Bicipital Ribs- A Report of Four Cases

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Abstract:

The Thoracic outlet is bounded by the first thoracic vertebra posteriorly superior border of manubrium sternum anteriorly, and the first rib and costal cartilage laterally. Thoracic outlet syndrome is a common term for a number of disorders producing neurovascular compression over this area. In the collection of bones in the Institute of Anatomy, Madras Medical College, Bicipital ribs i.e., fused first and second ribs were found which is one of the important bony factor leading to thoracic outlet syndrome. The present report will be useful to clinicians while dealing with thoracic outlet syndrome.

Key Words: Thoracic outlet syndrome, fused ribs, bicipital rib, synostosis of ribs.

Introduction:

Although Bicipital Ribs are known scarce for more than a century now but still it has been scarcey reported. A peculiar bifurcation of vertebral end of rib has been observed in the skeleton of some whales. Turner (1883) described Bicipital ribs in two cases. First Sixteen ribs are Bicipital in Ichthyosaurs (earliest amphibian tetrapod). The term ‘Thoracic outlet syndrome’ (TOS) is coined by Peet in 1956 to include a wide variety of symptoms caused by compression of neurovascular bundle at the transition between neck and axilla. It is not a single entity, but is a family of disorders caused by constriction at any one of several anatomical points (Ferguson et al, 1968). Costal anomalies such as cervical ribs, hypertrophied scalenus anterior muscle have been considered as important factors in the development of TOS. Abnormal first and second ribs, fused first and second ribs can also present with thoracic outlet syndrome (White et al, 1945; Baumgartner et al, 1989). An isolated specimen of fused first and second rib was reported (Gupta et al, 2009). A Radiological study reported two cases of fused first and second rib associated with Thoracic outlet syndrome (Baumgartner et al, 1989). Incidence of 0.3% of fused first and second ribs has been reported in a study based on chest radiographs (Etter et al, 1944).

Case Report:

During routine scanning of bones in the Institute of Anatomy in four specimens there were fused first and second ribs. Present study describes the anatomical features of fused first and second ribs in four specimens. Relevant Anatomical details and measurements were taken using Digital Vernier Caliper.

Case 1: Width of first rib at the tubercle was 12.75 mm. Fusion with second rib was seen at 12 mms from tubercle, fusion was from above downwards as if they were overlapping. First rib outline was distinct for 4 cms from tubercle. Shaft of first rib fused with second rib resulting in obliteration of first intercostals space (Fig. I; Table I). An osseous tunnel was present just in front of tubercle. Since it was present between the tubercle, it is named as intertubercular tunnel. The length of the tunnel was 12mms (Fig II). After this point the fusion of the two ribs took place along the outer border of first rib with the inner border of second rib so that they formed a large plate of bone gradually spreading to a maximum width of 27.50mms. Impression for Scalenus medius was present over the superior surface of first rib. Bifurcation took place anteriorly at a distance of 60mm from tubercle of first rib.

Case 2: Width of first rib at the tubercle was 19.86mms (Fig. I; Table I). Fusion took place at a distance of 34mms from tubercle. Bifurcation took place at a distance of 72mms from tubercle. After this point the fusion of the two ribs took place along the outer border of first rib. Shaft of first rib fused with second rib resulting in obliteration of first intercostals space (Fig. I; Table I). At the onset of fusion, an osseous tunnel was present just in front of tubercle. Since it was present between the tubercle, it is named as intertubercular tunnel. The length of the tunnel was 12mms (Fig II). After this point the fusion of the two ribs took place along the outer border of first rib with the inner border of second rib so that they formed a large plate of bone gradually spreading to a maximum width of 27.50mms. Impression for Scalenus medius was present over the superior surface of first rib. Bifurcation took place anteriorly at a distance of 60mm from tubercle of first rib.

Case 3: Bilateral rudimentary first rib fused with second rib. Width of first rib at tubercle on right side was 15.01mms and left side was 13.29mms (Fig. I; Table II). On the Right side the rudimentary first rib
immediately fused with second rib near the tubercle. The interosseous tunnel length was 14mm (Fig. II). On the left side the rudimentary fist rib fused with second rib at a distance of 19mm from tubercle. There was no interosseous tunnel on left side. Width of conjoined shaft on right side was 23.01mm, on left side 24.31mm. Bifurcation occurred anteriorly 47mm from tubercle on right side and 45mm on left side.

**Case 4:** Fused first and second rib was present only on left side. First rib fused immediately with second rib behind the tubercle. On right side it was normal. There was no fusion on Right side. Width of first rib on right side at the level of tubercle was 13mm and on left side it was 15mm. Width of conjoined shaft on left side was 23.49mm (Fig. I; Table II). Bifurcation occurred 59mm from tubercle on left side. Interosseous tunnel measured 1.4cms on left side (Fig. II).

