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Original Research

A Study of Morphological Characteristics of Lung Fissures and Lobes in the Indian Population

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ABSTRACT

Objective: The morphology of lung fissures and lobes influences the interpretation of radiological test results as well as the path of action in cardiothoracic surgical operations. The goal of this research is to evaluate the morphological characteristics of lung fissures.

Materials and Methods: A total of 80 (40 of each side, left and right) cadaveric lungs were included in the study carried out in the dissection hall at the Department of Anatomy, RNT Medical College, Udaipur, Rajasthan, India. Morphological features of lung fissures and lobes were noted. The presence of any accessor fissures was also recorded.

Results: Out of 40 right lungs, the horizontal fissure was absent in 8 lungs (20%) and incomplete in 20 lungs (50%). A complete horizontal fissure was seen in 12 lungs (30%). Oblique fissures were absent in six lungs (15%) and incomplete in 18 lungs (45%). A complete oblique fissure was reported in 16 lungs (40%). Incomplete oblique fissures were seen in 22 (55%) of the 40 left lungs, while full oblique fissures were found in 16 (40%). In two lungs (5%), the oblique fissure was absent. Superior Accessory Fissure and Inferior Accessory Fissure were detected in four (10%) and six (15%) of the forty right lungs, respectively. Superior Accessory Fissure, Inferior Accessory Fissure, and Left Minor Fissure were found in 2 lungs (5%), 2 lungs (5%), and 8 lungs (20%), respectively, out of 40 left lungs.

Conclusion: The knowledge of variations in the morphology of fissures is very helpful for cardiothoracic surgeons while performing segmental resection. It is also helpful for the radiologists and clinicians to make the correct diagnosis and to plan and modify the surgical procedures.

Keywords: Cadaver; Anatomy; Morphology; Lung Fissures; Lobes.

INTRODUCTION

Lungs are essential paired respiratory organs situated on either side of the heart in the thoracic cavity. Each lung is free in its pleural cavity except for its attachment to the trachea and heart at the hilum and pulmonary ligament, respectively. The division of the right lung is into superior, middle, and inferior lobes by its major (oblique) and minor (horizontal) fissures. The major fissure of the right lung extends obliquely from the hilum, crossing the inferior border of the lung roughly 7.5 cm behind its anterior end, whereas the horizontal fissure cuts the oblique fissure near the mid-axillary line and separates the superior and middle lobes at the level of the fourth costal cartilage. The left lung is divided into superior and inferior lobes by an oblique fissure. These fissures are called complete when the lobes are separated only at hilum, and they are designated incomplete when parenchyma is continuous and fissures do not reach hilum.[1] During respiration, these fissures make the expansion of the lung lobes easier in relation to one another.

The division of the lung bud gives rise to bronchopulmonary segments that are surrounded by splanchnopleuric mesenchyme. The sequential division and growth cause space obliteration, resulting in the fusion of these segments. All the parenchyma that is progeny of a lobar bronchus is separated from adjoining bronchus by splanchnic mesenchyme that will form visceral pleura, separating the lobes at two planes, forming two fissures (oblique and horizontal)

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in the right lung with the consequent formation of three lobes and only one oblique fissure in the left lung, dividing it into two lobes.[2]

The presence of a variant fissure can be due to a partial or complete failure of obliteration of these fissures that causes the formation of accessory lobes or results in absent lobes and fissures.[3] The knowledge of the location of fissures in the normal lungs and their position during normal breathing make reliable landmarks in identifying lesions within the thorax in general and within the lungs in particular.

Morphological knowledge of fissures and lobes of the lungs is important for radiologists in the interpretation of MRI and CT scans.[4] It is essential for cardio-thoracic surgeons to be aware of the variations in morphology of the lungs in order to plan lobectomies and segmental resections effectively.[5,6] Consequently, in light of the aforementioned statements, the present study was conducted to investigate the morphological characteristics of the lungs.

MATERIALS AND METHODS

A cross-sectional study was conducted in the Department of Anatomy, RNT Medical College, Udaipur, Rajasthan, India, from January 2020 to September 2021. Following ethical clearance, the data was collected according to the classification of lung fissures proposed and identified by Craig and Walker[7] (Table 1). The specimens with pathological lesions, marks of previous surgery, and those that were damaged during removal were excluded from the study.A total of 80 (40 of each side, left and right) cadaveric lungs from the dissection room were examined and studied. Data was entered and analysed using SPSS 22.0. Descriptive analysis was applied by using frequencies and percentages for qualitative variables.

RESULTS

A morphological study was conducted on 80 specimens of lungs (40 on each side, left and right) from cadavers. The specimens were observed and categorised according to Craig and Walker's classification.[7] Out of these 80 lung specimens, 60 (75%) presented with incomplete fissures. It was observed that 40 (50%) out of 80 lungs exhibited incomplete oblique pulmonary fissures, and out of these, 18 (22.5%) were found in the right lungs and 22 (27.5%) were present in the left lungs (Figure 1), whereas the incidence of incomplete horizontal fissures in the right lungs was 20 (25%) (Figure 2). [Table 2].

