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MORPHOLOGICAL STUDY OF PULMONARY FISSURES AND THEIR ANATOMICAL VARIATIONS IN ADULT CADAVERIC LUNGS

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ABSTRACT

Background and Rationale: Pulmonary fissures divide the lungs into anatomically and functionally distinct lobes, facilitating uniform expansion and serving as landmarks for bronchopulmonary segmentation. Variations in fissural morphology—such as incomplete, absent, or accessory fissures—may influence radiological interpretation and surgical outcomes. The present study was undertaken to document the morphological variations of pulmonary fissures in adult cadaveric lungs and compare them with classical anatomical descriptions.

Methods: A total of 72 adult human cadaveric lungs (36 right and 36 left) were examined grossly in the Department of Anatomy. Each specimen was assessed for the presence, completeness, and absence of oblique and horizontal fissures, as well as accessory fissures. Fissural completeness was graded according to the Craig and Walker classification, and findings were compared with standard anatomical references and previous studies.

Results: In the right lungs, the horizontal fissure was complete in 61.11%, incomplete in 27.78%, and absent in 11.11% of specimens; the oblique fissure was complete in 77.78% and incomplete in 22.22%. In the left lungs, the oblique fissure was complete in 75% and incomplete in 25%. Accessory fissures were rare, with an inferior accessory fissure observed in 2.78% of specimens. Grade I fissures predominated in both lungs, indicating a higher incidence of complete fissures.

Discussion: The study confirms that variations in pulmonary fissures are common, particularly involving the right horizontal fissure. Incomplete fissures may result from partial fusion of lobes during embryogenesis and can complicate lobectomy or segmentectomy procedures. The rarity of accessory fissures aligns with previous Indian cadaveric studies, though regional differences may exist.

Conclusion: Incomplete fissures are frequent anatomical variants, while accessory fissures are uncommon. Recognition of these variations is essential for anatomists, radiologists, and thoracic surgeons to avoid diagnostic errors and operative complications. Further studies incorporating radiological correlation are recommended to elucidate population-based differences and clinical implications.

Keywords: Pulmonary Fissures, Anatomical Variations, Cadaveric Study, Craig And Walker Classification, Accessory Fissures.

INTRODUCTION

The lungs are the principal organs of respiration situated within the thoracic cavity on either side of the mediastinum. Their external morphology is characterised by the presence of fissures, which divide the lungs into anatomically and functionally distinct lobes. These fissures are formed by invaginations of the visceral pleura and facilitate uniform expansion of pulmonary parenchyma during respiration.

In addition, they serve as important anatomical landmarks for localization of bronchopulmonary segments and provide pathways for movement of the lobes during breathing.

Normally, the right lung is divided into superior, middle, and inferior lobes by the oblique and horizontal fissures, whereas the left lung is divided into superior and inferior lobes by a single oblique fissure. The oblique fissure extends from the posterior border of the lung downward and forward toward the inferior border, while the horizontal fissure of the right lung extends horizontally from the oblique fissure to the anterior border at the level of the fourth costal cartilage. The completeness and normal arrangement of these fissures are essential for maintaining the classical lobar pattern of the lungs. ^[1]

However, considerable anatomical variations in



www.ajmrhs.com
eISSN: 2583-7761

Date of Received: 23-05-2026
Date Acceptance: 31-05-2026
Date of Publication: 30-06-2026

pulmonary fissures are frequently encountered. These variations may include incomplete fissures, absent fissures, and the presence of accessory fissures. Incomplete fissures occur when the pleural cleft fails to extend completely to the hilum, resulting in partial fusion of adjacent lobes by pulmonary parenchyma. Accessory fissures are additional pleural clefts that may partially or completely separate bronchopulmonary segments, occasionally leading to the formation of accessory lobes. Such variations arise due to altered obliteration of spaces between developing bronchopulmonary buds during embryogenesis.^[2] Knowledge of fissural morphology is of great clinical importance. Variations in fissures may alter the radiological appearance of the lungs and can mimic pathological lesions, pleural scars, or areas of atelectasis. Incomplete fissures may permit spread of infections, malignancies, or pleural effusions between lobes, whereas complete fissures may confine disease to a particular lobe. Furthermore, precise understanding of fissural anatomy is essential during thoracic surgical procedures such as lobectomy, segmentectomy, and video-assisted thoracoscopic surgeries, where unrecognised variations may increase operative difficulty and postoperative complications.^[3] Although standard anatomical descriptions present a consistent pattern of pulmonary fissures, cadaveric studies have demonstrated wide variations in their morphology and completeness. Documenting these variations is therefore important for anatomists, radiologists, and thoracic surgeons. The present cadaveric study was undertaken to observe the morphological variations of pulmonary fissures in adult human lungs and to compare the findings with classical anatomical descriptions and available literature.

