# Hemoglobin measurement in the optic nerve head using the Laguna ONhE program

## *Comparison with Spectralis OCT and image quality dependency*

13th EGS Congress in Florence, Italy held on 19-22 May 2018

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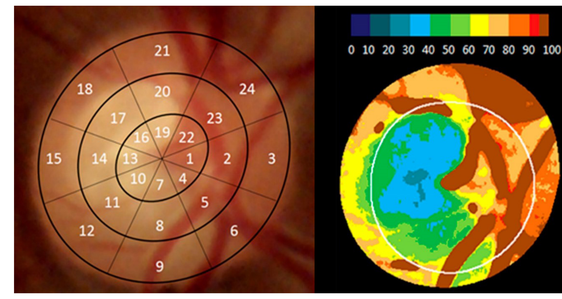
## PURPOSE

To evaluate the influence of image quality on glaucoma diagnosis by measuring hemoglobin content in the optic nerve by means the Laguna ONhE program (INSOFT SL, Spain) and compare its results with those of Spectralis OCT (Heidelberg Eng, Germany).

The Laguna ONhE program divides conventional color images of the optic nerve head (ONH) into 24 sectors using two ellipses, approximately parallel to its edge, and four diametrical lines.
It notes the differences between its red and green components and compensates the diversities of spectral composition of the illumination light, the absorption of the lens and the spectral response of the detector used by means a relative measure: the values of the tissue are divided by those obtained in the central vessels. (See references below)

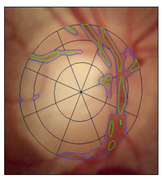
Previous experience in 700 normal and 494 glaucoma images obtained with Nidek, Kowa and Topcon fundus cameras was used to optimize the Laguna ONhE index "Glaucoma Discriminant Function, GDF".



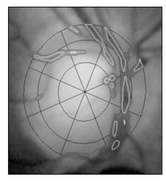

*THE ONH IS DIVIDED INTO 24 SECTORS, HEMOGLOBIN VALUES OF THE TISSUE ARE MEASURED AND COMPARED TO THE VALUES OF THE CENTRAL VESSELS. FINALLY, A GLAUCOMA DISCRIMINANT FUNCTION (GDF) IS CALCULATED.*

## METHODS

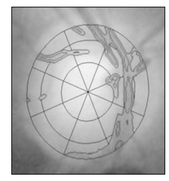
96 healthy subjects and 82 confirmed and suspect glaucoma were examined twice with the Laguna ONhE method (INSOFT, Spain), using images obtained with the Horus DEC-200 portable fundus camera (MiiS, Taiwan), and once with the Spectralis OCT (Heidelberg, Germany). The images were divided into two groups of better and worst contrast, comparing vessels Vs tissue, using the red and green channels in the optic nerve image. Differences between outcomes were analyzed with the MedCalc 17.9.7 program.



*COLOR*

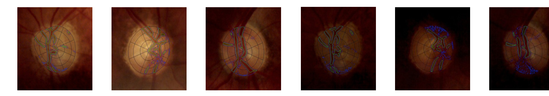


*GREEN CHANNEL*



*RED CHANNEL*

$$\text{CONTRAST} = \frac{(\text{GREEN OF THE TISSUE}) / (\text{GREEN OF THE VESSELS})}{(\text{RED OF THE TISSUE}) / (\text{RED OF THE VESSELS})}$$



*WORST CONTRAST (first three from left) and BETTER CONTRAST*

## RESULTS

Both series respectively had contrasts of 1.58±0.33 and 1.95±0.60 (p<0.0001). The Pearson correlation coefficient between GDF and BMO-MRW was 0.827-0.831 in the two groups of images (p<0.0001, Fig 1), between GDF and RNFLT was 0.763-0.766 (p<0.0001) and between BMO-MRW and RNFLT was 0.848 (p<0.0001, Fig 2).
Intra-class correlation coefficient between the GDF values of the two exams was 0.957.
Using ROC analysis, we calculated the confidence intervals (5%-95%) of the area under the curve, the specificity closest to 95%, and the corresponding sensitivity.
The following results were obtained:

| | | | |
|---|---|---|---|
| **Laguna ONhE, best images:** | 0.866-0.945, | 94.8%, | 70.7%. |
| **Laguna ONhE, worst images:** | 0.876-0.920, | 94.8%, | 72.0%. |
| **Spectralis BMO-MRW:** | 0.916-0.961, | 94.8%, | 79.3%. |
| **Spectralis RNFLT:** | 0.891-0.943, | 94.8%, | 74.4%. |

Comparatively analyzing these results, the sensitivity of the best OCT Spectralis index did not reach statistically significant differences with the sensitivity of images analyzed with the GDF of Laguna ONhE (p=0.19-0.26).

