

## Transclavicular approach to cervicothoracic spine : a reviewed surgery experience using the Birsch & Bonny's technique

Tawechai Tejapongvorachai\*

Pairatch Prasongchin\*

Pat Ongcharit\*\*

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*To reach the upper thoracic vertebra, a number of extensive approaches have been proposed, composed of thoracotomy, sternotomy, or clavicle resection with anterior dissection into the superior mediastinum. We present our experience and result of treatment using the Birsch & Bonny's technique, an anterior transclavicular approach, by this approach, the anterior cervicothoracic region is easily achieved.*

*Three patients are reviewed in whom this approach was used at the seventh cervical to second thoracic level. Decompression and instrumentation resulting in neurological improvement and axial stability were achieved in all three patients.*

**Keywords :** Cervicothoracic, Transclavicular approach.

Reprint request : Tejapongvorachai T. Department of Orthopaedic Surgery, Faculty of  
Medicine, Chulalongkorn University, Bangkok 10330, Thailand.

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\* Department of Orthopaedic Surgery, Faculty of Medicine, Chulalongkorn University

\*\* Department of Surgery, Faculty of Medicine, Chulalongkorn University

ทวีชัย เตชะพงศ์วรชัย, ไพรัช ประสงค์จีน, พิชร อ่องจريت. การผ่าตัดบริเวณรอยต่อกระดูกคอ และกระดูกส่วนอกด้วยวิธีผ่าตัดผ่านกระดูกไหปลาร้า : รายงานผู้ป่วย 3 ราย. จุฬาลงกรณ์-  
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มีวิธีผ่าตัดหลายวิธีในการที่จะเข้าถึงกระดูกส่วนอกช่วงบน ได้แก่ วิธี thoracotomy, sternotomy และ clavicle resection ผู้เขียนได้รายงานผลการผ่าตัดโดยใช้วิธีของ Birsch & Bonny's (transclavicular approach) ด้วยวิธีนี้เราสามารถเข้าถึงบริเวณ cervicothoracic ได้โดยง่าย ผู้เขียนได้รายงานผู้ป่วย 3 ราย ที่ได้รับการผ่าตัดด้วยวิธีนี้ โดยการผ่าตัดแก้ไขการกดทับของระบบประสาทและยึดกระดูกด้วยชุดโลหะ ซึ่งให้ผลการฟื้นตัวของระบบประสาท และมีการเชื่อมของกระดูกที่ปลูกถ่ายได้อย่างดี

**คำสำคัญ :** การผ่าตัดบริเวณรอยต่อกระดูกคอ และกระดูกส่วนอก, วิธีผ่าตัดผ่านกระดูกไหปลาร้า

The anterior aspect of the cervicothoracic junction is a particularly difficult region of the spine to approach. There are numerous structures that hinder the anterior approach. Proceeding from anterior to posterior, the first structures are the osseous articular. The *manubrium*, the sternoclavicular joint and the medial third of the clavicle pose problems with access to the region distal to C7-T1. The next level of structures recomposes the vascular structures. This includes the left subclavian and left brachiocephalic veins, the left common carotid and subclavian arteries and the aortic arch. Other deep structures in this same approximate coronal plane include the oesophagus, the trachea and the recurrent laryngeal nerve. More proximally, and superficially, are the strap and sternocleidomastoid muscles. The extent, breadth and difficulty of the access through this mire of vital tissues can be contrasted with the case of exposing the posterior region of the cervicothoracic junction. This posterior region requires only simple subperiosteal dissection of paraspinal musculature for adequate exposure. The three most common afflictions occurring at the cervicothoracic junction, which require surgical treatment from an anterior approach, are neoplasms, infections and fractures. The significant anterior destruction caused by these conditions, when coupled with the natural tendency toward kyphosis and anterior collapse, only makes the inherent surgical inaccessibility of this region even more difficult. Transpleural and sternal splitting approaches to the upper thoracic spine inadequately expose the lower cervical spine and are associated risks of entering the pleural cavity.<sup>(2-4)</sup> Conversely, the standard approaches to the lower cervical spine may offer good

visualization to T1, but their manual-working room distal is poor.

