



# Results of the Transsternal Approach to Cervicothoracic Junction Lesions

## *Servikotorasik Bileşke Lezyonlarına Transsternal Yaklaşımın Sonuçları*

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### ABSTRACT

**AIM:** Surgery for lesions involving the anterior column of the cervicothoracic junction is still challenging. The median transsternal approach provides a direct approach to this junction. The aim of this study was to present the results of cases operated using the median transsternal approach.

**MATERIAL and METHODS:** There were 8 cases (7 males, 1 female) aged between 18-39 (mean 28.2) years. The compression to the spinal cord was secondary to trauma in 3 cases, infection in 3 cases, and tumor in 2 cases.

**RESULTS:** Median sternotomy was performed from the right side in 6 cases, and the left side in 2 cases. 14 level corpectomies were performed in 8 cases. Reconstructions were performed using a fibula allograft in 6 cases, and an iliac autograft in 2 cases. The mean follow-up duration was 104 months. A progressive delayed kyphosis requiring posterior stabilization occurred in one case. Postoperative neurological evaluation revealed improvement in 6 cases, and no change in 2 cases.

**CONCLUSION:** Median sternotomy is an appropriate and safe approach for selected cases with lesions involving the anterior column of the cervicothoracic junction. The sternal-splitting approach remains the best method for equal exposure of the anterior thoracic and cervical spine from C4 to Th4 vertebrae through a single incision.

**KEYWORDS:** Cervicothoracic junction, Transsternal approach, Anterior

### ÖZ

**AMAÇ:** Servikotorasik bileşkede ön kolona ait lezyonların cerrahi girişimi halen tartışmalıdır. Median transsternal yaklaşım bu bileşkeye direkt olarak ulaşımı mümkün kılar. Çalışmanın amacı, median transsternal yolla opere edilen hastaların cerrahi sonuçlarını yayınlamaktır.

**YÖNTEM ve GEREÇLER:** 8 olguluk serinin 7'si erkek biri kadındı. Yaş aralığı 18-39 arasında değişirken ortalama yaş 28,2 idi. Omuriliğe bası 3 olguda travmaya bağlı iken, 3 olguda enfeksiyon ve 2 olguda tümöral lezyona bağlıydı.

**BULGULAR:** 6 olguda median sternotomi girişimi sağ taraftan yapılırken, 2 olguda sol taraftan yapıldı. 8 olguda toplam 14 seviyeye korpektomi yapıldı. 6 olguda fibula grefti ile rekonstrüksiyon yapılırken, 2 olguda da iliak kanat grefti olarak kullanıldı. Olguların ortalama takip süresi 104 ay olarak tespit edildi. Bir olguda, posterior girişime ihtiyaç duyan ilerleyici kifoz görüldü. Cerrahi sonrası 6 olguda nörolojik olarak iyileşme görülürken 2 olguda nörolojik olarak değişiklik görülmedi.

**SONUÇ:** Median sternotomi servikotorasik bileşke anterior kolonunda lezyonu olan uygun olgularda kullanılacak uygun ve güvenli bir yöntemdir. Sternumun ayrılması yöntemi ile tek cilt kesisi ile hem servikal hem de torakal vertebralara (C4-T4 arası) eşit şekilde ulaşımına imkan sağlamaktadır.

**ANAHTAR SÖZCÜKLER:** Servikotorasik bileşke, Transsternal yaklaşım, Ön

### INTRODUCTION

Cervicothoracic junction pathologies are not very frequently observed. While 15% of spinal tumors are observed in the cervicothoracic junction, 5% of tuberculosis cases are observed in this location (16, 18). A wide frontal exposure is required to see the upper and lower vertebrae when it is necessary to perform decompression and stabilization in this region (15, 20). It is difficult to perform surgical interventions in this region due to the presence of large veins in the vicinity and obstructed vision caused by the sternum and clavicle (6).

Therefore, many interventions including median sternotomy have been recommended. The sternal splitting approach is a common method used for exposing pathologies at Thoracic (T) 4 and below (12). This method enables resection interbody fusion and instrumentation from the cervical to the thoracic region, while providing direct access to the vertebral body (13, 15). The purpose of this study was to share our surgical experience using the median transsternal approach to cervicothoracic junction pathologies.

