

# Regrown First Rib in Patients with Recurrent Thoracic Outlet Syndrome

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**Background:** Recurrent symptoms of thoracic outlet syndrome (TOS) after first rib resection have varying etiologies. Regrowth of a first rib is a rare event. Recurrent symptoms in the presence of a regrown rib strongly suggest a causal relationship. We report our experience with recurrent symptoms of TOS and regrown first ribs.

**Methods:** We identified patients with recurrent TOS symptoms and regrown first ribs presented between 1995 and 2012. Details regarding their presentation, evaluation, and treatment were gathered.

**Results:** Eight patients (6 women and 2 men) presenting with recurrent TOS symptoms and regrown first ribs underwent 10 decompression surgeries. Prior surgeries included supraclavicular first rib resection (5), transaxillary first rib resection (5), scalenectomy (5), cervical rib resection (1). The average period between initial surgery and reoperation was 4.7 years. Average age at current presentation was 40.8 years (range 29–52). All patients (8) represented with neurogenic symptoms and 1 patient with concomitant venous TOS symptoms. Presenting symptoms included pain (8), numbness and tingling (7), weakness (6), headache (2), and venous congestion (3). Initial treatment included physical therapy in all. Preoperative assessment included chest X-rays (8), magnetic resonance imaging (7), electrodiagnostic studies (8), venography (2), and anterior scalene muscle block (2). Surgical approach included transaxillary resection of the regrown first rib (10), neurolysis of brachial plexus (10), scalenectomy (5), and lysis of subclavian vein (1). After an average follow-up of 10.8 months, resolution of symptoms included 4 complete and 4 partial.

**Conclusions:** Regrowth of the first rib is a rare event. There is a concordance between a regrown rib and TOS symptoms. Patients presenting with recurrent TOS symptoms and a regrown first rib have a high probability of improvement with resection of the regrown rib.

## INTRODUCTION

The surgical management of thoracic outlet syndrome (TOS) relies on decompression of the neurovascular structures as these traverse the anatomic thoracic outlet. Surgical approaches to this goal have included resection of the scalene muscles, the

clavicle, and the first rib either alone or in various combinations.

Although surgical decompression is generally successful, an appreciable recurrence of presenting TOS symptoms remains a concern. Recurrent TOS symptoms are most commonly associated with reattachment of scalene muscles or residual first rib elements. Most common among these are unresected cervical ribs or inadequately resected first ribs.<sup>1</sup> More recently, pectoralis minor impingement has been considered a significant element in the presentation of recurrent TOS symptoms.<sup>2</sup> Regrowth of a previously resected first rib is a rare cause of recurrent TOS. because of its rarity, it is often overlooked and has not been described in medical literature.

We describe our experience with regrown first ribs in a cohort of patients with recurrent TOS symptoms.

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## METHODS

A retrospective review of a prospectively maintained data set was performed to identify patients who underwent re-resection of regrown first ribs. Information collected includes data on presenting symptoms, prior surgical interventions, physical evaluation, radiographic examination, electrophysiological diagnostic testing, details of the index surgical intervention, surgical complications, and clinical outcomes. This study was conducted with the approval of the University of California Institutional Review Board.

### Patient Selection

Patients were identified in a 2-step process. First, patients were identified as having recurrent TOS symptoms. Recurrence was defined as return of initial symptoms after a period of at least 3 months without symptoms. Those patients whose evaluation indicated regrowth of a segment of the first rib were then identified and form the basis of this report.

### Clinical Diagnosis of TOS

The clinical diagnosis of recurrent neurogenic TOS is based on recurrence of radicular symptoms extending from Erb's point down the arm. Specifically noted are pain, numbness, tingling, weakness, coldness, headache, atrophy, and swelling. The diagnosis of recurrent TOS was supported by appropriate findings on physical examination. The combination of appropriate symptoms and physical examination findings were considered to establish the clinical diagnosis of recurrent TOS.

### Diagnostic Testing in Recurrent TOS

Diagnostic testing was employed with 2 goals: to exclude competing diagnoses and to support the diagnosis of recurrent TOS. Exclusion of competing diagnoses was established by examination, electroconductive testing, and magnetic resonance imaging (MRI) evaluation of the cervical spine. All patients underwent these evaluations at the time of their original surgery. These were repeated with the recurrent presentation when clinically indicated on the basis of symptoms or examination.

Testing used to support the diagnosis of recurrent TOS included anterior scalene muscle block, electroconductive testing, and MRI brachial plexus studies. X-ray imaging included chest radiographs and cervical films. Cases presenting with congestive symptoms were investigated with upper extremity venography.

Diagnosis of a regrown first rib was based on review of prior surgical history and postoperative radiographs to assure that the correct first rib was removed at the time of the initial TOS decompression. These were then compared with contemporary chest and cervical spine radiographs to establish the diagnosis of a regrown first rib. The presence of a notable increase in the size of the residual rib elements was considered to be a regrowth of the rib.

### Surgical Approach to Recurrent TOS

Patients whose recurrence followed a transaxillary approach were managed with supraclavicular scalenectomy and transaxillary resection of the regrown rib segment. Patients whose recurrence followed a supraclavicular resection were managed with a transaxillary approach for reoperation. Transpleural exposure was used liberally. Neurolysis of the brachial plexus was performed routinely.

### Assessment of Surgical Complications

A standardized evaluation of all patients undergoing thoracic outlet decompression includes evaluation of the function of the phrenic, long thoracic, thoracodorsal, intercostal brachio-cutaneous, and brachial plexus nerves. In addition, patients are assessed for presence of hemorrhage, lymphocele, hematoma, and persistent pneumothorax.

### Assessment of Outcomes

Outcomes are rated in 1 of 3 categories: complete resolution, partial resolution, and persistent symptoms.

Complete resolution patients reported none of the preoperative TOS symptoms. Partial resolution included those patients reporting mild or moderate persistent symptoms after reoperation. Patients with minimal resolution were those reporting no significant improvement after surgery.

## RESULTS

Over the period from 1996 through 2012, 726 procedures were performed for 551 patients. This included 94 operations for recurrent TOS. Of these, 10 operations were for resection of regrown first ribs in 8 patients. Thus, regrown ribs accounted for 10.6% of operations for recurrent TOS symptoms, 1.4% of all patients, 1.1% of all procedures. Of the 8 patients presenting with regrown first ribs, only one had undergone prior first rib resection at our institution. From this, we estimate an incidence of <0.18%. Of the 10 patients presenting with regrowth of the first rib and recurrent TOS, 6 were

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