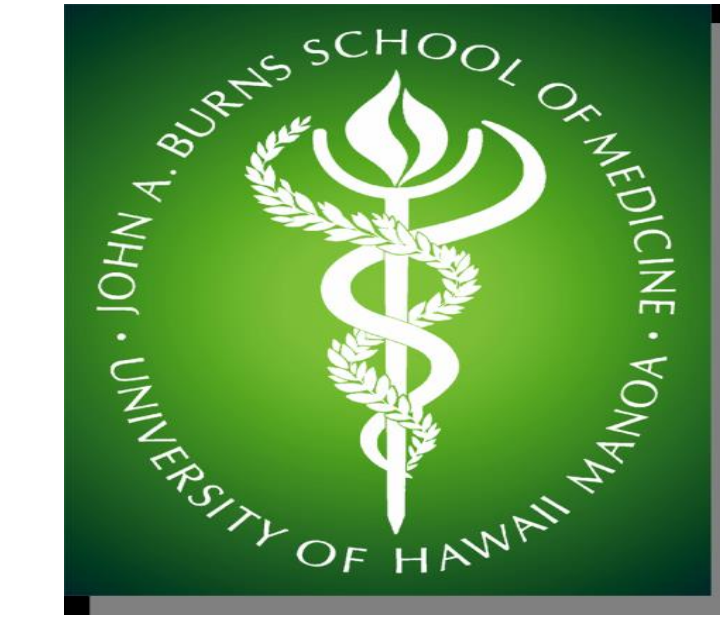




Optic Nerve Sheath Diameter (ONSD) in ventriculo-peritoneal shunt malfunction

S. Javed Zaidi MD; Loren Yamamoto, MD, MPH, MBA, FAAP, FACEP;
Department of Pediatrics, Univ. Hawai'i, JABSOM; Kapi'olani Medical Center for Women and Children



Background

Recent research shows a positive correlation of the ONSD measurement by US with increased ICP. Very few studies have been performed on children with VP shunt malfunction. Most studies have been done in adults.

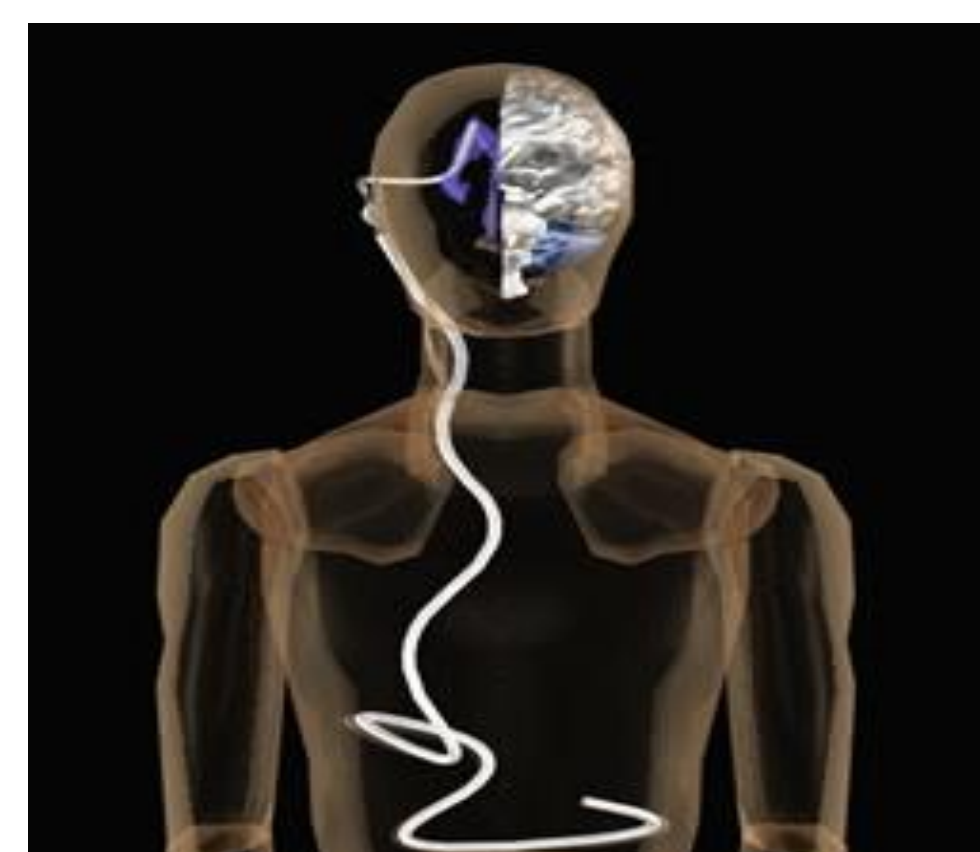
Some studies have measured the ONSD by MRI and found a positive correlation with increased ICP. Cranial CT scan is currently the most common method used to assess VP shunt function in children.

