

## Chapter 6. Case Studies

This chapter describes several case studies and demonstrates how the GDx VCC information can assist in glaucoma diagnosis. These cases can be divided into two main types: 1) cases of moderate to advanced glaucoma where there is good correlation between RNFL loss detected with the GDx VCC and visual field loss detected with standard automated perimetry (SAP), and 2) cases of early glaucoma where the GDx VCC detects RNFL loss but the visual field is still normal. Numerous studies have shown RNFL defects often occur prior to visual field loss<sup>33-37</sup>, and these cases are a few examples where the GDx VCC detects RNFL loss before visual field loss.

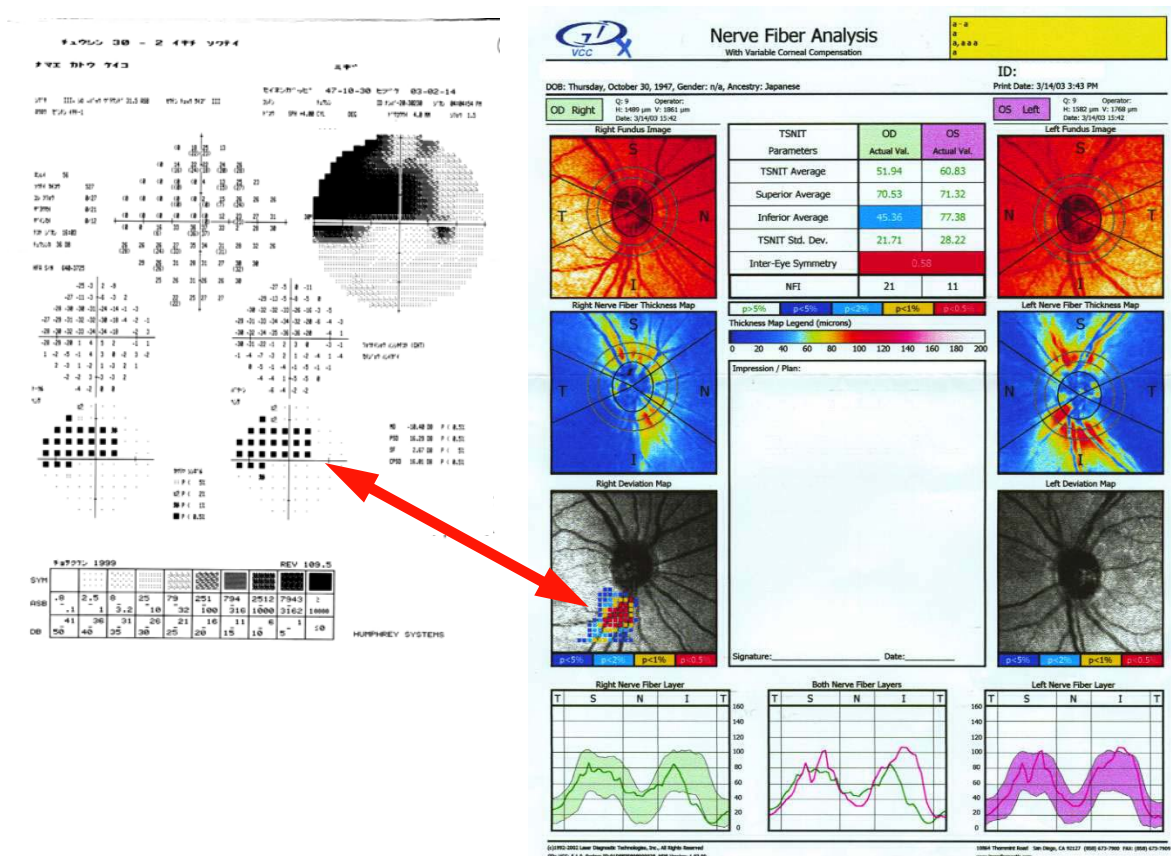
### Case 1.

The first case example is a 56 year old Japanese Male with Normal Tension Glaucoma. The optic disc photographs reveal normal C/D ratios in both eyes. In the right eye there is an inferior wedge defect (between white arrows), while the left eye is normal.

