Original Article

Comparison of laser-guided technology and conventional manual percutaneous lung biopsy: a single-center retrospective study

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Background: Percutaneous lung biopsy (PLB) is currently widely utilized in the diagnosis and treatment of lung tumors, owing to its advantages of minimal trauma, high detection rate, and precise localization. However, traditional computed tomography (CT)-guided freehand PLB procedures often involve multiple puncture adjustments and a relatively high incidence of complications. The aim of this study is to investigate whether laser-guided technology can effectively reduce the operative time and incidence of complications.

Methods: This study included 141 patients who underwent CT-guided PLB at the First Affiliated Hospital of Soochow University between January 2022 and January 2024. These patients were divided into two groups based on the use of laser-guided technology during the procedure: the laser-guided group (47 patients) and the manual group (94 patients). Clinical data from all patients were collected. Information such as the success rate of biopsy procedures and the incidence of complications was analyzed and compared.

Results: The procedure time in the laser-guided group was shorter than that in the manual group (P=0.008). In the laser-guided group, the number of adjustments needed to reach the tumor during the positioning step was less than the manual group (P=0.001). In the laser-guided group, the number of CT scans performed before reaching the tumor was smaller than in the manual group (P=0.01). The distance from the first puncture to the lung tumor in the laser-guided group was closer than that in the manual group (P=0.049). The laser-guided group had a smaller angular deviation from the target at the first puncture than the manual group (P=0.004).

Conclusions: Laser-guided technology has the advantages of shorter operation time and less adjustment of biopsy needles. However, laser-guided technology does not reduce the complication rate of biopsy surgery or the length of hospital stay after surgery and there is no statistical difference in the accuracy of pathological diagnoses obtained by the two methods.

Keywords: Laser-guided technology; percutaneous lung biopsy (PLB); lung cancer; pulmonary nodules

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Introduction

Lung cancer is one of the most prevalent and lethal malignancies in China (1,2). At the same time, due to its rich blood supply, lung tissue is a common site for metastasis of malignant tumors. Therefore, accurate diagnosis of pulmonary tumors plays a critical role in developing clinical treatment strategies and assessing the disease's progression. Early detection and accurate diagnosis of lung tumors are essential for improving treatment outcomes and reducing mortality rates (3). Pathological diagnosis, as the gold standard for confirming lung cancer, serves as the foundation and prerequisite for comprehensive lung cancer treatment (4).

Common diagnostic methods for pulmonary tumors include bronchoscopy, video-assisted thoracoscopic surgery (VATS), and percutaneous lung biopsy (PLB). For resectable tumors, VATS can simultaneously provide both diagnostic and therapeutic benefits (5). Central lung tumors are typically diagnosed using bronchoscopy (6). However, due to the complex anatomical structure of the lungs and the specific locations of some lesions, traditional diagnostic methods such as sputum cytology and bronchoscopic brush cytology have significant limitations in diagnosing peripheral lung lesions. For peripheral tumors, PLB is commonly employed (7).

PLB is a technique guided by imaging modalities such as X-ray fluoroscopy, ultrasound, or computed tomography (CT), where a fine needle is inserted into the lesion to extract cells or tissue for pathological examination. This method offers advantages such as simplicity of operation, high diagnostic accuracy, and short procedure time, making it particularly suitable for diagnosing solid pulmonary lesions. Additionally, for advanced lung cancer patients who are inoperable, PLB provides crucial pathological information for determining treatment options, such as radiotherapy and chemotherapy.

Although conventional PLB plays a crucial role in the diagnosis of lung cancer, it still faces several challenges in practical application. First, certain lesion locations, such as those within the mediastinum, adjacent to the spine, near the heart, around major blood vessels, or in deeper regions, present significant difficulty and high risk for puncture. Second, due to individual patient differences and the influence of respiratory movements, needle displacement can occur during the procedure, leading to puncture failure or complications. Additionally, traditional methods often require repeated adjustments of the needle angle and multiple scans, increasing the patient's radiation exposure and extending the procedure time.