Cranial irradiation with CT during infancy result in cognitive harm (Hall, et al). Similar lower severity effects are expected in older children?

Symptoms suggestive of VPS malfunction are very non-specific (sleepy, fussy, vomiting, headache). Most patients with VPSs receive multiple cranial CT scans, most of which are normal. More common causes of vomiting, headache, diminished activity are viral infections. Finding an alternative means of identifying shunt malfunction without high doses of brain radiation is desirable.

Hypothesis:

Use of Optic Nerve Sheath Diameter (ONSD) measurements obtained via other less harmful imaging modalities such as ophthalmic ultrasound may help with early diagnosis of increased intracranial pressure signifying VP shunt malfunction.



Specific Aims:

Previous studies report that optic nerve sheath diameter (ONSD) is increased with increased ICP.

We decided to determine the differences in ONSD measurements on CT scans of patients with VPS obstruction versus controls.

Study Design:

A retrospective review CT scans of patients with VP shunt malfunction and controls.

Age: Inpatients between 0 and 16 years with confirmed VPS obstruction requiring neurosurgical intervention (using ICD-9 codes)

Measurements: Optic nerve diameters (OND), orbit, cranium, and foramen magnum sizes, weight, height, AP length of the skull and skull circumference.

Patient Groups:

Cases: patients with VPS malfunction.

Controls:

- Cases at times when their shunts were functioning
- Other patients with functioning VPSs without malfunction
- Minor head trauma patients who do not have a VPS

VPS obstruction was defined as:

Sx of shunt obstruction (raised ICP) followed within 48 hours by at least one of these:

