical technique for treatment of patients with multilevel CSM or OPLL. The advantages of cervical laminoplasty compared with anterior surgery are safer, less technically demanding, preservation of cervical motion from long fusion and decreased adjacent degeneration. Furthermore, advantages compared with laminectomy are less epidural scarring or post-laminectomy membrane[7] that causes late deterioration. A number of laminoplasty techniques were described in the literature. The Hirabayashi technique[5] maintains an open lamina with a suture secured to soft tissue at the contralateral site. However, in the present study, the authors modified it to secure the suture with the lateral mass after drilling a small hole to improve the stability of the laminar elevation from suture. The results of unilateral open door laminoplasty with the Hirabayashi technique showed a recovery rate of 60% (range 45 to 81%)[5,7,8,11-13] and with the spinous process spacer (Itoh and Tsuji technique[6]) a recovery rate of 53 to 63%[6,14,15] which were similar results as the present study. After directly comparing the results in the present study, there was no statistically significant difference in the two groups in the final follow-up. Other laminoplasty techniques showed average recovery rates of 52 to 60%[7,8]. This suggested that both laminoplasty techniques were effective in treating CSM. In the same way, the Nurick score was used in European countries and showed improvement in both groups, i.e. a decrease in the Nurick grading. The recovery rate in the present study showed rapid improvement in the first three to six months after surgery and then gradual improvement up to the 18-month follow-up. The present results were consistent with most of the long-term studies[7,13,16], which showed recovery rates with significant improvement in the first one to three years and stable with a plateau phase, then slight deterioration after five to ten years.

The operative time was significantly less in the Hirabayashi technique than the Itoh and Tsuji technique because the Hirabayashi technique was less technically demanding since it does not harvest a bone graft, there is no need to drill a hole, and there is no passing of a suture from facet to bone graft to secure it with the elevated laminar. Furthermore, surgeons have gained more experience in this surgical technique that helps them perform the laminoplasty in less time. Chiba et al[7] showed an operative time in unilateral open door laminoplasty that was 129 minutes, which was a shorter operative time than in the present study. The estimated blood losses in the present study were low (189.70 $\pm$ 69.68 ml and 240.00 $\pm$ 45.18 ml) compared with other studies that were 206 ml[17] and 459 ml[7].

The incidence of post-operative axial neck pain was reported in the range of 30 to 60%[17-20]. A few explanations included posterior musculature weakness from massive posterior muscle dissecting during operation and prolonged post-operative

immobilization. In the present study, the post-operative neck pain was low (VAS 2 to 3). There might be shorter follow-up.

No case in the present study sustained C5 nerve root palsy. Previous studies[7-9] reported the incidence of post-operative nerve root palsy at 5-10%. Nerve root palsy develops from a posterior shift of the spinal cord at C4-5 level and a retraction of the C5 nerve root. Another explanation may be due to intervertebral foramen stenosis. There is no treatment for this problem. However, Imagama et al[9] recommended prophylaxis foraminotomy at the C5 nerve root to prevent nerve impingement or retraction.

Since the present study was not a randomized trial, a potential selection bias and evaluation bias might affect the surgical outcome. Due to a limited number of patients in each group, the power to detect the difference in both techniques might lead to results without statistical significance.

Conclusion

Cervical laminoplasty with either the Itoh or Hirabayashi technique is effective for multilevel CSM. However, the modified Hirabayashi technique has comparative advantages that it is less technically demanding, it take less operative time, and there is less blood loss.

Potential conflicts of interest

None.

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ผลการผ่าตัดขยายโพรงสันหลังในภาวะโรคกระดูกคอเสื่อมหลายระดับร่วมกับการสูญเสียหน้าที่การทำงานของประสาทไขสันหลัง: เปรียบเทียบสองเทคนิค

ชานินทร์ บุญตั้งใจ, ธีรสาส์น คีรีรัฐนิคม, บุญสิน ตั้งตระกูลวนิช

วัตถุประสงค์: *เปรียบเทียบผลการผ่าตัดขยายโพรงสันหลังแบบเปิดบานพับ 2 เทคนิคในผู้ป่วยโรคกระดูกคอเสื่อมหลายระดับร่วมกับการสูญเสียหน้าที่การทำงานของประสาทไขสันหลัง หรือ การกลายเป็นกระดูกของเอ็นยาวด้านหลังในโรงพยาบาลสงขลานครินทร์*

วัสดุและวิธีการ: *ศึกษากลุ่ม 2 กลุ่มใน 2 ระยะเวลา ตั้งแต่ มกราคม พ.ศ. 2550 ถึงธันวาคม พ.ศ. 2552 กลุ่มแรกผ่าตัดขยายโพรงสันหลังแบบ Itoh และ Tsuji technique (ขยายยกกระดูกและค้ำด้วย spinous process) กลุ่มที่ 2 ผ่าตัดขยายโพรงสันหลังแบบ Hibarayashi technique ประยุกต์ (เย็บยึดตรึงยกกระดูกส่วน facet joint) ผู้ป่วยทุกรายได้รับการติดตามผล 18 เดือน รวบรวมข้อมูลทั่วไป การตรวจร่างกาย คะแนน Nurick หลังผ่าตัด คะแนน JOA และอัตราการหาย*

ผลการศึกษา: *ผู้ป่วยทุกรายอาการระบบประสาท คะแนน Nurick คะแนน JOA และอัตราการหายดีขึ้น ไม่พบภาวะแทรกซ้อนหลังการผ่าตัด เช่น ภาวะอัมพาตของเส้นประสาทคอที่ 5 หรือ ปวดคอ ไม่มีความแตกต่างอย่างมีนัยสำคัญในผลที่ได้รับระหว่างการผ่าตัดขยายโพรงสันหลังสองเทคนิค อย่างไรก็ตาม การผ่าตัดแบบ Hibarayashi technique ประยุกต์ เสียเลือดน้อยกว่าอย่างมีนัยสำคัญ ($p = 0.005$) และระยะเวลาผ่าตัดสั้นกว่า การผ่าตัดแบบ Itoh และ Tsuji technique*

สรุป: *ไม่มีความแตกต่างทางสถิติอย่างมีนัยสำคัญในผลการผ่าตัดแต่ละแบบ ขณะที่การผ่าตัดแบบ Hibarayashi technique ประยุกต์ เสียเลือดน้อยกว่าและใช้เวลาสั้นกว่า แนะนำว่าการผ่าตัดแบบ Hibarayashi technique ประยุกต์ควรเป็นเทคนิคทางเลือก*