In recent years, with the rapid advancement of imaging technology and medical equipment, laser-guided technology has been widely applied in PLB procedures (8-10). By providing precise puncture pathways and real-time monitoring of the needle insertion angle, laser-guided technology significantly improves the accuracy and safety of the procedure (11). For instance, PLB guided by laser angle devices and laser lights enables real-time orientation and precise control of the needle angle, allowing for swift puncture while effectively avoiding damage to critical blood vessels and organs. This approach reduces the amount of radiation exposure to the patient and significantly lowers the risk of complications (12,13).

Given the significant advantages of laser-guided technology and the limitations of conventional methods, this study aims to compare the application effects of laser-guided technology with those of conventional PLB in the diagnosis of lung cancer. The objective is to explore the superiority of laser-guided technology in improving puncture accuracy, reducing complications, and shortening procedure time. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1812/rc).

Highlight box

Key findings

- Laser-guided technology can reduce the operational time for percutaneous lung biopsy (PLB), the number of needle adjustments, and the frequency of computed tomography (CT) scans. Additionally, it can decrease the deviation in angle and distance during the initial puncture.

What is known and what is new?

- PLB is currently widely utilized in the diagnosis and treatment of lung tumors, owing to its advantages of minimal trauma, high detection rate, and precise localization. However, traditional CT-guided freehand PLB procedures often involve multiple puncture adjustments and a relatively high incidence of complications. The laser-guided technology can reduce procedure time of preoperative localization of pulmonary and ablation surgeries in orthopedics.
- In this study, we investigate whether laser-guided technology can effectively reduce the operative time and incidence of complications. The result indicates that the laser-guided technology can reduce the biopsy duration but cannot improve the incidence of complications.

What is the implication, and what should change now?

- Laser-guided technology has the advantages of shorter operation time and less adjustment of biopsy needles. Further research on laser-guided technology is needed in the future to explore its influence in puncture procedures.

Methods

Study population

This study was conducted in accordance with the

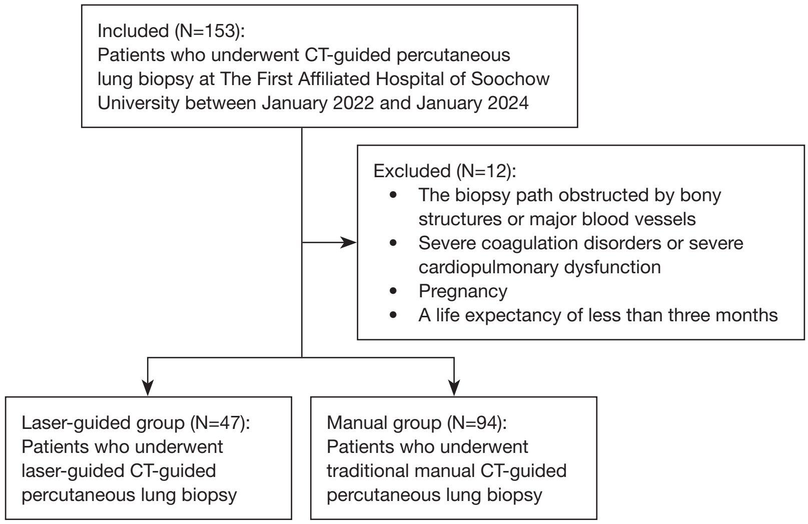

Figure 1 Flowchart of the inclusion principle and group distribution. CT, computed tomography.

