

Hyoid Displacement Calculation Instructions

Introduction: In this file you will find instructions for measuring hyoid displacement (single peak and two peaks). While recent data from research in our lab suggests that measurement of a single point (peak position) is adequate for capturing variations in hyoid movement during swallowing across different conditions, you may still wish to measure displacement between a rest and peak position. In this case, we recommend that you choose a rest position at the end of the swallow, after the hyoid has returned to baseline; we call this frame the “Swallow Rest” frame.

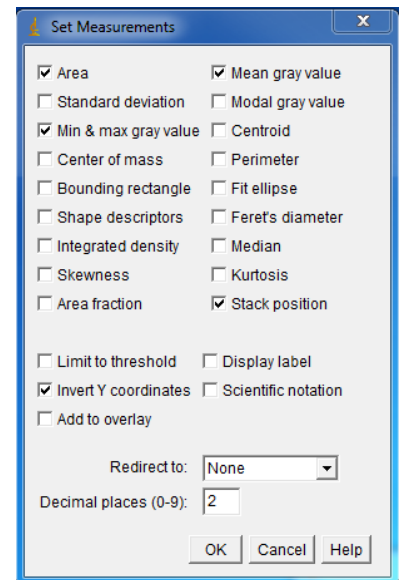
How to Measure Hyoid Rest to a Single Hyoid Peak

1. Open ImageJ

(Download from the following website: <http://rsbweb.nih.gov/ij/>)

2. Set Measurements

- Click *Analyze* → *Set Measurements*
 - Only necessary the first time you set up ImageJ on your computer
- Set measurements as per the diagram to the right:
- Click *OK*

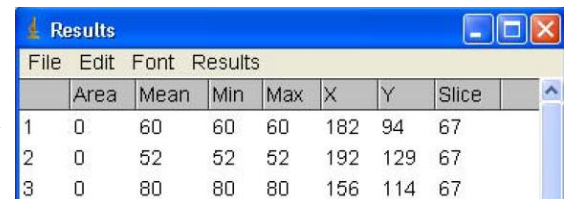
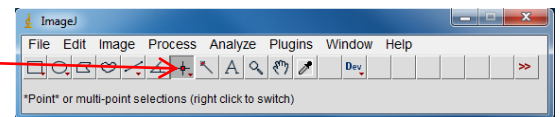


3. Find the hyoid rest frame

- Locate the hyoid rest frame

4. Take measurements on hyoid rest frame

- Select the *Point* tool
- Locate the C2 vertebrae:
 - Click on the anterior inferior edge of C2 vertebrae
 - Press *Ctrl + M*
- a. Locate the C4 vertebrae:
 - Click on the anterior inferior edge of C4 vertebrae
 - Press *Ctrl + M*
- b. Locate the Hyoid:
 - Click on the anterior inferior edge of the hyoid
 - Press *Ctrl + M*



	Area	Mean	Min	Max	X	Y	Slice
1	0	60	60	60	182	94	67
2	0	52	52	52	192	129	67
3	0	80	80	80	156	114	67

Note: The measurements must be taken in the exact order described above.