Aim:

To study the morphological variations of pulmonary fissures in adult cadaveric lungs.

Objectives:

1. To observe the pattern of pulmonary fissures in adult cadaveric lungs.

2. To identify complete, incomplete, and absent fissures.
3. To identify accessory fissures in the lungs.
4. To compare the findings with standard anatomical descriptions and previous studies.

METHODS

The present study was conducted on 72 adult human cadaveric lungs comprising 36 right lungs and 36 left lungs obtained from routine dissection specimens in the Department of Anatomy. Both right and left lungs were studied irrespective of sex. Each lung was examined grossly for the morphology of pulmonary fissures. The oblique and horizontal fissures were observed for their presence, completeness, incompleteness, or absence. Accessory fissures, if present, were also noted. The findings were recorded systematically and compared with standard anatomical descriptions and previous studies.

RESULTS

In the right lungs, the horizontal fissure was complete in 22 specimens (61.11%), incomplete in 10 specimens (27.78%), and absent in 4 specimens (11.11%). The oblique fissure was complete in 28 specimens (77.78%) and incomplete in 8 specimens (22.22%), with no absent oblique fissures observed. In the left lungs, the oblique fissure was complete in 27 specimens (75%) and incomplete in 9 specimens (25%). No absent oblique fissure was noted on the left side. [Chart No.1]

Based on the Craig and Walker classification, the right oblique fissure was Grade I in 28 specimens (77.78%), Grade II in 4 specimens (11.11%), and Grade III in 4 specimens (11.11%). The right horizontal fissure showed Grade I in 22 specimens (61.11%), Grade II in 5 specimens (13.89%), Grade III in 5 specimens (13.89%), and Grade IV in 4 specimens (11.11%). The left oblique fissure was Grade I in 27 specimens (75%), Grade II in 4 specimens (11.11%), and Grade III in 5 specimens (13.89%). [Chart No.2]