The GDx VCC scan also shows a clear inferior RNFL defect in the right eye, and the left eye is also normal. The location of the inferior RNFL defect as revealed by the Deviation Map closely matches the location of the defect on the optic disc photograph.



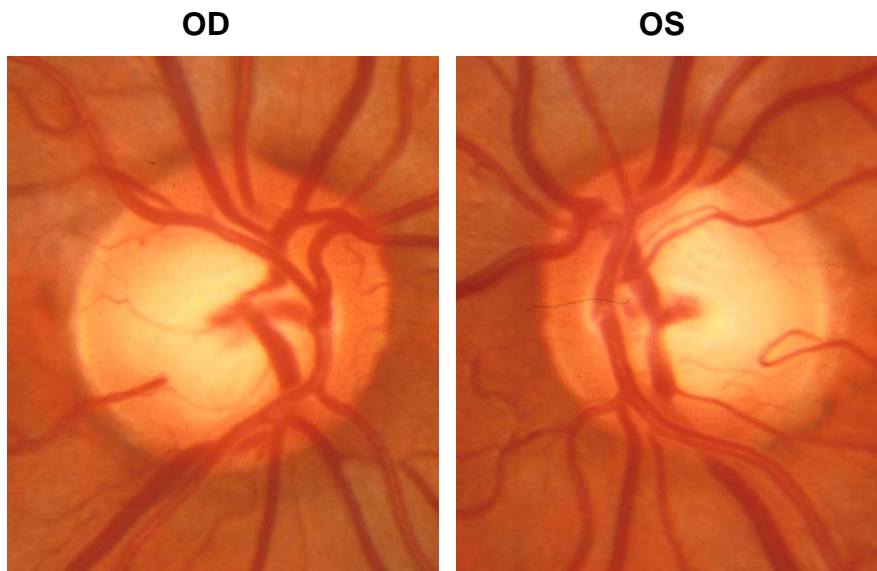
The GDx VCC scan for this case also shows a good correspondence between the inferior RNFL defect and the visual field, which has a superior nasal step scotoma in the right eye. Notice the cluster of colored-squares which indicates locations where the RNFL values for this eye fall below the normal limits as determined by the normative database for this age. The presence of a number of red squares in this cluster indicates the loss is severe, and would occur in less than 0.5% of the normal population for this age. As expected, the Inferior Average parameter is abnormal as well and corresponds with the inferior RNFL loss shown in the Deviation Map. The Inter-Eye Symmetry parameter is also abnormal, indicating asymmetric RNFL loss (OD > OS). The NFI for the right eye is 21, within the normal range. The RNFL defect is very local (confined to inferior region), which can be missed by the global RNFL assessment provided by the NFI. This local defect, however, was picked up by the Deviation Map and the Inferior Average parameter. The TSNIT graph for the right eye falls outside the shaded area in the inferior-temporal region, indicating RNFL loss. The optic disc photograph, visual field, and the GDx VCC scan for the left eye are all normal.



In summary, this case is a unilateral normal tension glaucoma patient with normal C/D ratios and a wedge-shaped RNFL defect. The RNFL defect was detected with the GDx VCC and corresponds with substantial superior visual field loss.

