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# New Technique of Laminoplasty—Modified Hirabayashi with Lateral Mass Screwing and Spinous Process Wiring for Cervical Myelopathy

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## Abstract

Gold standard laminoplasty techniques of Kurokawa, Itoh have been realized in Vietnam since 1995 with good results. Some disadvantages of these techniques are found: large destruction of muscles, tip of spinous processes, supraspinous ligament, interspinous ligaments, resection and re-insertion of C2 tip of spinous process; the tailed trapezoid iliac grafts are not always in satisfactory shape as good spacer in Kurokawa technique; the boneceram piece, quite expensive for Vietnamese patients, is not affordable for all patients; the Itoh technique demands a multi-level grafts with multiple silk wiring and it is not easy to make a hole in facet for silk anchorage. The suggested wiring of spinous tip to lateral mass screw is a simple technique as more stable modified Hirabayashi ELP with two weeks soft collar wearing. This prospective study was conducted to introduce the new modified Hirabayashi Extensive Open-door Laminoplasty (ELP) for Cervical Myelopathy (CM).

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## Keywords

Laminoplasty • Modified Hirabayashi ELP • Lateral mass screwing and spinous process wiring • Cervical myelopathy • Vo Van Thanh's technique

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## 1 Introduction

Cervical myelopathy is discovered more numerous in Vietnam due to the application of more advanced imaging techniques: computerized radiography (CR), magnetic resonance imaging (MRI), computerized tomography scan (CT Scan). The etiopathology is quite numerous with or without the developing cervical stenosis including: cervical disc herniation (CDH), cervical spondylosis (CS), ossification of posterior longitudinal ligament (OPLL), ossification of yellow ligament (OYL), calcification of yellow ligament (CYL), antero-posterior dynamic factors and so on. In the majority of cases it is usually accompanied by the developing cervical spinal stenosis; multiple combined etiologies with multiple continuous or separated compression on cervical spinal cord. The Japanese original extensive open-door

laminoplasty in aiming to decompress the cervical spinal cord have determined the surgical indication, improved the prognosis and prevent the cervical kyphosis as previously done by laminoplasty [1, 2, 9–11, 13, 14]. The gold standard laminoplasty methods have been practiced in Vietnam since 1995 as Kurokawa or Itoh technique with good results [1–4, 9–15]. We found some disadvantages in realizing these techniques: long operative duration, expensive bone substitute boneceram spacers, generous destruction of bone and soft tissue, one more incision for harvesting of the iliac grafts. We suggest our original modified Hirabayashi extensive open-door laminoplasty to overcome these disadvantages with the same results.

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## 2 Materials and Methods

72 cases were operated from Feb 22, 2002 to Dec 1, 2005 in Spinal Surgery Department A, Hospital for Trauma-Orthopedics, HCM City, Vietnam.

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Men: 57. Women: 15. Mean age: 53 (34–87). Mean onset: 19 months (1–85). CDH: 51. CS: 5. OPLL: 7. OYL and OPLL: 1. CDH and CSS: 1. CSS and YL hypertrophy: 1. CSS and disc Protrusion: 1. CSS and disc protrusion and YL hypertrophy: 1. YL hypertrophy and disc protrusion: 1. CDH and OPLL: 1. CDH and OPLL and YL hypertrophy: 1. One level: 34. Two levels: 23. Three levels: 6. Four levels: 8. Five levels: 1. Developmental stenosis: 64 cases. Spinal cord injury image on MRI in 52 cases: 19 lesions on C3–C4, 22 on C4–C5, 25 on C5–C6, 3 on C6–C7. Lhermitte's sign was found in 10 cases; neuro-deficits with motor paralysis of upper and lower limb in 69 cases; with bladder dysfunction in 21 cases (Fig. 1).

