

# NRRS Rating Instructions

**Introduction:** This file explains how to measure the severity of residue in the valleculae and piriform sinuses using a new, anatomically normalized scale known as the Normalized Residue Ratio Scale, which is described in a recent publication: Pearson, W. G. Jr., Molfenter, S. M., Smith, Z. M. & Steele, C. M. (2013). Image-based measurement of post-swallow residue: The normalized residue ratio scale. *Dysphagia*, 28, 167-177. DOI 10.1007/s00455-012-9426-9.

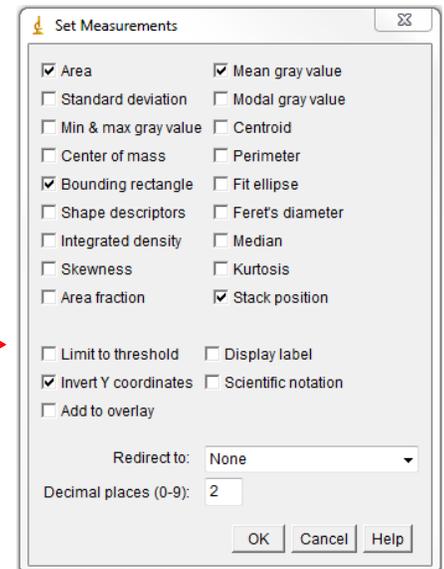
## How To Measure Residue (Valleculae & Piriform)

### 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*



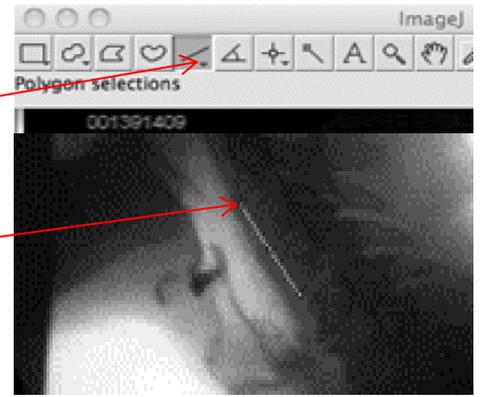
### 3. **Find the frame: post-swallow 'rest'**

- Click *File* → *Open* and select the video you want to work on
- Select the first frame\* of the lowest position of base of the pyriform sinus, provided that it occurs before the earliest of the following 3 events:
  - End of clip
  - End of fluoro
  - Onset of hyoid movement for the subsequent swallow/clearing swallow.
  - In the case where multiple swallows are used to clear a single bolus, use the rest frame at the end of the first swallow in the series.

\*This will be the 'first frame' such that if the pyriform stays in the same lowest position for multiple frames and does not go lower before any of the end points happen, select the first frame where it reaches that lowest location.

4. **Draw a scalar reference line from C2 to C4**

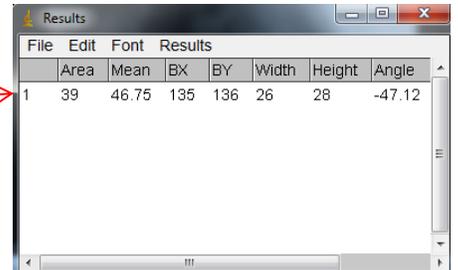
- Select the *Line* tool
- Click (and hold) on the anterior inferior edge of C2 vertebrae
- Hold the mouse button down and drag to draw a line to the anterior inferior edge of C4; release the mouse button
  - This generates an internal anatomical scalar reference



**Note:** If you make a mistake or want to change the line, click anywhere on the image; the line will disappear

5. **Save the area measurement**

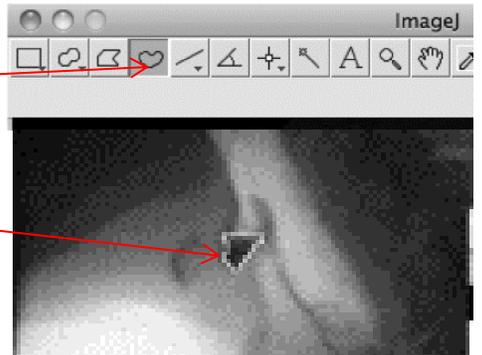
- Press *Ctrl + M*
- A *Results* box will appear
  - Leave this box open as more data will be added



