



Original Article

Unique Congenital Developmental Anomaly & Morphological Study on the Synostosis of First & Second Rib

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ABSTRACT

Congenital anomaly of the ribs are not so common and they are usually discovered as an incidental findings during routine radiography but in my work. I have got this “Bicipital rib” by routine purchasing of skeletal system to our KMMC & Research Centre, Muttom, Tamilnadu. The bicipital ribs results due to fusion of cervical rib with the first rib or first rib with the second. Its occurrence is unique and more frequently unilateral. Bicipetal ribs i.e., fused first and second ribs were found which is one of the important bony factor leading to thoracic inlet syndrome. The present report will be useful to clinicians while dealing with “thoracic inlet syndrome”.

Keywords: Bicipital rib, synostosis of ribs and thoracic inlet syndrome (TIS).

INTRODUCTION

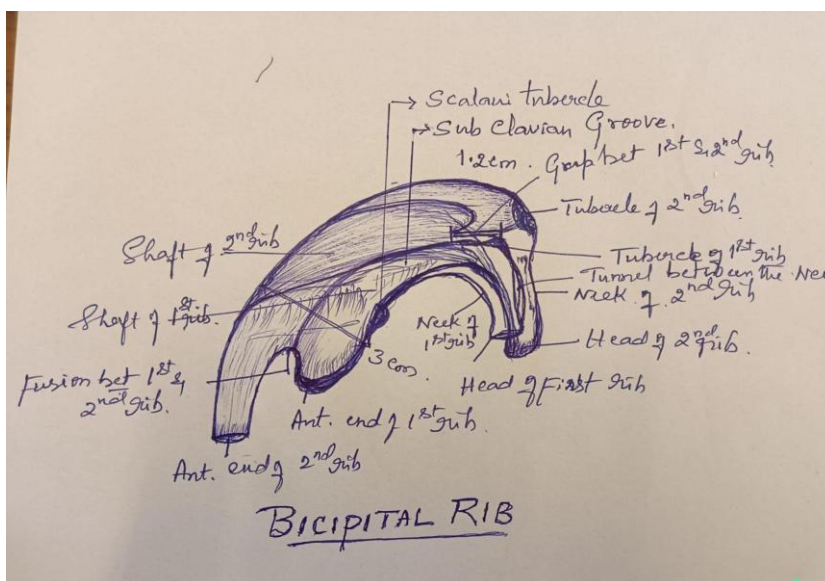
Ribs are twelve pairs of osseous- elastic arches and highly vascular cancellous bone enclosed in a thin layer of compact bone, which are thicker on its surfaces and thinner in its borders. All the ribs, including vertebral column and sternum forms the osseous framework of thoracic- cage and gives proper protection to vital- organs i.e; heart & lungs. All twelve pairs of ribs develops in the ninth week of intra- uterine life, from the costal process of the ribs are very rare. An unusual anomaly of the fusion of first and second ribs i.e; synostosis or the bicipital ribs had been said to have an incidence of 0.3%, as reported from a teaching in tutorial classes for MBBS students in our college. Although bicipital ribs are known scarcely for more than a century now but still it has been scarcely reported. A peculiar bifurcation of vertebral end of ribs has been observed in the skeleton of some whales sir william Turner (1883) described bicipital (2- headed) ribs in two cases. The first sixteen ribs are Bicipital in Ichthyosaurs (Earliest Amphibian Tetrapod). The term Thoracic Inlet Syndrome (TIS) is coined by Peet in 1956 to include a wide variety of symptoms caused by compression of neuro - vascular bundle at the transition between neck and Axilla. It is not a single entity, but it is a family disorders caused by constriction at any one of several anatomical points (forerguson et al, 1968). costal anomalies such as cervical ribs, hypertrophied scalenus anterior muscle have been considered as important factors in the development of thoracic inlet syndrome. Abnormal first and second ribs, fused first and second ribs can also present with thoracic inlet syndrome. (white et al, 2009). incidence of 0.3% of fused first and second ribs has been reported in a study based on chest radiographs (Etter et al, 1944).

Synostosis of the first rib is a rare anatomical peculiarity which occurs due to fusion of the shafts these distinct ribs, or fused ribs involving first rib mainly result from the misexpression of specific HOX 3 genes.

The synostosis of the first and second ribs is usually asymptomatic, but may also cause. Musculoskeletal pain, intercostal nerve entrapment or any significant vascular pathology. Since the first rib is involved, the bicipitals may be unique cause of thoracic inlet syndrome such an anomaly may be associated with many syndromes, like klippel- feil syndrome, paland syndrome, neurofibromatosis, spondylocostal dysostosis etc.

