# Correlation of Objective Pupillometry to Midline Shift in Acute Stroke Patients

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## Background

The relationship between pupil reactivity assessed with a flashlight, and intracranial midline shift has been previously noted. Pupillometers provide objective evaluation of the pupillary light reflex (PLR) including the Neurologic Pupil Index (NPi) and constriction velocity (CV). This study examines the hypothesis that pupillometry values correlate with intracranial midline shift.

## Methods

Data from the ENDPANIC registry provided data on 134 patients with an acute ischemic stroke or intracerebral hemorrhage who had at least 2 neurologic imaging studies (CT or MRI) performed within 6 hours of a pupillometer assessment. Septum pellucidum shift (SPS) was measured in 293 images meeting inclusion criteria. We computed the correlation between SPS and the following pupillary variables: Size, NPi, CV (Left, Right and left-right difference) using SAS software. We then performed a mixed effect regression model to control for confounders.

## Table 1 : Baseline Characteristics

| Variable | N(%) |
|---|---|
| **Primary Diagnosis** | |
| ICH | 40 (29.9) |
| Ischemic Stroke | 94 (70.1) |
| **Race** | |
| Black | 28 (20.9) |
| White | 83 (61.9) |
| Other | 23 (17.2) |
| **Gender** | |
| Male | 67(50.0) |
| Female | 67(50.0) |
| **Age Mean(SD)** | 65.1(15.2) 53.0-76.0 |

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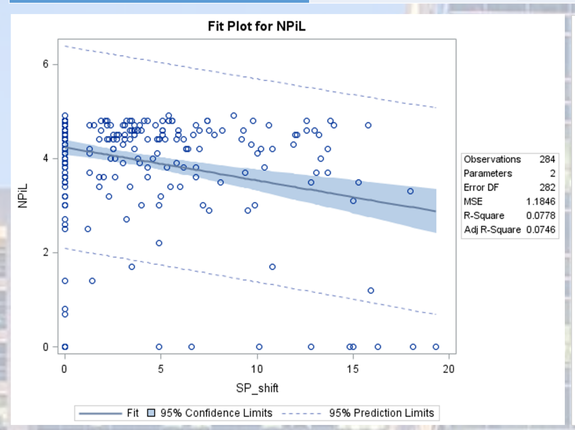
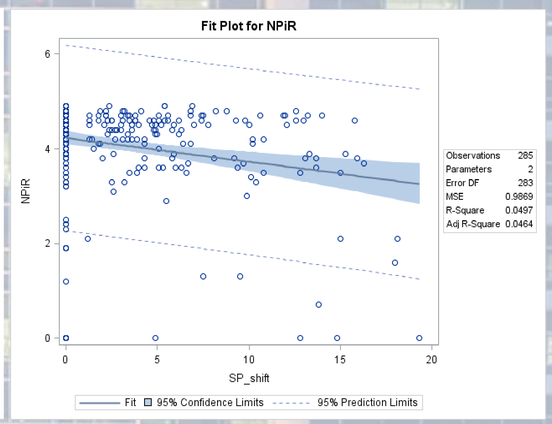
## Table 2 : Correlation Coefficients

| Variable 1 | Variable 2 | Correlation Coefficient (*p*-value) |
|---|---|---|
| SP Shift | NPIL | -0.28(0.001) |
| SP Shift | NPIR | -0.22(0.001) |
| SP Shift | SizeL | -0.05(0.383) |
| SP Shift | SizeR | -0.09(0.136) |
| SP Shift | CVL | -0.18(0.002) |
| SP Shift | CVR | -0.25(0.001) |
| SP Shift | NPIL when SP_side=L2R | -0.23(0.349) |
| SP Shift | NPIR when SP_side=R2L | -0.43(0.001) |



