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Title: Three-Dimensional Location Approach with Silk Thread Guided Laparoscopic Segmentectomy for Liver Tumor

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Author Questionnaire

1. We have marked your project as author-provided footage, meaning you film the video yourself and provide JoVE with the footage to edit. JoVE will not send the videographer. Please confirm that this is correct.

✓ Correct

2. Microscopy: Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **No**

3. Software: Does the part of your protocol being filmed include step-by-step descriptions of software usage? **Yes, all done**

4. Proposed filming date: To help JoVE process and publish your video in a timely manner, please indicate the proposed date that your group will film here: **done**

When you are ready to submit your video files, please contact our China Location Producer, [Yuan Yue](#).

Current Protocol Length

Number of Steps: 21

Number of Shots: 52 (15 SC)

Introduction

NOTE to VO producer: Please generate the interview statements

REQUIRED: What is the scope of this research?

- 1.1. This study validates the 3D-LAST technique for precise laparoscopic liver segmentectomy in patients with solitary tumors.

- 1.1.1. *B-roll: 2.3.6*

What are the most recent developments in this field of research?

- 1.2. Advancements focus on 3D reconstruction from CT scans and virtual simulations for improved surgical planning and navigation.

- 1.2.1. *B-roll: 2.5.1*

What technologies are currently used to advance research in the field?

- 1.3. Intraoperative ultrasound (IOUS) and indocyanine green (ICG) fluorescence imaging are commonly used for navigation.

- 1.3.1. *B-roll: 3.3.2*

What are the current experimental challenges?

- 1.4. Key challenges include dependence on high-quality CT scans, organ movement during surgery, and the 3D software learning curve.

- 1.4.1. *B-roll: 4.1.1*

What research gap does this protocol address?

- 1.5. This study addresses the gap in accessible, precise, cost-effective intraoperative navigation, especially for deep tumors and resource-limited settings.

- 1.5.1. *B-roll: 4.2.1*

Ethics Title Card

This research has been approved by the Review Committee at the West China Hospital of Sichuan University

Protocol

2. Preoperative Procedure and Surgical Planning

- 2.1. To begin, obtain high-resolution computed tomography or CT scans of the patient's liver in DICOM (*dye-com*) format [1].
 - 2.1.1. WIDE: Talent taking a seat at the computer that is displaying CT scans.
- 2.2. Launch the Mimics software, create a new project [1], and import the DICOM files to ensure all image data is correctly loaded for three-dimensional reconstruction and analysis [2].
 - 2.2.1. SCREEN: 1.2 input DICOM1.mp4 - 00:00 – 00:06.
 - 2.2.2. SCREEN: 1.2 input DICOM1.mp4 - 00:07 – 00:16.
- 2.3. Reconstruct the three-dimensional structure of the liver, vessels, and tumor [1]. Mark the liver in pink [2], the portal vein in blue [3], the artery in red [4], the hepatic vein and inferior vena cava in light blue [5], and the tumor in yellow [6].
 - 2.3.1. SCREEN: 1.3 input DICOM2.mp4 - 01:02 – 01:10.
 - 2.3.2. SCREEN: 1.3reconstruction.mp4 00:50-00:53.
 - 2.3.3. SCREEN: 1.3reconstruction.mp4 01:26-01:29.
 - 2.3.4. SCREEN: 1.3reconstruction.mp4 01:50-00:54.
 - 2.3.5. SCREEN: 1.3reconstruction.mp4 02:15-02:19.
 - 2.3.6. SCREEN: 1.3reconstruction.mp4 04:00-04:05.
- 2.4. Place three small virtual sticks on the three-dimensional liver model [1] and obtain four key points, S1, S2, S3 and S4 on the surface of the liver [2].
 - 2.4.1. SCREEN: 1.4 Jove ani-1.mp4 - 00:00 – 00:10.
 - 2.4.2. SCREEN: 1.4 Jove ani-1.mp4 - 00:15 – 00:18
- 2.5. Use the virtual stick tool to mark the resection point 1 centimeter from the tumor margin and at the midpoint of the edge of the liver at the bottom of the gallbladder [1]. These digital landmarks guide the surgeon in determining the precise location and orientation of the intended cut [2].
 - 2.5.1. SCREEN: 1.4.1Jove ani-2new.mp4 - 00:00 – 00:10.

2.5.2. SCREEN: 1.4.1Jove ani-2new.mp4 - 00:15 – 00:20.

- 2.6. Connect the four key points with lines on the liver surface [1] and measure their lengths to understand the proposed resection path and help visualize the post-resection liver contour [2].

2.6.1. SCREEN: 1.5Jove ani-3 new.mp4 - 00:00 – 00:10.

2.6.2. SCREEN: 1.5Jove ani-3 new.mp4 - 00:18 – 00:23

3. Laparoscopic Segmentectomy Procedure

- 3.1. Position the patient supine with their legs spread and inclined to the right [1-TXT].

