

Research on the Clinical Technology of Thoracic Surgery Based on 3d Reconstruction Technology

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Abstract: The three-dimensional reconstruction technology of medical images is a new field of interdisciplinary research. It is applied to biomedical engineering through computer graphics and image processing technology. This technology has important applications in diagnostic medicine, surgical planning and simulation, plastic and pseudosurgery surgery, radiotherapy planning and anatomy teaching. Three-dimensional reconstruction mainly involves related knowledge in the fields of digital image processing, computer graphics and medicine.

1. Introduction

Since its rise in the 1990s, after more than 20 years of rapid development, 3D reconstruction and 3D printing technology has been widely used in engineering design, manufacturing, medicine and other fields. As a new field of interdisciplinary research, the three-dimensional reconstruction technology of medical images is applied to biomedical engineering through computer graphics and image processing technology. This technology has important applications in diagnostic medicine, surgical planning and simulation, plastic surgery, prosthetic surgery, radiotherapy planning and anatomy teaching. The three-dimensional image presented by the multi-layer spiral CT is always limited to one-dimensional space in the transmitter. Even if it is processed as a 3D image at the workstation, it is difficult for the doctor to observe the condition to have a real feeling. The invention and application of the 3D printer can print the spiral CT three-dimensional reconstruction images to form a real three-dimensional object. The CT scanning workstation post-processed images can be used to generate a certain proportion of the physical model through the 3D printer. In this way, for the clinician, without the help of a computer, the diseased organs and tissues will be displayed intuitively, so that the diseased part can be observed, the operation plan is more convenient to make, and the patient and his family will also be clearly understood when explaining the condition. At the 2014 Surgical Education Week meeting, 95.8% of the 51 interviewed doctors wanted the 3D model to be applied to patients. The case model made by 3D printing can also be used in medical teaching in the future, which is more vivid and flexible than the obscure pictures and texts in books. After simple processing and format conversion, the three-dimensional reconstructed image after CT scanning can be directly produced by a 3D printer, eliminating the complex process of 3D modeling, reducing the difficulty of preoperative preparation for complex surgery, and simplifying the surgical operation process, Improve the success rate of surgery.

2. Three-Dimensional Visualization Technology of Medical Images

The three-dimensional visualization technology of medical images plays an increasingly irreplaceable role in the diagnosis and treatment of the medical field, and is mainly used in the following aspects:

Through image processing technology, CT images can be arbitrarily enlarged, reduced, rotated, contrast adjusted, 3D reconstruction and other processing to provide realistic 3D medical images to make up for the lack of imaging equipment imaging, which is convenient for doctors from multiple angles, multiple Observation and analysis at different levels, and enable doctors to effectively participate in the data processing and analysis process, can be qualitative to accurate quantitative analysis of lesions and other areas of interest, which can improve the accuracy and accuracy of

medical diagnosis. Simulated multi-angle scanning is of great significance in CT scanning. Because X-rays cause greater damage to the human body, it is impossible to scan the patient at multiple angles. Through three-dimensional graphics and image technology, the original data can be reorganized at multiple angles and simulated Angle scan. Digital anatomical models, reconstructing three-dimensional digital models based on image data, and showing the anatomical structure of the human body or other biological tissues three-dimensionally are of great significance for teaching and scientific research.

In surgical teaching and training, a series of slice images of a certain part of the human body can be obtained through tomography. Computerized three-dimensional reconstruction of these slice data can obtain a three-dimensional model of the human body part, and the doctor can perform surgical simulation on the three-dimensional model. Surgery in a virtual environment will not cause serious accidents, and can improve the doctor's ability to collaborate, especially in repair surgery has important application prospects. The doctor can observe the expert's operation process on the virtual operation system, or repeat the practice. Virtual surgery greatly shortens the time of surgical training, and at the same time reduces the demand for expensive experimental objects.

