Training on thoracoscopic anatomical segmentectomy

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Since Ginsberg *et al.* (1) reported a randomized trial of the surgery for lung cancer with stage-1A, lobectomy has been performed as a standard procedure for lung cancer all over the world. However, a prospective clinical trial—JCOG0802/WJOG4067—demonstrated the feasibility of segmentectomy for lung cancer ≤2.0 cm (2), even before that, segmentectomy has been reported as an acceptable procedure for small-sized lung nodules, particularly for early-stage lung cancers ≤2.0 cm or with ground glass opacity (3,4). In the trend of changing procedures for lung cancer, the outcomes and techniques of segmentectomy will be discussed as they are a valuable topic for further studies.

Thoracoscopic surgery has also been widely performed as a minimally invasive surgery and has shown some advantages, such as less pain, preservation of pulmonary function, and earlier recovery after surgery (5,6). Thoracoscopic segmentectomy is still a challenging procedure because it is necessary for surgeons to understand precise anatomy and learn technical skills to perform it. Therefore, in order to easily and precisely perform anatomical segmentectomy, many manuscripts on thoracoscopic segmentectomy using three-dimensional (3D) computed tomography (CT) images have been published (7-9). In other words, these 3D-CT images might enable surgeons to perform various types of segmentectomy in thoracoscopic surgery (10).

In most institutions where thoracoscopic surgery is routinely performed, it is expected that experienced thoracic surgeons usually perform thoracoscopic segmentectomy because this procedure requires detailed knowledge of pulmonary anatomy and experienced technical skills under a thoracoscopic approach. Therefore, even if young surgeons can understand pulmonary anatomy using 3D-CT images and hope to perform thoracoscopic segmentectomy with this understanding, they might lack the experience to perform thoracoscopic segmentectomy. In such a situation, 3D models for performing the thoracoscopic segmentectomy reported by Koliakos *et al.* (11) would be useful and might be applied in many educational institutes. In thoracoscopic lobectomy, an experimental model had been reported. Tanaka *et al.* (12) evaluated a wet-lung model using 3D-CT printing for thoracoscopic lobectomy and reported that the model can facilitate the basic skills for novices in 2021. Before the reports of the 3D models, some virtual reality simulations had been reported and applied as the training of thoracoscopic surgery, and favorably evaluated (13,14). On the other hand, in thoracoscopic segmentectomy, it is expected to require such 3D-CT printing models to overcome the difficulties in which the individual case has anatomical variations. Chen *et al.* (15) reported the usefulness of 3D printing models in uniportal video-assisted thoracoscopic surgery. Furthermore, among types of segmentectomy, there are different procedural types, such as simple and complex segmentectomies. Although the reports by Koliakos *et al.* (11) evaluated the anterior-basal segmentectomy of the right lower lobe, this type of segmentectomy was expected to be relatively easy thoracoscopically because the targeted bronchus and pulmonary artery were easily identified from the interlobar approach. In such types of segmentectomy requiring a

simple approach, perhaps the models might not be needed, but rather, be needed in more complex and difficult segmentectomies, such as postero-lateral segmentectomy of the lower lobe. However, the uses of some specific instruments are needed in thoracoscopic surgery. Inexperienced surgeons tend to use these instruments less effectively compared to experienced surgeons. The 3D models, therefore, might help young surgeons handle the instruments appropriately and improve their proficiency.

Among the training systems, except for the 3D models, the swine model has also been reported for thoracoscopic anatomical lung segmentectomy (16). In these models, although the surgeons can learn segmentectomy with more reality than the 3D models, ethical and hygiene concerns may make its use difficult and limited in certain countries as Koliakos *et al.* discussed (11).

Anatomical segmentectomy might have other aspects regarding the education of thoracoscopic anatomical lung resections. The dissecting areas of segmentectomy are usually in the periphery, not the hilum. This point is quite different from lobectomy, because surgeons dissect only the peripheral lung in segmentectomy. Even if young surgeons damaged the peripheral vasculature an bleeding occurs intraoperatively, the hemostasis is usually easily resolved, or if the bleeding is uncontrollable, conversion to lobectomy can be performed. On the other hand, bleeding due to injury of the pulmonary artery in lobectomy is more serious, and may require clamping of the main pulmonary artery, or conversion to pneumonectomy in some cases. It is thought that pneumonectomy for hemostasis should be avoided in patients with small-sized lung cancer. Regarding this aspect bleeding control in cases performed by young surgeons, segmentectomy may be more advantageous than lobectomy. Especially in simple segmentectomy, technical skills, such as the dissections of blood vessels and bronchus, can be learned using the thoracoscopic instruments in the peripheral lung. Additionally, the procedural steps are few and simple, therefore, a simple segmentectomy, not lobectomy, may be recommended as the first case of thoracoscopic anatomical lung resection for young surgeons.

