Hidden Vision Problems in Parkinson's and Stroke Patients

Geoff Shayler Bsc, FCOptom, FCSO

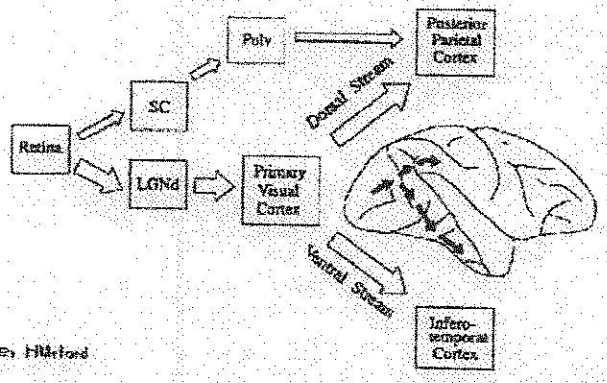
Abstract

Most of us regard our eyesight ability as what we see in the optician's consulting room, and we are happy with our confirmation of 6/6 or 20/20. However, is that all there is to seeing?

Our visual system is referred to as the operating system of the brain. It is known that the most complex activity of our brain is to process visual input. Over 70% of all brain activity is devoted to processing visual information.

The visual system is represented in every major area of the brain, as well as in the midbrain and brainstem, for example:
Frontal lobe: eye movement planning
Parietal lobe: provides our visio-spatial map
Temporal lobe: recognition of people, places, faces and motion

One of the factors identified in some patients with Parkinson's disease (PD), is a contraction of the functional visual field, as a result of an imbalance of the magno/parvocellular pathways. This results in balance, posture, and stability problems and contributes to difficulties in reading, concentration and attention.



A simple reading test, initially developed to identify school children with visually related learning difficulties, can identify which patients have these visual processing difficulties, as well as identify those who could be helped with appropriate optometric vision therapy!

Background Neurology

A number of studies have shown deficits in magno, parvo and koniocellular pathways in patients with PD:

" ...the koniocellular subpopulation of RGCs may be particularly vulnerable in early stages of Parkinson's disease" *Sartucci, Ferdinando, et al, 2003 1*

"Sensory deficits have been documented in Parkinson's disease, in particular within the visual domain" *Silva, et al, 2005 2*

"We conclude that in Parkinson's disease, independent damage occurs in the early magno-and parvocellular pathways" *Silva, et al, 2005 2*

"Indeed, previous studies have appropriately shown that Parkinson's disease patients demonstrate thinning of retinal ganglion cell axons reminiscent of ocular neurodegenerative diseases, such as glaucoma, where ganglion cell loss comprises an important part of disease pathophysiology and concomitant magno-, konio- and parvocellular deficits coexist" *Bruce I 3 2005/6*

"Ganglion cell loss in glaucoma has now clearly been shown to affect all ganglion cell populations." *M. Castelo-Branco 2006 4 (see Castelo-Branco et al., 2004).*

The same argument applies for PD if the underlying disease mechanism relates to contrast processing control. When procedures with unbiased color sampling strategies are applied, which is one of the main innovations of our study, "it becomes obvious that multiple pathways are concomitantly affected." ***Armstrong** 2007*

Parkinson's disease is associated with a range of visual signs and symptoms, including defects in: visual acuity, color vision, the blink reflex, pupil reactivity, saccadic and smooth pursuit movements and visual evoked potentials. Visual signs and symptoms can be an important though obscure aspect of the disease and should not be overlooked. ***Armstrong** 2007*

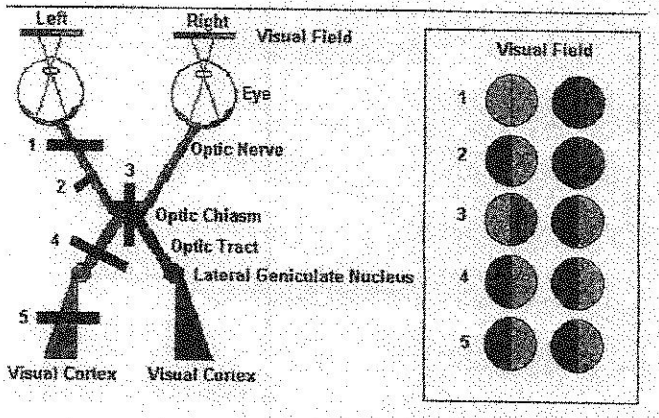
I am not sure if the above paragraph is supposed to be a quote. There were quotes around it but no endnote...unless Armstrong is supposed to be quoting it.

