DTI Tractography Reveals Changes in the Optic Radiations of Patients with Persistent Visual Impairment Following Surgery for Optic Chiasm Compression

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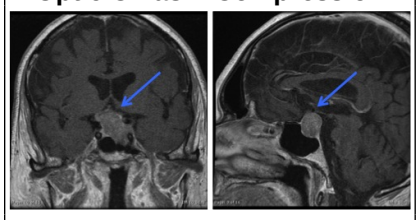
Introduction

Brain tumors in the sellar region can cause compression of the optic chiasm and lead to visual failure. These tumors account for up to 10% of all intracranial tumors. Previous studies have demonstrated a relationship between degree of visual loss and recovery following surgery for optic chiasm compression.(1) However, no previous study has investigated the downstream changes in the visual pathway from optic chiasm compression.

Optic Chiasm Compression



Pituitary adenoma causing optic chiasm compression

The magnetic resonance imaging (MRI) technique of diffusion tensor imaging (DTI) tractography allows in-vivo, non-invasive investigation of the white matter tracts in the human brain including the optic radiation.(2) This study uses DTI tractography biomarkers to investigate changes in the optic radiation (OR) of patients with tumors causing optic chiasm compression.

Methods

Patients recruited to the study were divided into groups based on visual function:

1. Normal Vision Group (n=10)
2. Abnormal Vision Group (n=7)

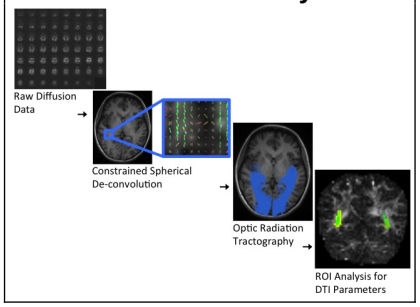
Study Participants

	Normal Vision	Abnormal Vision
Patients	n=10	n=7
Male	7	5
Female	3	2
Age (p=0.17)		
Mean	56.6	66.0
SD	9.88	14.48

Patients from both groups underwent a single additional MRI at least one year post surgery.

Optic radiation DTI tractography was performed using constrained spherical de-convolution(3) and OR tractography images were analysed for anatomical and DTI parameters using MRtrix.(4)

Optic Radiation Tractography Methods and Analysis



Results

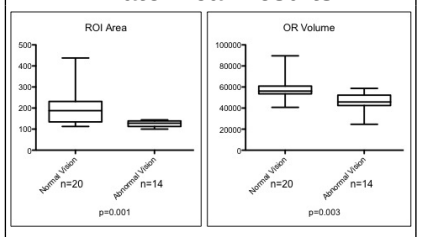
The OR DTI tractography data from this study correlated well with previously published dissection and DTI tractography studies.

There were a number of significant differences in the abnormal vision group:

Anatomical Findings:
1. Decreased OR volume (**p=0.003**)
2. Decrease OR area at mid-point (**p=0.001**)

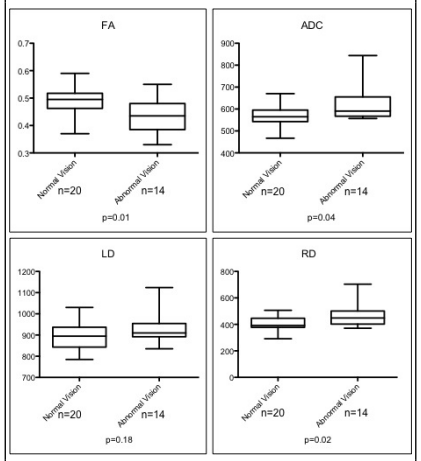
DTI Findings:
1. Decreased fractional anisotropy (FA) (**p=0.01**)
2. Increased apparent diffusion coefficient (ADC) (**p=0.04**)
3. Increased radial diffusivity (RD) (**p=0.02**)
4. No difference in longitudinal diffusivity (LD) (**p=0.18**)

Optic Radiation Tractography Anatomical Results



Analysis of OR tractography demonstrated OR atrophy in the abnormal vision group

Optic Radiation Tractography DTI Results



Analysis of OR tractography demonstrated decreased connectivity and integrity in the abnormal vision group

Conclusions

1. This study demonstrates decreased OR connectivity and integrity and OR atrophy in patients with persistent visual deficit following surgery for tumors causing optic chiasm compression.

2. This is the first study to demonstrate downstream changes in the visual pathway in patients with visual loss from optic chiasm compression.

3. Further studies utilizing DTI biomarkers may lead to improved visual outcomes in patients undergoing surgery for tumors causing optic chiasm compression.

Learning Objectives

By the conclusion of this session, participants should be able to:

1. Understand the visual consequences of tumors causing optic chiasm compression
2. Describe the use of DTI tractography in the visual pathway
3. Identify the utility of DTI tractography in optic chiasm compression
4. Discuss the need for further studies to improve visual outcomes in optic chiasm compression

References

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3. Tournier J-D, et al. *Neuroimage* 2007;35:145
4. *MRtrix Software Package*, Tournier J-D. http://www.brain.org.au/software/