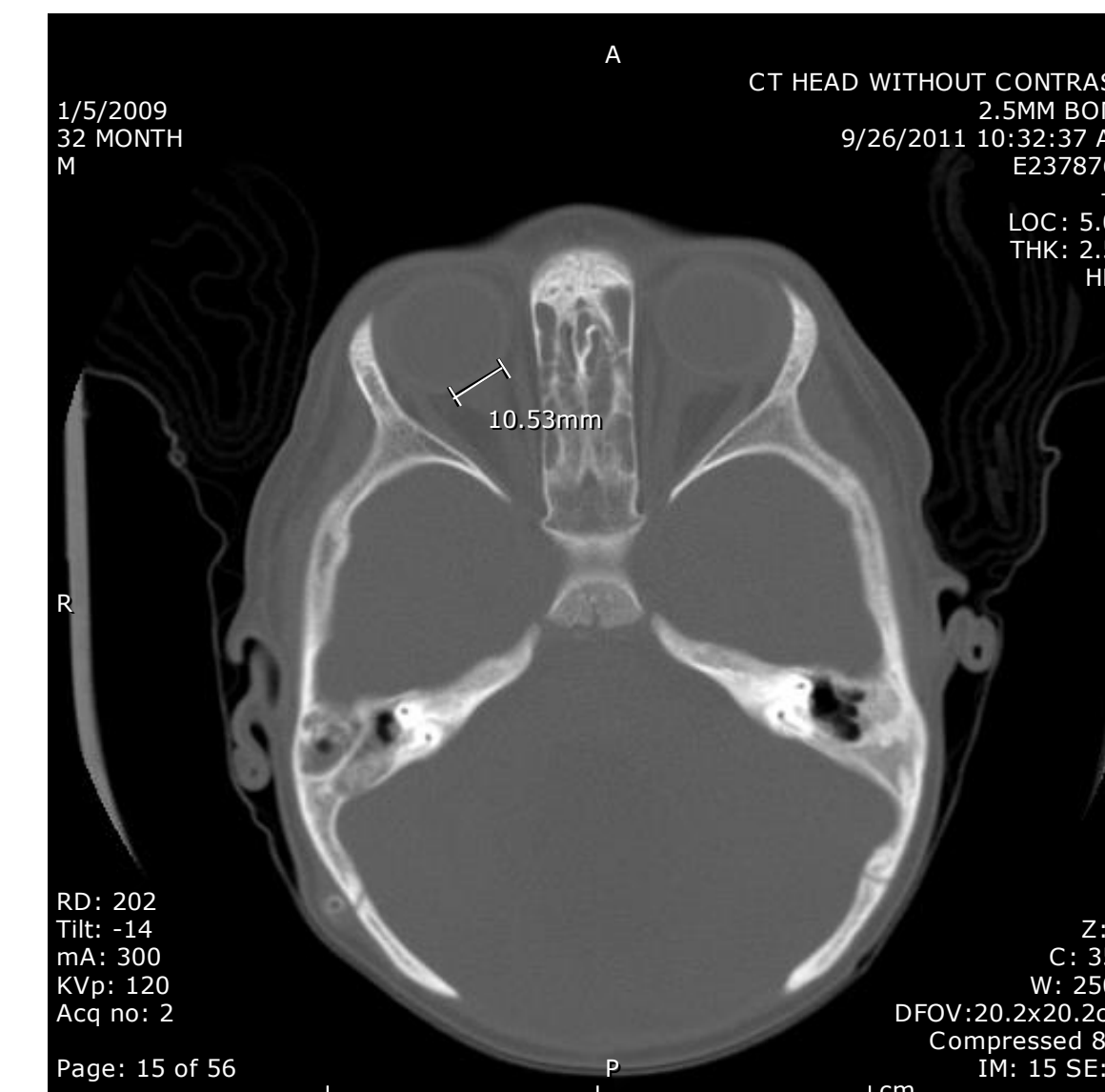
- Shunt revision surgery (total/Partial) in <3d of presentation
- Serial LPs (at least 3)
- Serial VP shunt taps (at least 3)