Formulating surgical planning, you can use the image data obtained before surgery to help doctors formulate surgical plans rationally and quantitatively, for selecting the best surgical path, reducing surgical damage and damage to adjacent tissues, improving the accuracy of lesion positioning, and completing complex surgical operations And improving the success rate of surgery are of great significance. Radiation therapy. In this field, computer technology is mainly used for precise positioning. Based on the images obtained from the image data, the specific parts that should be performed for radiotherapy are determined, so as to guide the instrument to accurately locate and avoid unnecessary radiation exposure of normal tissues. Surgical navigation and intraoperative monitoring, this application can match the three-dimensional model processed by the computer with the actual surgery, so that the image seen by the doctor has both the actual image and the superimposed graphics, so that the useful information is more and can be well Guide the doctor to the operation. Due to the intervention of the computer, the traditional surgical operation can be more precise, and the damage to the patient is smaller. Treatment planning, in this field, computer technology is mainly used to observe the local changes of the body lesions caused by drugs, radiation or other therapies during the treatment of patients, estimate the efficacy, and effectively adjust the treatment plan based on the evaluation results. The virtual endoscope is similar to the virtual reality technology. The computer graphics technology is used to reconstruct the obtained image data in three dimensions, so that the doctor can observe the blood vessels and organs from an internal angle, and avoid the patient suffering from interventional diagnosis. Telemedicine, with the development of computer technology, large-capacity storage media and image compression technology are widely used, so that medical images can be stored in large capacity; the increase in computer speed makes real-time analysis of images possible; and the rapid development of communication technology With the development, medical images can be transmitted quickly, and the rapid transmission and distribution of medical images in the hospital can be realized, so that doctors or patients can obtain the required medical images anytime and anywhere.

3. Application of 3d Reconstruction and 3d Printing Technology in Cardiothoracic Surgery

The application of 3D reconstruction and 3D printing in cardiothoracic surgery is still under continuous research and exploration. CHANG and other 3D printed polycaprolactone stents successfully reconstructed the trachea of rabbits, confirming that the reconstructed 3D printed tracheal stents are well integrated with normal trachea, and are expected to solve some tracheal reconstruction problems. KO and others used silicon as a material to print a specific endoscopic cap using 3D technology. Endoscopic myotomy for achalasia has a good clinical effect. Duan et al. Successfully created tricuspid valve after using methyl acrylate cross-linked hyaluronic acid and methyl acrylate cross-linked gelatin to build a hybrid hydrogel stent and implanted it into aortic interstitial cells.

Thoracoscopic minimally invasive surgery has shown many advantages in more than 20 years of

development. It is gradually and widely replacing traditional thoracotomy for the treatment of chest diseases. With the popularization of thoracoscopy minimally invasive technology and sublobar lobectomy Advancement, early treatment of lung tumors in thoracic surgery is more inclined to lung or subpulmonary resection. Studies have shown that partial sublobe (pulmonary segment) resection of selected early lung tumor patients can achieve a long-term effect no less than that of lobectomy, so the concept of precise lung resection was proposed. The premise of accurate surgery under thoracoscopy is to be familiar with the anatomy of the lung, and it is required to accurately identify the bronchus, the branch of the arterial vein and the lymph node of the removed lung lobe and lung segment. The anatomical variation of the lung lobe, especially the lung segment, increases the difficulty of minimally invasive sublobar resection, and it also increases the risk of surgery for beginners. Although the two-dimensional imaging of video-assisted thoracoscopy can treat lung disease, it cannot be morphological and qualitative Estimating the characteristics of lesions, so three-dimensional reconstruction and printing technology came into being, and has been widely researched and developed.

