1. Standardized echography of the optic nerve*

Jules François Memorial Lecture

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1. INTRODUCTION

Standardized Echography, a special advanced method of diagnostic ultrasound in ophthalmology (Ossoinig [21]) has become an effective, clinically very useful and, at times, indispensable diagnostic aid in the evaluation of the orbital portion of the optic nerve. Standardized Echography provides by far the most precise and accurate measurements of the thicknesses of the optic nerve and its sheaths throughout their orbital course. This method also provides a unique opportunity to study the in vivo dynamics of the subarachnoidal fluid surrounding the optic nerve and thus gives invaluable insight into the mechanism of compressive optic neuropathy and of BIH, and adds tremendously to the clinical differential diagnosis of optic nerve and related disorders.

Standardized Echography combines the uses of A-scan, B-scan and Doppler instrumentation and techniques for: (1) the evaluation of topographic (location, borders, shape and special relationship of normal as well as abnormal structures), quantitative (internal structure, reflectivity and sound absorption) and kinetic data (consistency, motility, pulsations and blood-flow). (2) The precise measurements of the thickness of the optic nerve (maximal pial diameter), of the amount of perineural fluid (maximal arachnoidal diameter), and of the thickness of the dura (half the difference between maximal arachnoidal and maximal dural diameters), anywhere within the orbit, i.e., at any site between the globe and the optic nerve canal.

Standardized Echography utilizes specially designed, highly sophisticated real-time A-scan technology, which allows easy and reliable extraction of quantitative data and eliminates falsification of such data by otherwise unavoidable and in part prohibitive artefacts. Together with high-resolution real-time B-scan instrumentation, this A-scan technology is applied with special techniques called topographic, quantitative and kinetic echography. Both the special A-scan technology and the A-scan as well as the B-scan and Doppler examination techniques are standardized thus representing a single

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optimal ultrasonic language and providing invaluable, understandable, comparable and repeatable results. This standardization gives the method its name.

Historically, Standardized Echography was developed mainly during the 1960's and was first presented (then under the name of ophthalmic clinical echography; Ossoinig [15, 16]) in its different facets during the 1st World Congress on Ultrasonic Diagnosis in Medicine, held in Vienna in 1969. In the 1970s the full range of clinical applications of Standardized Echography including the optic nerve examinations was realized and publicized (Ossoinig [21]). The diagnosis and differential diagnosis of optic nerve lesions was consolidated in the 1980's. While the first in vivo B-scan displays of the optic nerve were initiated as early as 1957, and were published, by Baum [2], the in vivo A-scan displays of the optic nerve were initiated in 1972, and were first published, by Ossoinig [17]. Many others performing Standardized Echography have contributed much to our today’s knowledge and to the state of the art in the imaging of the optic nerve and its disorders with Standardized Echography [1, 3–8, 10–14, 27–36].

A-scan vs. B-scan

The orbital optic nerve consists – for practical purposes – of two major compartments, which will be treated separately: the optic disk and the (orbital) optic nerve. While the optic disk is evaluated mostly with the B-scan method, the optic nerve (from its retrobulbar portion back into the orbital apex) is evaluated primarily with the standardized A-scan method.

For this study, the Kretztechnik 7200 MA model (the first standardized A-scan instrument), the Sono-Kretz module designed for the Ocuscan 400 of Sonometrics, the Ophthascan-S of Biophysic and, for the last 3 years, the most advanced digital Standardized A-scan instrument, the Mini A-scan by Biophysic/Alcon (all instruments were developed by the author with the respective companies) have been used for the A-scan examinations of the optic disk and the optic nerve. All A-scan echograms shown in the figures of this report, which are not designated otherwise, were obtained with the Mini A-scan and at the standardized tissue sensitivity, according to the rules of Standardized Echography.

For the B-scan examinations, first the Kretz 7900 S was used together with binocular immersion goggles. This instrument, developed by the author with Kretztechnik in the 1960s [8], was the first combined A-scan and B-scan instrument commercially available in ophthalmology (the A-scan part was the prototype of the Kretz 7200 MA). Next, in the early 1970s, the first real-time contact B-scan developed by Bronson-Turner, and later the Ocuscan 400 of Sonometrics, the analog B-scan instrument of Cooper-Vision, the Mini B-scan of Biophysic/Alcon, and in recent years predominantly the Ophthascan S (the standardized version of the Ophthascan B) of the same company, were utilized. Both the Mini B-scan and the Ophthascan S were developed by the author together with Biophysic Medical. All B-scan echograms shown in the figures of this report, which are not designated otherwise,