Out of 40 right lungs examined, Superior Accessory Fissure (SAF) was present in 4 lungs (10%) (Figure 3), whereas Inferior Accessory fissure (IAF) was present in 6 lungs (15%) (Figure 4). Out of 40 left lungs examined SAF and IAF were present in 2 lungs (5%) each. Left Minor Fissure (LMF) was present in 8 lungs (20%) (Figure 5) (Table 3).

These observations are of academic interest for the anatomists and are of clinical importance to surgeons and radiologists.

Figure 1: Incomplete oblique fissure of left lung.

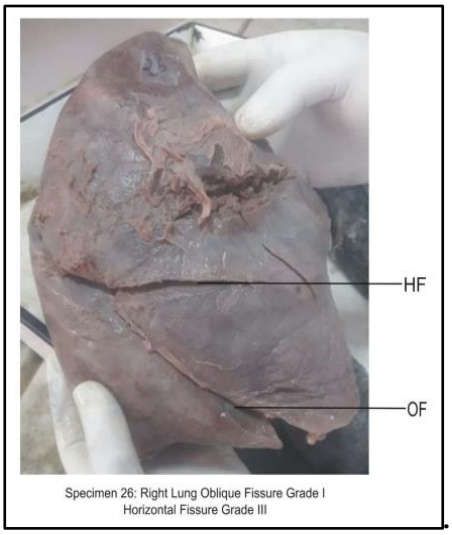

Figure 2: Incomplete horizontal fissure of right lung

Figure 3: Superior Accessory Fissure (SAF)

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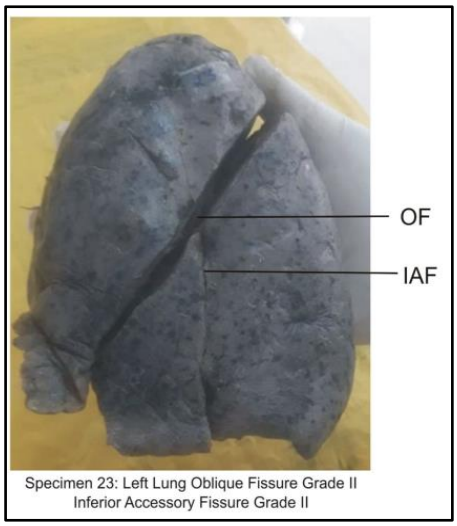

Figure 4: Inferior Accessory fissure (IAF).

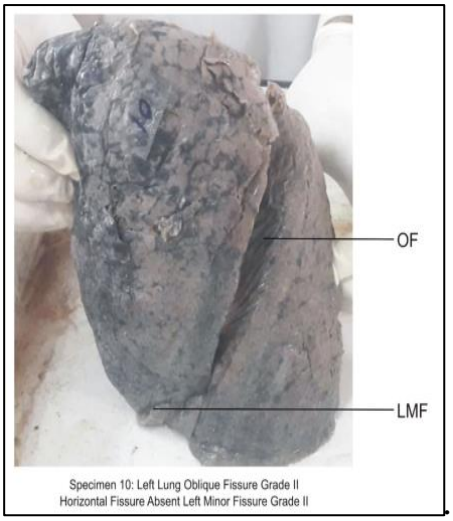

Figure 5: Left Minor Fissure (LMF)

Table 1: Craig and Walker grading of lung fissures.[7]

Grade	Description
I	Complete fissures (unite the lung lobes at hilum only)
II	Incomplete fissures (parenchymal fusion at the base of the lung)
III	Incomplete fissures (some part of the cleft is visible only)
IV	Absent fissures (complete fusion of lobes)

Table 2: Incidence of oblique and horizontal fissures of lungs based on Craig and Walker classification.

Lung	Fissures	Grade I		Grade II		Grade III		Grade IV	
		No.	%	No.	%	No.	%	No.	%
Right (n=40)	Oblique	16	40	10	25	8	20	6	15
	Horizontal	12	30	2	5	18	45	8	20
Left (n=40)	Oblique	16	40	16	40	6	15	2	5
	Horizontal	-	-	-	-	-	-	-	-

Table 3: Incidence of accessory fissures of lungs based on Craig and Walker classification.

