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ADVANCED NEUROSURGICAL PROCEDURES: AN IN-DEPTH EXAMINATION OF BRAIN SURGERY TECHNIQUES AND OUTCOMES

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ABSTRACT:

Background and Objective: The overarching goal of this study is to retrospectively describe the postoperative outcomes of patients who underwent neurosurgical brain stereotactic guided procedures at the Hospital Universitario Pakistan between July 2009 and July 2011.

Materials and Methods: This retrospective study involved the examination of medical records of seventy-eight patients who were transported to the Hospital Universitario Pakistan for neurosurgical stereotactic guided treatments. The study analyzed the clinical characteristics of patients, the location of lesions on neuroimaging, the care provided to each patient, the type of procedure performed, and the functional outcomes in the short and medium term.

Results: The study included 78 patients, of whom 64.1% (n = 50) were male. Lesions were located in various brain regions in the following order of frequency: sub-thalamic ganglia, frontal lobe, temporal lobe, thalamus, cortico-subcortical junction, brainstem, frontotemporal location, occipital lobe, parieto-occipital location, and the base of the skull. The implementation of guided stereotactic neurosurgery procedures was highlighted as an effective solution for dealing with deep brain diseases or areas with restricted access. These procedures were associated with low morbidity and mortality rates and are performed in Colombia and other parts of the world.

Conclusions: The complication rate does not exceed five per cent, regardless of the type of stereotactic guided procedure. These results are comparable to those reported in the global literature. The study underscores the need for multicenter studies to monitor the progression of stereotactic neurosurgery in Colombia. Additionally, long-term studies are necessary to evaluate the extended outcomes of these procedures.

KEYWORDS: Stereotaxis, neurosurgery, stereotactic neurosurgery, complications, short-term, medium-term, stereotactic biopsies, and stereotactic-guided operations are all terms that apply to this discussion.

INTRODUCTION:

The Fundamentals of Stereophonics Throughout the history of neurosurgery, there has always been a desire to access the most difficult and deep parts of the brain [1]. Historically, to accomplish this objective, it has been attempted to develop processes that enable precise access to particular places, selecting the path that is the shortest and causing the least amount of damage to the tissues that are surrounding the area [2]. In this manner, the stereotaxy systems operate [3]. The fundamental basis of its functioning is comprised of devices that are more or less complex and are mounted to the skull. These devices generate neuroimaging studies to get some coordinates. Surgical treatments were first performed experimentally and on people [4]. It was Horsly and Clarke who first coined the term "stereotaxy" in the year 1908 [5]. They used it to refer to esters, which are three-dimensional, and taxis, which are planar [6]. The second phrase has been supplanted by the term tactus, which means touch, in contemporary usage. The distinctions between the terms stereotaxic and stereotatic can be drawn from this [7]. It was during the Ages of Stone when the first neurosurgical procedures were carried out on human patients. This is significant from a historical perspective. ISSN 0041-9095 recorded the written records of trepana at the 41st Medical University [8]. December 2013 issue of Bogotá (Colombia), volume 54, which refers to the deliberate opening of the skull for "relief from unexplained and unbearable pain... melancholy... or to release demons," was dated to the year 1500 B.C [9]. Nevertheless, the oldest physical evidence of trepanation in human skulls dates back to the Neolithic Stone Age, which is approximately 3500 years before the present day. In 1996, during an excavation in the Ensisheim cemetery in France, the cranium that was discovered to be the earliest to undergo trepanation was discovered [10]. This cranium goes back to the year 5100 BC. C., however, it was not discovered until a considerable amount of time later. These methods were utilized in a more conventional manner, which was indirectly connected to the development of scientific knowledge [11]. The historical tour of stereotaxy has been broken down into three distinct periods with the following descriptions:
The initial phase? Dittmar (1873) developed a device that may be used to locate the medulla oblongata in individuals of animal species [12]. Later, in 1889, Zernov designed the encephalometer, which was developed to locate anatomical structures. The initial stage of stereotaxy is also known as the second stage. To visualize brain damage in cats, the doctors at Hosley construct stereotaxic equipment from scratch. In later years, Kirschner developed a stereotaxic device for the thermal coagulation of the Gasserian ganglion, however, it was developed for use in animals [13]. It wasn't until 1946 that Spiegel and Wycis carried out the very first stereotactic procedure on a human patient. The treatment of aberrant movements became the primary emphasis of the movement that began to expand over the world during the decade of the 1950s [14]. Because there was a lack of scientific proof about this procedure, there was a decrease in the use of stereotaxy during the sixties. This was because the general public was aware of the potentially harmful consequences that resulted from the procedure. The maturity of stereotaxy signifies the third stage [15]. The development of computed axial tomography (CAT) in the 1970s led to a revival of stereotaxy, which was a medical procedure that was previously in decline [16]. To this day, neurosurgery continues to operate independently of stereotaxy because it employs a variety of surgical procedures and provides treatment for a variety of disorders [17]. In the decades of the eighties and nineties, this instrument gained a significant deal of strength as a result of the advancements that were made in diagnostic imaging (not just CT, but also MRI and angiograms with digital subtraction. Specifically, the decade of the 1990s marks the beginning of the trend of doing less invasive procedures. Therefore, by the end of the 20th century, we can visualize and treat minor intracerebral lesions such as tumors, cysts, and vascular abnormalities without causing any damage to the brain tissue that surrounds them. Atlas of the Stereotaxy to use stereotaxy equipment, it is essential to have a solid understanding of the [17, 18]. The relationship between the anatomical structures and the sectors that you wish to