Analysis

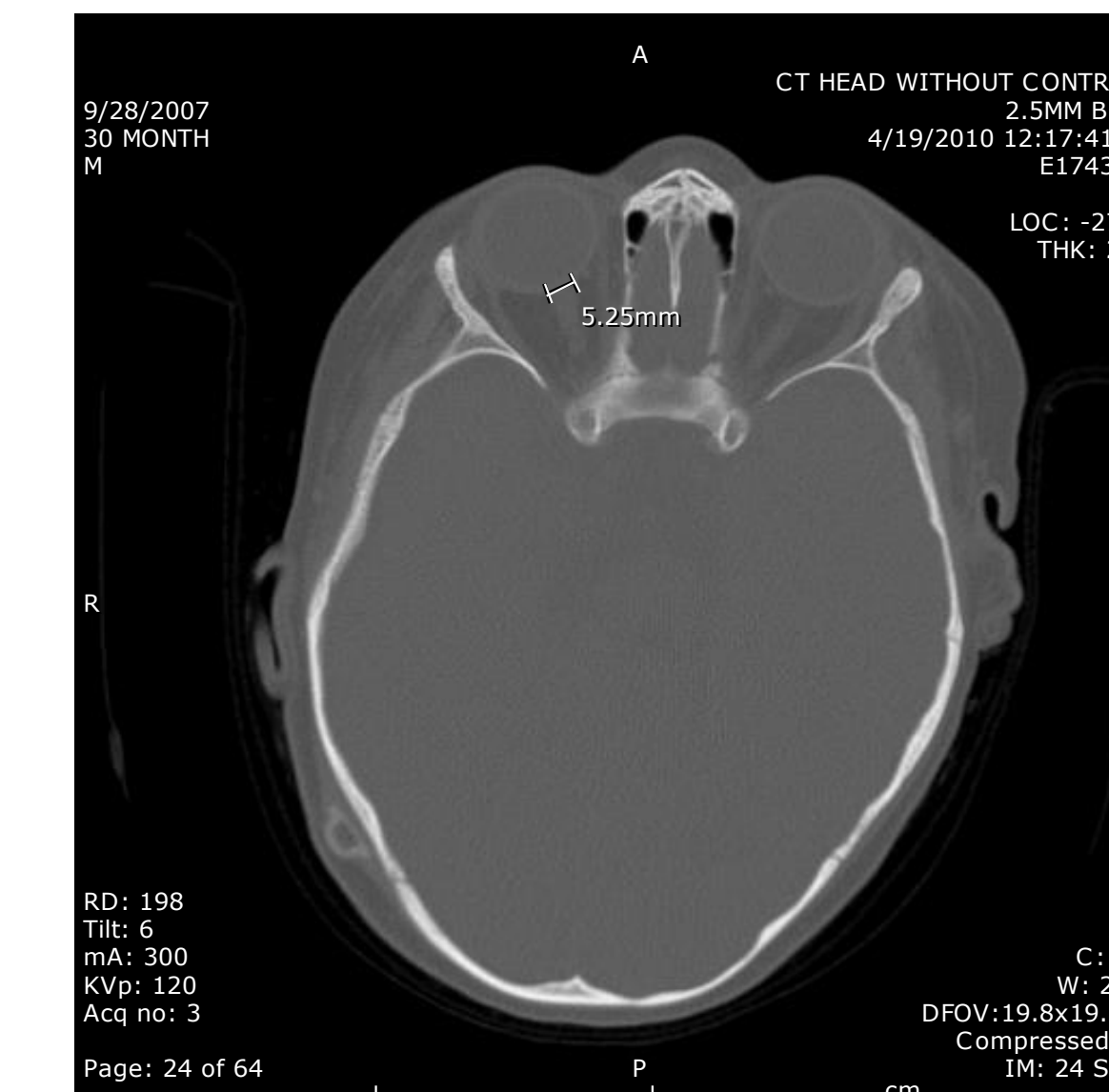
Paired T-tests were used for both case-control comparisons.

In order to compare the optic nerve size more accurately, we chose to correct it by dividing:

