Introduction: For a detailed evaluation of patients with thoracic outlet syndrome (TOS), we had previously performed three-dimensional computed tomography (3DCT) after brachial plexography. Recently, we focused on patients with TOS of traction type who complained of symptoms in the sitting or standing position but not in the position assumed during the Wright’s maneuver provocation test. Furthermore, the results of first rib resection surgery in these patients were reported to be poor. Dynamic 3DCT in different positions enhanced the definition of the brachial plexus anatomy and enabled a dynamic assessment of the compressed brachial plexus. For further examination of TOS, this method also enabled evaluation of the relationship between the clavicle and the rib, which is impossible to assess using typical brachial plexography.

Purpose: The purposes of this study were to assess the narrowest costoclavicular space using 3DCT after brachial plexography and evaluate changes in the costoclavicular space in the supine position with/without upper limb traction, thus revealing the costoclavicular relationship in the sitting and standing positions while lowering the upper extremities.

Materials and Methods: TOS was suspected based on patient history, symptoms, neurological findings, provocation test results, and electrophysiological examination findings. Patients with other conditions associated with neuropathy (e.g., hypothyroidism and diabetes mellitus), bilateral conditions, and clinical findings of neuropathies, such as cervical radiculopathy and polyneuropathy, were excluded. Brachial plexography and 3DCT were performed in 10 female and 4 male patients with a mean age of 37.6 years.

<Study 1> Brachial plexography was performed (Fig.1). The 3DCT images were assessed, with special attention given to reconstituting the images in the oblique sagittal view (Fig.2), and cross sections of the brachial plexus in 3DCT were observed. In these reconstituted images, we specified the narrowest costoclavicular space (Fig.3).

<Study 2> We assessed the distance between the clavicle and the rib as well as the thickness of the subclavius muscle, following which dynamic 3DCT was performed not only in the resting supine position but also in the supine position with upper limb traction to assess the costoclavicular relationship in the standing and sitting positions (Fig.4). These values were compared between the affected and healthy sides (Fig.5). And the ratio of the thickness to the distance of costoclavicular space were calculated (Fig.6).

Results

<Study 1> On the affected side, the most narrow space was the second rib–clavicular space in affected sides (Fig.7). On the healthy side, it was the second rib–clavicular space in nine cases.

<Study 2> The mean values for the narrowest costoclavicular space without traction were 32.1 mm on the healthy side and 27.6 mm on the affected side without limb traction (Fig.8). And the values with limb traction were 24.0 and 21.1 mm, respectively. The mean values for the height of contrast media without limb traction were 15.1 mm on the healthy side and 12.1 mm on the affected side (Fig.9,10). In addition, the mean values of thickness of the subclavius muscle with and without limb traction were not significantly different among them on the healthy side and the affected side (Fig.11). However, the mean ratio of the values of thickness of the subclavius muscle to costoclavicular space were three cases with ratios of >30% (Fig.12).

Discussion: This is a first study to assess the narrowest costoclavicular space using 3DCT after brachial plexography and to evaluate changes in the costoclavicular space with or without upper limb traction. This results showed that the most narrow space was not the first rib-clavicular space but the second rib–clavicular space in affected sides. The fact suggested the indication of the first rib resection requires consideration for the traction type of TOS patients. In addition the possibility of the subclavius muscle to be involved narrowing of costoclavicular space was suggested.

Conclusion: Brachial plexography Dynamic 3DCT was performed in 14 TOS patients complain in lowered upper extremities.

✓ Compression of brachial plexus was quantified with upper limb traction.
✓ Most narrowest costoclavicular space is clavicle-2nd rib.