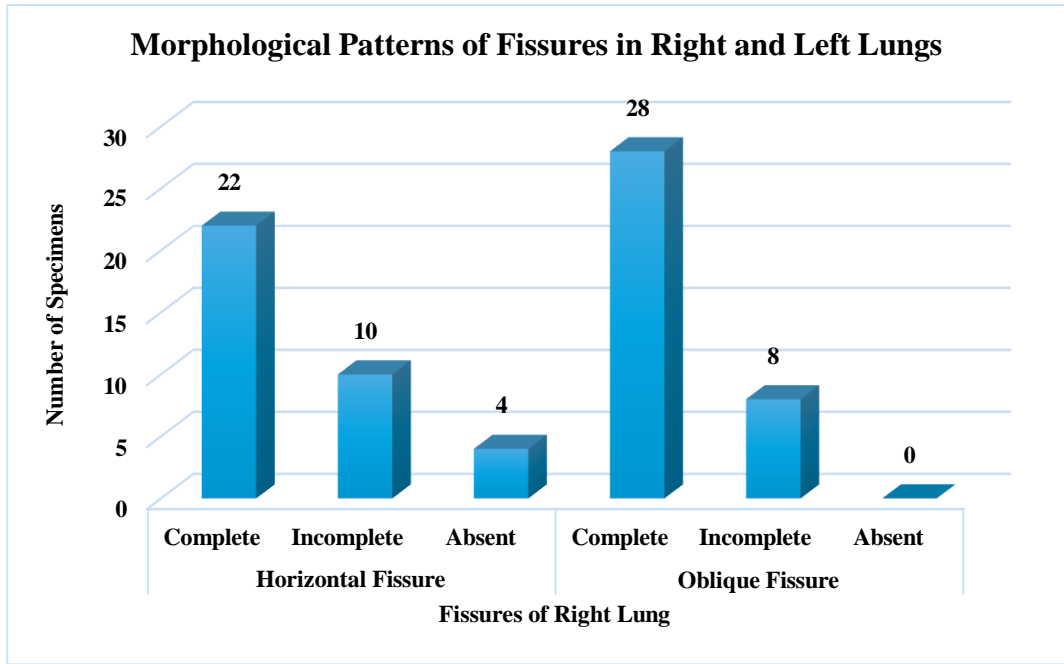


Chart No.1: Morphological Patterns of Fissures in Right and Left Lungs

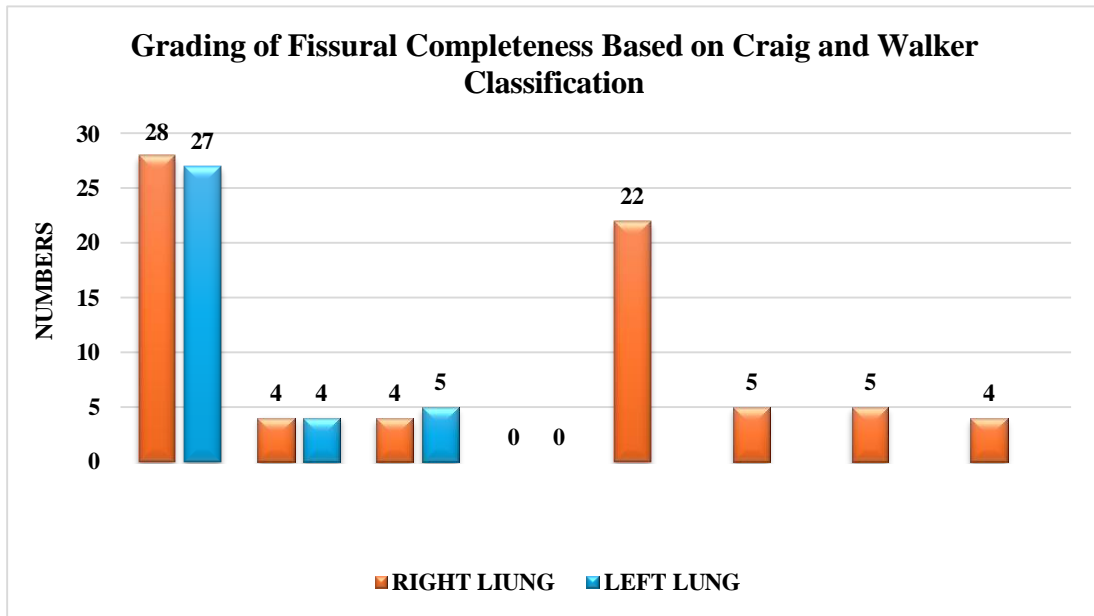


Chart No.2: Grading of Fissural Completeness Based on Craig and Walker Classification

Accessory fissures were infrequently observed. Inferior accessory fissure was present in 1 specimen (2.78%) and absent in 35 specimens (97.22%). Superior accessory fissure, left minor fissure, and azygos fissure were not observed in any specimen. Overall, complete fissures were more common than incomplete fissures in both lungs, while accessory fissures were rare findings in the present study. [Chart No.3]

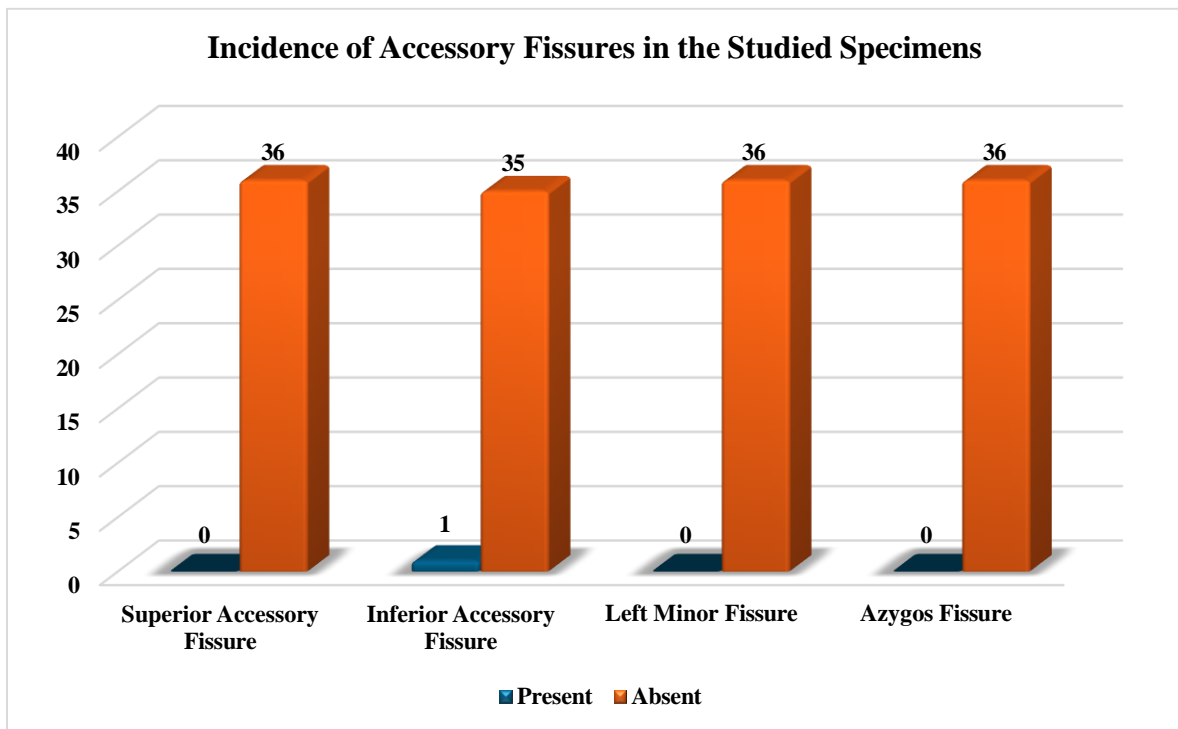


Chart No.3: Incidence of Accessory Fissures in the Studied Specimens

DISCUSSION

The present cadaveric study demonstrated that variations in pulmonary fissures are common anatomical findings, particularly involving the horizontal fissure of the right lung. These variations may arise due to incomplete obliteration of spaces between bronchopulmonary buds during embryological development and are of considerable anatomical and clinical importance.

