

## RETROGRADE TRANS-SYNAPTIC VISUAL PATHWAY DEGENERATION IN MULTIPLE SCLEROSIS: A CASE SERIES

AHMED TOOSY

### ABSTRACT

This commentary discusses a case series which demonstrates likely retro-grade trans-synaptic degeneration of the visual pathway in MS.

### COMMENTARY

Neurodegeneration in MS is an important determinant of the accrual of clinical disability. Many mechanisms are thought to interact and contribute to this phenomenon.<sup>1,2</sup> There has been recent interest in MS in investigating trans-synaptic degeneration. The visual system, in principle lends itself as an informative model to study this phenomenon across the LGN synapses.

Most in vivo imaging studies in MS or CIS have performed cross-sectional analyses to infer trans-synaptic degeneration.<sup>3,4</sup> Anterograde trans-synaptic degeneration (occurring from anterior to posterior visual pathways) has been postulated to explain optic radiation changes found in isolated optic neuritis and MS.<sup>5-8</sup> More recently, longitudinal studies of the optic radiations after optic neuritis have confirmed this phenomenon is very likely to occur.<sup>9,10</sup> Retrograde trans-synaptic degeneration (direction of degeneration from posterior to anterior visual pathways) is more difficult to study longitudinally, but cross-sectional studies provide some indirect evidence by demonstrating associations between optic radiation lesion volume and optic nerve OCT retinal nerve fibre layer thicknesses.<sup>5,7,11</sup>

In this issue of MSJ, Al-Louzi et al provide interesting observations in six MS patients with predominantly unilateral posterior visual pathway lesions, most of which are associated with homonymous visual field defects. They found hemi-macular reductions in GCIP thickness corresponding topographically to the field defects and presumed causative pathology. Although cross-sectional, it is very reasonable to infer the process of retrograde trans-synaptic degeneration affecting the GCIP layer. Interestingly three patients had MMP within the INL. This is becoming an increasingly recognized finding in several optic nerve disorders although its pathophysiological significance is uncertain.<sup>12</sup> This case series adds to the growing body of evidence supportive of retrograde trans-synaptic degeneration and provides further insight into one of the likely causes of neurodegeneration in MS. In the clinical setting, if available, high resolution OCT scanning, being relatively inexpensive and convenient for the patient, can help the neurologist to determine any secondary effects of focal pathology affecting the posterior visual pathways, which may in turn help to inform prognosis for the patient. There are some caveats for its clinical utility. The presence of OCT thinning related to previous optic neuritis episodes may reduce the sensitivity to detecting these changes. The temporal development of these changes is unknown after the retrogeniculate insult (appearance of optic radiation lesions), requiring longitudinal studies to investigate this aspect. It is possible that these changes are more likely to occur with more severe involvement of the post-synaptic pathways and they more detectable with unilateral or highly asymmetric posterior pathology. Nevertheless, this case series provides interesting insights in the complex mechanisms that underpin neurodegeneration in MS.

1. Friese M a, Schattling B, Fugger L. Mechanisms of neurodegeneration and axonal dysfunction in multiple

- sclerosis. *Nat Rev Neurol*. 2014;10(4):225–238.
2. Frischer JM, Bramow S, Dal-Bianco A, et al. The relation between inflammation and neurodegeneration in multiple sclerosis brains. *Brain*. 2009;132(5):1175–1189.
  3. Reich DS, Smith S a, Gordon-Lipkin EM, et al. Damage to the optic radiation in multiple sclerosis is associated with retinal injury and visual disability. *Arch Neurol*. 2009 Aug;66(8):998–1006.
  4. Ciccarelli O, Toosy AT, Hickman SJ, et al. Optic radiation changes after optic neuritis detected by tractography-based group mapping. *Hum Brain Mapp*. 2005;25(3):308–316.
  5. Gabilondo I, Martínez-Lapiscina EH, Martínez-Heras E, et al. Trans-synaptic axonal degeneration in the visual pathway in multiple sclerosis. *Ann Neurol*. 2014;75(1):98–107.
  6. Rocca M a, Mesaros S, Preziosa P, et al. Wallerian and trans-synaptic degeneration contribute to optic radiation damage in multiple sclerosis: a diffusion tensor MRI study. *Mult Scler*. 2013;19:1610–1617.
  7. Balk LJ, Twisk JW, Steenwijk MD, et al. A dam for retrograde axonal degeneration in multiple sclerosis? *J Neurol Neurosurg Psychiatry*. 2014;85(7):782–789.
  8. Kolbe S, Bajraszewski C, Chapman C, et al. Diffusion tensor imaging of the optic radiations after optic neuritis. *Hum Brain Mapp*. 2011 Sep 13;0(September 2010).
  9. Tur C, Goodkin O, Altmann DR, et al. Longitudinal evidence for anterograde trans-synaptic degeneration after optic neuritis. *Brain*. 2016;139(3):816–828.
  10. Kolbe SC, Walt A Van Der, Butzkueven H, Klistorner A, Egan GF, Kilpatrick TJ. Serial Diffusion Tensor Imaging of the Optic Radiations after Acute Optic Neuritis. *J Ophthalmol*. 2016;2016.
  11. Klistorner A, Sriram P, Vootakuru N, et al. Axonal loss of retinal neurons in multiple sclerosis associated with optic radiation lesions. *Neurology*. 2014;82(24):2165–2172.
  12. Gelfand JM, Nolan R, Schwartz DM, Graves J, Green AJ. Microcystic macular oedema in multiple sclerosis is associated with disease severity. *Brain*. 2012;135(6):1786–1793.