Modern update of ocular and orbital Ultrasound

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Théa
let's open our eyes

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01

B – MODE BIOMETRY

INTRODUCTION

B-mode biometry is a method for measuring the axial length of the globe. The measurement is based on A-mode ultrasound guided by a B-mode horizontal axial scan.

This B-mode axial length measurement has no limitation in case of cloudy media. Furthermore, posterior pole B-mode ultrasound examination can be performed during biometry for vitreoretinal analysis prior to surgery.

I. B-MODE MEASUREMENT TECHNIQUES

B-mode biometry is performed with the patient in supine position, eyelids open, usually without local anaesthetic (in this case, pupil dilation is not necessary). A target point on the ceiling helps patient keep a steady gaze, using contralateral eye.
The B-probe is brought in front of the eye using a coupling ophthalmic gel applied to the tip of the probe. This "pseudo-immersion" technique avoids corneal indentation and does not require a scleral shell, which can be tricky to handle. (Fig 1)

The probe is held vertically in front of the corneal apex, with the marker on the probe positioned to the right or left in order to obtain a horizontal scan. A gentle up and down translation of the probe is used to highlight interfaces on the screen showing a horizontal scan through the visual axis (Fig 2). At this stage, it is important not to tilt the probe in any axes.

Fig 1: B-mode biometry technique: The B-probe is prepared with a small quantity of ophthalmic gel.

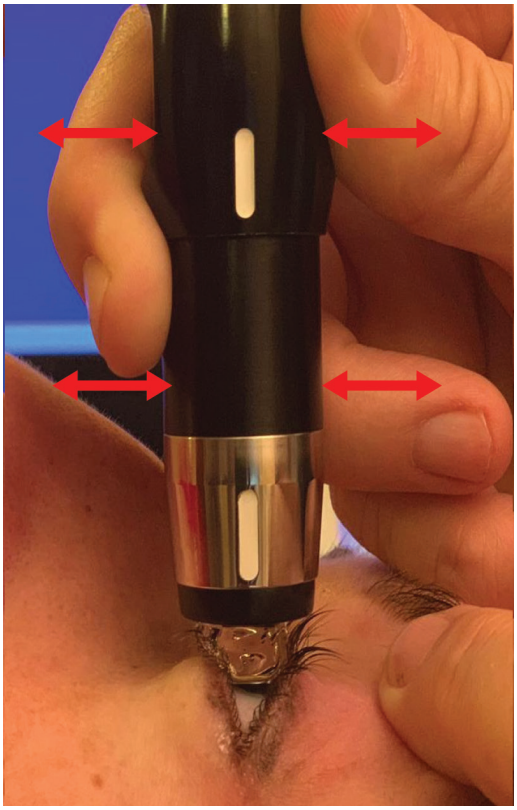

Fig 2: The B-mode probe is positionned with a gentle contact of the gel in front of the corneal apex in a perpendicular way. Just by applying an horizonal translation of the probe we can unlight the interfaces on the screen avoiding all other inclination of the probe.

On the screen, the horizontal axial scan is obtained by aligning the anterior and posterior corneal interfaces, the anterior and posterior lens interfaces, and the optic nerve head, which can be used to identify the macular region. (Fig 3)

When the cornea and the lens interfaces are aligned with a highest reflective response, the optic nerve head is very often observed at the fundus.

A control vector is superimposed over this horizontal axial scan to identify the measurement axis along the visual axis. The visual axis forms a 10 to 15° angle temporally to the optic disc. (Fig 4)

Interfaces can be shown on A-mode (Amplitude mode) in a direct correlation with B-mode (Brightness mode) scan. When displayed together, there is a spatial correspondence between the brightest images in B-mode and the highest peaks in A-mode (Fig 4). Callipers can then be added to mark off the sections of the globe through which ultrasound beam is conducted with a different ultrasound speed (Fig 5). Ultrasound devices do not measure distances directly: they measure the travel time of the ultrasound beam. This travel time is converted into a distance based on the ultrasound speed into the anterior chamber (1532 m/s), into the lens (1641 m/s) and the vitreous (1532 m/s).

To ensure reliability of B-mode axial length measurement, it is recommended to perform a series of four or five measurements selecting the values that fall within +/- 0.1 mm.

Optical biometry performed by a trained operator can be used very effectively to demonstrate the reliability of B-mode biometry results. It is very useful to calibrate B-mode biometry technique when axial length measurement is known by optical biometer. This learning curve will lead to a very high efficacy of B-mode biometry in case of cloudy media with no optical biometry available.

An automatic keratometer should be used for keratometry (in millimeter) and IOL calculation, using the ultrasound device calculator.

When pseudo-immersion axial length B-mode measurement and automatic keratometry are combined, the ULIB website's optimised A-constant can be used for the SRK/T formula. Note that nominal A-constant column corresponds to measurements taken using a contact A-scan.

