

Importance of the Implementation of a Stereotaxy System for Neurosurgical Activity in Botswana

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Abstract

In daily Neurosurgical practice in Botswana we can observe dissimilar pathologies located in deep brain structures where a conventional neurosurgical approach would cause irreversible damage. In these cases, exact localization methods with stereotaxy play a leading role. Unfortunately, the country does not have such a system and it is necessary to refer patients to other countries such as South Africa or India to provide them with these services, at an extremely considerable cost and in many cases these processes are delayed, which produces irreversible deterioration of the patients. We believe that with the implementation of a stereotactic system in Botswana, the costs of these types of procedures can be reduced and, in turn, greater effectiveness and safety can be achieved in the treatment of these diseases.

Keywords: Stereotaxic System, Botswana, Neurosurgery

Stereotactic Neurosurgery is a type of minimally invasive surgical intervention that uses a three-dimensional coordinate system to locate small structures within the body. From the Greek *στερεός* *stereos* which means "hard, rigid" and *τάξις* *táxis* which means "ordering". The stereotactic method was developed by two British scientists in 1908 at the University College London hospital, Sir Victor Horsley, a physician and neurosurgeon, and Robert H. Clarke, a mathematician and also a surgeon. Under the name of the Horsley–Clarke apparatus, they developed a system implementing Cartesian coordinates (three-axis system) for animal experimentation. Cartesian coordinates or rectangular coordinates are a type of orthogonal coordinates used in Euclidean spaces, for the graphic representation of a function, in analytical geometry, or of movement or position in physics, characterized because it uses as reference orthogonal axes that intersect each other in an origin point. Cartesian coordinates are thus defined as the distance to the origin of the orthogonal projections of a given point on each of the axes. The name 'Cartesian' was introduced in honor of René Descartes, who used it formally for the first time. ^(1, 2)

When we refer to a stereotactic system, we take into account: a stereotactic framework (Figure 1), a stereotactic location and localization procedure (Figure 2) and a stereotactic planning system (Figure 3), including atlases, multimodal imaging instruments and cartesian coordinate calculator. Within the types of stereotactic systems we can find: simple orthogonal systems, systems mounted on trepanation, systems based on polar coordinates, quadrant arc system and phantom arc system.

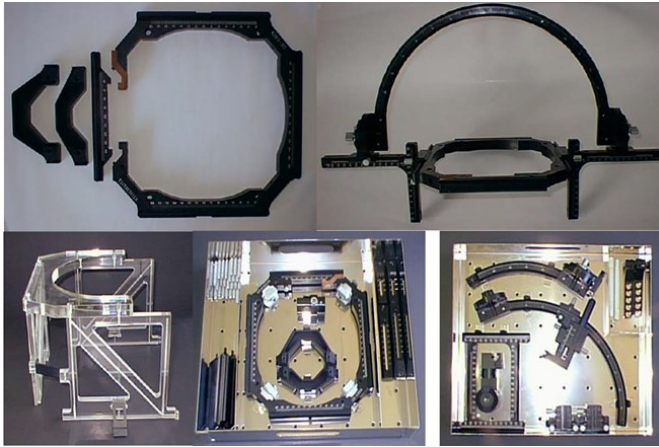


Figure 1: ESTEREOFLEX Stereotaxic Frame. (Taken from the conference by Professor Raúl Macías: Stereotactic Systems. CIREN).



Figure 2: ESTEREOFLEX placement and localization procedure. (Taken from the conference by Professor Raúl Macías: Stereotactic Systems. CIREN).