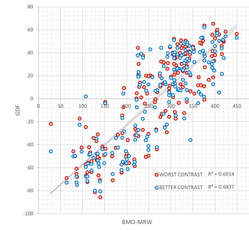



*FIGURE 1*

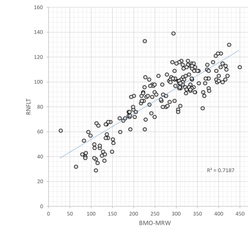
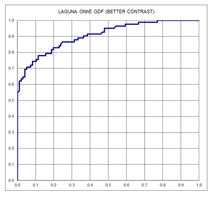
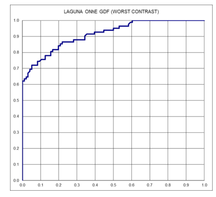
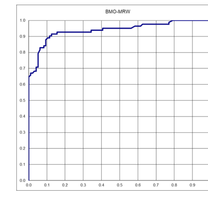
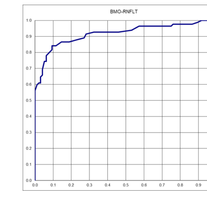



*FIGURE 2*




Inter-rater diagnostic agreement (kappa) between BMO-MRW and RNFL was k=0.69, between both GDF k=0.79 and between GDF and OCT indices k=0.63-0.73.

## CONCLUSION

Using a simple manual fundus camera to study the distribution of hemoglobin in the optic nerve achieves a diagnostic capacity of glaucoma almost equivalent, or minimally different, to an OCT, even using images of sub-optimal quality.

## REFERENCES

1. Gonzalez de la Rosa M, Gonzalez-Hernandez M, Sigut J, Alayon S, Radcliffe N, Mendez-Hernandez C, García-Feijoo J, Fuertes-Lazaro I, Perez-Olivan S, Ferreras A. Measuring hemoglobin levels in the optic nerve head: comparisons with other structural and functional parameters of glaucoma. Invest Ophthalmol Vis Sci. 2013; 54: 482-9.
2. Rodriguez Uña I, Mendez Hernandez CD, Saenz-Frances F, Garcia Feijoo J. Correlacion de la relacion excavacion/papila medida mediante HRT-III, SD-OCT y el dispositivo de colorimetria fotográfica Laguna ONhE. Arch Soc Esp Oftalmol. 2015; 90: 212-9.
3. Mendez-Hernandez C, Garcia-Feijoo J, Arribas-Pardo P, Saenz-Frances F, Rodriguez-Uña I, Fernandez-Perez C, Gonzalez de la Rosa M. Reproducibility of Optic Nerve Head Hemoglobin Measures. J Glaucoma. 2016; 25: 348-54.
4. Mendez-Hernandez C, Rodriguez-Uña I, Gonzalez-de-la Rosa M, Arribas-Pardo P, Garcia-Feijoo J. Glaucoma diagnostic capacity of optic nerve head haemoglobin measures compared with spectral domain OCT and HRT III confocal tomography. Acta Ophthalmol. 2016; 94: 697-704.
5. Pena-Betancor C, Gonzalez-Hernandez M, Fumero-Batista F, Sigut J, Medina-Mesa E, Alayon S, Gonzalez de la Rosa M. Estimation of the relative amount of hemoglobin in the cup and neuroretinal rim using stereoscopic color fundus images. Invest Ophthalmol Vis Sci. 2015; 56: 1562-8.
6. Gonzalez de la Rosa M. The existing controversy in today's paradigm between functional and morphological analysis. In: Jimenez-Roman J, Costa VP (eds). Glaucoma suspect book. The frontier. Mexico: Elsevier. 2015; 131-40.
7. Medina-Mesa E, Gonzalez-Hernandez M, Sigut J, Fumero-Batista F, Pena-Betancor C, Alayon S. Gonzalez de la Rosa M. Estimating the amount of hemoglobin in the neuroretinal rim using color images and OCT. Current Eye Res. 2016; 41: 798-805.
8. Gonzalez de la Rosa M, Gonzalez-Hernandez M, Mendez C, Garcia-Martin E, Fumero-Batista F, Alayon S, Sigut S. Measuring hemoglobin levels in the optic nerve head for glaucoma management. In: Ferreras A (ed). Glaucoma imaging. Heidelberg, New York, Dordrecht, London: Springer. 2016; 265-80.
9. Mendez-Hernandez C, Garcia-Feijoo J, Arribas-Pardo P, Saenz-Frances F, Rodriguez-Uña I, Fernandez-Perez C, Gonzalez de la Rosa M. Reproducibility of Optic Nerve Head Hemoglobin Measures. J Glaucoma. 2016 Apr;25(4):348-54.
10. Perucho-Gonzalez L, Mendez-Hernandez C, Gonzalez-de-la-Rosa M, Fernandez- Perez C, Saenz-Frances F, Andres- Guerrero V, Garcia-Feijoo J. Preliminary study of differences in optic nerve head hemoglobin measures between childhood glaucoma patients and healthy volunteers. Journal of Pediatric Ophthalmology and Strabismus. (in press)
11. Marta Gonzalez-Hernandez, Jose Sigut Saavedra, Manuel Gonzalez de la Rosa. Relationship between retinal nerve fiber layer thickness and hemoglobin present in the optic nerve head in glaucoma. Journal of Ophthalmology. Volume 2017 (2017), Article ID 2340236, https://doi.org/10.1155/2017/2340236