Supplementary Materials and Methods

How to measure the vestibular aqueduct (VA) bending angle with the "Cool Angle Calc"-software

1.   Go to https://danielzuerrer.github.io/CoolAngleCalcJS to use an online version of the software, or go to https://github.com/DanielZuerrer/CoolAngleCalcJS to download the software for offline use.

click here or drag here to display image

© Daniel Zuerrer. Shortcuts: ROTATE (Alt + Drag) • KEEP ASPECT RATIO (Shift + Resize) • FLIP (Alt + A) • SWITCH (Alt + W) • REPLACE (Alt + R) • SAVE MODE (Alt + S). Click Title to Copy.

Start screen of the Cool Angle Calc-software.

2. In your medical image viewer, choose from a temporal bone CT or MRI scan (axial plane) an image that shows the vestibule, the horizontal semicircular canal (SCC), and the distal portion of the VA. Save the image as a JPEG. Import the image into the software by dragging-and-dropping the JPEG-file on the grey-shaded area of the start screen, or by left-clicking the grey-shaded area. A drop-down menu will appear from which you can search and select the saved JPEG-file. Klick "Open" to import the file.

Note: In many cases, the vestibule and the horizontal SCC are seen in another focal plane than the distal portion of the VA. In those cases, two JPEG-files have to be saved and imported in the software by clicking on the grey-shaded area labeled "add second image".
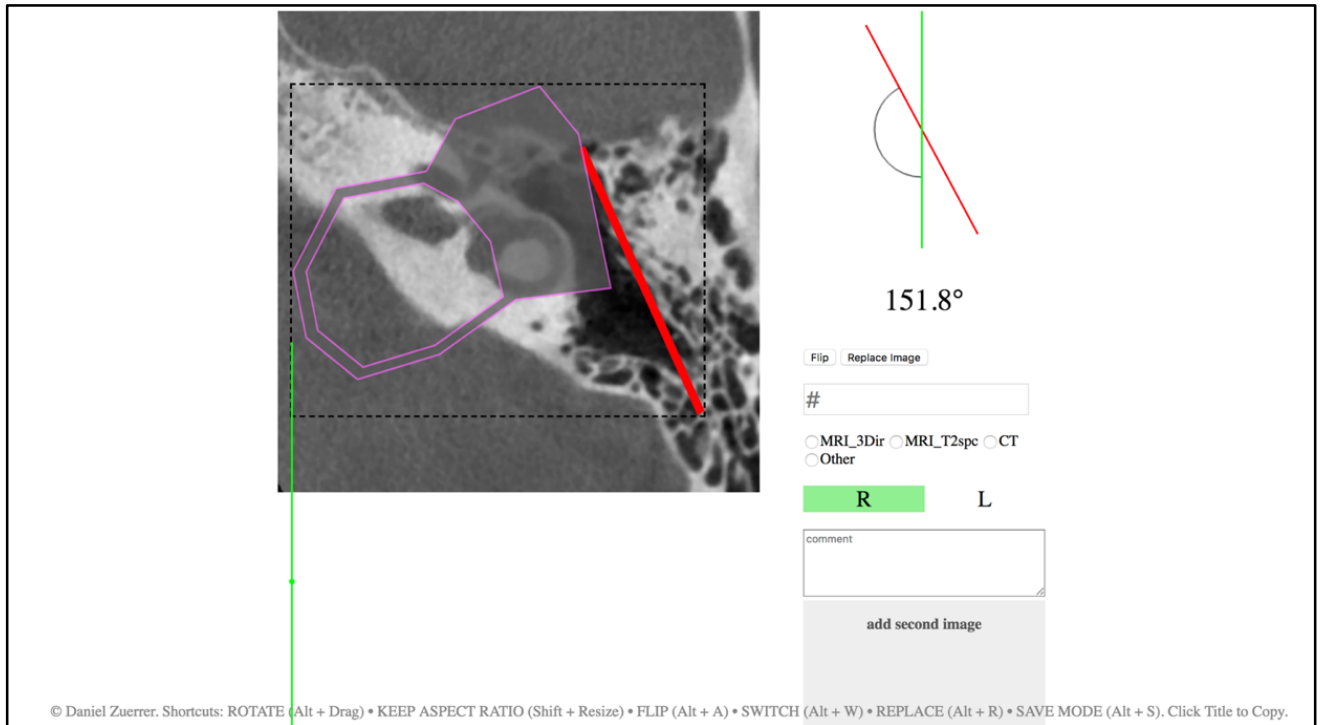

Image (saved JPEG-file) imported into the software.