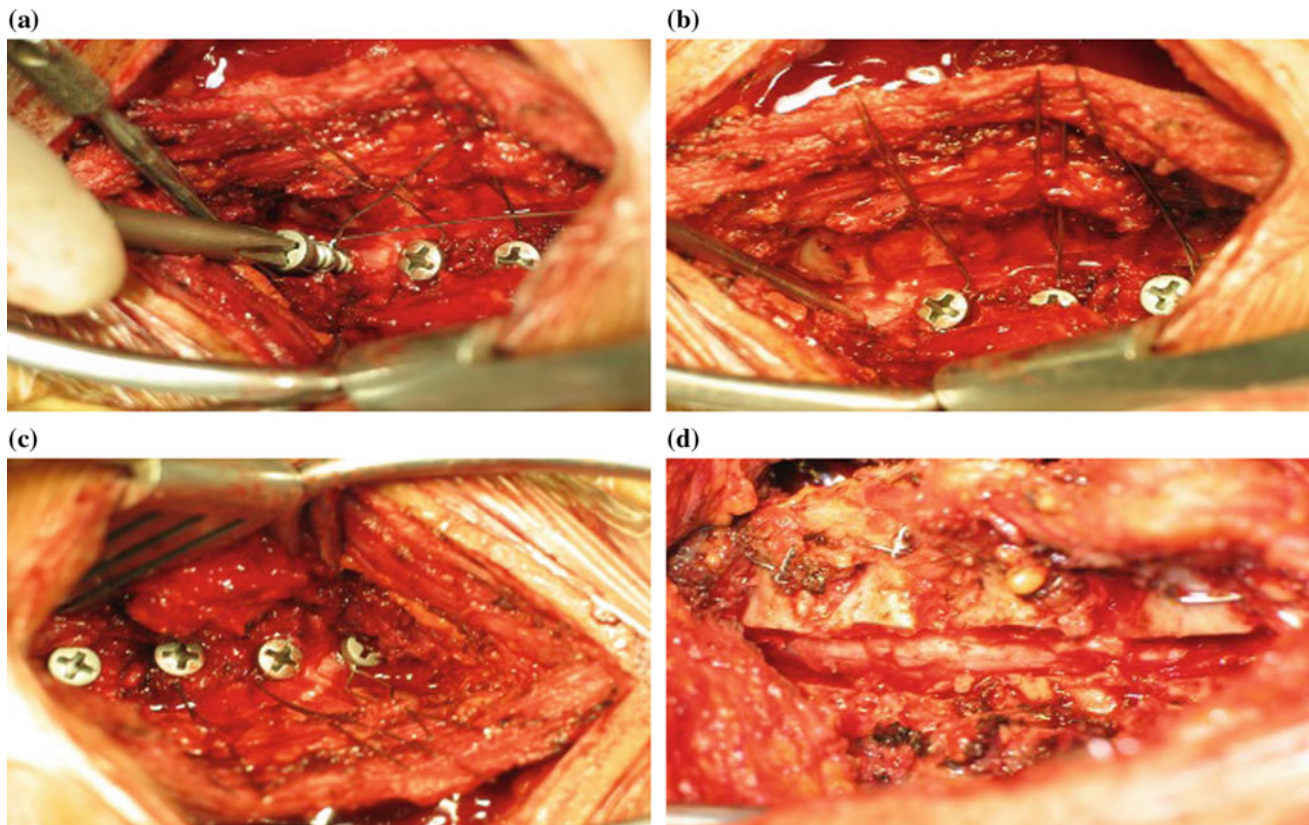
The diagnosis is based on the careful assessment of clinical examination combined with the scrutiny assessment of medical imagings offered by computerized radiography, multislide CT scanner, MRI which were applied for all of our patients. (1) The computerized radiography was realized in six different views: AP, lateral, lateral dynamic flexion and extension, right and left oblique. The Torg index was measured to assess the developmental cervical spinal canal stenosis (<80%). (2) MRI was realized in all of cases to assess the etiology and spinal cord lesions. (3) CT Scan was realized to assess the lesions related to bony changes as

spurs in cervical spondylosis, ossification of longitudinal ligament, ossification of yellow ligament (Fig. 2).