As Koliakos *et al*. (11) mentioned regarding the disadvantages of the 3D models, the cost of a 3D model is an important issue that must be considered in the education of thoracoscopic surgery. Although Koliakos *et al.* regrettably didn't describe the actual cost for the 3D models, if additional treatments for some postoperative complications could be certainly avoided by using the 3D models, the disadvantages may be negligible. Additionally, the 3D models that have been reported thus far still have other problems requiring improvement, such as lack of flexibility. Among the procedural steps of segmentectomy, dividing the intersegmental plane is unique and very important. However, this skill isn't included in the procedural steps of lobectomy. When dividing the intersegmental parenchyma, it is important for surgeons to control the staples with the appropriate angle. The flexibility of 3D models is especially demanding in this procedure; therefore, it is necessary to improve these disadvantages of 3D models in the future because their use can be beneficial in performing thoracoscopic segmentectomy. Currently, Tokuno *et al*. (17) reported an extremely unique and innovative method using virtual dynamic imaging for thoracoscopic anatomical pulmonary resection. This method had thoroughly considered the difficulties presented by lung deformity during surgery. Furthermore, virtual and augmented reality has also been developed in thoracic surgery (18). These systems might be useful for not only training but also for preoperative planning of thoracic procedures or intraoperative assistance.

Thus, thoracoscopic anatomical segmentectomy may have the possibility to be performed in patients diagnosed with early-stage lung cancer. It is also important how we evaluate the skills of young surgeons using these 3D models before performing thoracoscopic segmentectomy on actual patients. Learning the precise anatomy of the lung and the technical skills of thoracoscopic segmentectomy is essential for young surgeons. To establish a training system for thoracoscopic segmentectomy, the 3D printed models might be a useful tool. Though there are some remaining problems that should be improved, we intend to explore these problems in the future.

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References

1. Ginsberg RJ, Rubinstein LV. Randomized trial of lobectomy versus limited resection for T1 N0 non-small cell lung cancer. Lung Cancer Study Group. Ann Thorac Surg 1995;60:615-22; discussion 622-3.
2. Saji H, Okada M, Tsuboi M, et al. Segmentectomy versus lobectomy in small-sized peripheral non-small-cell lung cancer (JCOG0802/WJOG4607L): a multicentre, open-label, phase 3, randomised, controlled, non-inferiority trial. Lancet 2022;399:1607-17.
3. Okada M, Koike T, Higashiyama M, et al. Radical sublobar resection for small-sized non-small cell lung cancer: a multicenter study. J Thorac Cardiovasc Surg 2006;132:769-75.
4. Sugi K, Kobayashi S, Sudou M, et al. Long-term prognosis of video-assisted limited surgery for early lung cancer. Eur J Cardiothorac Surg 2010;37:456-60.
5. Kaseda S, Aoki T, Hangai N, et al. Better pulmonary function and prognosis with video-assisted thoracic surgery than with thoracotomy. Ann Thorac Surg 2000;70:1644-6.
6. Atkins BZ, Harpole DH Jr, Mangum JH, et al. Pulmonary segmentectomy by thoracotomy or thoracoscopy: reduced hospital length of stay with a minimally-invasive approach. Ann Thorac Surg 2007;84:1107-12; discussion 1112-3.
7. Oizumi H, Endoh M, Takeda S, et al. Anatomical lung segmentectomy simulated by computed tomographic angiography. Ann Thorac Surg 2010;90:1382-3.
8. Chan EG, Landreneau JR, Schuchert MJ, et al. Preoperative (3-dimensional) computed tomography lung reconstruction before anatomic segmentectomy or lobectomy for stage I non-small cell lung cancer. J Thorac Cardiovasc Surg 2015;150:523-8.
9. Xue L, Fan H, Shi W, et al. Preoperative 3-dimensional computed tomography lung simulation before video-assisted thoracoscopic anatomic segmentectomy for ground glass opacity in lung. J Thorac Dis 2018;10:6598-605.
10. Oizumi H, Kanauchi N, Kato H, et al. Anatomic thoracoscopic pulmonary segmentectomy under 3-dimensional multidetector computed tomography simulation: a report of 52 consecutive cases. J Thorac Cardiovasc Surg 2011;141:678-82.
11. Koliakos E, Pal M, Gonzalez M, et al. Learning of VATS right lobe anterior-basal segmentectomy (S8) on a 3D printed simulator. J Vis Surg 2022;8:34.
12. Tanaka T, Shimada Y, Furumoto H, et al. Comparative analysis of the results of video-assisted thoracic surgery lobectomy simulation suing the three-dimensional-printed Biotexture wet-lung model and surgeons' experience. Interact Cardiovasc Thorac Surg 2021;32:284-90.
13. Jensen K, Bjerrum F, Hansen HJ, et al. A new possibility in thoracoscopic virtual reality simulation training: development and testing of a novel virtual reality simulator for video-assisted thoracoscopic surgery lobectomy. Interact Cardiovasc Thorac Surg 2015;21:420-6.
14. Solomon B, Bizekis C, Dellis SL, et al. Simulating video-assisted thoracoscopic lobectomy: a virtual reality cognitive task simulation. J Thorac Cardiovasc Surg 2011;141:249-55.
15. Chen Y, Zhang J, Chen Q, et al. Three-dimensional printing technology for localised thoracoscopic segmental resection for lung cancer: a quasi-randomised clinical trial. World J Surg Oncol 2020;18:223.
16. Oizumi H, Kato H, Endoh M, et al. Swine model for training surgeons in minimally invasive anatomic lung segmentectomy. J Vis Surg 2017;3:72.
17. Tokuno J, Chen-Yoshikawa TF, Nakao M, et al. Creation of a video library for education and virtual simulation of anatomical lung resection. Interact Cardiovasc Thorac Surg 2022;34:808-13.
18. Arjomandi Rad A, Vardanyan R, Thavarajasingam SG, et al. Extended, virtual and augmented reality in thoracic surgery: a systematic review. Interact Cardiovasc Thorac Surg 2022;34:201-11.

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