



ORIGINAL RESEARCH PAPER

Anatomy

VARIATIONS OF FISSURES AND LOBES OF HUMAN LUNGS – A CADAVERIC STUDY

KEY WORDS: Fissures, lobes, oblique, horizontal, accessory.

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ABSTRACT	Background – Both the human lungs are divided into lobes by fissures and the knowledge of this lobar anatomy, along with its variation, is important for both radiologist for C.T scan interpretation and surgeons for performing lobectomy.
	Aim – To study the incidence of variation in lung fissures, grade it and study the presence of any accessory lobes.
	Method – 100 formalin hardened human lungs were studied for the presence of any variation in the fissure, classified according to Craig and Walker criteria and presence of any accessory fissures or lobes were noted.
	Result – Incomplete oblique fissure were seen in 36% of right and 24% of left lung; incomplete horizontal fissure in 38% of right lung; absence of oblique fissure was noted in 6% and 2% of right and left lung respectively. 12% showed absent horizontal fissure in right lung. Accessory fissure was seen in 6% of left lungs.
	Conclusion – Variations in lung fissures are relatively common. This knowledge is important for surgeons and cardiothoracic surgeons while performing lobectomy in order to reduce the mortality and morbidity arising out of invasive procedures. Radiologist must be aware of presence of accessory lobes or fissures as this may lead to mis-interpretation of C.T scan.

INTRODUCTION–

Lungs are the essential organ of respiration and invaginate into corresponding pleural sac. Whereas the Right lung presents two fissures: oblique and horizontal, dividing it into superior, middle, and inferior lobes; the Left lung has only one fissure: oblique, dividing it into two lobes - superior and inferior [1].

Fissures may be of three types- complete, incomplete or accessory. When the lobes remain held together only by means of bronchi and pulmonary vessels then they are called complete fissures, whereas incomplete fissures present areas of parenchymal fusion between the lobes. They may be absent altogether [2]. Cleft of varying depth lined by visceral pleura, is anatomically accounted as accessory fissure, which usually occurs at the boundaries of the broncho-pulmonary segments. Radiologically, it appears as thin white line, resembling the major or minor fissure, except for its location [3].

Knowledge of anatomical variations of fissures and lobes of lung is necessary for proper appreciation of lobar anatomy and to locate the broncho-pulmonary segments and thus helping the radiologists to interpret X-rays and CT scans and surgeons to perform lobectomies as a treatment of various lung diseases.

MATERIALS AND METHODS – The present study was carried out among 100 formalin fixed human lung specimens [50 right, 50 left], obtained from the museums of different West Bengal based medical colleges after taking proper ethical permission from concerned ethics committee. Specimens were studied on the basis of the followings –

1. Degree of completeness of fissures proposed by Craig and Walker² [Table-1]

TABLE- 1. GRADING OF COMPLETENESS OF FISSURE [Craig and Walker criteria]

Grades	Craig and Walker criteria for completeness of fissure
Grade 1	Complete fissure with entirely separate lobes
Grade 2	Complete visceral cleft but parenchymal fusion at the base of the fissure
Grade 3	Visceral cleft evident for part of the fissure
Grade 4	Complete fusion of the lobes with no evident fissural line

2. Whether there any accessory fissures/lobes present or not.

3. EXCLUSION CRITERIA – pathological lesions, having marks of previous surgery, damaged specimens were not studied. Age and gender were not identified.

RESULT – In the present study, incidence of incomplete oblique and horizontal fissure were 36% and 38% (fig-3) accordingly among the right lungs, compared to 24 % of incomplete oblique fissure among the left lungs. 2% of left lung (fig-5) and 6% of right lung (fig-2) had no oblique fissure, whereas 12% of right lung (fig-1) showed absence of horizontal fissure. In this study, accessory fissures were present in 3 left lungs [6%, fig- 4] and all were placed inferiorly [Table 2].

TABLE 2 – INCIDENCE OF ANATOMICAL VARIATIONS OF FISSURES IN RIGHT AND LEFT LUNGS

Types of fissure	Completeness of fissure	Right lung N = 50	Left lung N = 50
Oblique fissure	Complete	29	37
	Incomplete	18	12
	Absent	03	01
Horizontal fissure	Complete	25	-
	Incomplete	19	-
	Absent	06	-
Accessory fissure		00	03

Incidence of oblique and horizontal fissure according to Craig and Walker's criteria was shown in Table 3.