Introduction

A number of studies indicate that children with learning difficulties have visual processing difficulties due to an imbalance of the magno and parvo visual processing systems.

The effect of these problems include: eye movement problems, low convergence, poor accommodation , reduced reading range and reduced functional fields of vision. These measurements have a direct link to scholastic ability as identified by school examination results.

Similar problems may be found in some patients with Parkinson's disease, patients suffering from stress, depression, brain trauma and occasionally in individuals following a stroke.



Pathological and Functional Visual Field Loss

Threshold visual fields are those visual fields measured by the use of automated perimeters using light threshold measures, such as Henson, Friedmann, Dicon, etc. This type of screener is particularly good for identifying pathological disorders such as those found in glaucoma, or "typical" neural damage from brain trauma or stroke as shown in this diagram. I feel this type of field test is related to "detailed" parvocellular processing.

Functional visual fields are a measure of the ability to process specific visual information in the periphery. For example, the use of the Bjerrum (tangent) screen is a measure of when a moving target appears within the perceptual field of the individual which is more related to "motion" magnocellular processing.

Pathological defects such as those caused by neural damage are permanent, but functional loss can often be recovered with appropriate intervention by a behavioral optometrist. This is one area that is particularly suitable to the application and integration of optometric phototherapy (syntonics) with vision therapy.

In PD, visual field constrictions are generally functional and therefore potentially recoverable.

Osteoporosis.

PD may increase the risk for low bone density and osteoporosis. Both men and women are at risk. Experts recommend that patients with PD get tested for osteoporosis, especially if they have problems walking.

Generally, PD patients are in the older age range and have a greater risk of falls that result in broken bones. This may cause greater concern, or stress, with ambulation.

Stress

Stress and chronic illness are interconnected. Stress comes from a variety of different sources that can be physical, as well as emotional. Stress can come from the life adjustments that PD often creates, such as alterations in daily life tasks, fatigue, anxiety and frustration. The important thing to be aware of, however, is that stress can worsen PD symptoms, especially tremor.

The Neurology of Stress

Stress leads to the fight or flight response causing an overaction of the sympathetic nervous system. Some research into the heart rate variability of patients with PD has shown general depression of the autonomic nervous system, particularly depression of the parasympathetic. This is in addition to the structural damage to the magno-, parvo- and koniocellular pathways. As a result, more "energy" is required for the autonomic nervous system to function. This leads to reduced functional visual fields with ensuing visual processing difficulties.

Stress and Skeffingtons Four Circles

Stress reduces the functional visual field which impacts all areas of Skeffingtons circles. When we look at the recognized symptoms of PD, we can see how his concept is mirrored in this health condition.

- **Antigravity** - Disturbed gait and unstable posture are common and serious problems in elderly patients, since they increase the risk for falling and injury. Some studies have suggested that the appearance of these symptoms early in the course of the disease predict a faster decline

than having tremor as the predominant symptom.

- **Centering** – Many studies have found evidence of abnormal eye movement control in PD. Deficits in the inhibition of unintended saccades and slowed initiation of intentional saccades have been reported in some, but not all, investigations.

- **Identification** – Over recent years the presence of cognitive impairment in a proportion of patients with PD has been highlighted. Efficient use of working memory resources is thought to be involved in the performance of tasks in both domains. Vision is also affected, including impaired color perception and contrast sensitivity (parvo- and koniocellular deficits). These problems progress and can impair motor functioning.

- **Speech/Auditory** - Speech problems occur in more than 70% of patients, by some estimates. Speech difficulty can be caused by rigidity of the facial muscles, loss of motor control, and impaired breath control. Tone can become monotonous, words can be repeated over and over, or the rate of speech can become very fast.

Simple assessment of the Functional Visual Field

- Patient stands 3m from clinician.

- The patient is asked to concentrate on the clinicians nose. The patient is asked how far down the clinician's body they can see without moving their eyes.

- The clinician can simply compare their field to his.