6. **Capture vallecular residue**

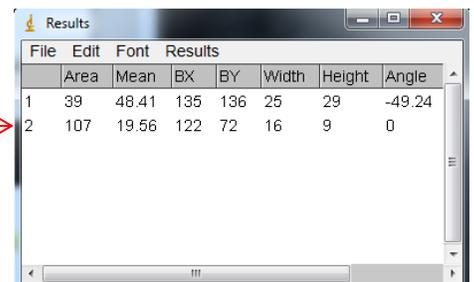
- Select the *Freehand* tool
- Click and hold to trace a contour line around vallecular residue (if any)

**Note:** If there is no vallecular residue, you will not need to complete this step; **jump to Step 10.** You will enter "0" for all vallecular measurements in Step 13 (*How To Collate Data*)



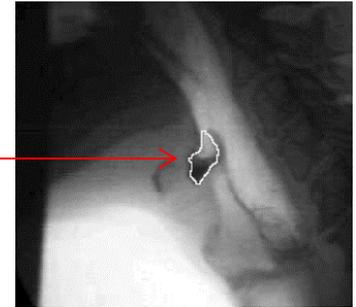
7. **Save the area measurement**

- Press *Ctrl + M*
- The values will appear in the same *Results* box
  - Leave this box open as more data will be added



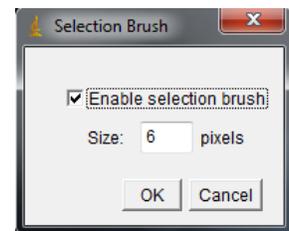
8. **Expand line to outline entire valleculae**

- Right-click *Oval Selection Tool*
- Choose *Brush Selection Tool*
- Click and hold down; a circle will appear
- Use this circle by nudging the contour line you have already created around the residue to include the entire spatial housing of the valleculae



**Note:** For finer control, you can adjust the 'size' (pixel width) of the brush:

- Double-click on the *Oval/Brush Selection Tool*
- Change the number of pixels and click *OK*



9. **Save the area measurement**

- Press *Ctrl + M*
- The values will appear in the same *Results* box
  - Leave this box open as more data will be added

	Area	Mean	BX	BY	Width	Height	Angle
1	39	46.75	135	136	26	28	-47.12
2	127	23.77	122	73	16	10	0
3	208	44.01	122	80	16	17	0

10. **Capture piriform sinus residue**

- Repeat steps 6-9 for the piriform sinus residue (if any)

**Note:** The top of the piriform sinuses is defined operationally using a line extending from the tip of the arytenoid shadow to the posterior pharyngeal wall, perpendicular to the vertebral axis

## How To Collate Data

### 1. Open NRRS Rating Excel Calculation Sheet

### 2. Copy the data from the Results box

- In the Results box, select all the rows in the results
- Press **Ctrl + C** to copy the data



	Area	Mean	BX	BY	Width	Height	Angle	Slice	Length
1	39	46.75	135	136	26	28	-47.12	1	37.98
2	127	23.77	122	73	16	10	0	1	0
3	208	44.01	122	80	16	17	0	1	0

### 3. Paste the data into the Excel sheet

- Press **Ctrl + V** to paste the data into the orange rectangle

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

MEASUREMENT	Measurement #	Area	Mean	BX	BY	Width	Height	Angle	Slice	Length
C2-C4	1									
Val Residue	2									
Valleculae Space	3									
Piriform Residue	4									
Piriform Space	5									

**Note:** Make sure **vallecular data** is in **rows 2 and 3**, and **piriform sinus data** is in **rows 4 and 5**

- If you have **vallecular residue only**:
  - Copy and paste all three rows from the ImageJ Results table into rows 1-3 in the Excel sheet
  - Leave rows 4 and 5 blank as you did not trace piriform sinus residue
- If you have **piriform sinus residue WITHOUT vallecular residue**
  - Paste the first row from the ImageJ Results table into row 1 in the Excel sheet
  - Leave rows 2 and 3 blank as you did not trace vallecular residue
  - Paste the second and third row from the ImageJ Results table into rows 4 and 5 in the Excel sheet

### 4. Review the results

- The NRRS ratings will be displayed in the Excel document
- Optional: Fill out the patient information fields

#### Step 2: Output/Results

##### Patient Information and VFSS Particulars:

Patient Name: \_\_\_\_\_

Exam Date: \_\_\_\_\_

Additional Info: \_\_\_\_\_

##### NRRS Results:

NRRSv: \_\_\_\_\_

N/A

NRRSp: \_\_\_\_\_

N/A