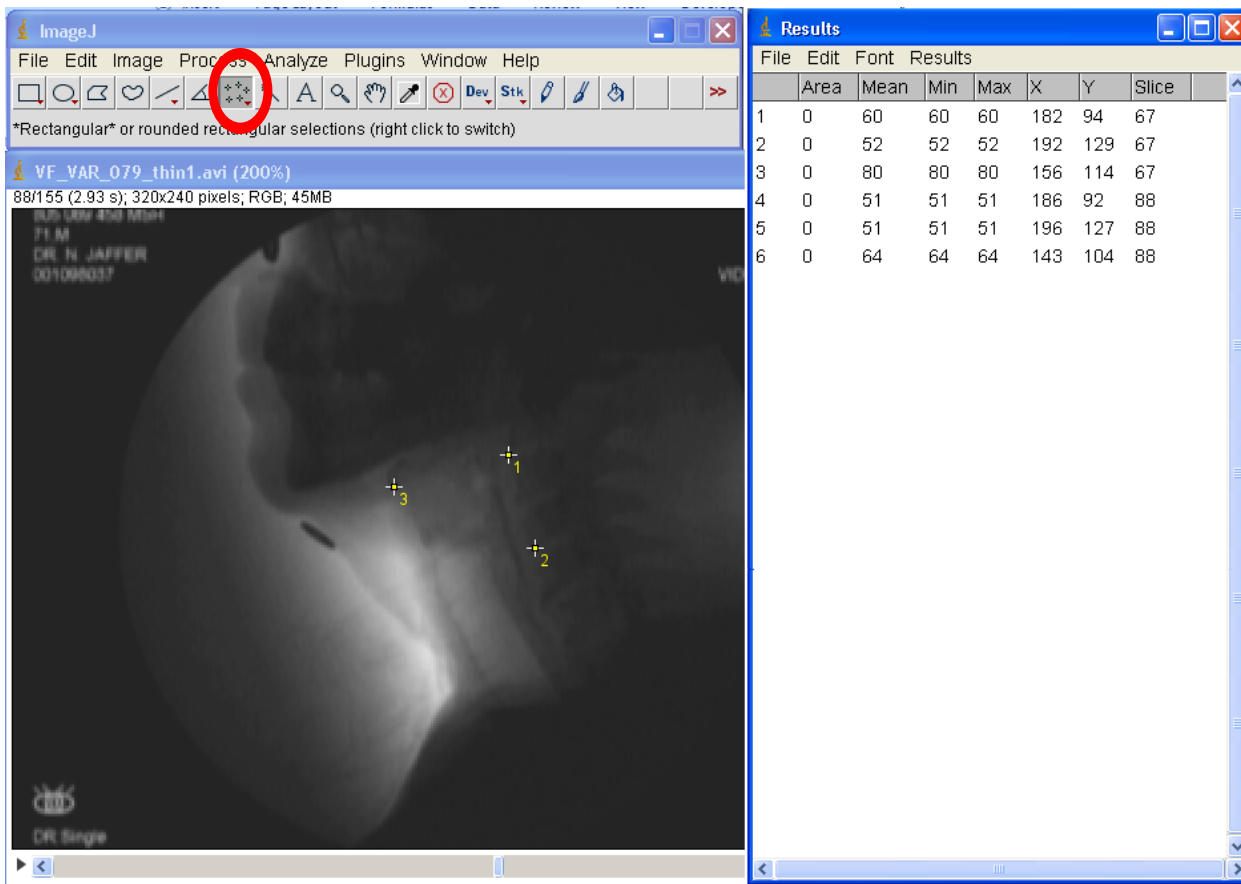
5. **Find the hyoid peak frame**

- Locate the hyoid peak frame

6. **Take measurements on hyoid peak frame**

- Select the *Point* tool
- Locate the C2 vertebrae:
 - Click on the anterior inferior edge of C2 vertebrae
 - Press *Ctrl + M*
- c. Locate the C4 vertebrae:
 - Click on the anterior inferior edge of C4 vertebrae
 - Press *Ctrl + M*
- d. Locate the Hyoid:
 - Click on the anterior inferior edge of the hyoid
 - Press *Ctrl + M*

Note: The measurements must be taken in the exact order described above.



7. **Collate data**

- Open the *Hyoid Displacement Calculation Sheet*
- Select the '1 Peak' tab
- In the Results box, select all 6 rows
- Press *Ctrl + C* to copy the data Press *Ctrl + V* to paste the data into the orange rectangle in the Excel worksheet

Step 1: Copy and Paste data from ImageJ into the following table (orange rectangle)

Frame	Measure	1-->6	Area	Mean	Min	Max	X	Y	Slice
Rest	C2								
	C4								
Peak	Hyoid								
	C2								
	C4								
	Hyoid								

The screenshot shows the Excel spreadsheet with the following data in the table:

Frame	Measure	1-->6	Area	Mean	Min	Max	X	Y	Slice
Rest	C2								
	C4								
Peak	Hyoid								
	C2								
	C4								
	Hyoid								

The ImageJ Results window shows the following data:

	Area	Mean	Min	Max	X	Y	Slice
1	0	60	60	60	182	94	67
2	0	52	52	52	192	129	67
3	0	80	80	80	156	114	67
4	0	51	51	51	186	92	88
5	0	51	51	51	196	127	88
6	0	64	64	64	143	104	88

The Excel spreadsheet shows the following output results in a green box:

Superior Hyoid Displacement: N/A (%C2-C4)
 Anterior Hyoid Displacement: N/A (%C2-C4)

The bottom status bar shows '1 Peak' selected.

8. Review the results

- The hyoid displacement will be displayed in the Excel worksheet (green box in image above)

How to Measure Hyoid Rest to Two Hyoid Peak

1. Open ImageJ

(Download from the following website: <http://rsbweb.nih.gov/ij/>)

2. Set Measurements

- Click *Analyze* → *Set Measurements*
 - Only necessary the first time you set up ImageJ on your computer
- Set measurements as per the diagram to the right:
- Click *OK*

3. Find the hyoid rest frame

- Locate the hyoid rest frame
- Select the *Point* tool
 - a. Locate the C2 vertebrae:
 - Click on the anterior inferior edge of C2 vertebrae
 - Press *Ctrl + M*
 - b. Locate the C4 vertebrae:
 - Click on the anterior inferior edge of C4 vertebrae
 - Press *Ctrl + M*
 - c. Locate the Hyoid:
 - Click on the anterior inferior edge of the hyoid
 - Press *Ctrl + M*

Note: The measurements must be taken in the exact order described above.

4. Find the hyoid peak SUPERIOR frame

- Locate the hyoid peak SUPERIOR frame
- Select the *Point* tool
 - d. Locate the C2 vertebrae:
 - Click on the anterior inferior edge of C2 vertebrae
 - Press *Ctrl + M*
 - e. Locate the C4 vertebrae:
 - Click on the anterior inferior edge of C4 vertebrae
 - Press *Ctrl + M*
 - f. Locate the Hyoid:
 - Click on the anterior inferior edge of the hyoid
 - Press *Ctrl + M*

Note: The measurements must be taken in the exact order described above.

5. **Find the hyoid peak ANTERIOR frame**

- Locate the hyoid peak ANTERIOR frame
- Select the *Point* tool
 - g. Locate the C2 vertebrae:
 - Click on the anterior inferior edge of C2 vertebrae
 - Press *Ctrl + M*
 - h. Locate the C4 vertebrae:
 - Click on the anterior inferior edge of C4 vertebrae
 - Press *Ctrl + M*
 - i. Locate the Hyoid:
 - Click on the anterior inferior edge of the hyoid
 - Press *Ctrl + M*

Note: The measurements must be taken in the exact order described above.

6. **Collate data**

- Open the *Hyoid Displacement Calculation Sheet*
- Select the '2 Peaks' tab
- In the Results box, select all 6 rows
- Press *Ctrl + C* to copy the data Press *Ctrl + V* to paste the data into the orange rectangle in the Excel worksheet

7. **Review the results**

- The hyoid displacement will be displayed in the Excel worksheet