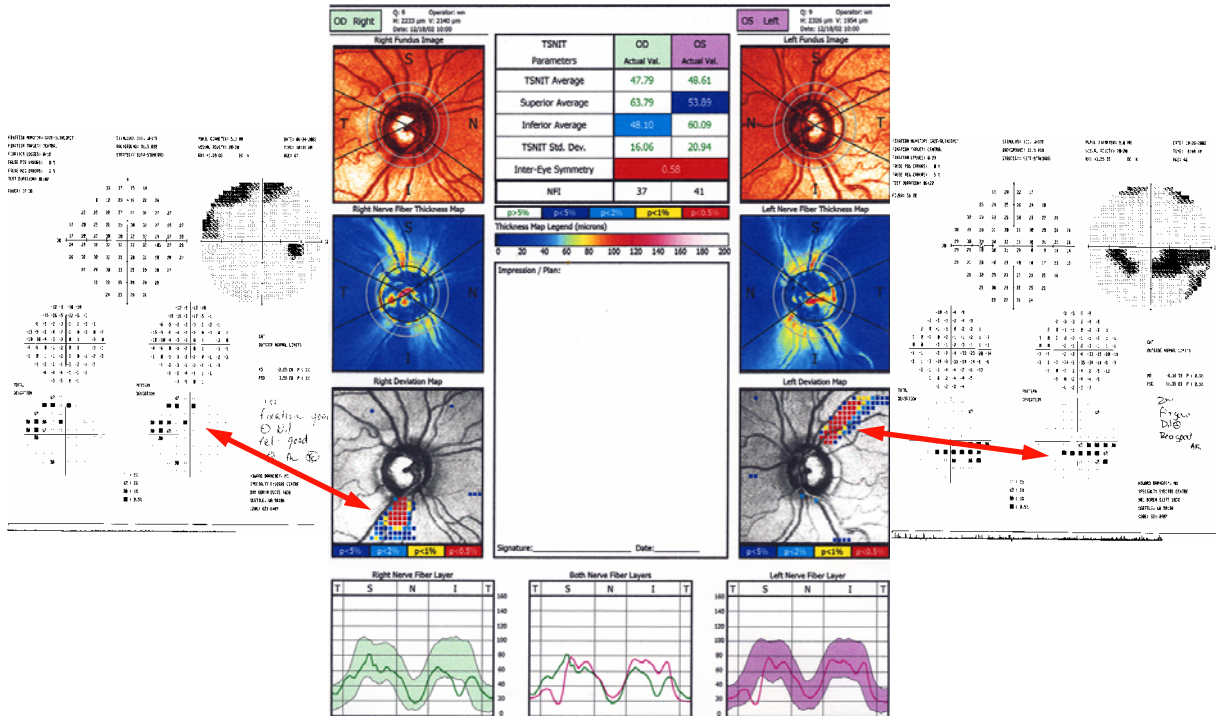
**Case 2.**

The second case is a 47 year old white male with C/D ratios of 0.7 in both eyes. The optic disc photographs for this patient reveal vertically elongated cups with rim thinning inferiorly in the right eye and superiorly in the left eye. The visual fields measured with SAP reveal corresponding deficits in the superior region of the right eye and inferior region of the left eye. The Mean Deviation (MD) and Pattern Standard Deviation (PSD) for this patient are  $-2.85$  and  $3.95$  respectively for the right eye and  $-6.38$  and  $11.85$  for the left eye, indicating moderate glaucomatous loss.

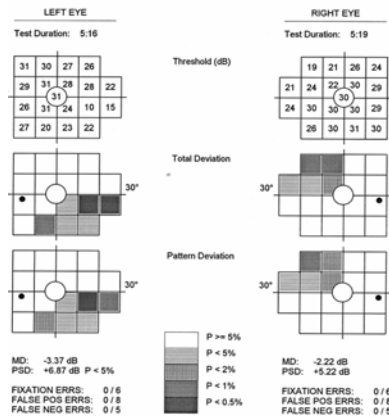


The GDx VCC scan for this patient reveals inferior loss OS in the right eye and superior loss in the left eye. Notice the wedge-shaped defects on the Deviation Map that include numerous red super-pixels that extend from the optic disc margin to the edge of the scan, indicating severe localized RNFL loss. These RNFL defects are also present in the TSNIT graph where the graphs fall outside the normal, shaded area. The Parameter Table had an abnormal Inferior Average parameter value in the right eye and an abnormal Superior Average parameter in the left eye.

The Inter-Eye Symmetry parameter is also abnormal, which is not surprising given the asymmetric pattern of RNFL loss.