## MATERIAL and METHODS

Patients who presented with destruction of the cervicothoracic junction caused by kyphosis and compressed canal were operated by using the median transsternal approach. There were 8 cases (7 males, 1 female) aged between 18-39 (mean 28.2) years. The neural compression was secondary to trauma in 3 cases, infection in 3 cases, and tumor in 2 cases. The lesion was located at T1-2 in 3 cases, T2-3 in 2 cases, and T3-4 in 1, T2 in 1, and T3 in 1 case. The diagnosis, results and patient details are provided in Table I.

### Surgical Technique

The patient is placed in the supine position to allow for cervical extension and a small size pillow is placed below the shoulders. The head is turned slightly to the left side. On the side of intervention, the skin incision starts from the anterior border of sternocleidomastoid muscle and goes towards the distal part of manubrium sterni (Figure 1). The platysma is excised and the sternocleidomastoid muscle is divided at the point of attachment. The sternohyoid and sternothyroid muscles are separated. All muscles attached to the medial half of the clavicle are detached subperiosteally. Fat tissue and thymus in the retrosternal region are isolated by blunt dissection. Sternotomy is performed with the help of a gigli saw or sternotomy saw. After bleeding control, the thoracic retractor is used to spread open the rib cage gently. The esophagus, trachea and brachiocephalic trunk are gently moved towards the right, while the pleura and left common carotid artery are moved towards the left. Exclusion of the longus colli muscle allows for intervention from C4 to T4

vertebrae. Bone graft or cement is applied after performing corpectomy at the correct level, as determined under scopy control. Anterior plating is performed by using bicortical screws. Stainless steel wires are used to close the sternum.

## RESULTS

Median sternotomy was performed from the right side in 6 cases, and the left side in 2 cases. 14 level corpectomy was performed in 8 cases. Reconstructions were performed using a fibula allograft in 6 cases, and an iliac autograft in 2 cases



**Figure 1:** The skin is dissected from the anterior border of the sternocleidomastoid muscle on the intervention side towards the distal part of manubrium sterni.

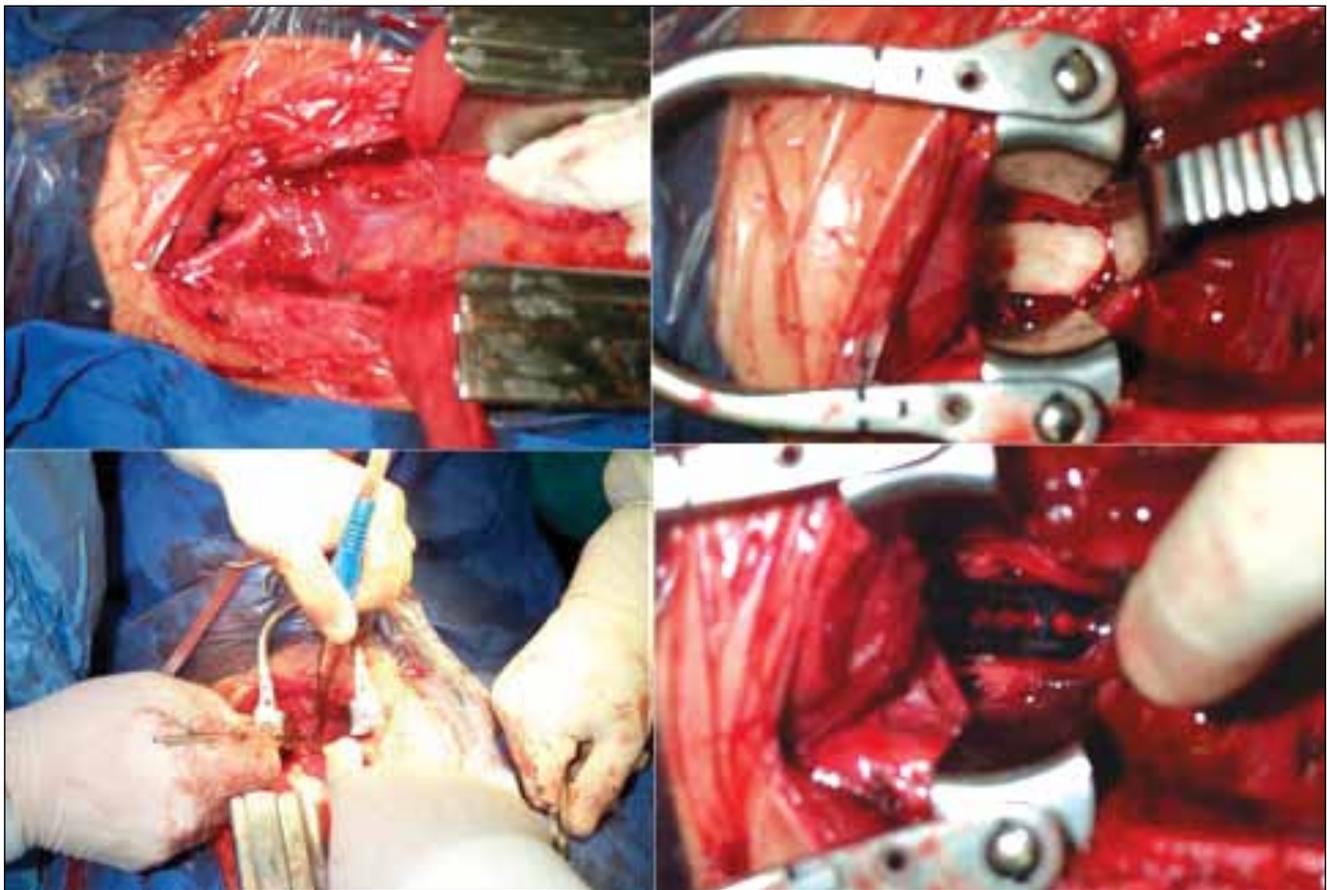
**Table I:** The Patients' Demographic Data are Shown along with the Respective Diagnosis, Pre-Operative Clinical Situation, Surgical Intervention and Post-Operative Neurological Status