3.1.1. 2.1-2.5.mp4 - 00:00 – 00:03. **TXT: General anesthesia; Tracheal intubation; Ventilator assistance**

- 3.2. Disinfect the skin with 0.5 percent iodine-based scrub three times [1].

3.2.1. 2.1-2.5.mp4 - 00:03 – 00:05.

- 3.3. Arrange the surgical team with the surgeon standing on the right and the assistant on the left. Position the camera centrally among the trocar sites, with the camera holder in the middle [1]. Make the necessary incisions and insert the trocars [2-TXT].

3.3.1. 2.1-2.5.mp4 - 00:05 – 00:07.

3.3.2. 2.1-2.5.mp4 - 00:07 – 00:09

- 3.4. Conduct an exploratory examination of the abdominal cavity, starting from the left epigastrium and moving rightwards down to the hypogastrium, to detect ascites, cirrhosis, and metastasis [1].

3.4.1. M_0.mp4 - 00:00 – 00:23.

- 3.5. Using an ultrasonic knife, Free abdominal adhesions [1], detach the round ligament of the liver, free the right hepatic ligament and adhesions [2], and expose liver segment V [3].

3.5.1. M_1.mp4 02:30-02:36.

3.5.2. M_1.mp4 02:50-03:00

3.5.3. M_1.mp4 03:30-03:36.

- 3.6. Next, with the ultrasonic knife, dissect the gallbladder triangle [1] and reveal the gallbladder duct and artery [2]. Ligate them with small hemo-lock clips [3] before excising the gallbladder [4].

3.6.1. M_2.mp4 - 00:36 – 00:41.

3.6.2. M_2.mp4 - 06:45 – 06:50.

3.6.3. M_2.mp4 - 07:20 – 07:24.

3.6.4. M_2.mp4 - 10:40-10:45.

- 3.7. Then, prepare three silk threads with correct lengths corresponding to segments S1-S2 (S1 S2), S1-S3 (S1 S3), and S2-S3 (S2 S3) [1-TXT].

3.7.1. File name: M_4.mp4 - 06:34 – 06:40. **TXT: Do not prepare silk threads for S4-S2 and S4-S3**

- 3.8. Place the three silk threads on the anatomical surface of the liver, aligning with the preoperatively planned resection path [1]. These threads provide a physical guide to visualize and follow the resection line precisely during surgery [2].

3.8.1. M_4.mp4 - 09:10 – 09:20, 12:23 – 12:39.

3.8.2. M_4.mp4 - 12:23 – 12:33.

- 3.9. Use an electric knife to cauterize the liver by cutting along the silk thread markers on the surface [1], and sew a rubber band on the liver to aid in traction [2].

3.9.1. M_5.mp4 - 00:15-00:25.

3.9.2. M_5.mp4 - 05:51-05:25.

- 3.10. Then, use an ultrasonic knife to transect the liver parenchyma along the marker lines [1]. Clip encountered vessels with hemo-locks [2], suction blood using an aspirator [3], and use bipolar forceps to stop any bleeding [4].

3.10.1. M_5.mp4 - 08:53 – 09:00.

3.10.2. M_5.mp4 - 12:33 – 12:38.

3.10.3. M_6.mp4 - 07:32 – 07:40.

3.10.4. M_9.mp4 - 09:25 – 09:30.

- 3.11. Now, place the specimen in a surgical bag and make a 4-centimeter incision in the upper

abdomen using a scalpel to extract it [1]. After confirming the absence of active bleeding [2], place hemostatic materials on the transection surface [3], and insert a drainage tube exiting from the right lower abdomen [4].

3.11.1. M_10.mp4 - 05:20 – 05:30.

3.11.2. M_11.mp4 - 03:10 – 03:15.

3.11.3. M_11.mp4 - 05:25 – 05:30.

3.11.4. M_12.mp4 - 02:09 – 02:21.

3.12. Finally, examine the resected specimen to confirm the integrity of the tumor capsule and measure tumor dimensions [1-TXT].

3.12.1. M_11.mp4 - 01:33 – 01:41. **TXT: Remove all trocars; Close the incisions in layers using 3-0 absorbable sutures**