Approaches, such as the lower anterior cervical transthoracic,<sup>(5)</sup> costotransversectomy,<sup>(6)</sup> sternal splitting<sup>(7)</sup> and posterior thoracotomy,<sup>(8)</sup> all have limitations. Since 1973, a transclavicular approach has been used, which is similar to an exposure of the deep vessels as described in 1921 by Fiolle and Delmas<sup>(9)</sup> and a recently described in exposure of the upper thoracic spine. Whereas Charles and Govender<sup>(10)</sup> described the excision of the clavicle and part of the *manubrium sterni*. We followed the transclavicular approach that proposed by Birch and Bonny.<sup>(11)</sup> This approach involves turning an osseous flap on a pedicle formed by the *sternocleidomastoid* muscle. The osseous components of the flap include the medial half of the clavicle and the upper corner of the *manubrium sterni*, together with the intervening sternoclavicular joint. The elevation of the *sternocleidomastoid*-based osseous flap can provide access from the third cervical to the fourth thoracic vertebra.

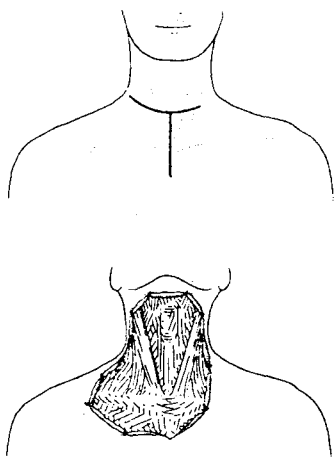
The modified anterior approach to the cervicothoracic junction<sup>(3,11,12)</sup> offers a distinctive advantage of providing a good exposure and working room from C4-T4. Hemostatic access to the great vessels is also provided. In addition, it allows a good technical visibility as well as the ability to perform extensive spinal cord decompression, bony and soft tissue resection, correction of deformity, and reconstruction and stabilization of the spine. Furthermore, this approach provides a rigid autogenous bony strut graft; it has few complications, and it eliminates the need for a chest tube.

### Surgical technique

Where possible the approach should be from the left side as the right recurrent laryngeal nerve crosses the operative field and is vulnerable to traction damage. The patient is placed in a supine position. After general anesthesia has been administered via a cuffed endotracheal tube, the head is turned slightly away from the side chosen for the approach.

The incision is T-shaped, with the transverse limb in the skin crease 2 cm above the clavicle and the vertical limb in the midline extending midway down the sternal body. Flaps are raised deep to platysma, extending upwards to the hyoid bone and downwards far enough to expose the clavicle on the side of the approach. The flaps are sutured back.

The sternocleidomastoid muscle is defined and separated from deeper structures. The clavicle is cleared by reflection of the *pectoralis major* muscle, and the bone is freed as far as the sternoclavicular joint. It is convenient now to divide the omohyoid muscle between stay sutures. Then, the anterior aspect of the internal jugular vein and the common carotid artery are defined.

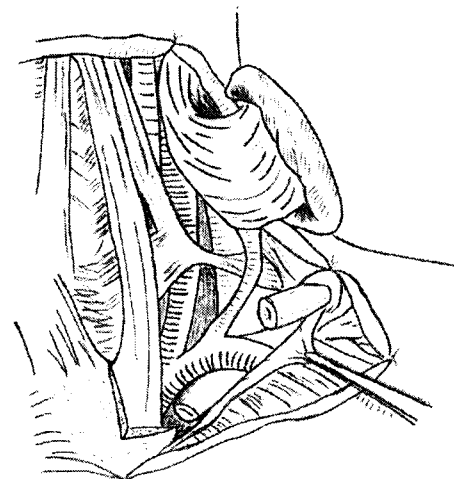


**Figure 1.** Skin incision, and elevation of skin flaps.

The upper part of the *manubrium* is cleared and the sternal head of *pectoralis major* is detached. The upper outer corner of the *manubrium* is isolated by appropriate cuts with a sternal saw and the first costal cartilage is divided. The clavicle is divided at its midpoint after drilling appropriated holes for the later application of the fixation plate. The manubrial corner, the sternoclavicular joint, and the medial half of the clavicle can then be elevated on a pedicle of the sternocleidomastoid muscle.

Expose now are the infrahyoid muscles, the trachea, the innominate veins and their tributaries, the innominate artery and its branches, the subclavian and common carotid arteries, the scalenus anterior and the phrenic nerve, the brachial plexus and part of the first rib.

If the object is the brachial plexus, the scalenus anterior is divided, the subclavian artery fully mobilized and the plexus exposed. If the object is the axial skeleton, the approach is made medial to the carotid sheath. Great care is taken of the recurrent laryngeal nerve. The front of the spine can be displayed from the third cervical vertebra above to the fourth



**Figure 2.** Exposure of the anterior cervicothoracic spine after elevation of the sternocleidomastoid-based osseous flap.

thoracic vertebra below. Access should be adequate for vertebrectomy as low as the second thoracic vertebra and instrumentation as low as the third.