Cases	Age/ Gender	Diagnosis	Preoperative Status	Surgery	Postoperative Status
Case 1	31/M	Trauma T3 burst fracture	ASIA-A	T2-3 corpectomy, reconstructed with fibular allograft and anterior plate	ASIA-C
Case 2	21/F	Tuberculosis T1-2	ASIA-A	T1-2 corpectomy, T3 partial corpectomy, decompression, fibular allograft, C7-T3 stabilization	ASIA-D
Case 3	30/M	Trauma T2-3 fracture	ASIA-B	T2-3 median corpectomy, fibular allograft and plate	ASIA-D
Case 4	39/M	Tuberculosis T1-2	ASIA-A	T1-2 corpectomy, decompression, fibular graft, anterior plate	ASIA-C
Case 5	18/M	Trauma T3-4 fracture	ASIA-A	T3-4 corpectomy, reconstructed with fibular graft anterior plate	ASIA-A
Case 6	26/M	Tumor T2	ASIA-B	T2 corpectomy, reconstructed with iliac graft	ASIA-D
Case 7	31/M	Tumor T1-2	ASIA-B	T2 corpectomy, T1 partial corpectomy reconstructed with iliac graft	ASIA-B
Case 8	29/M	Tuberculosis T2-3	ASIA-B	T2-3 corpectomy, reconstructed with fibular allograft anterior plate	ASIA-D

**ASIA:** American Spinal Injury Association, **M:** Male, **F:** Female, **C:** Cervical, **T:** Thoracic.



**Figure 2: A)** (Case 1) 31-year-old male. He had a traffic accident. In the clinical examination he was paraplegic, his ASIA score was A. **B)** The magnetic resonance imaging (MRI) revealed T3 burst fracture. The patient was treated with median sternotomy and corpectomy was performed on the second and third thoracic vertebra and reconstruction was done with fibular allograft and anterior plate.