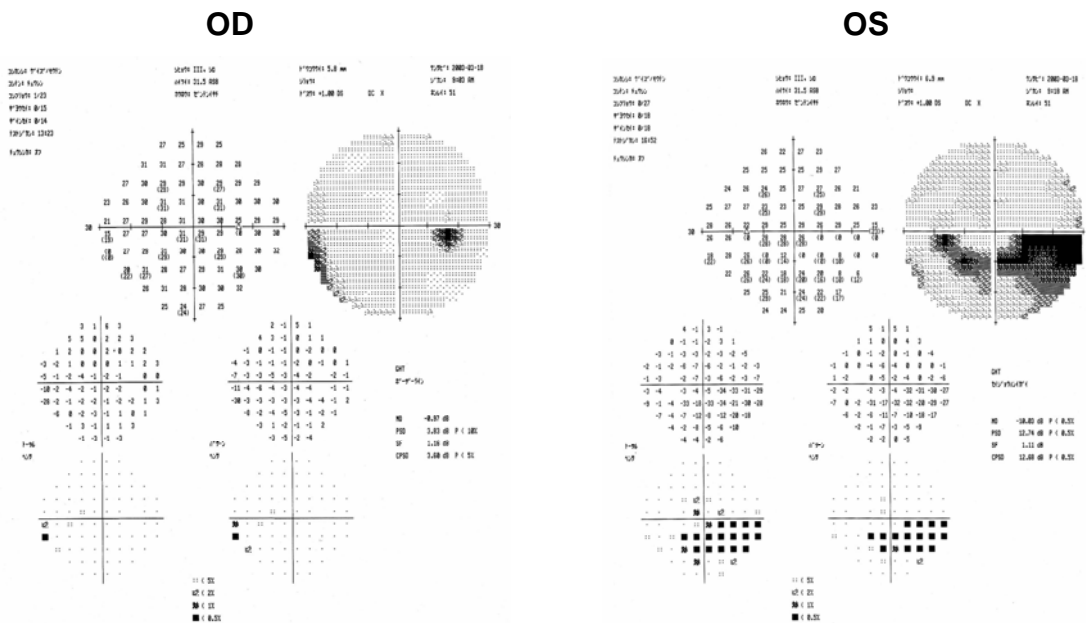
The results of Frequency Doubling Perimetry (FDT) are also available. There are defects detected with FDT in the superior region of the right eye and inferior region of the left eye, consistent with the results from SAP.



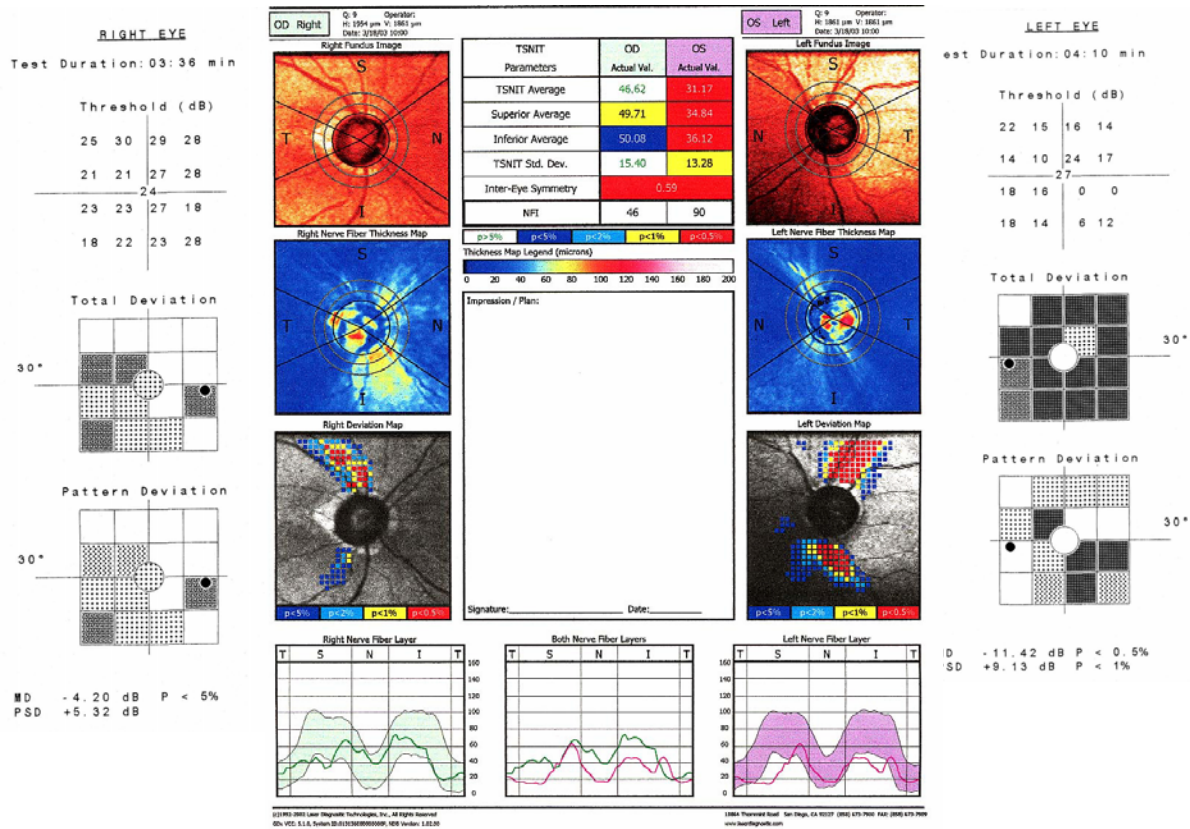
In summary, this is a case of moderate glaucoma showing good correspondence between the function as measured with SAP and FDT and the structure as measured with the GDx VCC and optic disc photographs.

