



Identification of the Intersegmental Plane of the Lung

Yun Liu^{1,2#} and Songlin Zhang^{1,2**}

¹Department of Cardiothoracic Surgery, The First College of Clinical Medical Science, Three Gorges University, China

²Department of Cardiothoracic Surgery, Yichang Central People's Hospital, China

#Authors Contributed equally

Abstract

Video-Assisted Thoracoscopic (VATS) segmentectomy is a parenchyma-sparing technique, considered an effective treatment for early-stage lung cancer, all these advantages were powerful attraction to both thoracic surgeons and patients. Owing to the key anatomic feature of the intersegmental plane was the segmental boundary, it has aroused the interest of thoracic surgeons, the intersegmental plane was considered to be the ideal cutting plane to separate diseased from healthy lung segments. In fact, inadequate determination and division of the intersegmental plane may lead to unsatisfactory oncological outcomes. Local recurrence after surgical resection was related to the range of safety margin, this margin was defined by guidelines.

Introduction

Thoracic surgeons have invested a lot of energy in developing a series of methods to determine the level of lung segments during the operation. However, the imaging research on the lung intersegmental plane (ISP) cannot content the clinical development, there are few researches on how to determine the intersegmental plane on two-dimensional computed tomography (2D CT) and three-dimensional (3D) reconstruction images, and no attention has been paid to the naming of the intersegmental plane. If the 2D CT and 3D reconstruction images can accurately determine the location of the plane between segments, it was conducive to determine the scope of resection and make accurate preoperative planning. In this study, by analyzing the 2D CT and 3D reconstruction images of patients, combined with the anatomical characteristics of the ISP, we can accurately determine the IPS on the 2D CT and 3D reconstruction images, and try to unify the naming and standardized writing the IPS [1-4].

OPEN ACCESS

ISP Characters

*Correspondence:

Songlin Zhang, Department of Cardiothoracic Surgery, Yichang Central People's Hospital, No.183 Yiling Road, Yichang, Hubei, 443000, China, Tel: 86 717 6488482; Fax: 86 717 6488482;

Received Date: 07 Oct 2024

Accepted Date: 24 Oct 2024

Published Date: 29 Oct 2024

Citation:

Liu Y, Zhang S. Identification of the Intersegmental Plane of the Lung. *World J Surg Surgical Res.* 2024; 7: 1573.

Copyright © 2024 Songlin Zhang. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

In terms of anatomical characteristics, each lung segment was independent, and there was an anatomical boundary between adjacent lung segments, which was called the intersegmental plane. The intersegmental septum consists of three layers, the deep layer was composed of loose connective tissue, the alveolar walls of the two adjacent segments serve as the superficial layers [5]. The ISP contains intersegmental veins, nerves and lymphatic vessels. The intersegmental vein was an indirect marker of the intersegmental boundary, intersegmental vein runs on the intersegmental plane (Figure 1).

2D CT and 3D Reconstruction Imaging Analysis of Right Upper Lobe

Based on the anatomic features of the ISP, we can combine 3D reconstruction image and 2D CT to recognize ISP. Take the right upper lobe as an example, the first step is to identify the segmental veins, which is relatively challenging and requires good memory and spatial imagination. The right upper lobe veins include veins in the apical segment (V1a and V1b), the posterior segment (V2a, V2b, V2c, and V2t), and the anterior segment (V3a, V3b, and V3c). The intersegmental veins (V1b, V2a, V2c) runs on the ISPs, so the second step was to determine the intersegmental veins (V1b, V2a, V2c), the curved surface formed by all the branches of the intersegmental vein is the boundary of the pulmonary segment. On this curved surface, we found that there was no artery or bronchial branch (Figure 2). In thin-slice CT of the lung, the segment boundary was a linear high-density shadow formed by the intersegmental veins (V1b, V2a, V2c) and its branches, which was usually connected to the mediastinum of the lung, and there were no arterial and bronchial branches on the curve (Figures 3 and 4). 3D reconstruction combined with 2D CT can accurately identify the ISPs.

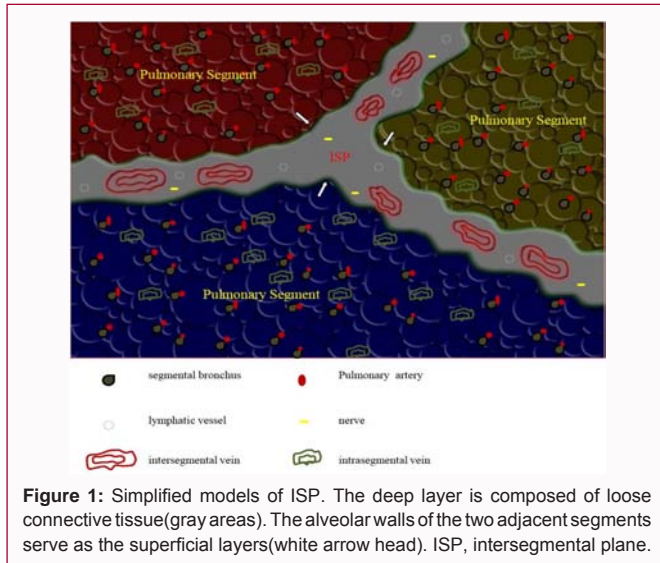


Figure 1: Simplified models of ISP. The deep layer is composed of loose connective tissue (gray areas). The alveolar walls of the two adjacent segments serve as the superficial layers (white arrow head). ISP, intersegmental plane.