Declaration of Helsinki (as revised in 2013) and had gained approval from the Medical Ethics Committee of the First Affiliated Hospital of Soochow University (Registry No. 2023510). Individual consent for this retrospective analysis was waived due to the retrospective nature. This study included 141 patients who underwent CT-guided PLB at the First Affiliated Hospital of Soochow University between January 2022 and January 2024. These patients were divided into two groups based on the use of laser-guided technology during the procedure: the laser-guided group (47 patients) and the manual group (94 patients). The inclusion criteria for the study were as follows: no severe coagulation disorders or bleeding disorders preoperatively, no severe cardiopulmonary dysfunction, the lung mass located in the peripheral lung tissue, no pleural effusion or pneumothorax, no pregnancy, and a life expectancy greater than three months. Exclusion criteria were: the biopsy path obstructed by bony structures or major blood vessels, severe coagulation disorders, severe cardiopulmonary dysfunction, pregnancy, or a life expectancy of less than three months (*Figure 1*). Patient demographics, CT characteristics of nodules (size, location, appearance), biopsy characteristics (posture, duration, deviation of angle and distance, adjustment times, pathological results) were collected. Patients received regular follow-up by outpatient or telephone for more than three months. All data can be retrieved in the electronic medical record system of the First Affiliated Hospital of Soochow University.

Biopsy procedure

First, patients need to undergo a thorough preoperative examination to exclude contraindications for the biopsy procedure. Comprehensive preoperative preparation should be carried out, including detailed communication with the patient and their guardian about the risks and relevant precautions of the biopsy. It is essential to ensure that the patient and their guardian fully understand the procedure and provide written consent.

Based on the preoperative CT images, select an appropriate position for the biopsy procedure. Before the biopsy, assist the patient in maintaining the position and instruct them to control their breathing and keep their body posture stable. Prior to the biopsy, perform an initial CT scan to plan the optimal puncture path on the CT images. Identify and mark the surface puncture point using the CT machine's laser guide lines and surface markers. After disinfection and draping, perform local anesthesia at the puncture site using 2% lidocaine. Once anesthesia is complete, insert a coaxial cannula (MCXS1815BP, Argon Medical Devices, Inc., USA) near the mass. After proper positioning, use a biopsy needle (18 Gauge × 15 cm, BioPince™ Full Core Biopsy Instrument, Argon Medical Devices, Inc., USA) to obtain tissue from the target nodule. The tissue samples are then fixed in formalin and sent for pathological examination.

