

## One third of the anterior portion of the optic nerve is susceptible to motion of different eye direction

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**Overview.** To investigate the extent of non-rigid optic nerve motion in relation to the positioning of the eyes in different directions during MRI acquisition.

**Background.** When eyes move, optic nerves (ON) move. However, few studies have explored the extent of ON motion and influence of eye movements on ON MRI-derived measures.

**Methods.** Four healthy controls were each scanned five times using a fat saturated coronal FLAIR sequence (1.7mm slice thickness). Each patient focused their eyes on set points placed six inches from a neutral focal point. These points positioned the optic nerve ON at four extremes of eye movement: left, right, up, down, and a neutral position. All scans were registered to the neutrally acquired scan for respective subjects and voxels were sub-sampled to be isotropic (voxel size 0.8594 mm<sup>3</sup>). ON lengths were measured by locating three landmarks on each nerve and calculating the Euclidean distance between points. The landmarks consisted of the points where the ON left the orbit, connected to the optic chiasm (chosen to be the same for both left and right nerves in order to increase reproducibility), and the point where the ON no longer moved with the eye's motion. The third point was calculated as follows: 1) the four extreme direction scans (left, right, up and down) were averaged to create one image showing the location of the ON; 2) the average scan was then subtracted from the neutral position scan, leaving visible only the part of the ON which did not overlap; 3) the slice where no more than two voxels of the ON on the subtracted image were visible was quantified as the rigid part of the ON. To quantify the amount of ON motion during eye movements, we calculated the percent of movement for the total length of the ON with respect to the total length of the ON (% motion of optic nerve).

**Results.** Mean length of the ON was 47.27 $\pm$ 1.18 mm. Mean length for total ON movement was 15.84 $\pm$ 2.13mm. Mean % motion of the ON was 33.46 $\pm$ 4.00%, occurring exclusively in the anterior part of the ON. Mean % motion of the ON was independent of the four eye direction movements (p=NS).

**Conclusions.** Measurement of the ON in high resolution MRI images revealed that approximately one-third of the ON's anterior portion is susceptible to motion of eye direction. The ON's posterior two-thirds were not susceptible to eye movements. This exploratory study showed fairly invariant results between subjects in measuring % motion of the ON. Although further studies need to be conducted with a larger sample, this study determined the ON's range of % motion and provided useful information for better understanding of whether eye motion may affect MRI ON analyses. One simple approach for reducing the error introduced by this % motion would be to remove the ON's anterior third in calculating different MRI ON measures.