Utilization of 3D Printing in the Surgical Planning of Liver Resection for III-Located Tumors: *A New Dimension in Individualized Liver Surgery*

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Background

• Liver resection is the mainstay of management of most malignant liver tumors, symptomatic benign tumors, and selected asymptomatic adenomas

• Ill-located tumors: hepatocaval confluence, centrally located tumors, perihilar cancers

• Current surgical planning, teaching, and patient education relies on CT and MRI

Background

• 3D printing technology allows the conversion of digital model into a tangible replica of the original

• 3D printing has started being utilized in other various surgical specialties

 Scarce studies that have reported the use of 3D printing to plan living-related liver transplantation and liver resection

Current Surgical Planning Protocol

• Surgical plans are made to determine several key parameters

• Determination of resectability

• Imaging

3D Printing

• 3D image reconstruction \rightarrow coding \rightarrow printing





Our Question

To assess whether the use of 3D printing for ill-located tumors improves:

1) Evaluation of resectability, surgical planning, and perioperative outcome

2) Education and understanding of surgical residents and medical students

3) Understanding and patient's informed consent to proceed for surgery

Protocol

• All consecutive patients planning for hepatectomy for malignant tumors and symptomatic benign tumors and ill-located tumors will be included

• Image acquisition and conversion to 3D imaging

• Assessment and comparison

Surgeons

• Comparison of preoperative assessment and surgical preparation using current imaging resources vs. 3D model

• Volume & anatomic comparison of 3D model to original

• Questionnaire

Surgeon Questions

Pre-Operative

1. I feel I understand the radiological imaging Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree 2. I was able to determine the resectability of the mass using radiologic imaging Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree 3. I have developed a preoperative plan using radiologic imaging Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree 4. The planned resection volume was determined using the radiologic imaging Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree 5. I anticipate potential anatomic difficulties specific to this procedure after using the radiologic imaging Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree 6. I was able to anticipate the need for vascular grafts after reviewing the radiologic imaging Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

Pre-Operative

7. I feel I understand better after examining the 3D model
Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree
8. I changed my determination of resectability of the mass after using the 3D model
Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree
9. I changed the preoperative plan after using the 3D model
Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

Surgical Residents & Medical Students / Patients

• Questionnaire

• Understanding and Confidence

• Understanding, Confidence, Satisfaction

Resident/Student Questions

Understanding

1. I feel I understand the procedure after reviewing the radiologic imaging

Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

2. I feel I understand the radiological imaging

Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

3. I feel the physician explained the patient's diagnosis and surgical plan well using radiologic imaging

Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

4. I feel that I understand the anatomy after reviewing radiologic imaging

Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

Confidence

5. I feel confident going into surgery after reviewing the radiologic imaging
Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree
6. I understand the preoperative plan after reviewing the radiologic imaging
Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

Understanding

7. I feel I have a better understanding of the procedure after reviewing the 3D model
Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree
8. I feel I have a better understanding after examining the 3D model
Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

Patient Questions

Understanding

1. I feel I understand the procedure

Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

2. I feel I understand the radiological imaging

Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

- I feel the physician explained my diagnosis and surgical plan well Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree Confidence
 - 4. I feel confident in receiving the procedure after having the radiologic imaging explained to me

Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

Satisfaction

5. I feel satisfied after the pre-surgical consultation using the radiologic imaging Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

Understanding

- 6. I feel I have a better understanding of the procedure after examining the 3D model Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree
- 7. I feel I have a better understanding after examining the 3D model

Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

8. I feel that the 3D model enhanced the physician's explanation of my diagnosis and surgical plan

Strongly Disagree Slightly Disagree Neither Slightly Agree Strongly Agree

Let's Try It

PollEV.com/harrisonvolask436



Methods

- 10 cases; currently at 8 but will close at 10
 - To be completed by 10 patients, ~20 residents, ~50 students, at least 2 hepatobiliary surgeons and more general surgeons
- Cohort/Case-Control study
- Data source/measurement surveys to be completed and analyzed
- Limitation 3D models are not perfect
- Data analysis
 - Mann-Whitney U test or one-way ANOVA
 - To be expressed as mean ± standard deviation
 - Statistical Package for the Social Science to be used for analysis
 - P < 0.05 = statistical significance

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