After removing the coaxial cannula and bandaging

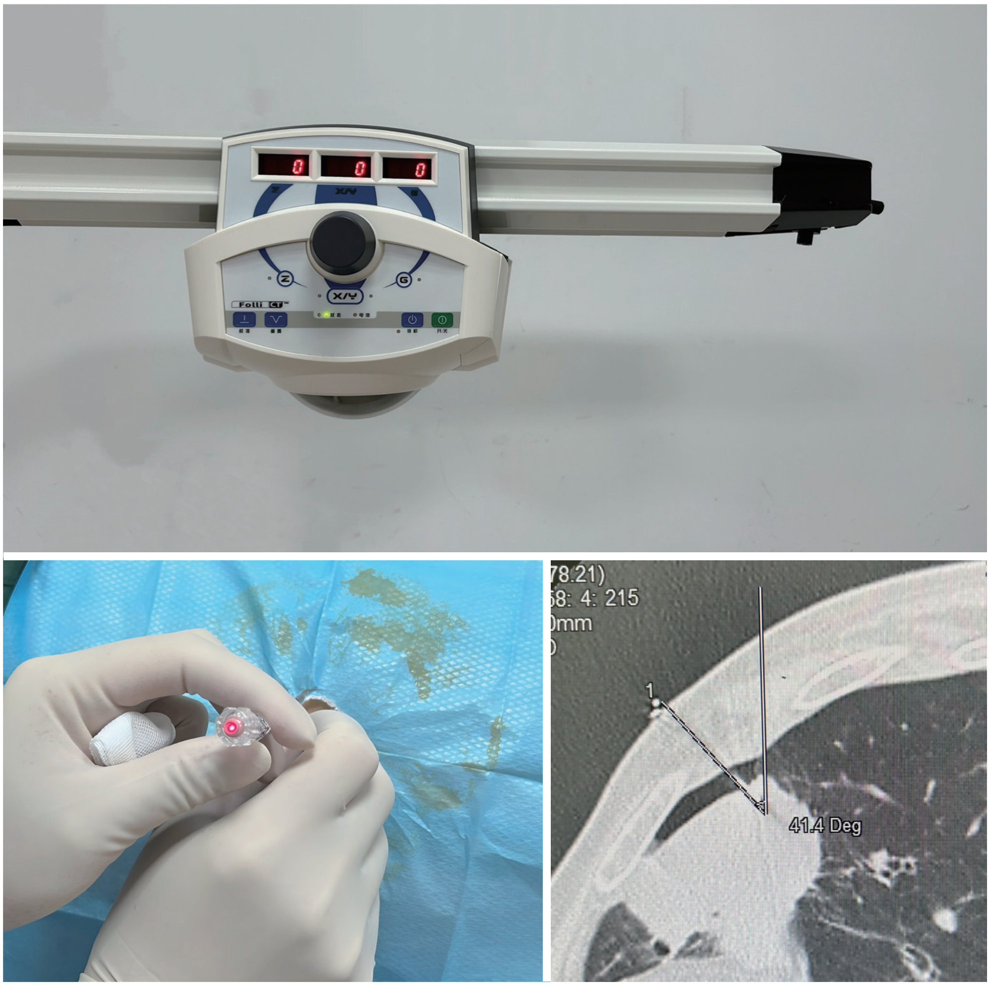

Figure 2 The laser-guidance machine. During the puncture process, maintain a laser spot on the tail of the puncture needle to ensure that the puncture path aligns with the planned path. During the CT scan, the puncture angle, which corresponds to the angle of the laser, is measured on the CT images based on the planned puncture path. CT, computed tomography.

the puncture site, adjust the patient to a comfortable position. Perform a follow-up CT scan to promptly detect any postoperative complications such as bleeding or pneumothorax. On the first postoperative day, conduct a chest X-ray to further confirm the presence of any complications. If complications are identified, provide timely and appropriate treatment.

Laser-guided device

SimpliCT (NeoRad AS, Oslo, Norway) (*Figure 2*), as a complete medical device, is safe and reliable. The machine emits Class 2 lasers, so during operation, the user only needs to avoid direct eye exposure to the laser and does not need to wear additional protective equipment.

Before initiating laser guidance, the machine must first be calibrated. The calibration process involves aligning the line laser of SimpliCT with the laser line of the CT machine. Once calibrated, the SimpliCT machine is fixed in place. After identifying the surface markers and the puncture path, measure the puncture angle and set the point laser's emission angle to the corresponding value. The point laser provides guidance for the puncture path as is shown in *Figure 2*. Align the endpoint of the point laser with the surface marker for puncture. By determining a line based on these two points, the laser line indicated by the point laser from the start to the endpoint represents the optimal puncture path. This optimal puncture path is visualized

Table 1 Patient characteristics

Variables	Laser-guided group (n=47)	Manual group (n=94)	P value
Gender			0.26
Male	28 [60]	65 [69]	
Female	19 [40]	29 [31]	
Age (years)	66.3±9.3	66.3±10.0	>0.99
Smoking history			0.28
Yes	10 [21]	28 [30]	
No	37 [79]	66 [70]	
Lung surgery history			0.25
Yes	5 [11]	5 [5]	
No	42 [89]	89 [95]	
Chronic disease history			0.28
Yes	26 [55]	43 [46]	
No	21 [45]	51 [54]	
Nodule size (mm)	30.9±12.8	32.7±16.2	0.82
Appearance of nodule			0.52
mGGN	1 [2]	4 [4]	
SN	46 [98]	90 [96]	
Nodule location			0.20
RUL	10 [21]	26 [28]	
RML	4 [9]	3 [3]	
RLL	10 [21]	25 [27]	
LUL	16 [34]	19 [20]	
LLL	7 [15]	21 [22]	

Data are presented as n [%] or mean ± standard deviation. LUL, left upper lobe; LLL, left lower lobe; mGGN, mixed glass ground nodule; RUL, right upper lobe; RML, right middle lobe; RLL, right lower lobe; SN, solid nodule.

through the laser.

