



## Original Research Article

## Types of pulmonary fissures and its surgical implications: A cadaveric study

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## ABSTRACT

**Introduction:** Being the essential organs of respiration, pair of lungs are situated on either side of the mediastinum. Each lung is divided into lobes by the fissures. These fissures allow for proper expansion of lungs and on the other hand fissures may have a role in restricting infection to a particular lobe. Fissures may be complete, incomplete or absent.

**Objective:** To study the variations in the fissures of lung, compare the results with the available data and to discuss the surgical importance of this study.

**Materials and Methods:** 37 pairs of lungs (37 right and 37 left) from formalin fixed cadavers were observed and classified into different grades of fissures (as per Craig and Walker criteria). Presence of accessory fissures was noted.

**Results:** Out of the 37 right lungs, 3 showed absence of horizontal fissure and the same fissure was incomplete in right sided 17 lungs. Among the left lungs, 9 had incomplete oblique fissure. Accessory fissure were found in 2 right and 1 left lungs.

**Conclusion:** The current study showed that right lung may be without horizontal fissure or fissures may be incomplete. Thus, a light on these variations by the cardiothoracic surgeons will help in better planning of surgeries like lobectomy. Knowledge about the fissures will aid in arriving at better diagnosis for the clinicians and radiologists.

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## 1. Introduction

Pair of lungs are the essential organs of respiration, occupying major part of the thoracic cavity and are located on either side of the mediastinum. The medial surface of each lung is connected to the mediastinum by means of various structures which either enter or leave the lung. The right lung has oblique (major) and horizontal (minor) fissures, by which it is divided into superior, middle and inferior lobes. The left lung has oblique fissure only, which divides it into superior and inferior lobes.<sup>1</sup> Presence of fissures allows for better accommodation of the lungs and uniform expansion of the lobes during their movement.<sup>2</sup>

The right oblique fissure runs in oblique path, cuts the inferior border of lung, at about 7.5cm behind the anterior

end. The horizontal fissure, runs horizontally from the oblique fissure and crosses the anterior end, behind the fourth costal cartilage.<sup>3</sup>

The oblique fissure of the left lung begins from the posterosuperior aspect of the hilum, runs upwards and backwards, to cut the posterior border at about 6cm below the apex, then proceeds downwards and forwards over the costal surface.<sup>4</sup>

If the lobes are held only at the hilum, such a fissure is called as a complete fissure and it will be an incomplete fissure if there is parenchymal tissue between the lobes.<sup>5</sup> Rarely a fissure may be completely absent.<sup>5</sup> Apart from regularly appearing fissures, lungs may show single or multiple accessory fissures, due to which a lung may have more than the normal number of lobes.<sup>6</sup>

Some of the usually found accessory fissures are, superior, inferior and left minor accessory fissures.<sup>4</sup>

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Accessory fissure is an inconsistent cleft of ill-defined depth, with linings of visceral pleura. Such an accessory fissure may be complete or incomplete.<sup>7</sup>

During the developmental stage, the bronchopulmonary segments are separated from each other by several fissures. But as the growth proceeds, many fissures get obliterated and only the oblique and horizontal fissures will persist.<sup>8</sup> But the non obliteration of the remaining embryonic fissures, results in accessory fissures.<sup>9</sup> The variations in the number or completeness of the fissures is due to variations in developmental pattern of the lungs.<sup>10</sup> By the early part of sixth week of intrauterine life, the differences between the right and left pulmonary lobes will be evident and the bronchopulmonary tree and fissures will be apparent by fourteenth week.<sup>11</sup>

A detailed anatomy of the fissures and lobes is an essential part of preoperative planning of lobectomy or segmental resection of the lung, as an incomplete fissure may be a reason for postoperative air leakage.<sup>12</sup> The knowledge of accessory fissure is a must for the clinicians during the segmental localization of the diseases. An accessory fissure appears like pleural effusion in X ray films. Such accessory fissures may remain unidentified in CT scans.<sup>13</sup>

Owing to the surgical and clinical importance of need of, the detailed anatomy of the fissures and lobes of the lungs, the current study has been carried out for the morphological variations of the fissures.

## 2. Materials and Methods

Specimens used are 37 pairs of lungs (37 right and 37 left) from formalin fixed cadavers in Department of Anatomy KIMS Koppal, Karnataka. Each lung is observed for the number and morphology of fissures. Presence of any accessory fissure is noted. The fissures were classified into different grades (as per Craig and Walker criteria). Numbers of lobes of the lungs are noted as determined by the presence or absence of fissures.

## 3. Results

Incidence of horizontal and oblique fissures is mentioned in Table 2.

Out of the 37 right lungs, 2 lungs showed superior accessory fissure and we didn't find inferior accessory fissure. Only 1 of the left lung showed inferior accessory fissure among 37 left lungs.

## 4. Discussion

Fissures of the lung divide them into lobes. The oblique fissure, present in both lungs, divides the upper from lower lobe. It extends anteroanteriorly from the posterior end of 4<sup>th</sup> rib (spinous process of T3 vertebra), cuts the 5<sup>th</sup> rib at the midaxillary line, runs inferiorly to cross the 7<sup>th</sup> rib on



Fig. 1: Left lung with accessory fissure



Fig. 2: Right lung with absence of Transverse fissure

right or 5<sup>th</sup> rib on left over the midclavicular line (about 7–8cm from the midline). Roughly the oblique fissure follows the medial border of scapula when the upper limb is in full abduction.<sup>1</sup> The left oblique fissure is slightly vertical than the right. The horizontal fissure, present in the right lung, divides the upper and middle lobes. This fissure begins from the right 4<sup>th</sup> costal cartilage at the level of right sternal border, runs horizontally towards right side to meet the oblique fissure.<sup>1</sup>