Results

4. Results

- 4.1. The preoperative CT scan showed the tumor located in the right liver [1] and the 3D reconstruction of liver indicating the mass was obtained [2].
 - 4.1.1. LAB MEDIA: Figure 1A *Video Editor: Highlight the area pointed by the black arrow*
 - 4.1.2. LAB MEDIA: Figure 1B *Video Editor: Highlight the area pointed by the black arrow*
- 4.2. The postoperative CT scan indicated successful tumor removal without perihepatic fluid accumulation on postoperative day 3 [1].
 - 4.2.1. LAB MEDIA: Figure 6 *Video Editor: Highlight the left half of the image*
- 4.3. The total duration of the surgery was 150 minutes, with a blood loss of 50 milliliters that did not necessitate transfusion [1].
 - 4.3.1. LAB MEDIA: Table 1. *Video editor: Highlight the row "Duration of surgery" and "Blood loss" showing values of "150 min" and "50 mL".*
- 4.4. On the first postoperative day, liver function showed a mild increase in transaminases with alanine transaminase at 222 international units per liter and aspartate transaminase at 217 international units per liter [1].
 - 4.4.1. LAB MEDIA: Table 1. *Video editor: Highlight the row "Postoperative liver function" showing "ALT 222 IU/L, AST 217 IU/L".*
- 4.5. The drainage tube was removed on postoperative day 4 [1], and the patient was discharged on postoperative day 5 without complications [2].
 - 4.5.1. LAB MEDIA: Table 1. *Video editor: Highlight the row "Removement of drainage tube" with the value "POD 4".*
 - 4.5.2. LAB MEDIA: Table 1. *Video editor: Highlight the row "Day of discharge" with the value "POD 5".*
- 4.6. Postoperative pathology confirmed an R0 resection with a tumor size of 1.5 centimeters by 1.5 centimeters [1] and a diagnosis of adenocarcinoma [2].
 - 4.6.1. LAB MEDIA: Table 1. *Video editor: Highlight the row "Tumor size" showing "1.5 cm x 1.5 cm".*

4.6.2. LAB MEDIA: Table 1. *Video editor: Highlight the row “Pathological type” showing “Adenocarcinoma”.*

1. **computed tomography**

Pronunciation link:

<https://dictionary.cambridge.org/pronunciation/english/computed-tomography>
(dictionary.cambridge.org)

IPA: /kəmˌpjʊːˈtɑːməˌɡræfi/

Phonetic spelling: kum-pyoo-TAH-muh-grah-fee

2. **DICOM** (Digital Imaging and Communications in Medicine)

Pronunciation link:

<https://www.forvo.com/word/dicom/> (dictionary.cambridge.org, cancer.gov, forvo.com)

IPA: /ˈdɪk.əm/

Phonetic spelling: DIK-um

3. **parenchyma**

Pronunciation link:

<https://dictionary.cambridge.org/pronunciation/english/parenchyma>
(howtopronounce.com, en.opentran.net, dictionary.cambridge.org)

IPA: /pəˈreŋ.kə.mə/

Phonetic spelling: puh-RENG-kuh-muh

4. **adenocarcinoma**

Pronunciation link:

<https://dictionary.cambridge.org/pronunciation/english/adenocarcinoma>
(dictionary.cambridge.org, wordpanda.net, dictionary.cambridge.org)

IPA: /ˌæd.əˌnoʊ.kɑr.siˈnoʊ.mə/

Phonetic spelling: AD-uh-noh-kar-sih-NOH-muh

Here are more technical and potentially challenging terms from your script, with their American pronunciation guidance:

1. Mimics (software)

Pronunciation link:

<https://www.howtopronounce.com/mimics> ([howtopronounce.com](https://www.howtopronounce.com), [howtopronounce.com](https://www.howtopronounce.com))

IPA: /'mɪm·ɪks/

Phonetic: MIM-iks

2. Hem-o-lok

Pronunciation link:

<https://www.howtopronounce.com/hem-o-lok> ([howtopronounce.com](https://www.howtopronounce.com))

IPA: /,hɛm·oo'lək/

Phonetic: HEM-oh-LOCK

3. Trocar

Pronunciation link:

<https://dictionary.cambridge.org/pronunciation/english/trocar> (US: /'troʊ.kər/) ([howtopronounce.com](https://www.howtopronounce.com), [us.myteleflex.com](https://www.us.myteleflex.com), dictionary.cambridge.org)

IPA: /'troʊ.kər/

Phonetic: TROH-kar

4. Epigastrium

Pronunciation link:

<https://www.spocien.com/pronunciation?code=en&word=epigastrium> ([pronouncebee.com](https://www.pronouncebee.com), [spocien.com](https://www.spocien.com))

IPA: /,ɛp.ə'gæs.tri.əm/ or /,ɛp.ə'gæs.tri.əm/

Phonetic: eh-puh-GAS-tree-um

5. Hypogastrium

Pronunciation link:

<https://www.merriam-webster.com/medical/hypogastrium> ([youtube.com](https://www.youtube.com), [merriam-webster.com](https://www.merriam-webster.com))

IPA: /,haɪ.poo'gæs.tri.əm/

Phonetic: HY-poh-GAS-tree-um

6. Bipolar forceps

Pronunciation link:

<https://www.howtopronounce.com/bipolar-forceps> ([thefreedictionary.com, howtopronounce.com](https://www.thefreedictionary.com/howtopronounce.com))

IPA: /ˌbaɪˈpoʊ.lər ˈfɔr.seps/

Phonetic: bye-POH-ler FOR-seps