**Discussion:**

Bicipital rib is an unusual anatomical peculiarity which results due to the fusion of shafts of two distinct ribs into a common body and is seen exclusively in relation to the first rib, either due to fusion of a cervical rib with 1st rib or more commonly due to the fusion of the 1st rib with the 2nd. Neurovascular compression at the shoulder is not a single entity, but is a family of disorders caused by constriction at any one of several anatomical points. Many subtle variations were recognized and described as hyper abduction syndrome (Wright, 1945), first rib anomalies (Siderys et al, 1967), costoclavicular syndrome (Falconer & Li, 1962), scalenus medius or pectoralis minor compression (Swank & Simeone, 1944). First rib anomalies include floating rib, rudimentary first rib forming synostosis or pseudarthrosis with second rib, or bifurcated first rib etc. (White et al, 1945). Anomalous first rib similar to present study was reported (Gupta et al, 2009) where the fused first rib was of normal caliber. Rudimentary first rib forming synostosis with second rib was also reported (Guttentag & Salwen, 1999; Stapford & Telford, 1919). Bicipital rib anomaly may occur when a cervical rib fuses with vertebral end of the first rib or the first rib may be rudimentary and may fuse with the second rib making a bicipital rib (Thomas & Jamieson, 1937). Rib anomalies has been traditionally classified into: 1) Numerical and 2) Structural.

Numerical anomalies are common like supernumerary (cervical / lumbar) and deficient pair of 11th ribs. Structural abnormalities are quite rare & they can be further classified into a) short ribs b) replacement of costal cartilage /part of rib shaft by fibrous tissue c) fused ribs. (Rani et al, 2009). Fusion anomalies can again be classified as Bicipital, Bifid or bridged varieties. The ribs normally develop as extensions of sclerotome tissue in the thoracic region (Arey, 1965). It has been stated that there are atleast 22 known syndromes in which fused ribs are a constant component. Klippel Feil, Jarco Levin, Poland and Gorlin syndrome are few among them (Rani et al, 2009).

In the present study the first, second and fourth specimens, first rib was of normal caliber. Only in the third specimen first rib was rudimentary and was fused with second rib. First rib malformation like rudimentary rib, fused rib are commonly associated with post fixed brachial plexus (Stapford & Telford, 1919; White et al, 1945). Possibly the first and second thoracic nerves
may get stretched over the broadened fused shaft resulting in neurological symptoms of Thoracic outlet compression (Stapford & Telford, 1919). Compression of neurovascular structures may occur while passing from neck to axilla between first rib and scalenus anterior muscle, hypertrophied scalenus medius (Dale & Lewis, 1975). The intertubercular tunnel might transmit first intercostals nerve or posterior intercostal vessels and could form a potential site for nerve entrapment or vascular compression (Gupta et al, 2009). Intertubercular tunnel was present in first, third and fourth specimens. In the second specimen the fusion of first rib with second rib took place 3.4cms from tubercle of first rib. Similar occurrence was reported by (Deepak & Dakshayani, 2011). Significant vascular compromise have been reported with fused first and second rib hence it warrents an early diagnosis and surgical intervention (Baumgartner et al,1989).

Conclusion:

Rib abnormalities at upper end of thoracic cage is due to defective bone segmentation which may be associated with variation in disposition of vessels and nerves(Todd, 1912). Rib fusion causes scoliosis and restriction of chest wall expansion which may require surgical correction (Glass et al, 2002). The present case report i.e., fused rib or Bicipital rib is not only an Anatomical curiosity but it is both clinically and surgically important variation which may predispose to Thoracic outlet compression.

Table I: Width of Bicipital RIB from Tubercle of 1st Rib. mm

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Width of 1st Rib (at the tubercle)</th>
<th>Distance of fusion width 2nd rib (from tubercle)</th>
<th>Length of the 1st un-fused outer border of 1st Rib</th>
<th>Maximum width of fused ribs</th>
<th>Distance of Bifurcation of fused ribs (from tubercle)</th>
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<td>1</td>
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<td>40.00</td>
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<td>34.00</td>
<td>44.00</td>
<td>45.18</td>
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Table II: Width of Bicipital Rib from Tubercle of 1st Rib, mm

<table>
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<tr>
<th>Case No.</th>
<th>Width of 1st Rib (at the tubercle)</th>
<th>Distance of fusion width 2nd rib (from tubercle)</th>
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References:

10. Gutten TAG, Solwen JK: Keep your eyes on the ribs. The spectrum of normal variants and dissection that


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