Frequently in PD, the field is less than the length to the clinician's waist and is frequently much smaller than this!

Instead of the above view patients with PD may see as little (or less!) as is shown below.

Note: the smaller the field, the poorer the measured visual acuity, and the greater the symptoms.

Consider how much of this patient's visual information is lost and the effect of this loss on that person's function and performance.

Reading Range

As we get older, reading becomes more difficult and glasses may become necessary.. However, the range (depth of focus) available for reading is linked to the functional visual field; when the field is small, the range of clear near reading is more limited.

The Reading Test

With their reading glasses on, measure the near (np) and far (fp) points that the print can be held before it just starts to blur., The difference between the two (fp-np = af) is their accommodative flexibility.

In a mature adult with an accommodative flexibility less than 17 cm, consider a visual processing deficit. Referral to a behavioral optometrist is therefore advisable for further investigation and possible optometric vision therapy.

Those patients with a small range of clear near vision are more likely to suffer from the outlined symptoms that are listed below.

A simple reading chart has been developed by optometrists Geoff Shayler and Dr. Roger Fitch which can be provided to local medical doctors so that they can identify patients who should be referred for behavioral vision assessment.

Typical Symptoms of a Functional Visual Problem in PD and Stroke

- vision less clear when stressed
- blurred vision at distance / computer and / or reading which is not fully relieved with spectacles
- eye strain with no apparent cause
- eyes feel tired with computer work which is not fully relieved with spectacles
- slow reading
- loss of concentration when reading
- poor or reduced comprehension of the written word
- can't be bothered with reading small print
- driving a car causes strain or tired eyes
- uncomfortable driving - multi-lane roads, motorways
- light sensitivity
- restricted depth of focus when reading – may need to hold close
- eyes just don't seem quite right!
- balance and/or postural problems
- photophobia
- clumsy, falls, walking into objects, knocking over ornaments, etc

Treatment Regime

This is a condition where Optometric Phototherapy (Syntonics) reigns supreme. Normal optometric vision therapy (OVT) is unlikely to prove beneficial as the cause is due to suppressed neurological function. Syntonics is a gentle, passive way of accessing and recovering peripheral visual function. Supplementary OVT can provide a stimulus for the patient to reorganize their visual abilities – fields, fixations, focus, fusion, flexibility. Developing peripheral function will also help stabilize their posture and reduce the risk of falls.

Results of Optometric Vision Therapy

Following vision therapy with Syntonics, the functional ability of the visual system can potentially be expanded to an age adjusted normalcy, allowing:

- more comfortable reading
- better comprehension of the written word
- better awareness when driving
- less strain when driving
- more comfortable vision and less eyestrain with VDU use
- reduced light sensitivity
- improved posture, balance, etc.

Attached is a summary of this article produced as a poster that was presented at a conference organized by the Neurorehabilitation Department at Southampton University in the UK in September 2008.

The Future

Our present research suggests that there may be an increase in these problems when there is a head down rather than head forward position.

There has been a lot of research into PD but little work in the visual consequences of the condition.

Through this research, I feel that we may soon be able to identify some of the biochemical aspects of visual processing and related visual (mal) functions that are related to contraction of the visual field.

Once we gain an insight into these other health conditions which are not related to 20/20 eyesight but impact visual processing, then we will be able to provide evidence that Optometric Phototherapy (Syntonics) and optometric vision therapy, have a huge combined potential to help millions of people.

Reading chart

Copies of the reading chart can be obtained by contacting me by email on kinoptom@lineone.net.

References:

Independent patterns of damage within magno-, parvo- and koniocellular pathways in Parkinson's disease Silva MF, Faria P, Januário C, Freire A, Castelo-Branco M.
Depart. of Biophysics / Center for Ophthalmology, IBILI-Faculty of Medicine, Coimbra University Hospital, Coimbra, Portugal.
Independent patterns of damage within magno-, parvo- and koniocellular pathways in Parkinson's disease (Silva MF et al. Brain 2005; 128: 2260–2271) Bruce I. Gaynes , 1725 W. Harrison St. Ste 931. Chicago, IL 60612, USA
Reply to "Letter to the Editor: Independent patterns of damage within magno-, parvo- and koniocellular pathways in Parkinson's disease (Silva MF *et al.* Brain 2005; 128: 2260–2271)."