3. Flip (alt + A), rotate (alt + drag) and resize (drag, keep aspect ratio with Shift + drag) the grey-shaped form to fit it into the boundaries of the vestibule and the horizontal SCC. The shape's red line indicates the trajectory of the proximal vestibular aqueduct, which, together with the medial wall of the vestibule, defines the vestibulo-aqueductal angle.
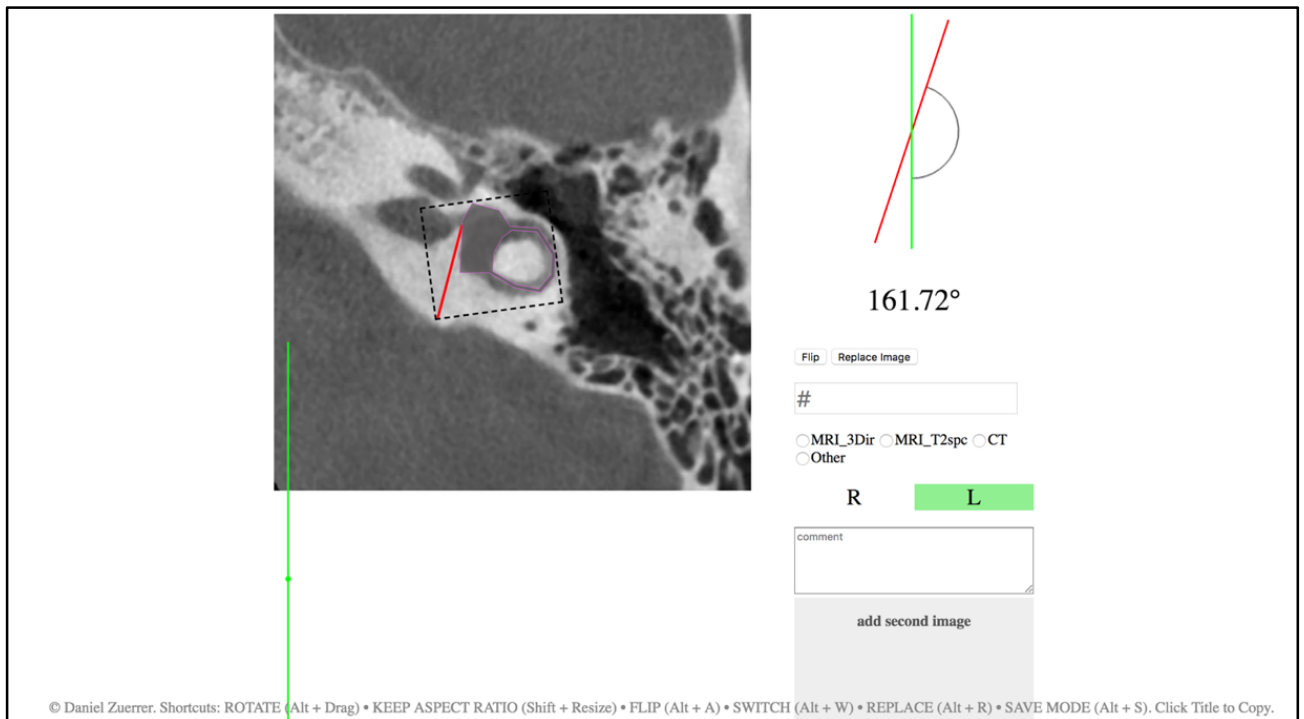
The form is fitted into the boundaries of the vestibule and the horizontal SCC. The red line now indicates the trajectory of the proximal VA portion (average vector, as determined on histological sections from normal adults)