Lung	Fissures	Grade I		Grade II		Grade III		Grade IV	
		No.	%	No.	%	No.	%	No.	%
Right (n=10)	SAF	--	--	4	10	--	--	--	--
	IAF	--	--	2	5	4	10	--	--
Left (n=12)	SAF	--	--	2	5	--	--	--	--
	IAF	--	--	2	5	--	--	--	--
	LMF	--	--	6	15	2	5	--	--

DISCUSSION

An understanding of normal anatomy and its variations forms the foundation of surgery. If the process of normal lung development gets compromised, then incomplete or accessory fissures and lobes are formed.[8,9]

The present study was conducted on 80 formalin-fixed lung specimens (40 right and 40 left) from cadavers to identify the variations of the fissures and lobes of lung specimens. It was found that the incidence of incomplete oblique fissures was 40%, with a prevalence of left-sided incomplete fissures of 27.5%. This is in accordance with the studies of Meenakshi et al. (2004)[10], Prakash et al. (2010)[11], and Wahengbam et al. (2019).[12] Vasuki and colleagues found 50% prevalence in cadavers from Tamil Nadu, India.[13] Kc and associates did their study in Nepali cadavers, which revealed 51.85% incidences of incomplete oblique fissures in the left lungs[14], whereas George and his fellow workers reported 15.06% incidences of oblique fissures in the left lungs in Indian cadavers (Table 4).[15]

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Table 4: Showing comparison of oblique and horizontal fissure by previous authors.

References	Right Lung				Left Lung	
	Oblique Fissure		Horizontal Fissure		Oblique Fissure	
	Incomplete	Absent	Incomplete	Absent	Incomplete	Absent
Medlar, (1947) [16]	25.60%	4.80%	62.30%	-	10.60%	7.30%
Lukose et al. (1999) [17]	-	-	21%	10.50%	21.00%	-
Meenakshi et al. (2004) [10]	36.60%	-	63.30%	16.60%	46.60%	-
Prakash et al. (2010) [11]	39.30%	7.10%	50.00%	7.10%	35.70%	10.70%
Nene et al.(2011) [18]	6.00%	2.00%	8.00%	14.00%	12.0%	0.00%
Quadros et al. (2014) [19]	5.55%	0.00%	25.00%	11.11%	2.50%	0.00%
George et al. (2014) [20]	3.07%	0.00%	35.38%	23.05%	5.06%	0.00%
Wahengbam et al. (2019) [12]	42.86%	7.14%	61.90%	19.05%	40.54%	2.70%

Table 5: Showing comparison of accessory fissure by previous authors.

References	Right Lung		Left Lung		
	SAF	IAF	SAF	IAF	LMF
Nene et al. (2011) [18]	4.00%	14.00%	0.00%	24.00%	26.00%
Quadros et al. (2014) [19]	8.33%	5.55%	0.00%	5.00%	17.50%
Wahengbam et al. (2019) [12]	7.14%	21.43%	2.70%	43.24%	29.73%

Absent horizontal fissure is found in 20% of cases of right lungs in the present study. There was no absent horizontal fissure found in the study of Medlar.[16]

In the left lung, horizontal fissures were not found in any of the studies. It is absent in the present study as well. Whereas the incidence of incomplete oblique fissures in the left lung is higher than that in the right lung, i.e., 55%, this is the highest percentage among all studies. An absent oblique fissure was reported in 5% of cases in the left lung in the present study. There were no cases of absent oblique fissures seen in the study done by George et al.[20] and Quadros et al.[19] In patients with incomplete fissures, pneumonia may spread to adjacent lobes through these incomplete fissures. Similarly, carcinoma of the lung may involve odd lobes via an incomplete fissure. They are also prone to developing air leaks.

In the present study, accessory fissures are found in both the right and left lung, with a higher incidence in the left than in the right lung. Left minor fissure was present in 20% of cases in the present study as compared to Quadros et al.[19], where it was 17.5% and 26% in Nene et al.[18]

The incidence of accessory fissures in the right lung is higher in the present study than in previous studies, except for the study conducted by Wahengbam et al.[12], which is 28.57%.

Its incidence in the present study is 25%, whereas it is 14% in the study conducted by Quadros et al.[19] In the left lung, its incidence is 30% in the present study, whereas it was 50% in the study conducted by Nene et al.[18] and 75.67% in the study conducted by Wahengbam et al.[12], which is much higher. In the study conducted by Quadros et al.[19], its incidence was 22.5%, which is lower than the present study.

Accessory lobes and fissures can be misinterpreted on X-rays and CT scans. They can also be confused with certain clinical conditions like linear atelectasis, pleural scars, and walls of bullae (Table 5).[12,18,19] Often, these accessory fissures act as a barrier to the spread of infection, creating sharply marginated pneumonia.

CONCLUSION

The knowledge of variations in the morphology of a fissure is very helpful for cardiothoracic surgeons while performing segmental resection. It is also helpful for the radiologists and clinicians to make the correct diagnosis and to plan and modify the surgical procedures. Recognition of lung anomalies improves understanding of pneumonia, pleural effusion, and collateral air drift, along with disease spreading through the lung as seen by imaging techniques.

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