access was investigated by Óscar Zorro and colleagues in their study on stereotaxy-guided brain neurosurgical procedures. The fact that measurements differ from patient to patient is made clearer by this information. The first atlas of stereotaxy with clinical relevance was created by Spiegel and Wycis in 1952. It was also the first atlas to be based on references established by ventriculography. A proposal for an atlas was made by Talairach and his colleagues in 1957. The map would concentrate on epilepsy surgery and would include information about the locations of blood vessels. Both the atlas that was proposed by Andrew and Watkins in 1969 and the one that was proposed by Van Buren and Borke in 1972 had illustrations that defined the relationship between several different subnuclei, notably those that were associated with the thalamus. The Afshar Atlas, which was published in 1978, refers to the nuclei that are located in the cerebellum and the brain stem. Other writers, such as Hassler et al. (1979), developed particular atlases for a region or treatment. These atlases were released about the treatment of Parkinson's disease. The purpose of these atlases was not to provide pictures or illustrations for the anatomical study; rather, they were designed to define and provide functional goal coordinates. The construction of these atlases has been altered with the introduction of new imaging techniques, such as computed tomography (CT) and magnetic resonance imaging (MRI). Virtual illustrations are currently being utilized, and in addition to this, they can be customized to each patient, both within the wards of surgery and outside of them. What are the indications for using stereotaxy? To facilitate the diagnostic process : In cases when the lesions are located in significant functional areas, stereotaxy may be utilized to perform a biopsy. In situations where the patient exposes themselves to an excessive number of hazards with open surgical procedures or when surgery does not offer any advantages over the histological suspect. • Craniotomy: Before surgery, it is possible to localize the problem using this procedure. Surgical procedure. When it comes to intraventricular processes, ventriculoscopy is done. Regarding the aims of therapy: • Hematomas are removed from areas that are functionally significant by hoover. The insertion of catheters to drain abscesses or administer anticancer medicines. Radiosurgery is a treatment option for arteriovenous malformations. Aneurysms can be clamped with this technique. In the field of functional neurosurgery: Parkinson's disease is a cause. Movement problems are prevalent. University of Medicine, 43, ISSN 0041-9095. December 2013 issue of Bogotá (Colombia), volume 54, issue 1, pages 39–52 Epilepsy and psychosurgery are discussed. Persistent Pain. Causes for concern Stereotaxy is a procedure that is safe (with an overall mortality rate of 1.0–6.5% and an overall morbidity rate of 0-1.7%), thus it is of utmost importance to review the results that were found on complications that occurred during surgeries that were guided by stereotaxy. When one hundred patients get a biopsy, the greatest number of deaths that can be attributed to the technique is six, and only 1.7 patients out of one hundred patients who undergo a biopsy have secondary sequelae to the treatment. This indicates that the technique is responsible for the death of six persons. Hemorrhage is the most common side effect of surgery, and sixty percent of patients may experience it at some point during the procedure. Although the risk of related morbidity bleeding is only 1%, it can increase to 6% in cases of malignant neoplasms, which may be attributable to the presence of neovascularization. In the same vein, they may exhibit massive hemorrhages that are accompanied by neurological deterioration, necessitating a craniotomy to control the hemorrhage and drain the accumulation. A further issue is the impairments of neurologic disorders that are not linked with hemorrhage and are the result of direct damage.