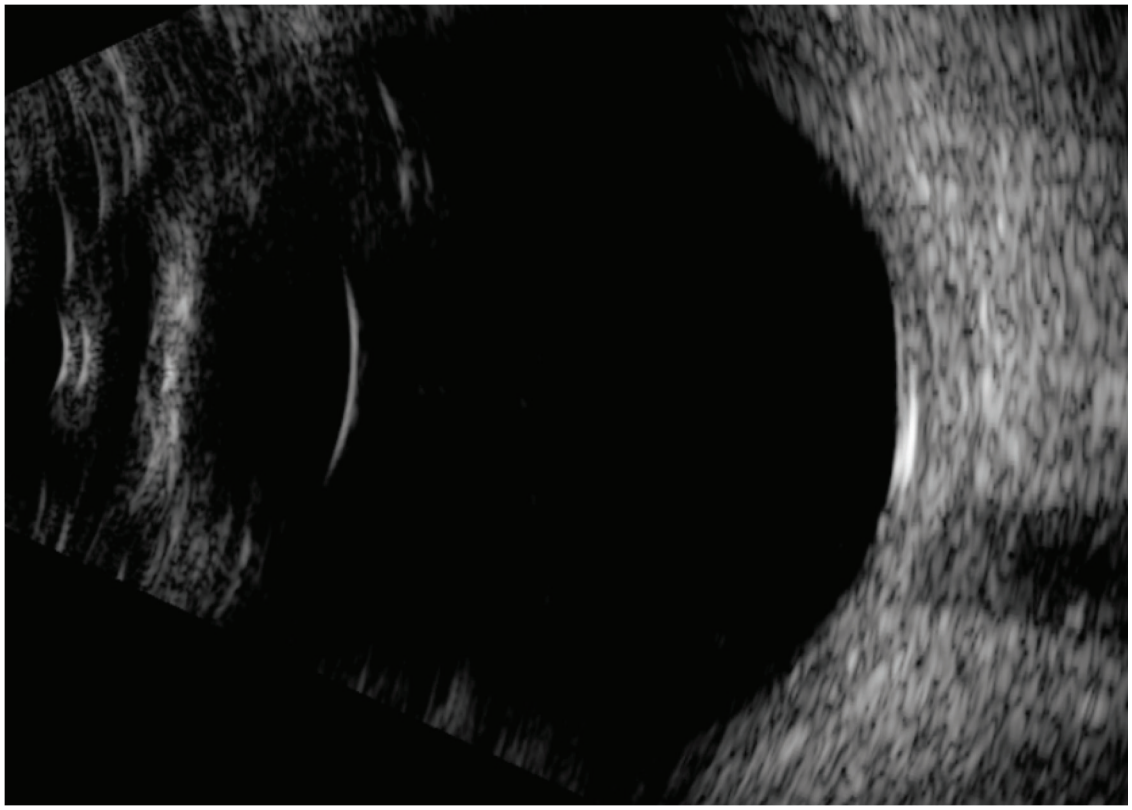

Fig 3: Horizontal axial scan with double corneal arc, double lens arc aligned and optic nerve head visualisation. This scan shows perpendicularity of ultrasound beam against interfaces : optic nerve head visualisation allows to define macular region positionning.

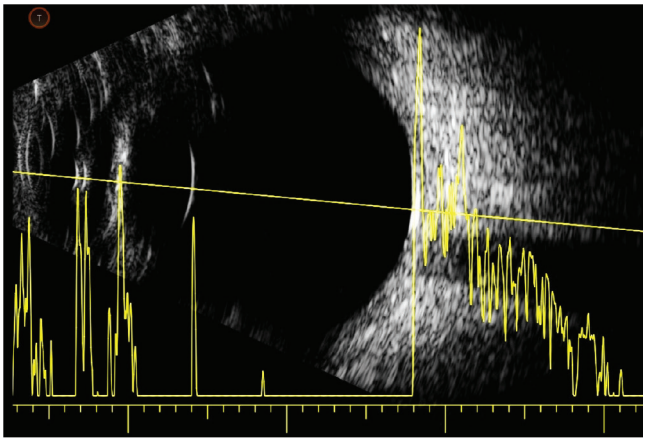

Fig 4: Horizonal axial scan with control vector: The higher interface reflectivity with B-mode gives the higher peak with A-mode with a direct spacial relationship.

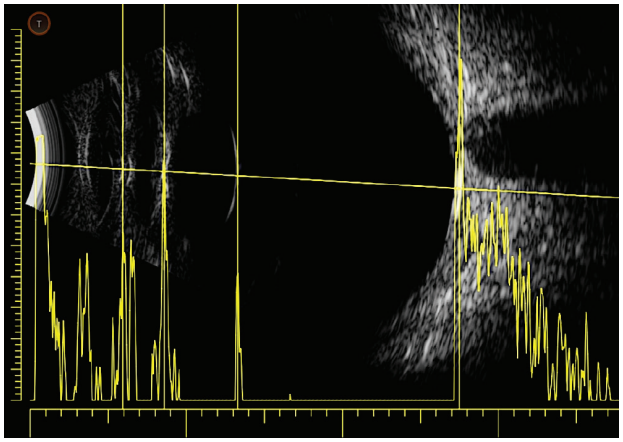

Fig 5: Calliper positionning selecting intra-ocular segment with various ultrasound speed : Cornea and ACD: 1532m/s, Lens: 1641m/s, Vitreous : 1532 m/s.

ERRORS TO AVOID

Wrong calliper positioning can lead to axial length measurement error (Fig 6), with axial length shortening when the lens section is measured as shorter than it actually is, and *vice versa*. This is a key point of B-mode biometry, since it helps to clearly identify the posterior lens capsule. It should be noted that A-mode biometry—generally performed in automatic mode—automatically selects the highest peak as the posterior lens capsule, which can lead to wrong measurement in case of lens opacities.

B-mode biometry measurements are taken with the eyelids open, since this makes it easier to distinguish the front of the cornea. When measurements are taken with the eyelids closed, it is not always possible to precisely identify the anterior cornea, and the patient cannot be instructed to look in a specific direction. (Fig 7)