Determination of benign diagnosis

Firstly, patients whose diagnosis of malignant tumors has been confirmed by biopsy can be excluded from the benign diagnosis. Secondly, if there is no evidence of malignancy in the puncture biopsy and the targeted anti-infection treatment based on the results of drug sensitivity tests leads to the shrinkage or disappearance of the lesions in the CT images after 1–2 months of follow-ups, a benign diagnosis can be determined. Finally, if malignant tumor cells are not obtained in the puncture biopsy and the anti-infection treatment fails to shrink the masses, VATS for resection and pathological examination of the specimens can make a definite diagnosis.

Statistical analysis

The descriptive method for continuous variables is mean ± standard deviation, with comparisons conducted using Students' *t*-test or Mann-Whitney *U* test. For categorical variables, the Chi-square test and Fisher's exact test are used for comparison. A P value less than 0.05 is considered statistically significant. Data analyses were performed using SPSS 26.0 software.

Results

The laser-guided group included 47 patients, comprising 28 males and 19 females. The manual group included 94 patients, comprising 65 males and 29 females. The average age of the laser-guided group was 66.3±10.0 years. The average age of the manual group was 66.3±9.3 years. There were no statistically significant differences between the two groups regarding gender (P=0.26) and age (P>0.99). The baseline variables of the clinical characteristics of the patients and pulmonary nodules are summarized in *Table 1*.

In the laser-guided group, 10 patients had a history of smoking and 5 patients had a history of lung surgery. In the manual group, 28 patients had a history of smoking and 5 patients had a history of lung surgery. There were no significant differences between the two groups in terms of history of smoking (P=0.28) and history of lung surgery (P=0.25). The study included a total of 69 patients with chronic diseases, such as diabetes, hypertension, hepatitis, and kidney disease. Of these, 26 patients were in the laser-guided group and the remaining 43 patients were in the manual group, indicating no statistically significant differences (P=0.28).

The average diameter of target nodules in the laser-guided group was 30.87±12.78 mm. In the manual group, the average diameter of target nodules was 32.74±16.16 mm. There were no statistically significant differences between the two groups in terms of nodule size (P=0.82). In the laser-guided group, 1 nodule was imaged as a mixed glass ground nodule (mGGN), while the remaining 46 nodules were solid nodules (SNs). In the manual group, 4 nodules

Table 2 Perioperative and postoperative conditions

Variables	Laser-guided group (n=47)	Manual group (n=94)	P value
Posture of patients			0.84
Lateral	3 [6]	7 [7]	
Prone	19 [40]	42 [45]	
Supine	25 [53]	45 [48]	
Biopsy duration (min)	28.1±4.7	30.0±3.8	0.008**
No. of adjustments	2.5±0.9	3.0±1.1	0.001**
No. of CT scans	4.7±1.1	5.2±1.3	0.01*
Deviation of distance (mm)	26.1±16.0	31.5±15.2	0.049*
Deviation of angle (degree)	4.7±6.8	9.3±9.3	0.004**
Length of needle trajectory within lung parenchyma (mm)	23.4±9.5	25.1±12.4	0.57
Complications			
Pneumothorax	13 [28]	34 [36]	0.31
Pleural effusion	2 [4]	3 [3]	0.75
Pulmonary hemorrhage	20 [43]	27 [29]	0.10
Chest tube insertion	0	2 [2]	0.31
Pleural reaction	0	0	
Biopsy failure	0	0	
Emergency surgery	0	0	
Death	0	0	
Postoperative hospital stays (days)	1.8±1.5	2.0±1.9	0.61

Data are presented as n [%] or mean ± standard deviation. *, P<0.05; **, P<0.01. CT, computed tomography.

were mGGNs, and 90 nodules were SNs. No nodules were pure glass ground nodules (pGGN). There were no statistically significant differences between the two groups in terms of nodule characteristics (P=0.52).

