Introduction
- B-scan ultrasound has been used to measure the diameter of the optic nerve sheath in the setting of elevated intracranial hypertension.[1,2]
- No previous studies have compared B-scan ultrasound measurement of optic nerve sheath diameter in pediatric patients with measurements obtained by MRI in the same patient on the same day.
- The purpose of this study is to determine the correlation of B-scan ultrasound optic nerve sheath diameter (ONSD) measurements with high resolution orbital MRI in pediatric patients.

Methods
- Prospective study was approved by IRB and enrolled pediatric patients who were already scheduled to have an MRI of the brain.
- A supine B-scan completed within 30 minutes of MRI (10-MHz Sonomed EZ Scan BS500 + Ophthalmic B-Scan).
- 3 measurements of the vertical ONSD on the B-scan image obtained at 3, 6, and 9 mm posterior to the papilla. (Fig.1)
- High resolution MRI oblique coronal T2 images were acquired perpendicular to the long axis of each optic nerve. (Fig.2)
- The radiologist performed similar blinded measurements of the ONSD on MRI.
- The means and standard deviations were calculated for each eye and location comparing B-scan to MRI measurements.
- A repeated measures crossover model with a compound symmetry correlation structure was used to test statistical hypotheses, fit separately for each eye.

Results
- 10 patients, ages 5 to 17, average age 11.5 years.
- 6 females and 4 males.
- 1 patient with history of leukemia, the MRI demonstrated mild dilatation of the optic nerve sheaths. A subsequent ophthalmic exam demonstrated normal vision, a normal appearing fundus and optic nerve. 9 patients had normal or stable MRI. None of the patients had elevated intracranial pressure.

<table>
<thead>
<tr>
<th>Eye</th>
<th>Point along optic nerve</th>
<th>Average B-scan ONSD (SD)</th>
<th>MRI ONSD (SD)</th>
<th>Mean of Differences (SD)</th>
<th>Repeated Measures Model P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD</td>
<td>3 mm</td>
<td>4.48 (0.697)</td>
<td>5.61 (1.026)</td>
<td>1.13 (1.34)</td>
<td>0.0085</td>
</tr>
<tr>
<td></td>
<td>6 mm</td>
<td>5.70 (0.611)</td>
<td>4.42 (1.048)</td>
<td>-1.28 (1.34)</td>
<td>0.0032</td>
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<tr>
<td></td>
<td>9 mm</td>
<td>6.73 (0.855)</td>
<td>4.02 (0.719)</td>
<td>-2.71 (1.13)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>OS</td>
<td>3 mm</td>
<td>5.72 (0.592)</td>
<td>4.50 (0.744)</td>
<td>-1.22 (1.01)</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>6 mm</td>
<td>6.64 (0.647)</td>
<td>4.25 (0.528)</td>
<td>-2.39 (0.94)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Figure 1: B-scan ultrasound of ONSD measurement at 3 mm posterior to the papilla

Figure 2: Oblique coronal T2 images were acquired perpendicular to the long axis of each optic nerve for vertical ONSD measurements.

Discussion
- There is new interest in comparing ONSD MRI imaging to ultrasound measurements.[14]
- The B-scan ultrasound is a sectoral ultrasound, with one crystal vibrating back and forth. This creates an image in a “fan-like” projection, with a wider signal of decreasing intensity, farther from the tip of the probe.
- Our concern, based on anatomical studies of cadavers, is that ONSD measurements become less accurate the farther away from the probe, because of a “shadowing effect” from the sectoral ultrasound.[2]
- The difference between the B-scan and the MRI measurements in this study becomes larger as the point moves away from the globe, and is statistically significant.

Conclusion
- When using sector ultrasound to image retro-orbital anatomy, especially ONSD, measurements beyond 3 mm posterior to the anterior papilla may not be accurate, and MRI may be more reliable in providing more anatomically accurate measurements of the optic nerve sheath diameter.

References

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