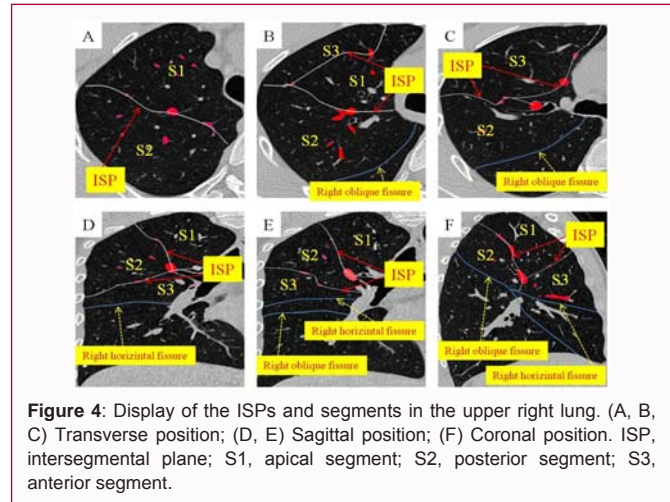


Figure 4: Display of the ISPs and segments in the upper right lung. (A, B, C) Transverse position; (D, E) Sagittal position; (F) Coronal position. ISP, intersegmental plane; S1, apical segment; S2, posterior segment; S3, anterior segment.

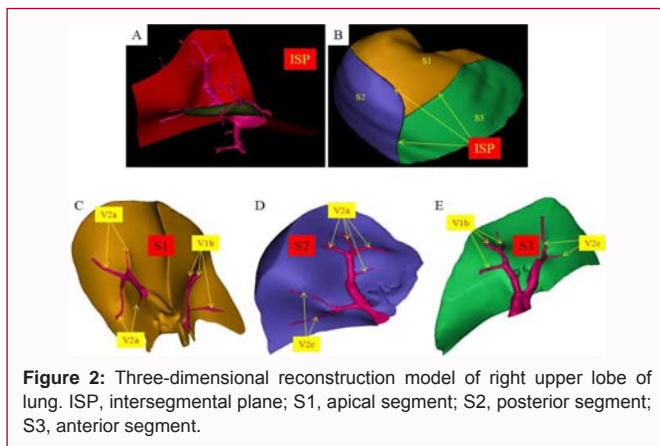


Figure 2: Three-dimensional reconstruction model of right upper lobe of lung. ISP, intersegmental plane; S1, apical segment; S2, posterior segment; S3, anterior segment.

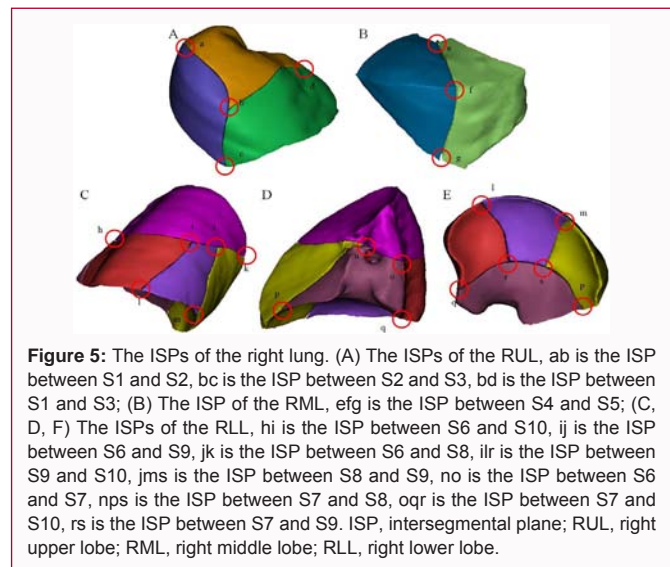


Figure 5: The ISPs of the right lung. (A) The ISPs of the RUL, ab is the ISP between S1 and S2, bc is the ISP between S2 and S3, bd is the ISP between S1 and S3; (B) The ISP of the RML, efg is the ISP between S4 and S5; (C, D, F) The ISPs of the RLL, hi is the ISP between S6 and S10, ij is the ISP between S6 and S9, jk is the ISP between S6 and S8, ilr is the ISP between S9 and S10, jms is the ISP between S8 and S9, no is the ISP between S6 and S7, nps is the ISP between S7 and S8, oqr is the ISP between S7 and S10, rs is the ISP between S7 and S9. ISP, intersegmental plane; RUL, right upper lobe; RML, right middle lobe; RLL, right lower lobe.