TABLE 3 – INCIDENCE OF OBLIQUE AND HORIZONTAL FISSURE ACCORDING TO CRAIG AND WALKER'S CRITERIA

Lung	Fissure	Grade 1	Grade 2	Grade 3	Grade 4
Right N = 50	Oblique	29	00	18	03
	Horizontal	25	12	07	06
Left N = 50	Oblique	37	07	05	01

DISCUSSION – At about 28 days after fertilization, as an endodermal diverticulum lung develops. Right and left primary bronchi are the result of bifurcation of lung bud [4]. During the early phase of 5th week of intrauterine life, the right bronchial bud branches into three and the left bronchial bud branches into two secondary bronchial buds. By 6th week of development secondary

bronchial buds branch into tertiary bronchial buds to form bronchopulmonary segments [5]. Lung fissures separate individual bronchopulmonary segments in prenatal life. After that all fissures gradually get obliterated except the fissures along the inter-lobar planes, which persist and give rise to major [oblique] and minor [horizontal] fissures. Obliteration of these prenatal fissures partially or completely is responsible for incompleteness or absence of lung fissures. There is partial fusion between lobes where incomplete fissures are present. Non obliteration or persistence of prenatal fissures results in development of accessory fissures and lobes. Any variation in the morphological pattern of fissures is responsible for the variations of normal pattern of development of lung [6].

The present study showed presence of incomplete oblique fissures 36% on the right lungs which was nearly similar to the findings of

the study done by Meenakshi S et al[2] in 2004 and Prakash et al[7] in 2010, whereas incidence of incomplete oblique fissures on the left lung was 24% in our study and 21% in the study done by Lukose R et al[8] in 1999. In the present study, oblique fissures were absent more on the right lung [6%] than the left lung [2%]. 38% of right lungs showed incompleteness of horizontal fissure which was much less than the studies done by Bergman R A et al [9]. Incidence of absent horizontal fissures [12%] of this study was comparable with the study done by Magadum A et al [10] in 2015[12.5%]. In the present study, accessory fissures were found only on three left lungs [6%] which were present inferiorly whereas Arora A K et al [11] and Quadros L S et al [12] in 2012 observed accordingly 7.3% and 22.5% of accessory fissures on left lung.

Table 4 shows wide variations among different studies which may be due to the regional variations.

TABLE – 4 ; COMPARATIVE INCIDENCE OF VARIATIONS OF LUNG FISSURES

AUTHORS	YEAR	RIGHT LUNG OBLIQUE FISSURE		RIGHT LUNG HORIZONTAL FISSURE		LEFT LUNG OBLIQUE FISSURE	
		INCOMPLETE	ABSENT	INCOMPLETE	ABSENT	INCOMPLETE	ABSENT
Lukose R et al[8]	1999	-	-	21%	10.5%	21%	-
Meenakshi S et al[2]	2004	36.6%	-	63.3%	16.6%	46.6%	0%
Bergman RA et al[9]	2010	30%	-	67%	21%	30%	-
Prakash et al[7]	2010	39.3%	7.1%	50%	7.1%	35.7%	10.7%
Nene AR et al[13]	2011	6%	2%	8%	14%	12%	0%
Magadum A et al[10]	2015	60%	10%	52.5%	2.5%	42.5%	7.5%
Arora AK et al[11]	2012	20%	0%	27.2%	9%	11%	7.3%
Quadros LS et al[12]	2014	2%	0%	9%	4%	1%	0%
Present Study	2018	36%	6%	38%	12%	24%	2%

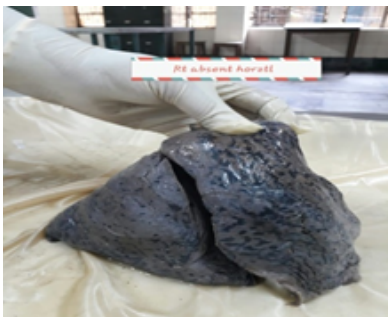


Fig1 shows absent horizontal fissure in right lung



Fig4 shows accessory fissure in left lung



Fig2 shows absent oblique fissure in right lung



Fig5 shows absent oblique fissure in left lung



Fig3 shows incomplete horizontal fissure of right lung

CONCLUSION – Importance of knowing the frequency and different variations of lung fissures lies on different invasive thoracic surgical procedures. Surgeons must be aware of pattern of lobes and fissures of lung in order to avoid and reduce the mortality and morbidity associated with those invasive procedures. Knowledge of lobes and accessory fissures are of great significance to cardiothoracic surgeons during pulmonary lobectomy or segmental resections. Accessory fissures can be mistakenly confused with various lung lesions like linear atelectasis, pleural scars or walls of bullae [14] and radiologists must be aware of that.

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