Editorial

Strabismus and the twenty-first century☆

El estrabismo y el siglo XXI

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In recent decades, the ophthalmology specialty has undergone one of the biggest changes in the diagnostic and therapeutic procedures of all specialties, driven by the technological developments of the past century.

The development of techniques like photokeratoscopy, optic coherence tomography or optic nerve fiber analysis have brought about a revolution in their respective fields, without mentioning the huge developments based on refractive surgery, notably PRK, LASIK and IntraLasik, among others. Similarly, the field of glaucoma also experienced significant changes with the development of valve micro-implants which are revolutionizing surgical treatments, in addition to the latest retinal pathology treatments for ARMD and the promising future of stem cell development.

However, the specialty which seemed to be lag behind in diagnostic and treatment techniques was strabology. Strabologists continued to measure ocular deviation with a simple prism and an occluding palette. To this date, this surprisingly simple method has facilitated the majority of strabismus interventions and deserves our respect even though it entails significant inter-and intra-observer variations due to the inevitable lack of precision involved in all manual measurements. 1

In addition, we must consider that movement is a dynamic phenomenon but to this date we have approached strabismus from a predominantly static viewpoint, i.e. we measure said deviation in different positions but do not take into account ongoing movements and the dynamic concept, possibly due to the complexity involved in its analysis.

At any rate, the 21st century has also arrived for strabology, hand-in-hand with changes in ocular movement recording systems derived from electro-oculography methods and other 20th century photoelectric techniques which analyzed changes in electrical potential between the anterior surface of the ocular globe (the cornea) and the posterior surface (the retina), achieving an increasingly precise record of horizontal and vertical eye movements.

High resolution camera recording systems began to be applied for analyzing ocular movements on the basis of horizontal and vertical movements (2D), 2 which involved a significant progress as their precision ranged between 0.1 and 0.5°.

In this field, we must acknowledge the work of Dr. Perea, a Spanish researcher who in the past few years has focused on the development of video-oculography equipment which records horizontal and vertical eye movements with great precision. In his book Dr. Perea provides a previously unequaled in-depth study of ocular movements from an objective viewpoint.

However, the most complex component for analysis is torsional ocular movement, which represented a significant challenge for scientists. In the past, this movement was analyzed with semi-invasive techniques applying scleral ring systems, 3 but their cost and complexity rendered them...
impractical. This disadvantage gave rise to the idea of applying 3D video oculography techniques which enabled recording ocular movements along the 3 axes.\textsuperscript{5,6} Between 1989 and 1991, prototypes of these techniques were developed in Germany and matured into devices which enabled the development of 3-D video-oculography (Fig. 1).

Spanish scientists are also playing a significant role in the development of devices, allowing for the recording of ocular movements with a precision above 0.1°, providing the possibility of constant dynamic records, analyzing the speed of said movements among other elements and more importantly recording movement along the 3 axes of space, particularly the most difficult movement, i.e. the above-mentioned torsional component (Fig. 1).

Said systems could represent a turning point in the history of strabismus as they provide a degree of precision unattainable in the past, in addition to removing the inter- and intra-observer subjectivity and thus yielding an entirely objective and reproducible record. The systems also enable movement analysis from the dynamic viewpoint, allowing us to see in real time ocular globe movements in an immediate and noninvasive manner requiring very little patient cooperation. Likewise, as some of these movements are limited to the head, they enable freedom of movement and therefore allow us to make a combined analysis of torticollis in combination with ocular movements. More importantly, it allows analyzing torsional movements not only while in straight frontal gaze but also in secondary and tertiary positions which are more difficult to analyze.

In fact, the beginning of any precise surgery requires exact measurement systems and, even though said systems are still in development, they are already available with the cooperation of Spanish scientists.

The next step will be a surgical methodology which prevents inter-surgeon differences. This will allow us to say that the 21st century has also arrived for strabismus. Obviously, if we are able to ablate corneal tissue with a precision of microns, we could also entertain the idea that in the not too distant future we will have methods that will truly signify that the 21st century has brought about a turning point in the history of strabismus.

**REFERENCES**