Optical Coherence Tomography Visualization of Optic Nerve Head Structure Detects Acute Changes in the Intracranial Pressure

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Background and Objectives

Background: Biomechanical changes in the optic nerve head (ONH) with sustained elevation in ICP are well-established. However, the time course of structural changes in ONH related to ICP has not been studied. It is unknown whether acute ICP changes will cause dynamic measurable changes in the ONH. High definition optical coherence tomography (HD-OCT) allows in-vivo enhanced depth imaging of papillary sub-structures.

Objectives: To determine whether dynamic changes in ONH structure, as measured by HD-OCT, occur immediately after lowering ICP.

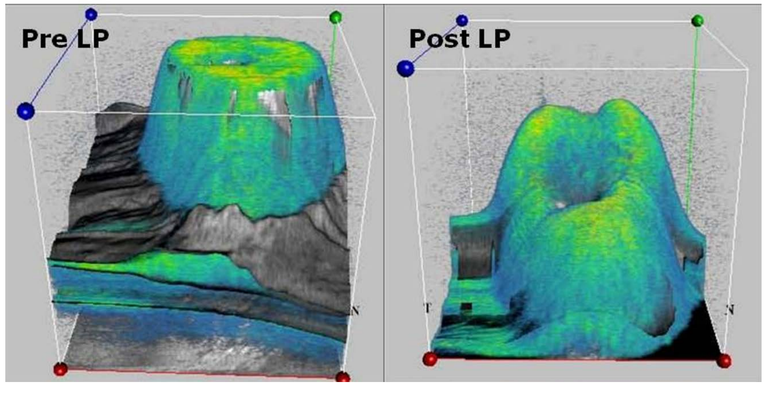
Methods

- A pilot study in 5 female patients with idiopathic intracranial hypertension undergoing a clinically indicated lumbar puncture.
- The Cirrus HD-OCT was positioned sideways to acquire images in the lateral decubitus position.
- Optic disc cube 200x200 and HD5 Line Raster scans centered on the optic nerve head were obtained immediately before and after draining CSF while the patient remained in the left lateral decubitus position.
- Parameters measured:
  - Retinal nerve fiber layer (RNFL) thickness.
  - Peripapillary retinal pigment epithelium / Bruch's membrane (RPE/BM) angulation.
  - Transverse diameter of neural canal at RPE/BM.
  - Highest vertical point of internal limiting membrane (ILM) from transverse diameter.

Results

CSF Pressures and OCT Measurements Pre- to Post-CSF Drainage	
ICP	Decreased ICP 31.6 ± 11.8 → 11.6 ± 3.3 cmH20
RPE angle	Decreased RPE angle 5.8 ± 2.0 degrees
Papillary height	Decreased papillary height 976 ± 274 → 938 ± 300 µm
Transverse canal diameter	Decreased canal diameter 1985 ± 559 → 1590 ± 228 µm
Retinal nerve fiber layer thickness	Decreased RNFL thickness 151 ± 71 → 129 ± 40 µm

3D Visualization of Optic Nerve Head



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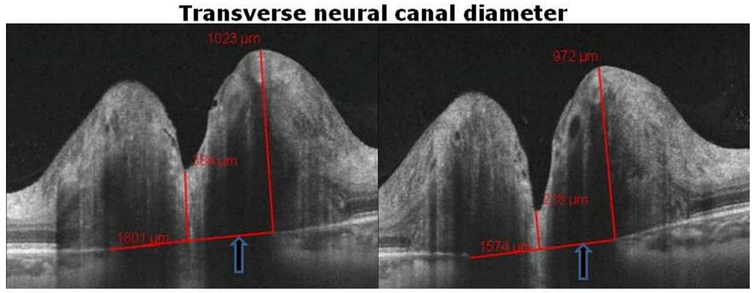
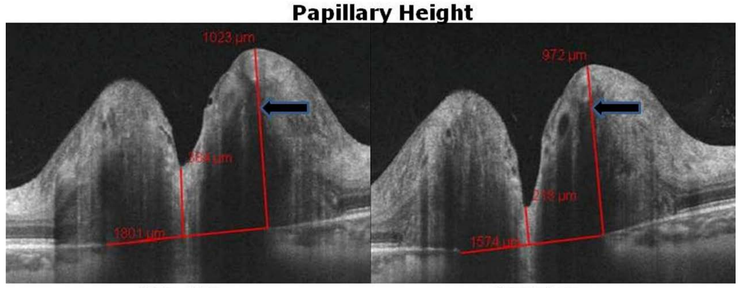
Results

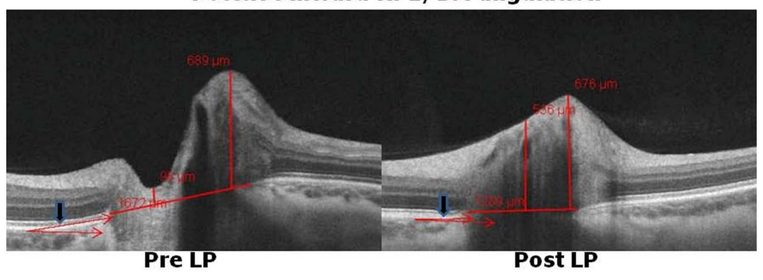
Transverse neural canal diameter



Papillary Height



Positive inward RPE/BM angulation



Conclusions

- In our pilot study, we observed acute changes in the optic nerve head anatomical structures associated with lowering of the intracranial pressure in idiopathic intracranial hypertension patients.
- A larger prospective study is needed to determine the utility of OCT as an objective measure to monitor changes in intracranial pressure.

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