In the laser-guided group, the distribution of nodules was as follows: 10 in the right upper lobe (RUL), 4 in the right middle lobe (RML), 10 in the right lower lobe (RLL), 16 in the left upper lobe (LUL), and 7 in the left lower lobe (LLL). In the manual group, the distribution was: 26 in the RLL, 3 in the RML, 25 in the RLL, 19 in the LUL, and 21 in the LLL. There were no statistically significant differences between the two groups regarding nodule location (P=0.20). In the laser-guided group, 3 patients were in the lateral decubitus position, 19 patients were in the prone position, and 25 patients were in the supine position during the procedure. In the manual group, 7 patients were in the lateral decubitus position, 42 patients were in the prone position, and 45 patients were in the supine position. There were no statistically significant differences between the two groups in terms of patient positioning (P=0.84).

The perioperative and postoperative information of the two groups is presented in *Table 2*. The average procedure time was 28.1±4.70 minutes in the laser-guided group and it was 30.0±3.80 minutes in the manual group, highlighting significant difference between the two groups (P=0.008). The average number of adjustments needed to reach the tumor during the positioning step was 2.45±0.88 in the laser-guided group and was 3.02±1.14 in the manual group indicating a significant difference between the two groups (P=0.001). The average number of CT scans performed before reaching the tumor in the laser-guided group (4.72±1.14) was smaller than that in the manual group (5.22±1.32), demonstrating notable differences (P=0.01).

In the laser-guided group, the average distance from the first puncture to the lung tumor was 26.06±16.01 mm. In the manual group, the average distance was 31.53±15.15 mm. There was a statistically significant difference between the two groups in the distance from the first puncture to the tumor (P=0.049). The average angular deviation from the target at the first puncture was smaller in the laser-guided group (4.72±6.82 degrees) compared to that in the manual group (9.27±9.33 degrees), indicating significant difference between the two groups (P=0.004). The average final puncture depth was 23.36±9.45 mm in the laser-guided group and was 25.10±12.41 mm in the manual group. There was no statistically significant difference between the two groups in terms of final puncture depth (P=0.57).

Regarding complications, 13 patients in the laser-guided group and 34 patients in the manual group developed pneumothorax. Two patients in the laser-guided group and three patients in the manual group had pleural effusion. Moreover, 20 patients in the laser-guided group and 27 patients in the manual group experienced pulmonary hemorrhage. There were no statistically significant differences between the two groups regarding the incidence of pneumothorax (P=0.31), pleural effusion (P=0.75) and pulmonary hemorrhage (P=0.10). No patients in the laser-guided group required pleural drainage due to pneumothorax or pleural effusion. And in the manual group, 2 patients underwent pleural drainage. There was no significant difference between the two groups (P=0.31). Neither the laser-guided group nor the manual group experienced pleural reactions, biopsy failure, emergency

Table 3 Pathological results of the two groups

Variables	Laser-guided group (n=47)	Manual group (n=94)	P value
Final pathological result			0.94
SCLC	1 [2]	5 [5]	
ADC	26 [55]	50 [53]	
SCC	8 [17]	14 [15]	
Benign lesion	2 [4]	6 [6]	
Metastatic tumor	7 [15]	12 [13]	
Others	3 [6]	7 [7]	
Accuracy			0.85
True positive	40 [85]	77 [82]	
True negative	2 [4]	6 [6]	
False positive	0	0	
False negative	5 [11]	11 [12]	
Primary site of metastatic tumor			>0.99
Breast	3 [43]	3 [25]	
Liver	0	1 [8]	
Colon	1 [14]	1 [8]	
Cervix	1 [14]	2 [17]	
Pancreas	0	1 [8]	
Thyroid	1 [14]	0	
Ovary	0	1 [8]	
Bladder	0	1 [8]	
Uncertain	1 [14]	2 [17]	

Data are presented as n [%] or mean ± standard deviation. ADC, adenocarcinoma; SCLC, small cell lung cancer; SCC, squamous cell carcinoma.

surgery, or death as complications.

