

## Case Report

# MULTIPLE OSSIFIED COSTAL CARTILAGES FOR 1<sup>ST</sup> RIB

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## ABSTRACT

Costal cartilages are flattened bars of hyaline cartilages. All ribs except the last two, join with the sternum through their respective costal cartilages directly or indirectly. During dissection for 1<sup>st</sup> MBBS students in the Department of Anatomy, JJMMC, Davangere, variation was found in a male cadaver aged 45 –50 years. Multiple ossified costal cartilages for 1<sup>st</sup> rib were present on left side. There were 3 costal cartilages connecting 1<sup>st</sup> rib to manubrium. There were two small intercostal spaces between them. The lower two small costal cartilages fused together to form a common segment which in turn fused with large upper costal cartilage. The large upper costal cartilage forms costochondral joint with 1<sup>st</sup> rib. All costal cartilages showed features of calcification. The present variation of multiple ossified costal cartilages are due to bifurcation of costal cartilage. It may cause musculoskeletal pain, intercostal nerve entrapment or vascular compression. Awareness of these anomalies are important for radiologists for diagnostic purpose and for surgeons for performing various clinical and surgical procedures.

**KEYWORDS:** Costal cartilage, bifurcation of Rib, Sternum.

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## Access this Article online

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DOI: 10.16965/ijar.2014.538

**Web site:** International Journal of Anatomy and Research  
ISSN 2321-4287  
[www.ijmhr.org/ijar.htm](http://www.ijmhr.org/ijar.htm)

Received: 14 Nov 2014

Peer Review: 14 Nov 2014 Published (O):31 Dec 2014

Accepted: 02 Dec 2014 Published (P):31 Dec 2014

## INTRODUCTION

Costal cartilages are flattened bars of hyaline cartilages, extending from the anterior ends of ribs. They impart elasticity and mobility of the thorax. The costal cartilages are unossified anterior parts of embryonic cartilaginous ribs [1]. A typical costal cartilage has medial and lateral ends, anterior and posterior surfaces, and upper and lower borders [2]. The upper seven costal cartilages join with the sternum. The eighth to tenth cartilages articulate with the lower borders of the adjacent upper cartilages; the lowest two cartilages possess free pointed tips in the muscular wall of abdomen. The first chondrosternal joint is primary cartilaginous, rest

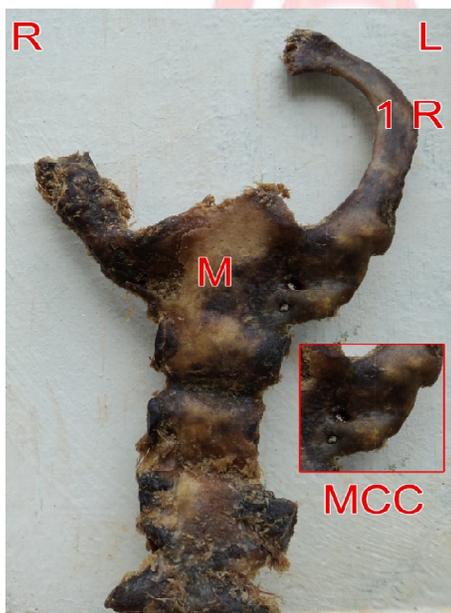
of the articulations are synovial. The interchondral joints are also synovial, except that between the 9<sup>th</sup> and 10<sup>th</sup> cartilages which is a fibrous joint [1]. The costochondral articulations are hyaline cartilaginous joints. Each rib has a cup shaped depression in its sternal end into which the costal cartilage fits. No movements normally occurs at costochondral joints [3].