**Case 3.**

This example is a 51 year old Japanese male with normal tension glaucoma, more advanced in the left eye. The C/D ratio in this eye is 0.8 and the visual field reveals a strong nasal step, with an MD of  $-10.03$  ( $p < 0.5\%$ ) and a CPSD of 12.68 ( $p < 0.5\%$ ). The visual field loss is confined to the inferior hemifield. The right eye's visual field, however, has only a minimal defect present in the inferior hemifield, with an MD score of  $-0.97$  and CPSD of 3.6 ( $p < 5\%$ ).



The GDx VCC scan for this patient reveals more extensive loss than was detected by the visual fields. For the left eye, the Deviation Map shows a large superior RNFL defect with numerous red super-pixels, indicating a severe loss ( $p$ -value of 0.5%). This defect corresponds well with the inferior nasal step defect in the visual field for this eye. However, the GDx VCC also detected an inferior RNFL defect in the left eye (as shown in the Deviation Map), although not as extensive as in the superior region. The superior visual field for this eye, however, is still normal. The fact that there is an RNFL defect in an area with a corresponding normal visual field is suggestive that the patient is at high risk for developing a future visual defect in that hemifield. The parameters for the left eye are abnormal, with all but one at the most severe level ( $p < 0.5\%$ ). The Nerve Fiber Indicator (NFI) for this eye is 90, which is indicative of advanced glaucoma.



In the right eye, the GDx VCC also detected RNFL loss in the superior region. In the Deviation Map there is a defect extending from the optic disc margin to the edge of the scan, with many colored super-pixels, including some at the most severe level (red). Although not as marked as in the left eye, this defect is substantial. There is a more mild defect beginning in the inferior region ( $p < 5\%$ ). The parameters support this interpretation with both the Superior Average and Inferior Average showing a significant deviation from normal, at the  $p < 1\%$  level superiorly and  $p < 5\%$  inferiorly.

The Inter-Eye Symmetry measure is abnormal at the  $p < 0.5\%$  level, and the NFI is approaching the abnormal classification (NFI above 50 is considered abnormal, NFI 30-50 is considered borderline).