In the present study, the right horizontal fissure was complete in 61.11% of specimens, incomplete in 27.78%, and absent in 11.11%. The horizontal fissure showed the greatest degree of variability among all fissures studied. Similar findings were reported by Lakshmi Kumari

K. et al., who observed absence of the horizontal fissure in 15.6% of specimens, and by Mamatha H. et al., who documented incomplete horizontal fissures in 50% and absent fissures in 20% of lungs.

[4,5] These observations support the concept that the horizontal fissure is developmentally more variable than the oblique fissure. Incomplete or absent horizontal fissures may alter the normal pattern of lobar collapse and influence the spread of infections or malignancies between lobes.

The right oblique fissure was complete in 77.78% and incomplete in 22.22% of specimens, with no absent fissures noted. Similar observations were reported by Naveen Kumar et al., who demonstrated Grade II fissural patterns in 15% of specimens, and Quadros

L. S. et al., who also identified frequent variations in

fissural completeness? The relatively high incidence of incomplete oblique fissures suggests partial fusion of pulmonary lobes during development. [6,7] Clinically, incomplete oblique fissures may complicate surgical separation during lobectomy and increase the risk of postoperative air leakage.

In the left lung, the oblique fissure was complete in 75% and incomplete in 25% of specimens. Bhimai Devi. et al. similarly reported incomplete left oblique fissures in 30% of lungs. [8] Rosse and Gaddum-Rosse described the left oblique fissure as usually complete in classical anatomy; however, the findings of the present study indicate that incomplete left oblique fissures are relatively common anatomical variants rather than rare anomalies. [9] Such variations may affect radiological interpretation and permit interlobar spread of pulmonary disease.

According to the Craig and Walker classification, Grade I fissures constituted most specimens in the present study, indicating predominance of complete fissures. However, Grade II and Grade III fissures were also observed in both lungs, particularly involving the horizontal fissure. Grade IV fissures were observed only in the right horizontal fissure, corresponding to complete absence of the fissure. These findings are consistent with previous cadaveric studies and reinforce the usefulness of the Craig and Walker classification in assessing fissural completeness.

Accessory fissures were infrequently observed in the present study. Inferior accessory fissure was

identified in only 2.78% of specimens, while superior accessory fissure, left minor fissure, and azygos fissure were absent. Similar findings were reported by Sanjeev K. et al., who observed inferior accessory fissures in 5% of specimens. ^[10] In contrast, Prakash et al. reported a higher incidence of superior accessory fissures, suggesting regional and population- based differences in pulmonary morphology. ^[11] Although uncommon, accessory fissures are clinically significant because they may mimic pathological shadows on radiographs and CT scans or produce unusual patterns of disease spread. The findings of the present study confirm that pulmonary fissural variations are common in adult cadaveric lungs. Knowledge of these variations is essential for anatomists, radiologists, and thoracic surgeons to ensure accurate interpretation of imaging findings and to facilitate safe and effective surgical procedures involving the lungs.

CONCLUSION

The present cadaveric study demonstrated that variations in pulmonary fissures are common anatomical findings, with the horizontal fissure of the right lung showing the greatest variability. Incomplete fissures were more frequently observed than absent fissures, while accessory fissures were relatively rare. The study also showed that complete fissures constituted most specimens according to the Craig and Walker classification.

Knowledge of these fissural variations is important for anatomists, radiologists, and thoracic surgeons, as they may influence radiological interpretation, interlobar spread of disease, and surgical procedures such as lobectomy and segmentectomy. Recognition of such variations can help reduce diagnostic errors and operative complications.

Further studies with larger sample sizes and radiological correlation using CT imaging are recommended to better understand population-based variations in pulmonary fissures and their clinical significance.

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How to cite this article: Dr. Lathi Kumari.K, Dr. Rathisha.S, MORPHOLOGICAL STUDY OF PULMONARY FISSURES AND THEIR ANATOMICAL VARIATIONS IN ADULT CADAVERIC LUNGS, *Asian J. Med. Res. Health Sci.*, 2026; 4 (2):1477-1481.
Source of Support: Nil, Conflicts of Interest: None declared.