MATERIALS AND METHODS

During routine osteology demonstration classes for 1st year MBBS students in the department of anatomy KMMC medical college muttom. The morphological pattern of the fusion of first and second ribs are found. The anomaly of the synostosis of the first and second rib, was obtained on the right side of only on thoracic cage skeleton. Where the other side revealed normal first and second ribs. The line of fusion in the observed specimen was very obvious and prominent. The specimen was well examined, photographed and relevant anatomic features and measurements were recorded.



Schematic diagram of Bicipital Rib showing the measurement and parts of my findings



Superior view of Bicipital Rib showing Scalani Tubercle & Subclavian groove on the first Rib



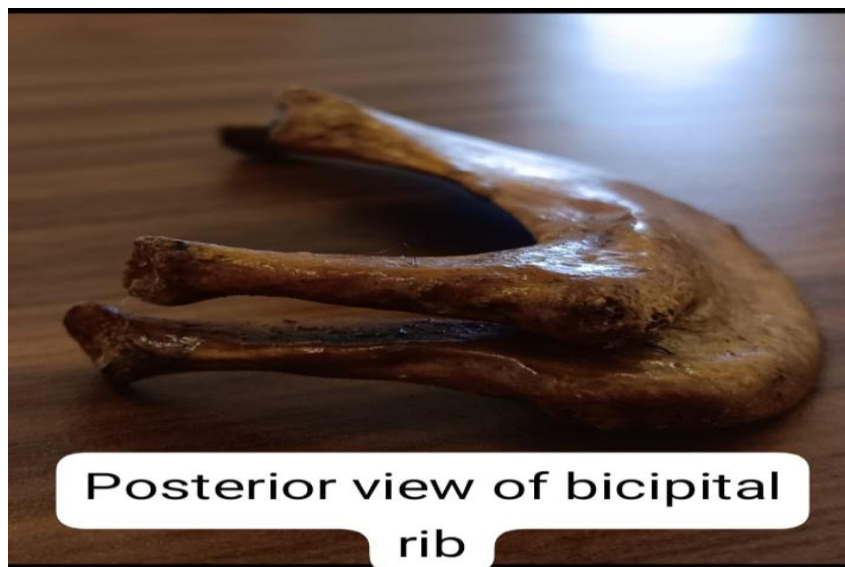
Inferior surface of Bicipital Rib showing Costal Groove in the Second Rib



Lateral view of Bicipital Rib showing Anterior & Posterior Ends showing breadth of superior surface is 3 cm



Posterior View of Bicipital Rib Showing Tunnel between the Neck of First & Second Ribs



Posterior View of Bicipital Rib showing Fusion between First & Second Rib 1.2 cm away from Tubercle of First Rib

OBSERVATION AND RESULTS

The morphological analysis showed that the specimen was a fusion of first and second ribs on the right side. Each of these ribs possessed two separate heads, an elongated neck, a tubercle and beginning of the shaft. The two shafts are fused with each other at 1.2 cm from the tubercle of the first rib on the superior surface of the second rib. Both the heads had articular surfaces for its articulation with the numerically corresponding thoracic vertebrae. A cleft between the two ribs was 1 cm in a vertical diameter and 2.5 cm long from its vertebral and thus obliterating the 1st intercostal space. The breadth of the shaft of first rib immediately before the fusion was (1.5) and that of the second rib was 2 cms. After the fusion the common body assumed a breadth of (3cms) at its widest part. The line of fusion of both the ribs was marked by faint groove on the inferior surface and a ridge extending from the tubercle of the first rib to the middle of the conjoint shaft on the superior surface.

The ribs are developed from the mesenchymal processes of the primitive vertebral arches in the thoracic region. Malsegmentation of the axial skeleton, before 20th day of embryonic life leads to multiple morphological anomalies of the vertebrae and ribs. Mal-expression of myogenin MYF 5 and MRF 4 could be potential cause of such anomalies.

DISCUSSION

- A. **Bicipital rib:** fused anterior ends and shafts but separate posterior ends (two headed)
- B. **Bridged rib:** fused middle of the shafts but separate anterior and posterior ends.
- C. **Forked rib:** fused posterior ends but separate shaft as well as separate anterior ends.

First rib anomalies create a narrow space through which the brachial plexus and subclavian vessels pass causing compression. These anomalies include a fused cervical and first rib or a fused first and second rib. The tunnel formed between first and second rib transmits the first intercostal nerve and posterior intercostal vessels and this could form a potential site for nerve entrapment or compression of vessels.