The average postoperative hospital stay was 1.81±1.51 days in the laser-guided group and 2.03±1.90 days in the manual group. There were no statistically significant differences between the two groups in terms of postoperative hospital stay (P=0.61).

The final pathological results indicated that in the laser-guided group, there was 1 case of small cell lung cancer (SCLC), 26 cases of lung adenocarcinoma (ADC), 8 cases of lung squamous carcinoma (SCC), 7 cases of metastatic tumors, 2 cases of benign lesions, and 3 cases of other pathological types. In the manual group, there were 5 cases of SCLC, 50 cases of lung ADC, 14 cases of lung SCC, 12 cases of metastatic tumors, 6 cases of benign lesions, and 7 cases of other pathological types. There were no statistically significant differences between the two groups (P=0.94). In the laser-guided group, the results showed 40 true positives, 2 true negatives, and 5 false negatives. In the manual group, there were 77 true positives, 6 true negatives, and 11 false negatives. There was no significant difference between the two groups in terms of the accuracy of pathological results (P=0.85).

In the laser-guided group, the primary sites of the metastatic tumors included 3 from the breast, 1 from the colon, 1 from the cervix, 1 from the thyroid, and 1 with an unknown primary site. In the manual group, the primary sites of the metastatic tumors included 3 from the breast, 1 from the liver, 1 from the colon, 2 from the cervix, 1 from the pancreas, 1 from the ovary, 1 from the bladder, and 2 with an unknown primary site. There was no significant difference between the two groups (P>0.99). Data of pathological results of the two groups are summarized in *Table 3*.

Discussion

According to our research results, laser-guided technology can reduce the operative time of CT-guided PLB. During the operation, the laser-guided group also experienced fewer CT scans and fewer adjustments of puncture needles, which may be the reason for the shortened operative time. During the operation, the deviation angle of the first puncture and the distance between the puncture needle and the tumor were also smaller in the laser-guided group.

Research indicates that angle-guided puncture devices, also known as the laser angle guide assembly, can reduce the number of puncture needle adjustments, thereby shortening operative time and reducing radiation exposure (14), this technology can subsequently minimize the incidence of complications as well (15). Our study drew similar conclusions. This may be due to the fact that traditional puncture biopsy procedures require multiple adjustments of the puncture angle to achieve precise puncture. However, both laser-guided devices and laser angle guide assembly can provide precise puncture angles, avoiding the problem of multiple punctures caused by the inability to quantify the puncture angle. The reduction in the number of punctures also leads to a shorter operative time and a decrease in radiation exposure during the procedure. This technology is currently widely used in lung puncture procedures and ablation surgeries in orthopedics, and can benefit patients during treatment (12,13). All the operations in this study were carried out by experienced clinicians. As the results showed, the laser guidance technique can reduce their operation time. On the premise of ensuring the therapeutic and diagnostic effects, they can already complete the biopsy as quickly as possible. Therefore, the help of the laser guidance technique for them is limited. In the follow-up studies, we will prospectively study whether less experienced doctors can complete the operations more quickly and accurately with the help of this technique.

The laser-guided group exhibited superior performance in terms of both angular deviation and distance deviation during the initial puncture compared to traditional puncture techniques. The puncture pathway is guided by a laser beam, theoretically enabling the target puncture site to be reached with the first attempt. However, during actual procedures, minute movements by the patient can occur. Especially when in the lateral decubitus position, prolonged operative time may lead to small-scale shifts by the patient. Such minor movements significantly impact precise puncture procedures. Therefore, to ensure accuracy, the initial puncture is typically a probing one before entering the pleural cavity. The notable reduction in angular deviation is attributed to the precise guidance obtained. The decrease in distance deviation is statistically significant, albeit with a P value at the threshold, potentially due to the small sample size. This may be a consequence of the reduced angular deviation. At the same initial puncture depth, a smaller angular deviation corresponds to a reduced distance deviation. The clinical significance of decreased distance deviation is substantially less than that of decreased angular deviation.