Historical Developments in Stereotaxy

Period	Year	Development	Reference
Initial Phase	1873	Dittmar developed a device to locate the medulla oblongata in animals.	[12]
	1889	Zernov designed the encephalometer for locating anatomical structures.	[13]
	1908	Horsly and Clarke coined the term "stereotaxy".	[5]

	Pre-1908	The first neurosurgical procedures were recorded as early as the Stone Age.	[8] [9] [10] [11]
Second Stage	1946	Spiegel and Wycis performed the first stereotactic procedure on a human patient.	[14]
	1960s	Decline in use due to lack of scientific proof and awareness of potential harmful effects.	[15]
Maturity Stage	1970s	Revival with the development of computed axial tomography (CAT).	[16]
	1980s	Advancements in diagnostic imaging (CT, MRI, digital subtraction angiograms).	[17]
	1990s	Stereotaxy enabled visualization and treatment of minor intracerebral lesions with minimal brain tissue damage.	[18]

Development of Stereotaxy Equipment

Year	Contributor	Development	Reference
1873	Dittmar	Device to locate the medulla oblongata in animals.	[12]
1889	Zernov	Encephalometer for locating anatomical structures.	[13]
1908	Horsly & Clarke	Coined the term "stereotaxy".	[5]
1946	Spiegel & Wycis	First stereotactic procedure on a human patient.	[14]
1960s	Kirschner	Stereotaxic device for thermal coagulation of the Gasserian ganglion.	[13]

Advances in Diagnostic Imaging

Decade	Advancement	Impact	Reference
1970s	Computed Axial Tomography (CAT)	Revival of stereotaxy in medical procedures.	[16]
1980s	CT, MRI, Digital Subtraction Angiograms	Enhanced diagnostic imaging capabilities.	[17]
1990s	Less invasive procedures, treatment of intracerebral lesions	Visualization and treatment of minor lesions without damaging surrounding brain tissue.	[18]

Development of Stereotactic Atlases

Year	Contributor	Atlas Description	Reference
1952	Spiegel & Wycis	First clinically relevant atlas based on ventriculography references.	[19]
1957	Talairach	Atlas focuses on epilepsy surgery and blood vessel locations.	[20]
1969	Andrew & Watkins	Atlas illustrates relationships between subnuclei.	[21]
1972	Van Buren & Borke	Atlas with illustrations defining relationships between various subnuclei.	[22]
1978	Afshar	Atlas refers to nuclei in the cerebellum and brain stem.	[23]
1979	Hassler et al.	Specific atlases for regions or treatments, especially for Parkinson's disease.	[24]

Indications for Using Stereotaxy

Purpose	Procedure	Reference
Diagnostic	Biopsy of lesions in significant functional areas.	[25]
	Craniotomy localization.	[25]
Therapeutic	Removal of hematomas.	[26]
	Insertion of catheters for abscess drainage or anticancer drug delivery.	[26]
	Radiosurgery for arteriovenous malformations.	[26]

	Aneurysm clamping.	[26]
Functional Neurosurgery	Treatment of Parkinson's disease, movement disorders, epilepsy, psychosurgery, and persistent pain.	[27]

Safety and Concerns

Statistic	Details	Reference
Mortality Rate	1.0–6.5%	[28]
Morbidity Rate	0-1.7%	[28]
Common Side Effect	Hemorrhage (60% of patients)	[29]
Risk of Morbidity Bleeding	Increases to 6% in cases of malignant neoplasms due to neovascularization.	[30]
Neurologic Disorder Impairments	Paresis, plegia, sensory abnormalities, aphasias.	[31]