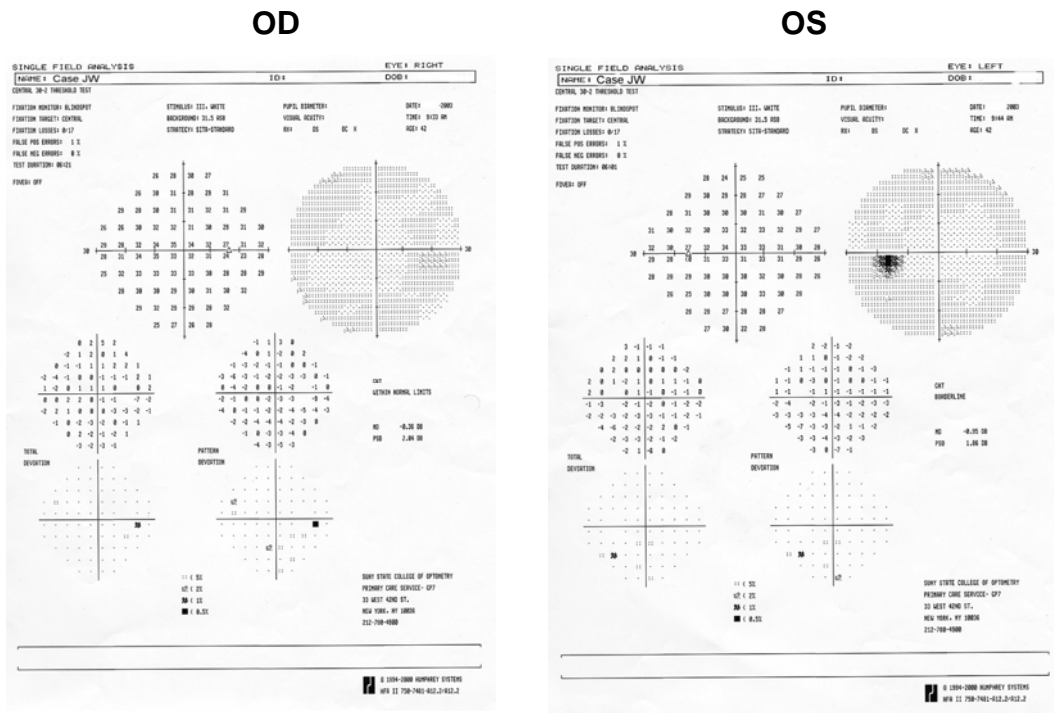
The abnormal GDx VCC results for the right eye strongly suggest this eye has significant RNFL loss which will likely manifest into future visual field defects on SAP. This interpretation is corroborated by the FDT results for this patient. The FDT is often more sensitive than SAP at detecting

functional defects, and for this patient the FDT detected substantial inferior loss for the right eye, which corresponds to the damage detected by the GDx VCC. The FDT results also detected damage to both hemifields in the left eye, a finding also supported by the GDx VCC, but not SAP.