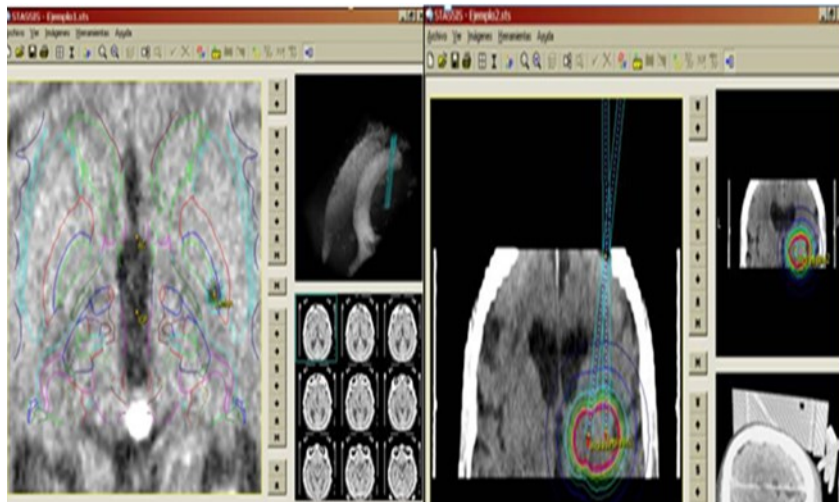


Figure 3: Stereotactic planning system. STASSIS: planning system in Neurosurgery with Ct-Scan images (Taken from Professor Raúl Macías's conference: Stereotactic Systems. CIREN)

Stereotaxy was introduced in Cuba in 1955 through a Cooper system, and subsequently evolved with the development of imaging techniques and computer software. In the early seventies, thalamotomy in parkinsonian patients and lesion of the centromedian nucleus in patients with trigeminal neuralgia began at the Institute of Neurology and Neurosurgery guided by iodine and pneumoventriculography. Biopsy guided by computed axial tomography, interstitial and intracavitary brachytherapy were introduced for the first time in Cuba at the Hermanos Amejeiras Clinical Surgical Hospital in December 1990, as well as radiosurgery starting in 1991 in 24 patients (11 tumors and 13 arterial malformations). -venous). Lesionotomy in movement disorders began at the International Center for Neurological Restoration in 1991 (pallidum and subthalamotomy), as well as volumetric resection of intracranial lesions. In 1997, the ESTEREOFLEX, the first Cuban stereotaxic frame, was manufactured in this center, bringing stereotaxy to several provinces of the country. In 2010, the Hermanos Amejeiras hospital and the Neurosciences Center introduced tractography for stereotaxic resection of lesions in eloquent areas. Likewise, endoport or brainport surgery for endoscopic resection, guided by stereotaxy of pineal tumors, began on this date at the aforementioned hospital. In the 2010-2011 stage, stereotaxic radiosurgery was restarted both at the Hermanos Amejeiras hospital and at the National Institute of Oncology and Radiobiology. ⁽³⁾

The applications of Stereotactic Neurosurgery are varied, in Cuba through the use of its own system such as ESTEREOFLEX, it has been used successfully in: functional stereotactic neurosurgery at the International Center for Neurological Restoration, mainly in patients with Parkinson's Disease ^(4,5,6,7,8), even making modifications to the surgical technique that has offered greater safety for the treated patients ^(9,10,11,12,13,14,15), biopsy of intracranial lesions and stereotaxic resection volumetric or not of Intracranial lesions such as tumors, vascular malformations ^(16,17,18,19), implantation of radioactive material (Brachytherapy), surgery for abnormal movements, epilepsy surgery, pain surgery, psychosurgery, puncture and evacuation of cysts, intraparenchymal hematomas and brain abscesses, stereotaxic neuroendoscopy, placement of shunt systems and reservoir systems, neurotransplants (restorative surgery), radiosurgery, guided approaches in skull base and upper cervical spine surgery.

In daily Neurosurgical practice in Botswana we can observe dissimilar pathologies, among which infections of the nervous system and brain tumors stand out, sometimes many of these located in deep brain structures where a conventional neurosurgical approach would cause irreversible damage, in these cases the Exact localization methods with stereotaxy play a leading role as part of minimally invasive neurosurgery. Unfortunately, the country does not have such a system and it is necessary to refer patients to other countries such as South Africa or India to provide them with these services, at an extremely considerable cost and in many cases these processes are delayed, which produces irreversible deterioration of the patients. We believe that with the implementation of a stereotactic system in Botswana, the costs of these types of procedures can be reduced and, in turn, greater effectiveness and safety can be achieved in the treatment of these diseases.

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