## CASE REPORT

The present variation was observed during gross anatomy dissection of thoracic region for 1<sup>st</sup> MBBS students in the Department of Anatomy, J.J.M. Medical College, Davangere in a male cadaver aged about 40-50 years. It involved

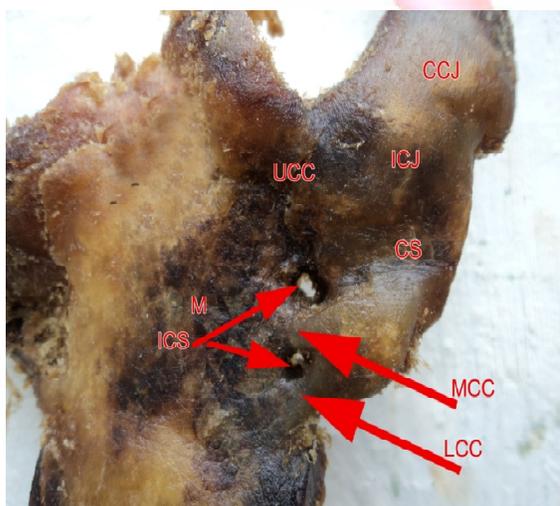
multiple ossified costal cartilages for 1<sup>st</sup> rib on left side(Figure.1). There were 3 costal cartilages connecting 1<sup>st</sup> rib to manubrium. They were named as upper, middle and lower costal cartilages. There were two small intercostal spaces between them. The middle and lower costal cartilages were small and fused together to form a common segment which in turn fused with large upper costal cartilage. The large upper costal cartilage forms costochondral joint with 1<sup>st</sup> rib (Figure.2). The remaining all other costal cartilages were normal on both sides.

**Fig. 1:** Multiple ossified costal cartilages for 1<sup>st</sup> rib.



MCC-Multiple costal cartilages; 1R-1<sup>st</sup> rib;M-manubrium; L-left; R-right.

**Fig. 2:** Formation of multiple ossified costal cartilages for 1<sup>st</sup> rib.



UCC-upper costal cartilages; MCC-middle costal cartilage; LCC-lower costal cartilage; CS-common segment;ICS-intercostal space; ICJ- interchondral junction; CCJ-costochondral junction; M- manubrium.

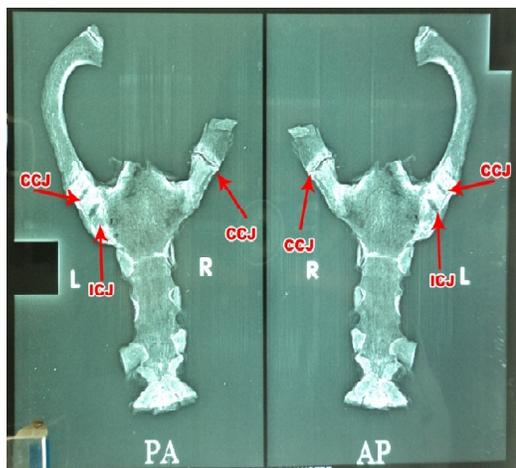
The upper costal cartilage situated horizontally measures 3.5 cms length from manubrium to 1<sup>st</sup> costochondral joint and 6cms in circumference. The middle costal cartilage situated horizontally measures 0.5 cms length from manubrium to common segment formed by middle and lower costal cartilages and 2cms in circumference. The lower costal cartilage inclined upwards measures 0.5 cms length from manubrium to common segment formed by middle and lower costal cartilages and 2cms in circumference. The common segment formed by union of middle and lower costal cartilages inclined upwards measures 3.5 cms length and 5cms maximum circumference. The common segment fused with lower border of upper costal cartilage and forms interchondral junction. All costal cartilages showed features of calcification.

The intercostal spaces between costal cartilages measures 2mm in vertical length and filled with connective tissue.

The fibres of pectoralis major had taken origin from anterior surfaces of all costal cartilages. The lower border of lower costal cartilage along with lateral border of common segment had given attachment to internal intercostal muscle and external intercostal membrane. The posterior surface of all costal cartilages were smooth and normal.