**Table 1:** Grading of fissures (Craig and Walker Criteria)<sup>14</sup>

| Grades  | Craig and Walker criteria of completeness of fissures                     |
|---------|---|
| 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                |

**Table 2:** Classification of fissures as per Craig and Walker criteria

| Lung side  | Type of fissure | Grade 1 | Grade 2 | Grade 3 | Grade 4 |
|------------|-----------------|---------|---------|---------|---------|
| Right lung | Oblique         | 24      | 09      | 04      | 00      |
|            | Horizontal      | 17      | 10      | 07      | 03      |
| Left lung  | Oblique         | 28      | 03      | 06      | 00      |

**Fig. 3:** Right lung with accessory fissure

The incidence of the incomplete oblique fissure in current study is 35%, which is less than that reported by Azmera et al<sup>15</sup> (47.82%) and Amit<sup>16</sup> et al (60%). But the incidence is similar to that reported by Meenakshi et al<sup>17</sup> (36.6%). One of the study concludes the absence of horizontal fissure in 14% of right side lungs.<sup>17</sup> Whereas, we have identified 3 lungs (8.1%) with absence of horizontal fissure and we report an incidence of incomplete horizontal fissure of 45%.

Lukose et al,<sup>18</sup> studied 100 lungs (50 right and 50 left) for the variations in fissures and lobes and reported that, horizontal fissure was absent in 10.5% and was incomplete

**Fig. 4:** Right lung with complete oblique fissure

in 21% of the specimens.

Table 3 shows the comparison of the results of studies done by different authors and the results of the current study.

During lobectomy surgeries, surgeons need to ligate the pulmonary vessels and the bronchi, through the depth of the fissure. In case of an incomplete fissure, the lung parenchyma needs to be dissected for ligating the vessels and the bronchi; this may result in hemorrhage or post operative complications.<sup>4</sup>

Along with allowing for normal expansion of the lungs, the fissures can be used as a landmark for specifying the lesions in the thorax and also the lesions particular to the lungs. An incomplete fissure may be the reason for altering

**Table 3:** Comparison of the Variations in fissures of lungs by different authors with current study

| Authors and Year of Publication | Right lung Oblique fissure |        | Right lung Horizontal fissure |        | Left lung Oblique fissure |        |
|---------------------------------|----------------------------|--------|-------------------------------|--------|---------------------------|--------|
|                                 | Incomplete                 | Absent | Incomplete                    | Absent | Incomplete                | Absent |
| Azmera <sup>15</sup>            | 47.82%                     | 0      | 68.42%                        | 17.39  | 35%                       | 0      |
| Meenakshi <sup>17</sup>         | 36.6%                      | 0      | 63.3%                         | 16.6%  | 46.6%                     | 0      |
| Amit <sup>16</sup>              | 60%                        | 10%    | 52.5%                         | 12.%   | 42.5%                     | 7.5%   |
| Prakash <sup>19</sup>           | 39.3%                      | 7.1%   | 50%                           | 7.1%   | 35.7%                     | 10.7%  |
| Medlar <sup>20</sup>            | 25.6%                      | 4.8%   | 62.3%                         | 0      | 10.6%                     | 7.3%   |
| Lukose <sup>18</sup>            | 0                          | 0      | 21%                           | 10.5%  | 21%                       | 0      |
| Divya <sup>21</sup>             | 10.7%                      | 0      | 50%                           | 21.4%  | 14.8%                     | 7.4%   |
| Current study                   | 35%                        | 0      | 45.94%                        | 8.1%   | 24.32%                    | 0      |

**Fig. 5:** Right lung with incomplete oblique fissure

the course of a disease. Pneumonia which should get restricted to a particular lobe, may spread to adjacent lobes in case of an incomplete fissure. The carcinoma of the lung may also affect adjacent lobes via an incomplete fissure.<sup>6</sup>

Azmera et al<sup>15</sup> did a study on 20 left lungs and Meenakshi et al<sup>17</sup> studied 30 left lungs and reported 35% and 46.6% of incomplete oblique fissure respectively. There was no left lung with absence of oblique fissure. Our study reports an incidence of 24.32 % of incomplete left oblique fissure, which is close to the incident reported by Lukose et al<sup>18</sup> (21%).

**Fig. 6:** Right lung with incomplete transverse fissure

The pattern of the fissures is determined by their embryologic basis of development. Presence of accessory fissures indicates the persistence of embryonic fissures.<sup>2</sup>

The usual pattern of lung collapse may be altered by an accessory fissure, because of which there may be difficulty in diagnosis of a particular lesion. On the other hand, an accessory fissure acts as a barrier for the spread of infection.<sup>4</sup> Out of the 37 pairs of the lungs in our study, 2 lungs showed superior accessory fissure and we didn't find inferior accessory fissure. One of the left lungs showed inferior accessory fissure.

The variations in the results, of the different studies on fissures and lobes of the lungs imply the possibility of environmental and genetic influence on the anatomy of lung fissures.

## 5. Conclusion

Our study concludes with reporting of more incidence of incomplete horizontal fissure, than other fissures. Comparison of this study with the works of the previous authors reveals that, there are differences as far as the incidences of the oblique, horizontal and accessory fissures are concerned. These variations are the answers for atypical presentations of certain lung diseases. Knowledge of such variations might help the radiologists for better radio diagnosis. These results and also the comparative report will help in better understanding of pleural effusion and spread of the disease within the lung parenchyma. The grading of the fissures and their incidence is of immense help for the cardiothoracic surgeons during segmental resection of the lung or during lobectomy.

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## 7. Conflict of Interest

None.

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