4. If the distal portion of the vestibular aqueduct is not displayed on the first imported image, add a second image from the respective focal plane. Click the grey-shaded area labeled "add second image" and select an image from the drop-down menu or drag and drop an image on the grey-shaded area. If no second image is required, perform the following step on the first image: Fit the green line along (parallel to) the vestibular aqueduct by rotating it (alt + drag). To go back and forth between two imported images, use the "Switch Images" button (or shortcut: alt + W). Images can be replaced using the button "Replace Image".
    Note: In the upper right corner of the browser window, the measured VA bending angle is illustrated.
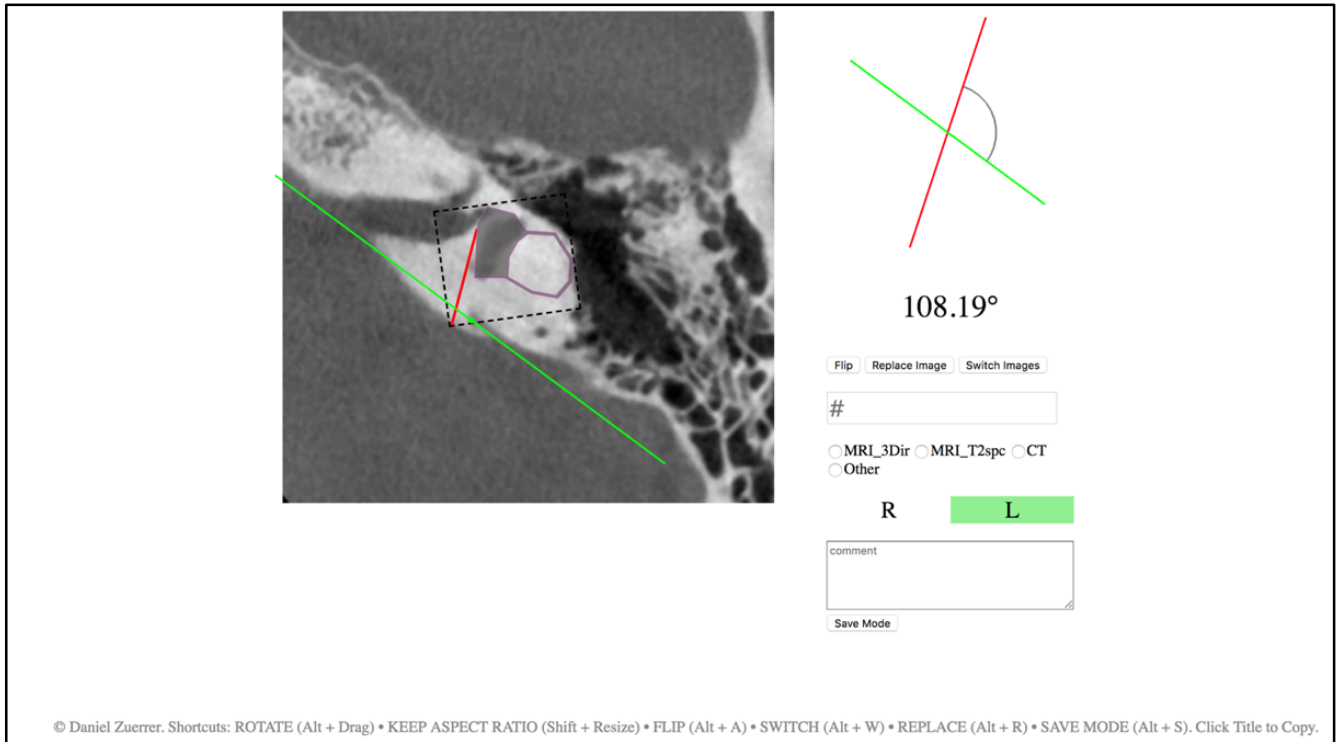
Completed measurement of the VA bending angle. The geometrics and value of the measured angle are displayed in the upper right part of the browser window.

5. To save the measurement results, type a file name and indicate the imaging modality, then click the "Save Mode" button (shortcut alt + s). By clicking OK, the image will be saved to the clipboard, from where it can be copied in an image processing software, or a data storage file.

Save screen. The image and angle measurement will be saved to the clipboard.