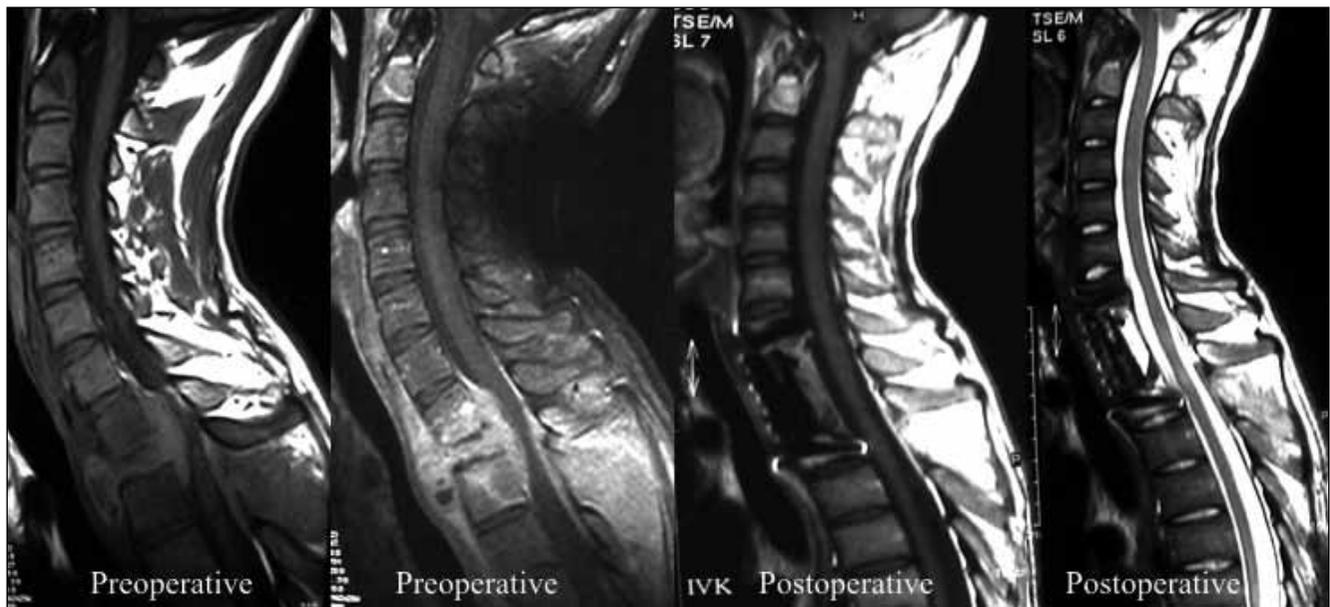
**Figure 3:** (Case 1) Intraoperative views of the patient.

(Figure 2A,B; 3; 4; 5). Two cases developed transient recurrent laryngeal nerve palsy postoperatively. The mean follow-up duration was 104 months. A progressive delayed kyphosis requiring posterior stabilization occurred in one case. Postoperative neurological evaluation revealed improvement in 6 cases and no change in 2 cases.

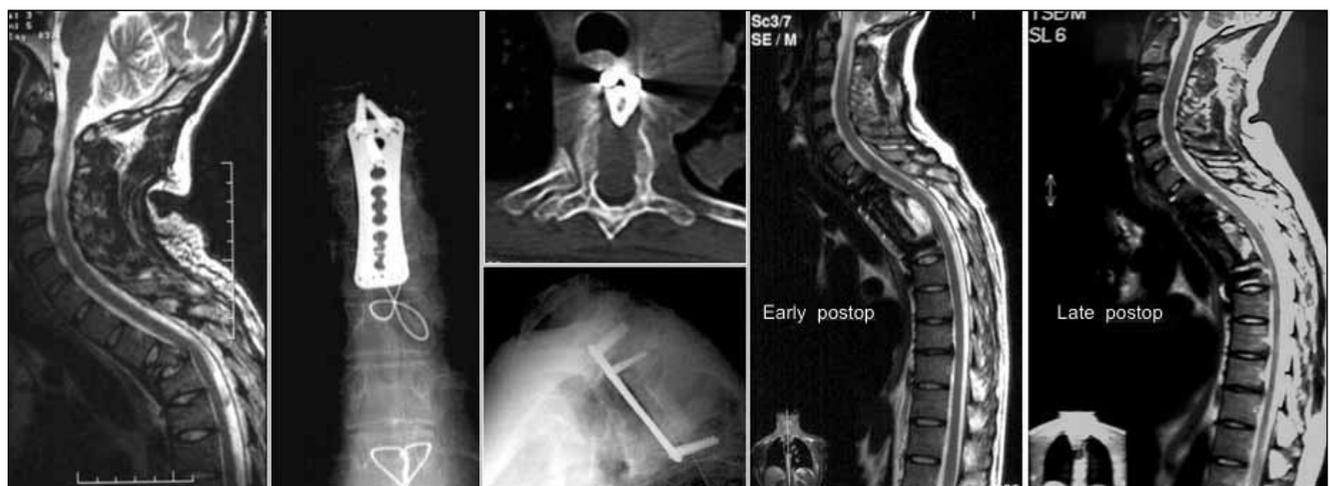
### DISCUSSION

With the introduction of advanced imaging methods, it is now possible to perform imaging studies for several pathologies concerning the upper thoracic vertebrae. The anterior

approach is usually considered as the most appropriate method for lesions of the vertebral body. Intervention to the upper thoracic vertebrae is technically difficult in most cases. Therefore, several approaches have been recommended. Fundamental approaches recommended for this region include the low anterior cervical approach, high anterior transthoracic approach, modified anterior approach, and the sternal-splitting approach (10, 13). The low anterior cervical approach is preferred in patients with a short neck and high sternum and for interventions at T2 and below (1, 12). Anterior instrumentation of the upper thoracic vertebrae is rather



