

Confocal Tomography of the Retina and the Optic Nerve Head

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with contributions of

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PREFACE

During the long years of practice as an ophthalmologist, I have used most of the methods explained in chapter 1 of this book for the study of the optic nerve. Along with those methods, I would draw the optic nerve head of each patient and study oblique bio-microscopic sections of the optic nerve in particular with the slit lamp: the section extending from the superior nasal to the inferior temporal part and that extending from the superior temporal to the inferior nasal part, in order to record the findings in those particular optic disc sectors. Prof. Archimedes Busacca had taught me this procedure many years before.

I have always been highly interested in **measurements**, therefore, I would do this whenever possible. Airaksinen's method allowed me to measure surfaces more accurately.

From 1990 through 1992 I examined different machines which already measured optic nerve parameters. In 1992, at the Joint Meeting of the American Academy of Ophthalmology and the Pan-American Ophthalmology Society held in Anaheim, I met Prof. Reinhard Burk, who demonstrated the Heidelberg Retina Tomograph (HRT). I went to Heidelberg, where I was able to examine patients with this machine, together with Prof. Burk. I realized then that this machine enables the observation of Elschnig's Ring in all its contour, at different planes. Also, I confirmed the great reproducibility in the results of successive examinations, whether performed by the same operator or by several observers, provided that three tomographies were performed and that the pertinent mean and standard deviation values were obtained.

I ordered the HRT and my son Juan went to Heidelberg, where he received extensive training during which he managed to master the technique and to evaluate its results properly.

It was the first time we were able to perform a **three-dimensional morphometric study of the optic nerve**. We measured areas, lengths and particularly, **volumes**, accurately.

In the four years which have elapsed since we started working with the HRT, we have carried out four thousand optic nerve studies through which we gathered the experience we want to convey in these pages.

Through this practice we gained reliability on the method and on the reproducibility of its results. We were able to determine the normal value for each parameter and their standard deviation, which are consistent with similar studies reported in the literature

worldwide. We got to know the different types of glaucomatous optic discs and the location of the most frequent damages. Further, we were able to establish five evolution types in the optic disc pathology of glaucoma.

Once again, we confirmed the hypothesis postulated by Goldmann and Leydhecker in 1959, that there is a first **hypertensive** period in which the only change observed is the elevation of intraocular pressure though the optic nerve remains completely normal; a second **preperimetric** period during which the optic nerve starts to become damaged. This period is of great importance for the monitoring of the effect of medical or surgical therapy. During this period, in the absence of visual field loss, the evolution of the disease as well as the effect of medical therapy, can be monitored. When the glaucoma picture of the case indicated surgery, the presence of a normal optic nerve, either counter indicated or postponed it, and in other cases, it occurred otherwise. Finally, in the **perimetric** period, the damage of both optic nerve and visual field continues in correlation if no medical or surgical therapy are prescribed. Some clinical histories have become examples of the value of the HRT in differential diagnosis.

We believe the critical aspect of the studies we perform is their application of the HRT to clinical practice.

The enlargement of the anteroposterior axis of the eye is a feature of congenital glaucoma. The optic nerve examination in congenital glaucoma, with the HRT, allowed us to know that in this pathology, **Elschnig's Ring** which is part of the sclera, **becomes distended** and thus, the optic disc surface enlarges. This change alters the relationship between neuroretinal rim surface and cup surface and leads to mistakes upon ophthalmoscopic examination. The volumetric measurement of the optic disc parameters in the optic discs of congenital glaucomas, reveals an appearance which is completely different from that of an adult. We have demonstrated that those parameters which are important for the verification of optic nerve damage in an adult, are not the same which are valuable for the verification of optic nerve damage in an infant.

Finally, I would like to add that sometimes, in ophthalmology, we are faced with some conditions which are difficult to understand, e.g. in the study of intraocular pressure. Glaucoma is studied by means of thorough and sophisticated examinations such as computerized static perimetry: sensitivity is measured several times for each retinal point and then, the mean and standard deviation of these measurements are obtained. The blood pressure is monitored continuously during the 24 hours and the vascular flow is measured in the optic nerve and in the peripapillary retina. When monitoring of the intraocular pressure is required, a single-spot check is carried out and, only in lucky opportunities, the time at which it was performed is recorded. Only 25% of ophthalmologists perform daily pressure curves. We measure the intraocular pressure seven times in a day, every three hours, the first measurement is made with the patient in bed, at 7 a.m. and the remaining readings are obtained at the medical office. Then, the mean and standard deviation of these measurements are obtained, and, since we know which the normal values for both parameters are in the population, we can determine if the behavior of the intraocular pressure is either normal or pathological. This procedure evidences the close relationship between ocular hypertension and visual field loss, as well as the relationship between intraocular pressure and optic nerve damage, which occurs when there is still no visual field loss.

At present, the above referred situation regarding intraocular pressure also happens with the HRT. Most ophthalmologists - 75% - do not **measure** the optic nerve parameters and content themselves with the flat surface images shown by the ophthalmoscope. We wonder whether why, if so many parameters are measured, the optic nerve parameters are ignored.

Only those with a long experience in daily pressure curves, with optic nerve computerized tomography and with computerized perimetry, can really be acquainted with the physiopathology and the chronology of the symptoms and signs of the disease. They can therefore, help their patients to be prepared for the final stages of the disease, when the visual function is irreversibly involved.

We want to thank Prof. R.O.W. Burk for the knowledge taught to us, for his invaluable advice and his letters in answer to our questions, in addition to his friendship. We are also grateful to Prof. H.E. Völcker and to Dr. K. Rohschneider, from the Ophthalmology Clinic of the University of Heidelberg, as well as to Dr. G. Zinser for his continuous support and the utmost care with which he handled our machines.

We want to thank Prof. Jorge Zárate, for his contribution with chapter 6, where he made a review of the anatomopathologic nomenclature of the optic nerve, so that it could be compared with that of the HRT parameters, and to Dr. Roberto Ebner, who, in chapter 15, demonstrated the value of computerized tomography in neuro-ophthalmological problems, with great efficiency.

Since we are dealing with a novel method which is under continuous development, we hope this book will have a fruitful, as well as critical reading.

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