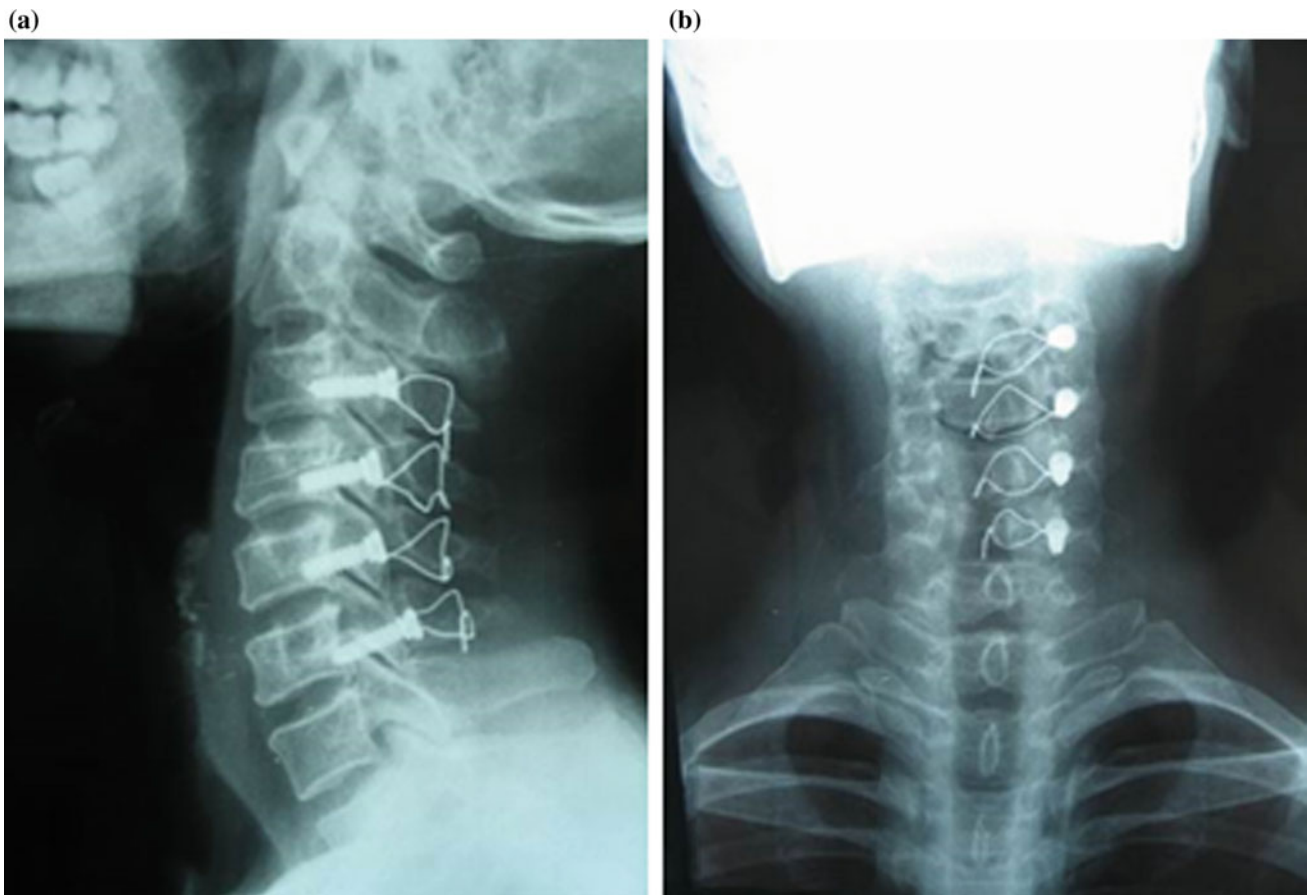
The indication for surgery is determined for:

- The compressive acute or chronic myelopathy due to cervical disc herniation (CDH), cervical spondylosis (CS), ossification of posterior longitudinal ligament (OPLL), ossification of yellow ligament (OYL), calcification of yellow ligament (CYL), antero-posterior dynamic factors, isolated or combined etiologies.
- Three or four levels without developmental cervical spinal canal stenosis and kyphosis.
- One to four levels accompanied by the severe developmental cervical spinal canal stenosis, but without cervical kyphosis.

