Orbitometer-Ophthalmometer: New Surgical and Clinical Device

George E. Anastassov, MD, DDS
Philip A. van Damme, MD, DMD
Nijmegen, the Netherlands

On the basis of analysis of the orbital bony architecture and the locations of the medial and lateral canthi, as well as the pupillary position, a new orthomorphic linear scale was devised for orbital surgery. The measuring device was designed to facilitate hard- and soft-tissue repositioning during mono-orbital and biorbital surgery. The device is useful for craniofacial, reconstructive, and periorbital trauma surgery and, to the best of our knowledge, is the first one described.

Key Words: Orbitometer, ophthalmometer, orbital surgery, craniofacial surgery

Temporary surgical displacement of the orbits is an old practice (Jules Boeckel of Strasbourg). Periorbital, reconstructive, trauma, ablative, corrective, and decompressive procedures are widely performed. Surgical corrections of hypertelorism and teleorbitism, pioneered by Converse (1970-1974) [1, 2], Tessier (1967, 1971, 1972) [3-9], and van der Meulen (1974, 1976, 1979) [10-12], are commonly performed procedures. Congenital periorbital clefts (no. 3-11 according to Tessier's classification) [13], even though rare, are being successfully corrected. Periorbital trauma is relatively common and caused by motor vehicle accidents, violence, and sport activities. These injuries are repaired in a primary delayed phase (in case of central nervous system or general hemodynamic instability) or in a secondary phase. Ablative surgery involving the orbits is performed on the pediatric (e.g., lymphangiomas, hemangiomas, fibrous dysplasia, retinoblastoma, meningioma) and the adult population [14, 15]. Orbital volume expansion or reduction is also often accomplished for orbital decompression secondary to Graves' disease (dyshyperthyroid exophthalmos) [16] or after trauma, respectively. Cosmetic procedures such as blepharoplasties, canthoplasties, and canthopexies are commonly used.

All these interventions are based on certain established criteria for normality, such as interpupillary distance, intercanthal distance, intercrestal distance, orbital height, orbital width, ratios, and so on [17-21]. Access and good visibility to the orbital region can be obtained via coronal incision, combined with a transconjunctival approach with lateral-medial canthotomy. With rigid fixation, good stability and quite predictable outcomes can be achieved. However, during the intraoperative stabilization (both hard and soft tissue), certain deviations may occur as a result of the subjectivity of the operator or the difficulty in achieving symmetry between both orbits or contralateral orbital segments simultaneously. Sometimes it is difficult to correlate preoperative predictions with the concrete operative situation, even with use of CD ROM/CAM techniques. The measuring devices used during orbital surgery are calipers and scales, which do not permit simultaneous, bilateral measurements and midline correlations. Postoperatively, Hertei's exophthalmometer, which only measures anteroposterior projections of the globe, may be used [22]. However, besides axial measurements, vertical and horizontal measurements are paramount. In correcting teleorbitism, the interorbital angulation should be taken in consideration (i.e., the medial and lateral anterior orbital margins are not located on a straight horizontal line; rather there is an obtuse angle measured from the nasion). Therefore, the normal interorbital angle is to be established during orbital rotations (hemifacial bipartition, monobloc) or during posttraumatic reconstructions.

INSTRUMENT DESIGN

A linear combined orbitometer and ophthalmometer was designed. It consists of several components (Figs 1, 2).

- Two horizontal metric scales (80 mm long, 10 mm high, 2 mm thick). The two horizontal bars are connected to semirigid hinge joints and a superiorly positioned protractor. The horizontal bars are adjustable from 0° to 180°.
- Two lateral orbital rim positioners.
- Two vertical adjustable scales with midline grooves (1 mm wide) with inferiorly based pupillary positioners
Fig 1  Anterior view of the device. (A = horizontal metric scales; B = vertical sliding metric scales; C = semirigid hinge joint; D = lateral orbital rim positioners and rests (removable); E = "L"-shaped mediolaterally retractable arms with metric scales.)

Fig 2  Superior view of the device. (1 = horizontal metric scales; 2 = vertical sliding metric scales; 3 = semirigid hinge joint; 4 = lateral orbital rim positioners and rests (removable); 5 = protractor; 6 = "L"-shaped mediolaterally retractable arms with metric scales.)

Fig 3  The orbitometer-ophthalmometer positioned on a dry skull.

(hollow indentations). The vertical scales are sliding superoinferiorly for 30 mm and mediolaterally for 60 mm bilaterally. The horizontal width of the scales is 20 mm; the vertical height is 50 mm.

- Metric measuring scales located laterally to the midline grooves. The width of the vertical segment is 20 mm with central oval concavity for compensation of the scleral configuration posteriorly.
- Two inferiorly based "L"-shaped, mediolaterally retractable arms, 20 mm long with vertically positioned and rounded pointers. The superior horizontal bar of the "L" has a metric scale. The horizontal mediolateral pointers are retractable for a distance of 20 mm each for 60 mm total.

MODE OF OPERATION

The lateral positioners are placed on the lateral orbital rims, on the skin externally, or on the frontal process of zygomatic bones, depending whether the instrument is used preoperatively, intraoperatively, or postoperatively (Figs 3, 4) and whether skeletal orbital or soft-tissue (blepharoplasty, canthoplasty) surgery is being performed (i.e., the operative access). The horizontal bars are adjusted next, and a proper interorbital angle is established. The vertical sliding devices (scales) are adjusted, and the pupillary positioners are placed on the pupillary level bilaterally. The medial intercanthal-intercrestal distances are measured, and the vertical-horizontal symmetry as well as sagittal symmetry are evaluated.

DISCUSSION

Orbital symmetry should be the goal of every surgeon operating in the region. The periorbital structures are the most prominent facial features and are, therefore, most affected. Noticeable asymmetries are more obvious than in other facial regions (e.g., ears or jaws).

Precise clinical-paraclinical (e.g., computed tomographic [CT] scan, three-dimensional CT, CD ROM/CAM reconstruction) evaluation and treatment planning are paramount. It would be helpful to use the same orbitometric-ophthalmometric device during the preoperative, operative, as well as postoperative phases in the course of treatment. To our knowledge such a device does not exist.

The first exophthalmometer was devised in 1865 by Cohn [23]. Since then numerous modifications have been made [24–26]. Unfortunately, these devices are designed for evaluation of axial positions and displacements of the
Fig 4 (A) Anterior view of the device positioned on a patient. Note the placement of the small retractable arms on the canthus bilaterally. (B) Bird's eye view of the device. Note the protractor showing the interorbital angle.

globe only. The position of the eye, as well as orbital soft and hard-tissue movements, should be evaluated in terms of horizontal, vertical, and axial directions. Of course, a device that could measure absolute, comparative, and relative prospective would be most helpful. With this in mind, an orbitometer-ophthalmometer was designed.

We acknowledge Mr. François Beuse from Walter Lorenz Surgical Co. for his cooperation with the construction of the device described here.

REFERENCES
5. Tessier P. Total osteotomy of the middle third of the face for faciostenosis or sequelae of Le Fort III fractures. Plast Reconstr Surg 1971;48:533–541