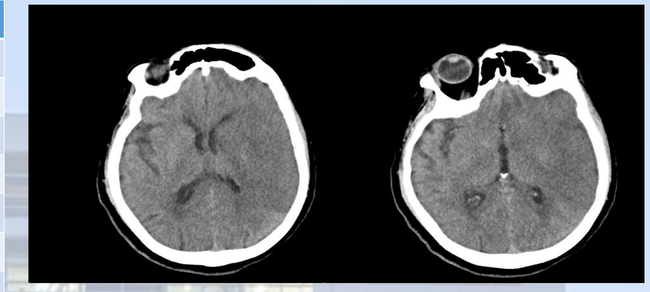

## Results

The mean age was 65.1 years, 67 (50%) of subjects were female, 94 (70.1%) had an Ischemic stroke and 40 (29.9%) had hemorrhagic stroke. After controlling for age, race and gender, there was a significant correlation between the SPS and NPi [Left ($p<0.001$), Right ($p<0.001$) and left-right difference ($p<0.005$)], CV [Left ($p<0.005$), Right ($p<0.001$) and pupillary asymmetry (absolute difference between right and left; $p<0.05$), but not between SPS and pupillary size (left or right). There was also a significant correlation between the NPi and CV for the right pupil when there was a right-to-left SPS ($p<0.001$ and $p<0.05$ respectively), but none between the NPi and CV for the left pupil and left-to-right SPS.

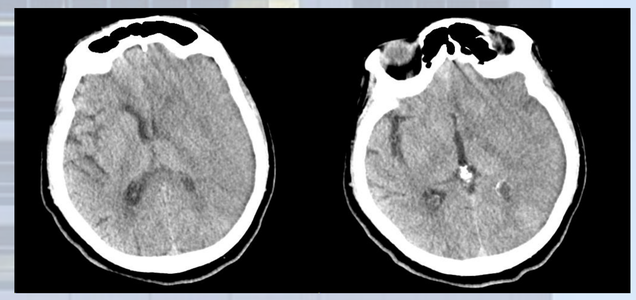
## Conclusion

There is statistically significant relationship between midline shift and objective measures of pupillary reactivity (NPi and CV) but not with pupillary size. This indicates that NPi assessment by automated pupillometry has the potential to detect midline shift in stroke patients. Automated pupillometry assessment may therefore become an adjunct to the utilization of neuro-imaging in determining the need for intervention. Prospective trials are needed to further assess the role of objective automated pupillometry in predicting impending herniation and decline in stroke patients.

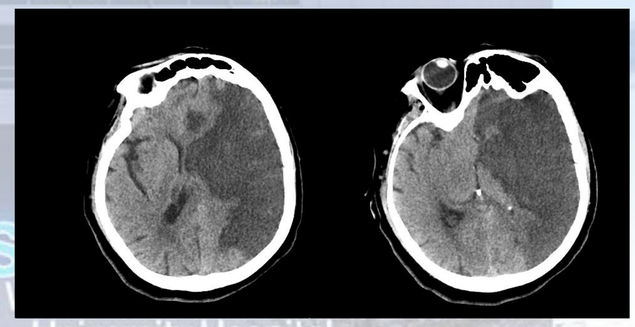
## Case Example



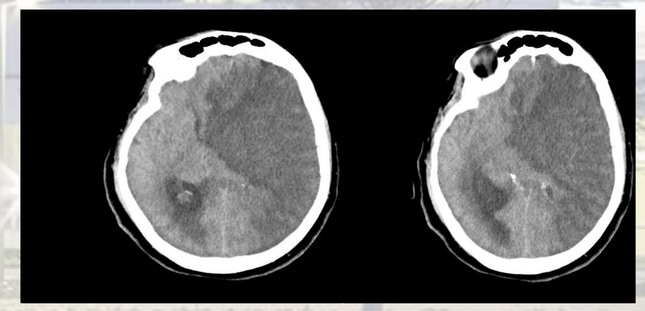
Day 1 : Midline Shift 3.9mm/NPi L:4.7, R:3.5



Day 2 : Midline Shift 5.1mm/NPi: L:4.6, R:3.6



Day 5 : Midline Shift 12.6mm/NPi: L:4.8, R:4.6



Day 8 : Midline Shift 19.3mm/NPi: L:0, R:0