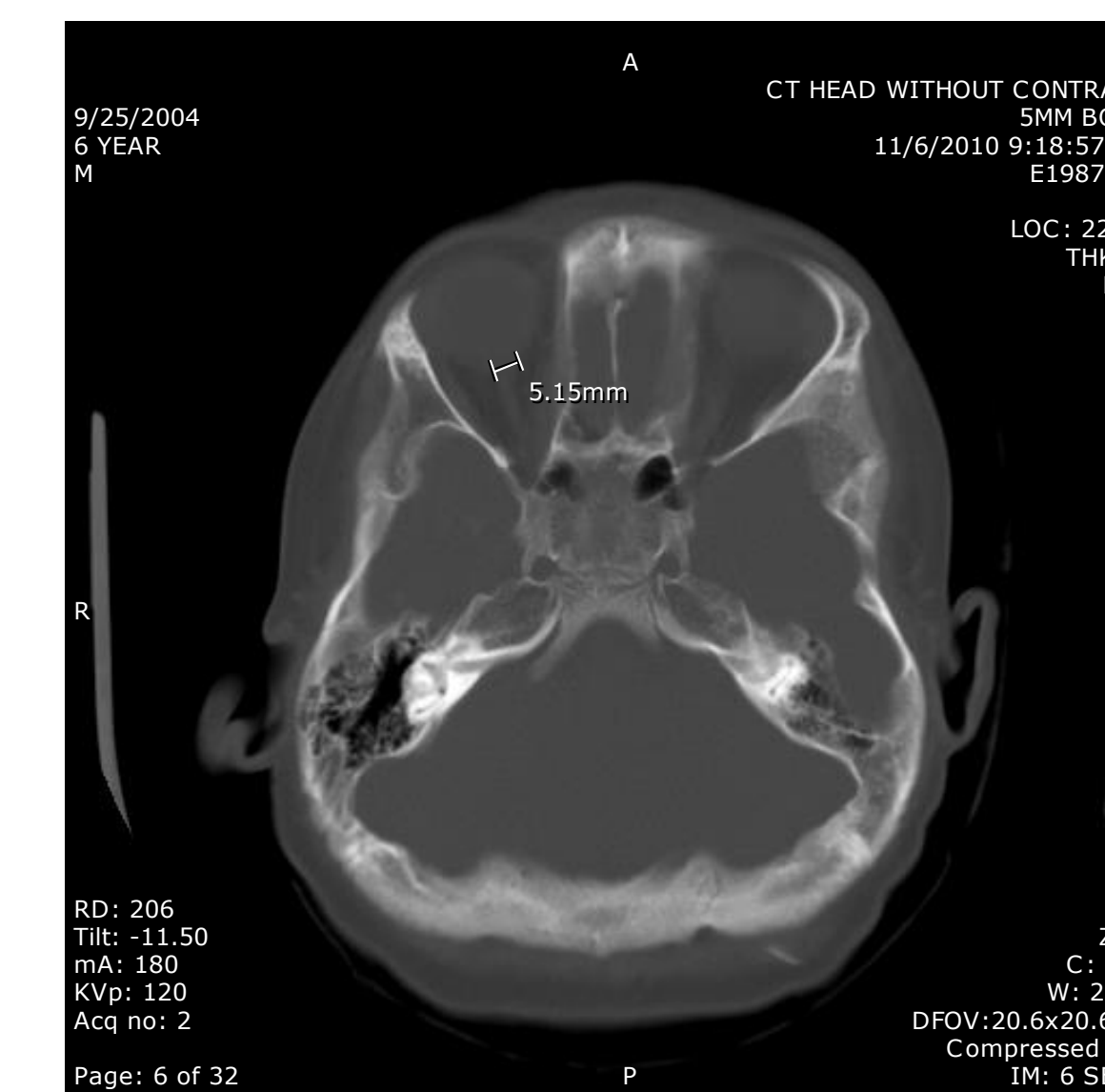
- ONSD by the width of the orbit (OND1)
- ONSD by the foramen magnum width (OND2).
- 20 patients with 25 cases of VPS obstruction.
- Right ONSD chosen to study.
- We could not measure all values on some cases
- Some lacked self-controls



ONSD in pt with shunt malfunction



ONSD in pt with shunt but no malfunction (controls)



ONSD in pt with shunt but no malfunction (case as own control)



ONSD in pt with head injury (no shunt)

Results:

- In comparing OND1 and OND2 for the VPS obstruction versus self-controls, we studied 9 patients with 13 cases of VPS obstruction.
- OND1 and OND2 were 0.224 and 0.219 for the VPS obstruction cases, respectively, compared to 0.192 and 0.183, respectively, for the non-obstructed self-controls (p=0.044 and p=0.008, respectively).
- In comparing OND1 and OND2 for the VPS obstruction versus age/gender matched head trauma controls, we studied 14 patients with 19 cases of VPS obstruction.
- OND1 and OND2 were 0.215 and 0.212 for the VPS obstruction cases, respectively, compared to 0.171 and 0.160, respectively, for the age/gender matched head trauma controls (p<0.001 and p<0.001, respectively).



Conclusions:

This data confirms that the optic nerve sheath diameter increases during a VPS obstruction.

Ultrasound can be used as an alternative test to detect VP shunt malfunction avoiding the radiation exposure from a head CT scan.

Absolute ONSD measurements are age/size dependent requiring a correction factor such as the orbit width which can be measured on ultrasound as well.