

## Three-dimensional CT of Thoracic Outlet Syndrome: Report of Three Cases

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**Recently, three-dimensional (3-D) imaging has become useful for the diagnosis and treatment of several diseases as computed tomography (CT) imaging technology has advanced. We used three dimensional CT for determination of the narrowing of the thoracic outlet (TO) in three patients with thoracic outlet syndrome (TOS).**

**3D-CT images are effective for visually identifying the relationships of the structures and planning the operation in TOS. (Ann Thorac Cardiovasc Surg 2002; 8: 45–46)**

**Key words:** thoracic outlet syndrome, three-dimensional imaging

### Introduction

Thoracic outlet syndrome (TOS) is a complex symptom consisting of neural, arterial, and venous disorders of the upper extremity. These are caused by compression of the neurovascular structures between the clavicle and first rib in the thoracic outlet (TO). An understanding of the anatomy of the TO region is helpful in the subsequent evaluation and treatment of this syndrome. Narrowing of the TO and presentation of the cervical rib are significantly caused by TOS.<sup>1)</sup> Direct cervical radiogram is an inadequate method in determining the narrowing of the TO.

Recently, three-dimensional (3D) imaging has become useful for the diagnosis and treatment of several diseases as computed tomography (CT) imaging technology has advanced.<sup>2,3)</sup> We used three dimensional CT for determination of the narrowing of the TO in three patients with TOS.

### Case 1

An 18-year-old female patient was admitted to our clinic with complaints of pain and paresthesia of the bilateral upper limbs. In a physical examination, Adson's test and

hyperabduction maneuver were positive in the left upper limb. Routine laboratory studies and blood chemistries were normal. Cervical spine X-rays showed bilateral cervical ribs. Doppler ultrasonography scan revealed bilateral TOS. Electromyographic examination of bilateral upper limbs was normal. In a 3D-CT scan, synostosis between the cervical and first ribs was determined (Fig. 1).

The patient underwent cervical and first rib resection and scalenotomy with a left transaxillary approach.

### Case 2

A 21-year-old female patient presented with pain and paresthesia of the right upper limb. In a physical examination, Adson's test was positive in the right upper limb. Routine laboratory studies and blood chemistries were normal. In cervical spine X-rays, the left first rib was rudimented. Doppler ultrasonography scan was consistent with TOS in the right upper limb. Electromyographic examination was normal. A calcified band between the cervical and first ribs was seen in the 3D-CT scan (Fig. 2).

The patient underwent first rib resection and scalenotomy with a right transaxillary approach.

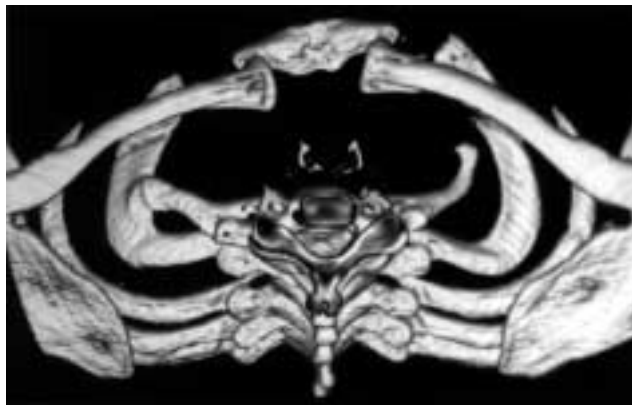
### Case 3

A 35-year-old female patient complained of pain in her arms and neck. Physical examination revealed that Adson's test and hyperabduction maneuver were positive in the bilateral upper limbs. Routine laboratory studies and blood chemistries were normal. Cervical spine

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**Fig. 1.** Preoperative three-dimensional computed tomographic (3D-CT) scan of thoracic outlet (TO) showing synostosis between cervical and first ribs.



**Fig. 2.** Preoperative 3D-CT scan of TO showing calcified band.

X-rays showed bilateral cervical ribs. Ulnar nerve conduction velocity was slow in the electromyogram of the bilateral upper limbs (55 m/s). Doppler ultrasonography confirmed the diagnosis. Fusion between cervical and first ribs was determined by a 3D-CT scan.

The patient underwent cervical and first rib resection and scalenotomy with a right transaxillary approach.

A conservative treatment (non-steroidal antiinflammatory drugs and physiotherapy) was always attempted prior to surgery in all cases, but unsuccessful in all patients.

## Comment

Diagnosis and management of TOS are still controversial. Diagnosis of TOS is difficult, however, because such maneuvers and other diagnostic tests (nerve conduction studies, electromyography, X-ray films, sensory tests) are not specific.<sup>4)</sup> Therefore, we think that 3D-CT can be used in the diagnosis of TOS.

Bony abnormalities are present in approximately 30% of patients with TOS, either as a cervical rib, a bifid first rib, fusion of the first rib and second ribs, clavicular deformities or previous thoracoplasty.<sup>1)</sup> These bony abnormalities can be better evaluated with a 3D-CT scan than direct cervical radiograms. In addition, the cervical ribs, their length, and their attachment zone in the first ribs are easily analyzed with 3D-CT.<sup>2)</sup>

Furthermore other pathologic conditions in the neck and the TO may mimic TOS such as a herniated cervical disk, rotator cuff rupture, tumors or peripheral nerve entrapment.<sup>5)</sup>

3D-CT is expected to be useful for determining the

complex underlying pathophysiologic processes.<sup>2,3)</sup> Three-dimensional CT images have also many advantages; they are usually realistic, they are able to be rotated 360 degrees in any direction, the images are valuable in individualized planning of operation.

It is also very likely that simulation, treatment planning, and guidance of therapeutic or diagnostic interventions using 3D-CT and multimodality imaging technologies can be routinely applied in the near future.

In conclusion, 3D-CT images are effective for visually identifying the relationships of the structures and planning the operation. But further trials and series are needed to evaluate the value of this diagnostic method.

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