The 2<sup>nd</sup> intercostal space was narrow below the lower costal cartilage and 2<sup>nd</sup> costal cartilage measuring 5mm in vertical length. Radiologically,

**Fig. 3:** X-ray of multiple ossified costal cartilages for 1<sup>st</sup> rib.



ICJ- interchondral junction; CCJ-costochondral junction; L-left; R-right.

normal costochondral junction with ossified bridges surrounding the junction noted. There was evidence of additional ossified cartilages extending from the lower part of the manubrium to first costal cartilage forming interchondral junction (Figure.3).

## DISCUSSION

The first costal cartilage inclines downwards and medially [1]. The manubrium and the first ribs are fixed to each other and move together as one [4].

In thoracic vertebra the costal elements undergo independent growth and form the ribs. As the ribs grow outwards through the segmental myotomes of the body wall, they describe the costal arches. At first each arch is completely chondroformed. The ventral ends of upper seven or eighth arches unite on each side to form a cartilaginous sternal plate. Finally the sternal plates are fused in the middle and form the rudiment of the sternum. A typical rib is ossified from one primary centre which appears close to the posterior angle of the shaft during the seventh week. From there the ossification proceeds dorsally and ventrally. At birth ventral part of the costal arch remains cartilaginous, since ossification has to extend for longer distance, and this persists as such throughout life to establish elastic recoil of the thoracic wall [5]. During this process multiple bifurcations of the 1<sup>st</sup> costal cartilage medially and then forming the sternal plate explains the possible course of this variation.

Anatomic rib variants include developmental deformities, cervical rib, and short rib which may mimic true rib diseases. Apart from this there may be rare occasions where unusual variations are encountered; for example, the costal cartilage and adjacent portions of the body of the rib may be occasionally replaced by fibrous tissue, two adjacent ribs may be completely fused, or the bodies of two or more ribs may be joined by fusion [6].

A bifid rib or bifurcated rib is an unusual malformation and is rarely observed in the clinical scenario. It is a congenital abnormality of the rib cage and associated muscles and nerves in which the sternal end of the rib is cleaved into two. It is usually unilateral and

asymptomatic but it can present as an isolated abnormality or be associated with pathologic malformations such as jaw cysts and basal cell nevus syndrome [7]. In the current case bifurcation of costal cartilage is medially towards the sternum instead of usual bifurcation of costal cartilage, which is lateral and in association with the bifid rib. Moreover the bifurcated common segment bifurcates again before forming the sternal plate, forming middle and lower costal cartilages, showing multiple bifurcations of costal cartilage.

In elderly people, the costal cartilages lose some of their elasticity and become brittle; they may undergo calcification, making them radiopaque [3]. In the current case there is a radiological evidence of age related calcifications.

Bifid ribs associated with pathologic malformations such as Gorlin–Goltz syndrome [8,9] and malignancy in childhood usually occur in the young [10], and might be characteristic of multiplicity of the bifid rib on the same side. In older people, the bifid rib when it is not associated with other disease may present few clinical problems. However, knowledge of bifid ribs is necessary for the differential diagnosis with other diseases, such as tumors of the chest wall or costal fracture, because the various types of bifid rib present with diverse appearances on normal chest X-rays [11].

The ribs and the intercostal spaces provide important surface marking for various physical examination procedures and clinical procedures. Hence it is imperative that the radiologists and clinicians be familiar with normal rib anatomy, rib variants, and the radiologic appearance of the ribs to prevent misdiagnosis [12].

## CONCLUSION

The present variation of multiple costal cartilages are due to bifurcation of costal cartilage.

In the present case bifurcation of costal cartilage is not associated with bifid rib and it showing multiple bifurcations. It may cause musculo-skeletal pain, intercostal nerve entrapment or vascular compression. Awareness of these anomalies are important for radiologists for diagnostic purpose and for surgeons for perfor-

-ming various clinical and surgical procedures.

**Conflicts of Interests: None**

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### How to cite this article:

Raghavendra D.R, Nirmala D. MULTIPLE OSSIFIED COSTAL CARTILAGES FOR 1<sup>ST</sup> RIB. Int J Anat Res 2014;2(4):744-747.

DOI: 10.16965/ijar.2014.538