The midline posterior cervical approach kindly preserves all of ligaments and tip of spinous processes in exposing clearly: (1) the laminae of C3, C4, C5, C6 and upper part of C7. (2) Lateral masses of C3, C4, C5 and C6 without destroying the facets capsules. At the most clinical affected side of laminae and facet joint junction, a gutter through two cortices was made in using the high-speed diamond burr airdrill. A partial resection of ligamentum flavum between

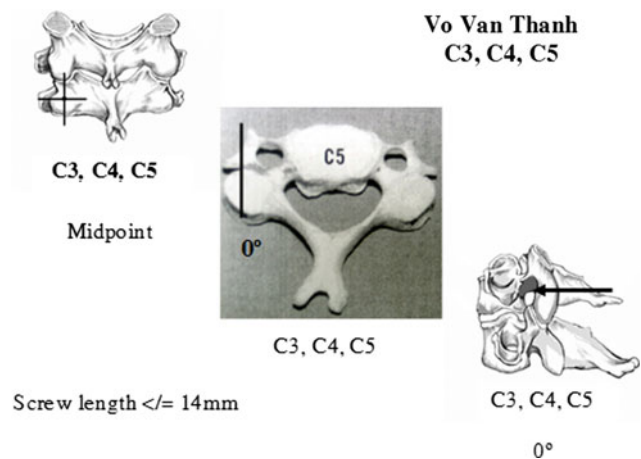


**Fig. 1** One gutter through one cortex and four lateral mass screws with wires for wiring from the spinous process tip to lateral mass was realized with good alignment of screws. Good opening gap was seen from C3 to C6. Soft tissues and tips of spinous processes are completely preserved



**Fig. 2** Post-op XR. Good alignment

C2–C3 and C6–C7 was realized by thin-bladed 2 mm Ker-rison rongeur to facilitate further elevation of laminae. Another gutter through one cortex was made in the opposite side at the junction of laminae and facet mass. On this side, a middle point of lateral mass is selected as insertion point of lateral mass screw as Roy Camille described for each level from C3 to C6. A straight ahead for both horizontal and vertical direction is practiced with the length of screws less than 14 mm is quite safe and stable for the stainless steel wiring from the tip of spinous process to the lateral mass screws from C3 to C5 and 15° out for C6, to open the other side’s laminae. All the screws must be 14 mm or less in length. The variety of diameters (3.5; 4; 4.5 mm) can be used. The ligamentum flavum of each level was coagulated by bipolar cautery and resected before opening the gap. The bleeding must be controled well especially in upper end between C2 and C3 epidural veins with bipolar cautery or surgicel. The opening gap of laminae is usually 10 to 15 mm is enough. The skin closure with 24 h lasting drain was realized carefully. The patients have to wear only in two weeks one soft collar as to start as soon as possible all of the



**Fig. 3** Vo Van Thanh’s technique for C3, C4, C5

cervical neck movements to prevent from muscle atrophy and neck pain. The rehabilitation program for the motor recovery is practiced as usual for the paralytic patients (Fig. 3).