Pulmonary resection surgery must fully understand the patient's pulmonary vascular anatomy in order to properly remove, FOURDRAIN and others believe that CT three-dimensional reconstruction of the pulmonary artery before lung surgery is very necessary. The number of video-assisted thoracoscopic surgery, lobectomy, or segmentectomy has increased tremendously in recent years. These operations require the surgeon to be fully familiar with the anatomy of the lung blood vessels and bronchial tubes of each patient. IKEDA and others believe that surgeons must carefully dissect the branches of the pulmonary blood vessels during the operation. In traditional thoracotomy, the identification of the patient's anatomy depends on the three-dimensional vision and haptics of the surgical field. However, the anatomical identification of blood vessels and bronchial tubes in thoracoscopic surgery is displayed on the TV screen through endoscopic conduction, and the lack of tactile feedback may lead to an unclear anatomy of the lung tissue by the operator. Existing studies have confirmed that through the three-dimensional reconstruction and virtual technology of bronchial tubes and blood vessels before surgery, most of the anatomical variations of pulmonary blood vessels and bronchial tubes can be found. Therefore, the use of CT images to three-dimensionally reconstruct the anatomical structure of the patient's lung tissue before surgery is very Necessary, especially thoracoscopic lung surgery.

4. Feasibility and Research Bottleneck of 3d Reconstruction and 3d Printing Technology in Thoracic Surgery

At present, most lung diseases can be completed by thoracoscopic surgery. Thoracoscopic lobectomy has become the mainstream in the early stage of lung cancer surgery; however, the variation of the blood vessels in the lungs increases uncontrollable intraoperative bleeding, so it is very important to evaluate the variation of blood vessels and bronchial tubes before surgery. The development of any new technology faces opportunities and challenges. Although 3D reconstruction and 3D printing technologies are advanced and widely used, they are limited by many factors. Consumables are the key reason for the inability of 3D reconstruction and 3D printing to be widely used. In order to be widely used in medicine, more cheap printing materials must be developed. The accuracy, speed and efficiency of printing equipment are not high enough, and the high cost of printers is also a problem to be solved. CT three-dimensional reconstruction technology and 3D printing consume time and manpower, which limits the promotion and application of preoperative three-dimensional diagnosis to a certain extent. At present, it is possible to print lung tumors and major blood vessels and trachea, but the CT reconstruction and 3D printing technology of lymph nodes around the lung tumors are not yet perfect, which is the focus of the next research.

5. Conclusion

However, based on the existing research results, we speculate that 3D printing technology can also be used in lung surgery to assist in enhancing the safety of the surgery and to minimize surgical

trauma. The application of multi-layer spiral CT three-dimensional reconstruction and 3D printing technology in complex lung surgery can play a role in preoperative diagnosis, intraoperative risk avoidance, shorten operation time, reduce iatrogenic injury, and achieve the purpose of precise lung resection. At the same time, it can also be used in teaching to make up for the scarcity of lung anatomical specimens and promote the development of thoracic surgery. With the continuous deepening of the research on the combination of 3D printing technology and medical imaging modeling and simulation technology, its rapid, accurate and good at making complex entities make it have broad application prospects in the field of medical and health.

References

- [1] Li Yaqin, Dong Xinzhai, Pan Bo, et al. Application of three-dimensional reconstruction technology in clinical teaching and training of newly recruited nurses in cardiothoracic surgery. *International Journal of Nursing*, vol. 39, no. 3, pp. 398-400, 2020.
- [2] Yu Yue, Wang Wei, Ye Jun, et al. The application of three-dimensional image reconstruction technology in the anatomy teaching of lung segment in thoracic surgery. *Science and Technology*, vol. 12, no. 1, pp. 180-181,151, 2019.
- [3] Zhang Jin, Sun Liangzhang. Discussion on the application of three-dimensional reconstruction technology in clinical teaching of lung tumors. *Continuing Medical Education of China*, no. 9, pp. 35, 2017.
- [4] Jiang Rui, Zhang Zhe. Application of 3D reconstruction and 3D printing in thoracic surgery. *Journal of Qingdao University*, 2017.
- [5] Gao Yu. The value of multi-slice spiral CT scanning and three-dimensional imaging in the diagnosis of rib fractures. *Journal of Hebei Union University: Medical Edition*, vol. 3, no. 3, pp. 365-366, 2011.