The wound is closed over vacuum drains. If the pleura have been opened, a drain into an underwater seal is used. The osseomuscular flap is returned to its former position, the *manubrium* being re-attached by wires and the clavicle with a plate and screws. Soft-tissue anatomy is restored and the skin closed.

### Case Report

A 67-year-old man with an underlying of diabetes mellitus for 10 years noticed muscle spasms

and numbness in his both legs. His condition progressed to severe muscular atrophy of both legs and decreased sensation below the trunk by one year. 8 months later, the man reported progressive walking disturbance, even with a cane he could walk only 50 meters. His both knees and ankle jerks were hyperactive, and Babinski's sign was positive on both sides. There was a paresthesia below the T4 dermatome with occasional bowel bladder dysfunction.

The radiography showed moderately spondylotic changes from cervical, thoracic and lumbar spine. The MRI showed severe compression on the thecal sac with the large thoracic disc of T1-2. There

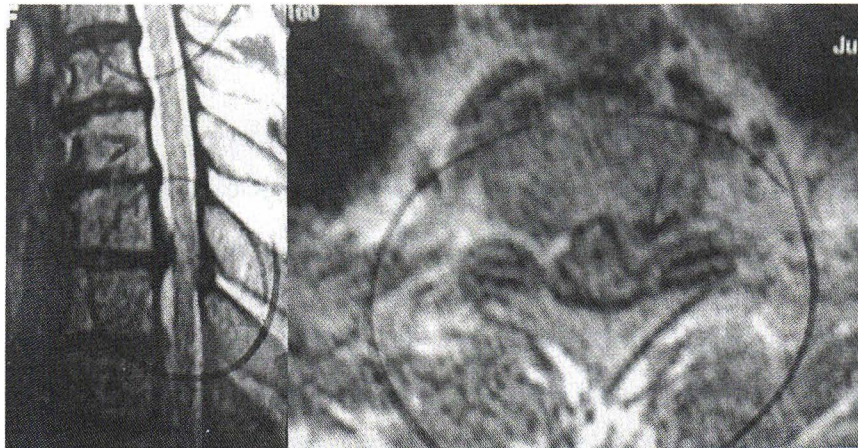


Figure 3. MRI of a T1-2 thoracic disc herniation with spinal cord compression.(case 1)

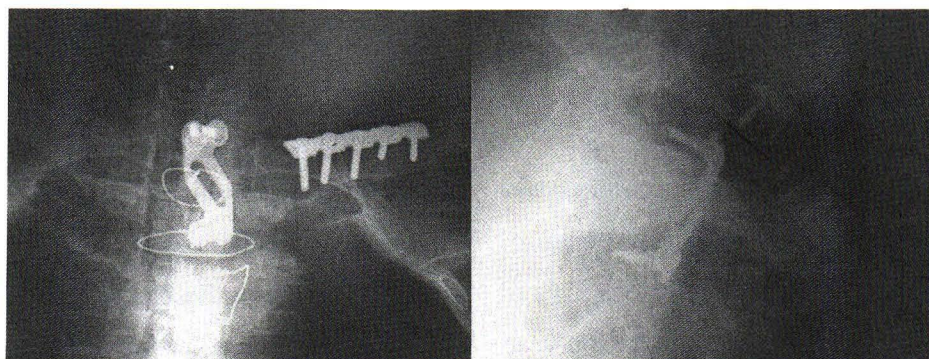


Figure 4. Postoperative radiographs were taken 1 year after surgery. (case 1)

**Table 1.** Details of operations by the transclavicular approach.

| Case | Age & Sex | Diagnosis                         | Neural status                               | Procedure  | Complications | Course               | Length of follow-up (yr.) |
|------|-----------|-----------------------------------|---|--|---------------|----------------------|---------------------------|
| 1    | 67 M      | HNP T1-2                          | Paraparesis                                 | Subtotal corpectomy T1, disc excision and anterior plating | -             | Neural Recovery      | 1                         |
| 2    | 27 M      | Neglected facet dislocation C7-T1 | Paraplegia                                  | Subtotal corpectomy T1                                     | -             | Recovery of C7,8, T1 | ½                         |
| 3    | 56 F      | Thoracic outlet syndrome          | Pain, sensory disturbance, weakness C7,8,T1 | Decompression  | -             | Good Recovery        | 1                         |

was also a moderately C4-5 disc herniation with moderately compression on the spinal cord. The subtotal corpectomy of T1 was done with complete removal of T1-2 herniated nucleus pulposus. The tricortical iliac bone graft was applied and the cervical plate was fixed from C7 to T2. Six months after the surgery, the man had gained one grade of muscle power in both lower extremities and could walk longer than 200 meters with a cane, his sensation was also recovered. His bowel and bladder functions became in good control.