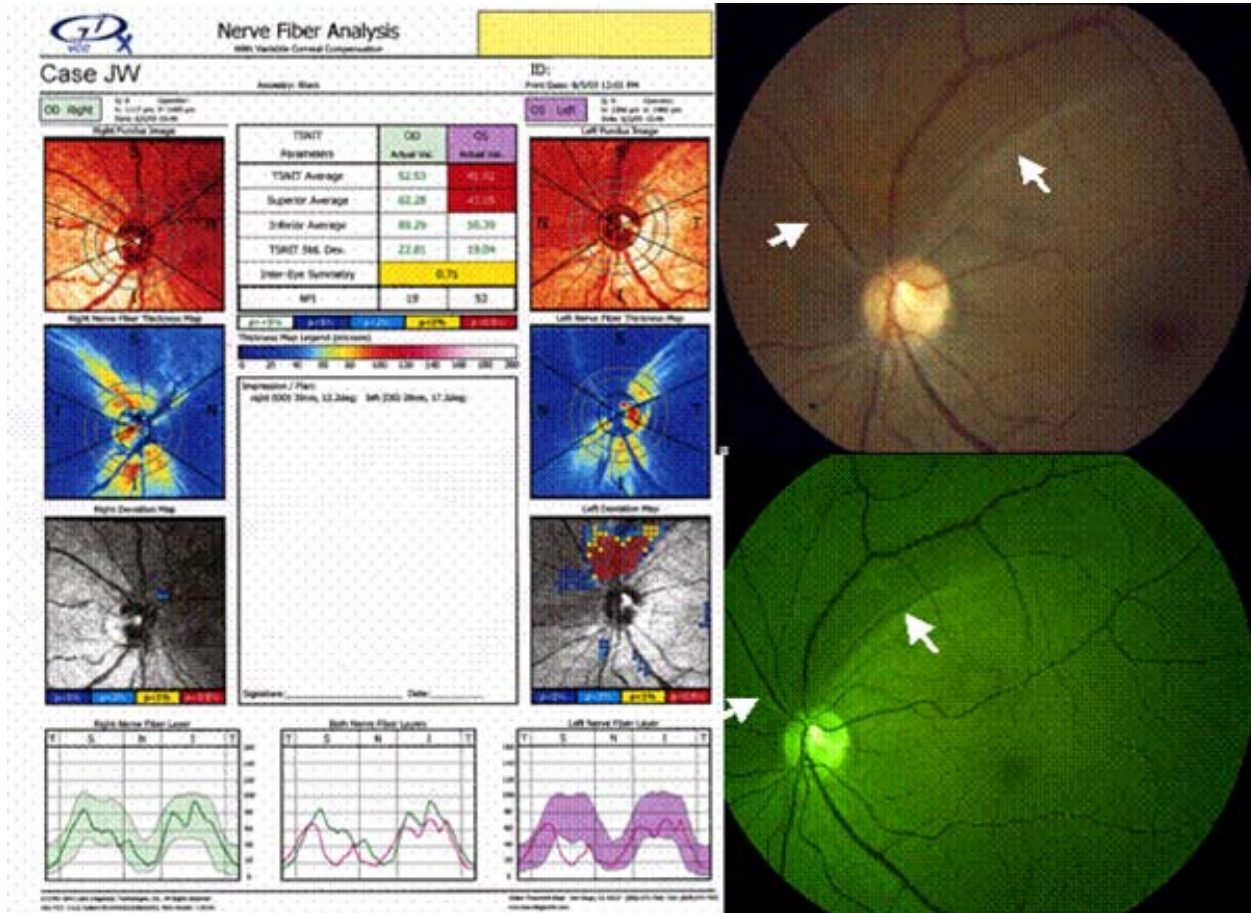
In summary, this case shows how the GDx VCC can detect glaucoma before SAP. This finding is not surprising because it is generally accepted that structural defects will precede functional defects, and also the structural measures have the added advantage of being an objective measure and not affected by the inherent variability present in subjective tests such as visual fields.

**Case 4.**

This case is a 42 year old black male with normal IOP (17 mm Hg OU). His visual fields are normal. GHT results were borderline for the left eye. Clinical examination of his optic discs was normal, with C/D ratio in both eyes of 0.2.



However, his optic disc photographs (color and red-free) revealed a large RNFL defect superiorly in his left eye. The defect extends from approximately the 10 o'clock position to the 1 o'clock position. The GDx VCC on this patient detected the large superior RNFL defect in the left eye as well, with the location on the Deviation Map showing excellent correspondence with the location of



the defect on the optic disc photographs. The defect on the GDx VCC is also apparent on the TSNIT graph as large dip in the superior region, with corresponding parameters, TSNIT Average and Superior Average abnormal as well as the Inter-Eye Symmetry measure. The NFI for this eye is 53, which is in the abnormal range.

This case is another example of how the GDx VCC can detect glaucomatous damage before SAP. More interesting, however, was that in this case the optic disc was still normal and exhibited no cupping. Given the combination of normal IOP and normal optic disc appearance, without the GDx VCC results this patient would likely have been missed by a standard clinical exam.

**Case 5.**

This case is a 62 year old white female with normal IOP (15 mm Hg OU). Her visual fields with standard automated perimetry are normal. Clinical examination revealed large optic discs with large cups with a C/D ratio in the right eye of 0.85 and 0.8 in the left eye. The optic disc photographs