These clinical manifestations may be seen with congenitally abnormal 1st rib or with first and second rib synostosis. First rib malformations such as rudimentary first rib, fused ribs are commonly associated with post-fixed brachial plexus with a large contribution from second thoracic nerve.

The first and second thoracic nerves may get stretched over the broadened shaft of fused first and second rib and it may result in neurological symptoms of thoracic inlet syndrome. Significant vascular compromise has also been reported with fused first and second ribs and warrants an early diagnosis and surgical intervention, Rib fusion also causes scoliosis and restriction of chest wall expansion.

Anomalous ribs are rare anatomic findings discovered incidentally on routine radiographs. Many a time they are associated with different syndromes and therefore should not be neglected.

There are 22 syndromes described, in which rib anomalies are one of their constant components. Few examples: Klippel - Feil syndrome, Jarcho-Levin syndrome, Poland syndrome. Basal cell nevus syndrome (Gorlin syndrome).

Jaw cyst basal nerves- bifid rib syndrome or gorlin - golts syndrome is a rare autosomal dominant disorder associated with multiple odontogenic cysts in the jaw and basal cell carcinoma of the skin with bifid rib.

The first case to be recorded was communicated in 1740 to Royal Academy of sciences in paris by M.Hunauld who started that “ the skeleton of an adult in which the first rib in each side is well formed posteriorly and articulated with the first dorsal vertebra, joins and fuses with second ribs, which by this union becomes larger than usual in primitive tetrapods, joins and fuses with second ribs which by this union becomes larger than usual in primitive tetrapods the ribs were double headed; a capitulum or head proper which is attached in early forms to the intercentrum and the tuberculum or an accessory head attached to the transverse process of the neural arch in mammals, fused two headed ribs are seen with a foramen between them. Fused ribs are also called as pleuroapophysis.

A few tetrapods like anurans, lizards, snakes and monotremes exhibit sigle headed ribs resulting from the fusion of the 2 head or from the disappearance of one head during development. Necturus exhibits very shorts, almost vestigial bicipital ribs along the entire length of the body and tail. First and second rib except the head and tubercle was noted by Anupama. The case report given by vidhya is almost similar to the present case report with the costal groove in the under surface of the second rib.

A knowledge of this Anatomical variation is important for clinicians and orthopaedic surgeons during the different diagnosis with other diseases, such as a chest - wall tumors or costal (groove) fractures and for counting the ribs. The bicipital rib may cause severe anatomical and vascular compromise and such as defect should be connected surgically without delay.

CONCLUSION

The rib anomalies were found in 0.3% of the population. Synostosis of the first and second rib is an important variable anomaly to be noted not only by the anatomists, but the knowledge of its incidence should also be known to the Radiologists, clinicians and surgeons. It is usually asymptomatic and may be incidentally detected during routine chest radiography. It may cause musculoskeletal pain due to the conjoint shaft or interlosteral nerve entrapment which occurs from the obliteration of the intercostal space due to synostosis. Professor W.M Turner had stated in his article that the first case of bicipital ribs was recorded in 1740 by Dr. M.Hunauld, which he communicated to the Royal Academy of sciences in paris. Turner himself had mentioned in his study that such anomaly is presented in man and Cetacea species. Ramazan, in his study on 650 patients had observed 18% of cases with union of the midpoint of the shaft of first and second ribs, using multidetector computed tomography procedure. He also mentions that older studies had revealed 0.3% incidence of fusion of ribs. Jyothi's case report on such kind of anomaly states that the fusion had started 1.5cm from the tubercle of the first rib. The fusion in her case was found more anteriorly than that found in the present case. Anita had given an incidence of 0.1% for this anomaly when she detected such a specimen out of 1000 ribs. The presence of osseous tunnel in the fusion of first and second rib was the unique finding in the specimens as reported by Gupta. He denotes the risk of entrapment of the 1st inter-costal nerve when it passes through such tunnel. Similar kind of bicipital rib with complete fusion can also be the indirect cause for thoracic inlet syndrome. It was mentioned in many studies that such type of rib anomaly is found to be a constant component of some 22 kinds of syndromes when a patient presents with the signs and symptoms of Neuro-vascular compression, the possibility of the synostosis detect of the 1st rib should be kept in mind, also through investigation without neglecting any underlying systemic disorder should be done when a rib anomaly like bicipital rib is detected. A prompt decision for proper surgical interventions should be correct the pathologic consequences of such rib abnormalities.

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