### Discussion

Access to the anterior aspect of the lower cervical and upper thoracic spine is difficult because of restrictions imposed by bony obstructions, by the change from lordosis to kyphosis, and by the vital structures in the way. Although splitting the sternum

provides some access, the exposure is still limited by the sternocleidomastoid and the clavicles. Partial resection of the clavicle<sup>(10)</sup> or medial clavisectomy provides a good access to the upper thoracic spine, but it seems unnecessarily destructive and causes impaired function of the upper limbs. Posterolateral costotransversectomy<sup>(13)</sup> and lateral extracavitary approaches<sup>(14,15)</sup> are difficult because of the limitations imposed by the scapula. A direct anterior approach should be considered as indicated in the presence of central and centrolateral disc herniations. Either a transternal splitting approach<sup>(7)</sup> or a medial clavisectomy approach<sup>(10)</sup> extending distally from a cervical Smith-Robinson approach<sup>(10)</sup> leaving the sternum intact can be used.

This transclavicular approach, as described by Birch and Bonny, allows access not only to the axial skeleton, but also to the brachial plexus and

related vessels. Despite the extensive exposure, the osseomuscular flap can be reattached to restore normal anatomy and do not interfere with the functions of the shoulder girdle. The approach is, therefore, recommended to those requiring access to the anterior aspect of the cervicothoracic junction, to the proximal parts of the innominate, subclavian and carotid vessels, and to the lower part of the brachial plexus with the minimal complications.

### References

1. Sundaresan N, DiGiacinto G. Surgical approaches to the cervicothoracic junction. In Sundaresan N, Schmidek H, Schiller A, Rosenthal D, eds. Tumors of the spine: diagnosis and clinical management. Philadelphia: WB Saunders, 1990: 358
2. Hodgson AR, Stock FE, Fang HS, Ong GB. Anterior spinal fusion. The operative approach and pathological findings in 412 patients with Pott's disease of the spine. Br Surg 1960 Sep;48:172 - 8
3. Kurz L, Brower R, Herkowitz H, Surgical approaches to the cervicothoracic junction. In : Sherk H, ed. The cervical spine: an atlas of surgical procedures. Philadelphia: Lippincott, 1994:113
4. Sundaresan N, Shah J, Feghai JG. A transsternal approach to the upper thoracic vertebrae. Am J Surg 1984 Oct;148(4): 473 - 7
5. Perry J. Surgical approaches to the spine. In: Pierce DS, Nickel VH, eds. The total care of spinal 53 - 79
6. Capener N. The evolution of lateral rhachotomy. J Bone Joint Surg Br 1954 May;36(2):173 - 9
7. Cauchoix J, Binet JP. Anterior surgical approaches to the spine. Ann R Coll Surg Engl 1957 Oct; 21(4): 237 - 43
8. Turner PL, Webb JK. A surgical approach to the upper thoracic spine J Bone Joint Surg Br 1987 Aug;69(4): 542 - 4
9. Fiolle J, Delmas J. The surgical exposure of the deep-seated blood vessels. London: Heinemann, 1921: 61 - 7
10. Charles R, Govender S. Anterior approach to the upper thoracic vertebrae. J Bone Joint Surg Br 1989 Jan;71(1): 81 - 4
11. Kurz LT, Pursel SE, Herkowitz HN. Modified anterior approach to the cervicothoracic junction. Spine 1991 Oct;16 (10 Suppl): S542 - 7
12. Birch F, Bonney G, Marshall R. A surgical approach to the cervicothoracic spine. J Bone Joint Surg Br 1990 Sep: 72(5); 904 - 7
13. Simpson JM, Silveri CP, Simeone FA, Balderston RA, An HS. Thoracic disc herniation: Re-evaluation of the posterior approach using a modified costotransversectomy. Spine 1993 Oct 1;18(13): 1872 - 7
14. Mainman DJ, Larson SJ, Luck E, El-Ghatiti A. Lateral extracavitary approach to the spine for thoracic disc herniation: report of 23 cases. Neurosurgery 1984 Feb;14(2):178 - 82
15. Singounas EG, Kypriades EM, Kellerman AJ, Garvan N. Thoracic disc herniation: Analysis of 14 case and review of the literature. Acta Neurochir (Wien) 1992;116(1): 49 - 52