



Cracking the Case of the Split Rib: A Rare 3rd Costal Anomaly

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ABSTRACT

Bifid ribs are rare congenital anomalies where a single rib splits into two branches, typically near the sternal or vertebral ends, and are often discovered incidentally due to their asymptomatic nature. During a routine cadaveric dissection at Darbhanga Medical College & Hospital, a bifid third rib was observed on the right side, with the split occurring near the anterior end before the costochondral junction. The two bony branches rejoined at the costal cartilage without any associated abnormalities or signs of trauma. This variation is likely due to incomplete fusion of costal elements during embryonic development. While usually benign, such anomalies can mimic fractures or masses in imaging and should be recognized during diagnostic and surgical procedures. This case highlights the importance of cadaveric dissection in identifying rare anatomical variations and contributes to the existing knowledge of thoracic cage anomalies.

Keywords: Bifid, Costochondral junction, thoracic Vertebrae.

I. INTRODUCTION

The human rib cage is an intricate and vital structure that safeguards the heart, lungs, and other essential thoracic organs while playing a dynamic role in respiration. It is typically composed of 12 pairs of ribs, arranged in a fairly consistent anatomical layout. However, nature sometimes deviates from the norm. Among the various rib anomalies encountered in clinical and anatomical settings, bifid ribs—where a rib splits into two branches—stand out for their rarity and diagnostic significance.

Though usually harmless, these variations can surprise clinicians and anatomists alike. Bifid ribs occur in about 0.15% to 3.4% of the population, most often affecting the 3rd to 5th ribs and more frequently appearing on the right side (Mavrodi & Paraskevas, 2014). While they often go unnoticed, their potential to mimic fractures or

masses on imaging makes awareness essential. This report presents a rare case of a bifid **third** rib identified during routine cadaveric dissection—a notable variation that adds to the growing literature on anatomical diversity.

II. MATERIALS AND METHODS

This observation was made during a scheduled dissection session in the Department of Anatomy at Darbhanga Medical College & Hospital in Bihar, India. The cadaver, an adult male estimated to be between 40 and 45 years old at the time of death, was being used for undergraduate anatomical education.

As the anterior thoracic wall was methodically exposed following standard dissection protocols, a distinctive anomaly in the ribcage caught our attention. Careful inspection revealed a bifurcation in the third rib on the right side. Measurements were taken using calipers and protractors to document the morphology—particularly the point and angle of bifurcation, and the extent of fusion at the costal cartilage. To contextualize our findings, we also reviewed the current literature on costal anomalies through databases such as PubMed, Scopus, and Google Scholar.

III. RESULTS

The anomaly was quite striking: the third rib on the right side split into two distinct bony branches approximately 2 cm before the costochondral junction, forming a noticeable ‘Y’ shape. These two limbs extended for around 4.5 cm before merging again at the costal cartilage and continuing on to articulate normally with the sternum.

No similar findings were observed in the contralateral ribs, and there was no visible evidence of trauma, surgical history, or associated syndromic features.

Key morphometric details include:

- **Bifurcation site:** Anterior one-third of the rib
- **Superior branch length:** 4.7 cm
- **Inferior branch length:** 4.5 cm
- **Fusion point:** Costal cartilage of the third rib



Figure: Right-sided bifid third rib identified incidentally during routine cadaveric dissection, showing distinct bifurcation near the costochondral junction and reunion at the costal cartilage.

Embryological Insight

Rib development is a finely orchestrated process that begins around the 4th to 6th week of gestation. It involves the chondrification and ossification of costal processes derived from the thoracic vertebrae. Bifid ribs, such as the one observed here, are thought to result from incomplete fusion of these costal elements during embryogenesis (Sadler, 2020). In this case, the rib developed two parallel ossification paths, later reconnecting distally—a subtle yet significant deviation from the standard anatomical script.

Comparison with Previous Studies

Author(s)	Year	Rib Involved	Side	Mode of Discovery	Clinical Significance
Moore et al.	2011	5th	Not Specified	Cadaveric dissection	Incidental, no symptoms
Lichtenstein et al.	2004	4th–6th	Bilateral/Unilateral	Radiology	Occasionally misdiagnosed; chest pain noted
Present Study (Karna et al.)	2025	3rd (rare)	Right	Cadaveric dissection	Asymptomatic; educational value highlighted

IV. CONCLUSION

The discovery of a bifid third rib in a cadaver offers valuable insights into anatomical variation and reinforces the role of dissection in medical education. While clinically silent in this case, such anomalies should not be overlooked, especially in imaging or surgical contexts where misinterpretation can lead to error. This case not only enriches anatomical literature but also serves as a reminder that even the most familiar structures can surprise us with their variability.

Discussion

Bifid ribs are typically discovered by accident—either in radiographic scans or during dissection—and are usually benign. However, their presence can pose diagnostic challenges. For instance, on chest radiographs, a bifid rib might resemble a fracture or even a pathological mass, leading to unnecessary investigations or interventions.

While previous reports, such as those by Moore et al. (2011), have described bifid 5th ribs during dissection, and Lichtenstein et al. (2004) noted similar anomalies through radiological scans, involvement of the **third** rib remains exceedingly rare. Our observation not only contributes a new case to the limited pool of third rib bifurcations but also underscores the importance of hands-on anatomical training in identifying such variants.

Clinical Implications

- Radiologically, bifid ribs can be mistaken for fractures, tumors, or congenital deformities.
- Surgeons performing thoracic procedures should be mindful of such variants, as they may alter the anatomy of intercostal spaces and complicate approaches for chest drains or incisions.
- In trauma cases, unusual rib morphology might influence how force is transmitted through the thoracic cage.

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Conflict of Interest

None declared.

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