**Figure 4:** (Case 2) 21-year-old female had tuberculosis osteomyelitis and her ASIA score was A. Preoperative MRI revealed thoracic one and two osteomyelitis (on the left side). Thoracic one, two and partial upper corpectomy and decompression was performed. Fibular allograft was used for reconstruction. Cervicothoracic alignment was maintained after the surgery (on the right side). In the fifth year follow-up, the patient's ASIA score was D.



**Figure 5:** (Case 3) 30-year-old male. Thoracic 2 and thoracic 3 fracture was present due to trauma and kyphotic angulation was observed (on the left side). The patient was treated with T2- T3 median corpectomy and reconstruction was with fibular allograft and plate via median sternotomy (On the right side).

hard to achieve using the anterior transthoracic approach (20). This approach is relatively traumatic for the patient and mediastinal structures may be damaged. Hodgson reported 40% mortality in ten patients he operated by using this approach (9). The modified anterior approach involves removal of the medial clavicle and sternoclavicular junction (17). This approach is both less traumatic and it provides easy access down to T3 (4).

The transsternal approach is useful and practical when it is required to perform anterior decompression and realignment of the spine due to tumors of the cervicothoracic junction, infection, deformity or trauma. Darling et al. suggested a modification for such cases. The authors obtained access to the lesion by performing only a median osteotomy vertical to the manubrium and a horizontal osteotomy through the synostosis, and then retracting the clavicle laterally (7). After the operation, the manubrium is closed by wire suturing.

The transsternal approach enables an anterior approach from C4 to T4 vertebrae (15, 20). The surgeon can have direct visibility of the larger veins by using this approach (3, 5, 6). Unlike approaches to the high anterior thoracic and lower anterior cervical levels, it enables operating on a larger surgical area (14). The transition from cervical lordosis to thoracic kyphosis makes the cervicothoracic junction a limited area for operations. While neurological improvement was observed in 6 patients, 2 patients had no change in their neurological status in our study.

Hodgson et al. reported in 1960 that they had performed median sternotomy in 10 cases with upper thoracic vertebrae tuberculosis (9). While Hanakita described sternal splitting for pathologies at the T1-T3 levels, Lesoin et al. defined partial cervicosternotomy that allowed direct access to the upper thoracic vertebrae (8, 11). Thanks to these approaches, the desired levels of stabilization were achieved with the anterior approach only, without any further need for the posterior approach.

The sternal splitting approach is the best method for use at C4 and T4 vertebrae within the cervicothoracic region (2, 18, 19). Minimum morbidity has been associated with this method. Familiarity with the regional anatomy and the surgical approach together with meticulous intraoperative technique ensure minimum complications in this procedure.

The connectors required for linking cervical and thoracic pedicle screws to rods were problematic in these cases. We followed up the patients who underwent an anterior approach, in order to check any possible kyphosis development. Upon observing kyphosis in one patient, the posterior approach was added. We currently consider that posterior stabilization must be added to especially the type of decompression that includes several vertebral bodies. Thus, a combined approach is necessary in cases that include multiple level corpectomies, while it is sufficient to perform an anterior approach only in cases that require single level corpectomy at the cervicothoracic junction.

Our choice as to intervention from either the right or left side depended on the course of the recurrent laryngeal nerve. The intervention was therefore made from the left side in early cases. However, after getting used to the anatomy, the right side was preferred as we were more familiar with it during exploration. Intervention from either side is equally effective if the surgeon is experienced and the exploration is carefully performed. It is up to the surgeon to decide on the side of intervention.

## CONCLUSION

Median sternotomy is an appropriate and safe approach for selected cases with lesions involving the anterior column of the cervicothoracic junction. The sternal-splitting approach remains the best method for equal exposure of the anterior thoracic and cervical spine from C4 to T4 vertebrae through a single incision. Familiarity with the regional anatomy and surgical approach and meticulous intraoperative technique ensure minimum complications in this procedure.

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