### 3 Results

Surgical time: 142mn (95–220). Blood loss: 293 ml (80–1600). No transfusion: 70. Transfusion: 2. FU: 16.4 months (1–39). 70 surgeries were applied by this technique; one combined with lateral mass plating screwing and one combined with ACDF. JOA of 40 cases with full data: Pre-op JOA: 9.9. Post-op JOA: 13, JOA with mean FU 16.4 months: 14.6. Post-op recovery JOA rate: 56%. FU recovery JOA rate: 67%. Mean Torg index improvement: 55–83% on C3 level, 66–87% on C4, 65–91% on C5, 64–79% on C6. Mean FU: 16, 4 months (1–39). One died after two years. There were four with deteriorated results after more than 12 months in FU. No axial pain complaint. There were 2 with one C5 and one C6 post-op partial paralysis, one with good recovery after 2 months (Fig. 4).

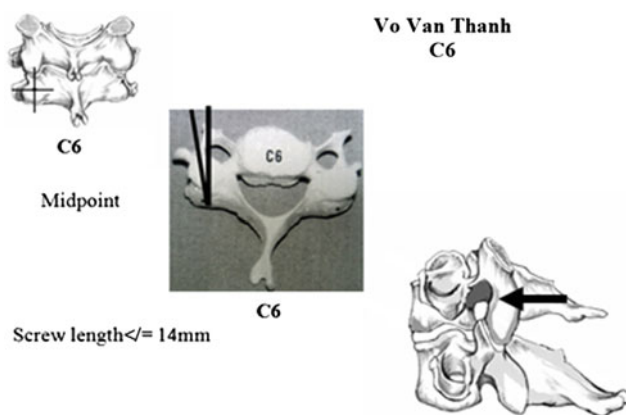
### 4 Discussions

Kurokawa and Itoh Laminoplasty techniques have been the treatment of choice for selected patients with cervical myelopathy involving in the cervical disc herniation (CDH), cervical spondylosis (CS), and ossification of the posterior longitudinal ligament (OPLL) accompanied by developmental cervical spinal canal stenosis. The long term results has been satisfactory with the same effectiveness as laminectomy or anterior decompression- fusion (ACDF) with less surgical morbidity [9–11]. We have practiced the Kurokawa technique since 1995, after learning it in Japan and after the first laminoplasty for quadriparetic patient involving in severe cervical myelopathy due to continuous OPLL operated by Shoichi Kokubun with complete motor recovery during 10 years FU. We have also practiced the Itoh technique since 2001 after learning it in Hiroshima with Hisatoshi Baba. The good and satisfactory results were

obtained with these two standard laminoplasty among many others as Chiba, titanium substitute plate for grafting, Z plasty [3, 7, 14, 18]. Some of their disadvantages were recognized (Fig. 5).

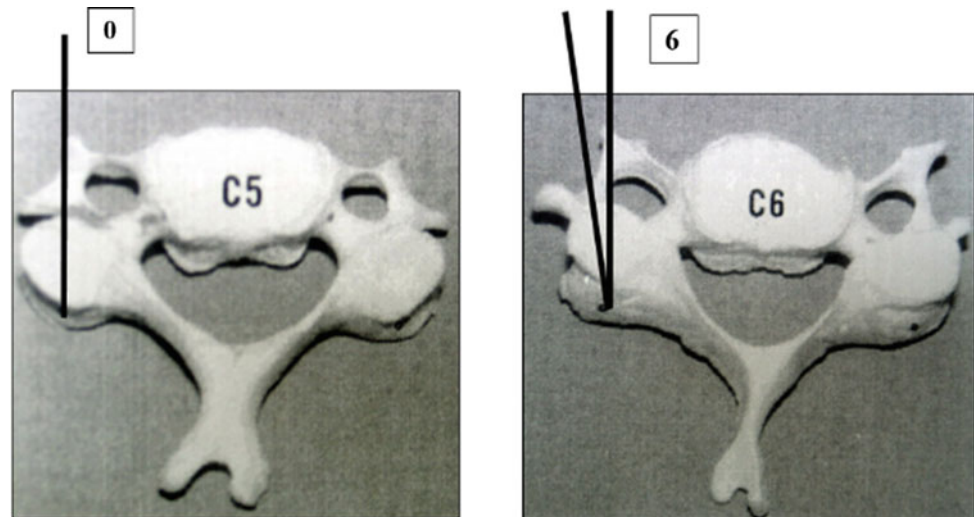
- Four pieces of bonoceram spacer for Kurokawa technique are quite expensive implants not affordable for poor patients.
- The iliac graft tailed in trapezoidal shape is not always perfectly obtained; one more painful incision is needed and it takes longer surgical time.
- Itoh technique [12, 13] takes quite long time and is a complicated procedure with multiple silk suture and tightening to stabilize the small piece of grating between laminae and facet mass on one side and the tip of spinous process on the other side. Hirabayashi technique [9–11] is weakly stabilizing silk suture to the muscle mass resulting in opening gap collapse and deteriorated effectiveness.
- All of these techniques destroy completely the interspinous and supraspinous ligaments, the tips of all spinous processes [1, 3, 9–11, 13, 12, 14–16].
- We never move up this ELAP to C2 and very rarely move down to C7.

