We have analyzed the diagnostic results in 129 cases of unilateral exophthalmos of at least 2 mm. All cases were examined with A scan ultrasonography. Besides, other technical investigations such as X-rays and tomography, angiography of the ophthalmic artery, gammagraphy of the orbit, and orbital phlebography, were also carried out. The computerized axial tomography introduced in ophthalmology by Lloyd & Wright in 1974 (Wright et al., 1975) could only be used in a limited number of patients.

All associated clinical signs, which could be helpful for the etiological diagnosis, were recorded and discussed: onset; degree and reducibleness of the exophthalmos; retraction of the upper eyelid; signs of congestion of the anterior segment; limitation of the external eye motility; changes of the retina and the optic nerve.

DIAGNOSIS OF EXOPHTHALMOS

The mean exophthalmos of the normal eye is 15 to 17 mm. An exophthalmos exceeding 22 mm is pathological (Rundle, 1964; Françoïs & Goes, 1977).

Lavergne & Winand (1973) reported that successive measurements made by the same examiner with the Hertel exophthalmometer are only significantly different when the difference exceeds at least 2 mm. When the measurements are made by different examiners only a difference of at least 3 mm is statistically significant (Tengroth et al., 1964).

On the other hand, the maximal difference between the exophthalmos of both eyes in normal conditions is 3 mm. There is no difference between both sides in 44% of cases and there is a difference between 1.5 and 3 mm in only 3.5% of normal subjects (Knudtzon, 1949). Moreover, the exophthalmos does not change with age.

Therefore, an exophthalmos can be considered as pathologic when:
1. The value exceeds the limits of the normal distribution (> 22 mm).
2. There is a difference of 3 mm or more between both eyes.
3. There is a change in the exophthalmos reading of more than 2 mm, when the measurement is made by the same examiner, and of more than 3 mm, when the measurement is made by different examiners.
We must keep in mind that a change in the position of the corneal apex in relation to the temporal orbital wall can also be caused by a change in the form of the eye (myopia, hyperopia, atrophy of the globe) as well as by the presence of an infiltrative process in the orbit. Especially in the presence of opaque ocular media, the diagnosis of pseudo-exophthalmos can be made by measuring the position of the eye apex in relation to the temporal orbital wall. This position is given by the formula \( E - \frac{A}{2} \), where \( E \) represents the exophthalmometric value (mm) and \( A \) the axial eyelength (mm). Buschmann & Schwaar (1967) have calculated a mean value of 2.90 (± 0.28) in emmetropic eyes, with a maximum difference between both eyes of 1 mm. In anisometropic eyes the maximum difference between the position of the centre of both eyes was always less than 2 mm.

**METHOD OF EXAMINATION**

All our orbital examinations were made with A-scan ultrasonography. Our survey covers a period from 1969 to 1976. Up to 1971 we used the 7000 Kretz apparatus which had a very strong amplification, but a too small dynamic range (26 db), so that a differential diagnosis was very difficult. Since 1971 we have been using the 7200 MA standardized Kretz apparatus with a good dynamic range (36 db), a strong amplification and a built-in calibration scale.

We used the standard amplification for tumour diagnosis, which is calculated according to the technique of Ossoinig (1971). For the differential diagnosis this setting was usually diminished by two to four decibels.

A possible change in width of the orbital echogram was studied after compression of the eyeball-orbit complex by the transducer.

A frequency of 8 MMZ was used. This allows a sufficient resolution and penetration, so that the normal orbit can be explored to a depth of 15 mm behind the eye. In the case of tumour a distance of 35 mm behind the eye may be demonstrated on the screen because of less attenuation. The normal human orbit changes according to the position of the transducer, and the absorption of ultrasound varies according to the composition and the hydration of the fat tissue, which is variable from one eye to another. For these reasons the examination has to be transbulbar and parabulbar in symmetrical positions for both eyes, the transducer being in a limbal, paralimbal or equatorial position.

**ULTRASOUND DIAGNOSIS OF ORBITAL DISORDERS**

Ultrasonography was introduced in ophthalmology in 1956 (Mundt & Hughes, 1956) and in orbital diagnosis in 1960 (B-scan, Baum & Greenwood). A-scan was first considered to be less appropriate than B-scan, but since 1963 Ossoinig and co-workers stressed the high reliability and accuracy of A-scan ultrasound in detecting orbital disorders.