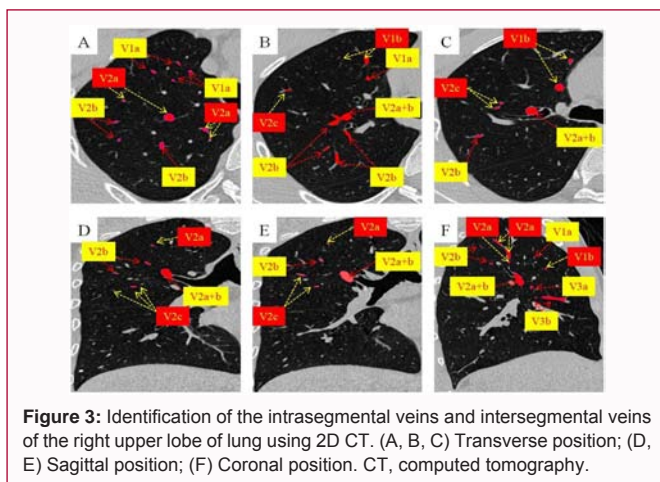


Figure 3: Identification of the intrasegmental veins and intersegmental veins of the right upper lobe of lung using 2D CT. (A, B, C) Transverse position; (D, E) Sagittal position; (F) Coronal position. CT, computed tomography.

Naming and Writing

There were 18 segments in a human lung, the number and verbal description of pulmonary segments are listed (Table 1). There were 21 ISPs in total, the ISPs names and their intersegmental veins were listed (Table 2). To avoid confusion, we modestly proposed that the plane between segments can be named in a unified way worldwide, and unified writing format, it can be expressed as Intersegmental Planes Sa-Sb, abbreviated as ISP: Sa-Sb. For example, the intersegmental

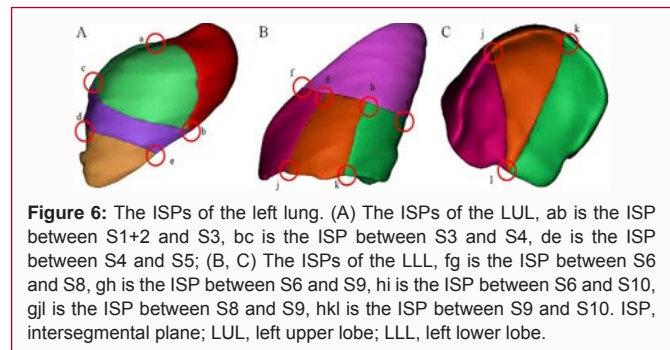


Figure 6: The ISPs of the left lung. (A) The ISPs of the LUL, ab is the ISP between S1+2 and S3, bc is the ISP between S3 and S4, de is the ISP between S4 and S5; (B, C) The ISPs of the LLL, fg is the ISP between S6 and S8, gh is the ISP between S6 and S9, hi is the ISP between S6 and S10, gjl is the ISP between S8 and S9, hkl is the ISP between S9 and S10. ISP, intersegmental plane; LUL, left upper lobe; LLL, left lower lobe.

plane between right upper lobe apical segment and posterior segment can be abbreviated to ISP: RS1-S2. It was simple and clear, it can clearly indicate the plane between the two segments, and it was beneficial to clinical record, annotation and academic exchange (Figures 5 and 6).

Discussion

A clear demarcation of the ISP can provide guidance for tailoring the ISP, necessary to achieve a high success rate of surgical operation. In addition, it can be very helpful in surgical planning, especially if a preoperative study using an 2D CT and 3D reconstructions were routinely performed. To avoid confusion, we modestly propose that

the plane between segments can be named in a unified way worldwide, and unified writing format.

Acknowledgments

Funding

This work was supported by the Medical and Health Research Program (NO. A20-2-015), Science & Technology Bureau of Yichang.

References

1. Zhong C, Fang W, Mao T, Yao F, Chen W, Hu D. Comparison of thoracoscopic segmentectomy and thoracoscopic lobectomy for small-sized stage IA lung cancer. *Ann Thorac Surg.* 2012;94(2):362-7.
2. Zhao X, Qian L, Luo Q, Huang J. Segmentectomy as a safe and equally effective surgical option under complete video-assisted thoracic surgery for patients of stage I non-small cell lung cancer. *J Cardiothorac Surg.* 2013;29:8:116.
3. Schuchert MJ, Pettiford BL, Keeley S, D'Amato TA, Kilic A, Close J, et al. Anatomic segmentectomy in the treatment of stage I non-small cell lung cancer. *Ann Thorac Surg.* 2007;84:926-33.
4. Howington J, Blum M, Chang A, Balekian A, Murthy S. Treatment of stage I and II non-small cell lung cancer: diagnosis and management of lung cancer, 3rd ed: American College of Chest Physicians evidence-based clinical practice guidelines. *Chest.* 2013;143:e278S-313S.
5. Zuo YZ, Liu C, Liu SW. Pulmonary intersegmental planes: imaging appearance and possible reasons leading to their visualization. *Radiology.* 2013;267-75.