Our technique is quite simple and less bleeding. 16/18 cases did not need blood transfusion; even we must be very careful to prevent the epidural bleeding especially in C2–C3. We always preserved all the ligaments and tips of spinous processes. The procedure for lateral mass screw insertion was fast and simple. We could actively control the opening laminar gap during easy wiring and tightening. The Torg index was improved frankly in post-op 96% in comparison with 67% in pre-op. The patients could wear the soft collar within two weeks instead of two months with previous Kurokawa or Itoh laminoplasty. Our patients do not complaint the neck axial pain. The good result was obtained with FU JOA = 60%. One of two C5 post-op paralysis was completely recovered. This is a complication described in literature, not yet known precise etiopathogenesis [12]. The patients were discharged a couple of days after surgery. The satisfactory results were reached in the majority of patients. Longterm follow-up will permit the assesment of the real kyphosis. But, we think the kyphosis is not different from the one observed with other laminoplasty techniques due to the more kind conservative behaviour to soft tissues and bone. One advantage of our technique is the metallization for the patients, it will prevent from the MRI assesment if needed. We did not put the grafts on the lateral gutters, after 2 months the fusion happened. The screw combined with



**Fig. 4** Vo Van Thanh's technique for C6

**Fig. 5** Direction for C5 and C6 via transverse foramen following Nabil Ebraheim et al.



silk was quite good but the support forces for wiring was weaker than wires.

There are four techniques for the insertion of lateral mass screws: Roy-Camille, Magerl, and An [5, 6, 8]. The mid-point of facet mass following Raymond Roy Camille is selected for our technique. But we insert at zero degree in the both sagittal and frontal plan from C3 to C5 lateral mass; Roy Camille angled laterally 10 degree; for C6, the insertion has to be out 15 degree. Following the Ebraheim and Yeasting's research, the projection point from midpoint with straight ahead direction will be out of the transverse foramen C3, C4 and C6. For C6, it would be 6° out of it [6]. The length of screws less or equal to 14 mm is safe and strong enough [5, 6]. The diameter of screw can be varied: 3.5, 4 or 4.5 mm. Wang et al. use MITEK [17], quite expensive with the price of more than 100 USD each.

The training and learning curve for the young surgeons for our technique are very short and safe. They can easily understand the principles, technique and maneuvers for screw insertion; then practice with not much difficulties. The screws and wire are the least expensive means they can find easily in any surgery hospital.

## 5 Conclusions

The modified Hirabayashi with lateral mass screwing and spinous process wiring is a valuable method which offers one more option among the gold standard laminoplasty of Kurokawa or Itoh techniques. We can obtain good results for the severe cervical myelopathy with this potential technique in using the inexpensive means affordable for almost all of the patients. The modified Hirabayashi Open Door Extensive Laminoplasty in using the wiring technique from the tip to lateral mass screws is a safe, cost-effective method, affordable for almost all of patients

involving in cervical myelopathy. It offers one more option among the gold standard laminoplasty of Kurokawa, Itoh or others.

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