Our research results indicate that there are no significant differences in the incidence of complications and postoperative hospital stay between the laser-guided group and the manual group. A study by Tsai *et al.* (15) noted that the reported incidence of pneumothorax in current research ranges from 11.1% to 65.1%, with the incidence for angle-guided devices being 11.1%, which is relatively low. Moreover, a routine CT scan immediately after the biopsy procedure can relatively reduce the incidence of pneumothorax (16). In our study, the incidence of pneumothorax was 27.66% in the laser-guided group and 38.30% in the manual group, with no statistical difference between the two groups. The incidence of pneumothorax in the laser-guided group is also at a relatively low level within the context of current research.

Pneumothorax is one of the more common complications associated with PLB procedures. Studies have indicated that a greater number of needle adjustments during the biopsy procedure can lead to a higher incidence of pneumothorax (17). Among the factors influencing the number of needle adjustments, deviation in puncture angle cannot be overlooked. A larger deviation in puncture angle implies a need for more frequent needle adjustments (18). This is partially consistent with the conclusions drawn from our study.

The results indicated that the diagnostic accuracy rates for the laser-guided group and the manual group were 89.36% and 88.30%, respectively, with no significant difference between the two groups. A multicenter study in South Korea showed that the accuracy rate of PLB was 91.1% (95% confidence interval: 90.6% to 91.7%) (19), which is similar to our findings. The study by Hong *et al.* (20) introduced cone-beam CT (CBCT) technology, and the accuracy rate of CBCT-guided PLB was 92.7%, representing a high level of accuracy. Huang *et al.* (21) demonstrated that PLB guided by multiplanar reconstruction technique for difficult CT achieved an accuracy rate of 100%, significantly higher than traditional biopsy methods (84.1%). Intraoperative immediate cytology examination can also enhance biopsy accuracy (22). Studies have shown that this examination can increase the biopsy accuracy rate from 79.6% with traditional biopsy methods to 94.8%. In our study, none of the aforementioned techniques to improve accuracy were used during the biopsy process. The combined use of laser-guided technology with the aforementioned techniques may simultaneously reduce procedural time and enhance biopsy accuracy.

Animal experimental studies have shown that by integrating CT images with sensor data, a motorized needle steering robot can effectively reduce the incidence of complications following lung biopsy procedures (23). Another animal experiment, based on angle guidance and a biopsy stabilizer, demonstrated that this biopsy guidance system can significantly enhance biopsy accuracy (24). These studies may indicate new approaches for PLB procedures. By providing a visualized biopsy path and assisting the biopsy process with robotic arms, the effectiveness and safety of biopsy procedures can be improved.

With the continuous maturation of laser guidance technology and angular guidance technology, coupled with the stability of robotic arms, future PLB procedures may be performed with shorter operative times and fewer complications. Not limited solely to lung biopsy procedures, patients can also benefit from better treatment options provided by new technologies in CT-guided interventional examinations, such as percutaneous ablation of bone tumors and biopsy of liver tumors, among others. There are several limitations in this study. Firstly, although all the operators involved in the puncture procedures were experienced clinicians and radiologists, each had different operative habits and planning for the puncture pathway, which could contribute to variations in the results. Secondly, the sample size included in this study was relatively small, and it was a single-center retrospective study, leading to limitations in the conclusions drawn. Further research is still needed for validation in the future.

Conclusions

Laser-guided technology has the advantages of shorter operation time and less adjustment of biopsy needles during the procedure compared to traditional biopsy methods. However, laser-guided technology does not reduce the complication rate of biopsy surgery or the length of hospital stay after surgery. There is no statistical difference in the accuracy of pathological diagnoses obtained by the two methods. This study is a single-center study with a small sample size, and further multi-center studies with larger sample sizes are needed in the future.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1812/rc

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and had gain approval from the Medical Ethics Committee of the First Affiliated Hospital of Soochow University (Registry No. 2023510). Individual consent for this retrospective analysis was waived due to the retrospective nature.

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