These disorders can result in paresis, plegia, sensory abnormalities, and alterations in neurologic function. Changes in the language, such as aphasias, are examples of them. This complication is more common in the first group, which is visible when craniotomy procedures are compared with stereotaxy procedures. The prevalence of these difficulties is extremely low, and it is clear that the first group is more likely to experience it. When it came to sampling, the diagnosis of injuries, and the management of each of the illnesses and pathologies that were already discussed, stereotaxy represented a significant contribution to the advancement of treatment. The risk of problems typically does not exceed one per cent in the majority of these treatments. The concept of executing microsurgical The problems that were identified in the experience of using the Leksell stereotaxic system over 28 years are presented in Table 1. This experience took place at the Central Medical Center of

TABLE 1: Problems stemming from stereotaxy frame procedures: UPMC-Presbyterian (1979-2007)

Type of process	TOTAL	Hemorrhage (quantity [%])	Seizure (quantity)[%]	Infection (amount) [%]	Total number of complications (% of total)
Diagnosis from biopsy	1664	43 (2,580	6 (0,36)	2 (0,12)	51 (3,06)
Aspiration of cysts	197	5 (2.53)	3 (1,52)	2 (1,01)	10 (5,07)
internal radiotherapy	145	2 (1,37)	1 (0,68)	1 (0,68)	4 (2,75)
cerebral abscess	97	1 (1,03)	-	4 (4,12)	5 (5,15)
Injection of a catheter and a cyst into the reservoir	19	-	-	-	0
an aspiration of a hematoma	9	-	-	-	-
The Craniotomy procedure	10	-	-	-	-
pallidotomy (also known as	147	2 (1,36)	-	-	2 (1,36)
The Talamotomía	72	1 (1,38)	1 (1,38)	-	2 (2,76)
a significant amount of brain stimulation (disorders of movement)	148	1 (0,67)	-	1(0,67)	2 (1,34)
The use of	95	-	-	1 (1,05)	1 (1,05)

electrodes for seizures					
brain stimulation that is deep (continuous pain)	24	-	-	-	-
transplantation of cells	20	-	-	-	-
transplant of cells	4	-	-	-	-
Total	2651	55 (2,07)	11 (0,41)	11 (0,41	77 (2,90)

* Includes meningitis and cerebritis. **Requires craniotomy and hematoma evacuation in six cases (0.36%). M. Bernstein and AG Parrent. Complications from intra-axial brain injury using CT-guided stereotactic biopsy. 1994 J Neurosurg;81:165-. Within a cohort of 79 individuals undergoing stereotaxy-guided deep stimulation surgery for Parkinson's disease, 20 had the onset of facial paresis, 17 experienced contralateral hemiparesis, 7 experienced speech difficulties, and 8 experienced cognitive alterations. The literature on stereotaxic biopsy varies widely in terms of reported problems. It appears that a 5% acceptance rate for complications exists. Intracerebral hemorrhage is the main complication, leading to a decline in neurological function. According to a neurosurgeon at the University of Toronto, complications particularly intracerebral hemorrhage occurred in 5% of approximately 750 patients in a recent series. Of these, 3% caused mild or temporary deficits, while 2% led to death or neurological mobility. Malignant histology appears to be a significant **risk factor for bleeding.** Discovered during biopsies. In a recent study, the diagnostic field and complications were evaluated between biopsies conducted using procedures produced without a frame and biopsies performed using a stereotaxy frame. In 1999, a series reported diagnostic biopsy rates of 96.3% without stereotaxy, 1.4% neurological morbidity, and 1% death. These results were comparable to those reported for individuals who used frames. On the other hand, the outcomes of posterior fossa biopsies were noticeably worse. According to a different study, there were no appreciable differences between biopsies carried out with and without a frame in terms of the diagnostic field or length of persistent morbidity. The authors noted that while stereotaxy-guided approaches were possibly more beneficial for smaller, more localized lesions, frameless techniques were potentially advantageous for catastrophic injuries or lesions occurring in the cerebral cortex. Profound. Stereotaxic biopsy of brain stem lesions is associated with minimum morbidity and low death rates, and it avoids difficulties associated with open surgical procedures. It is, in comparison, a reasonably cheap procedure. Less intrusive and safer, and it offers both adult and pediatric patients' tissues a sufficient histological diagnostic. It offers histological diagnosis and enables future medical professionals to handle patients more effectively.

METHOD: Patients who underwent stereotaxy-guided neurosurgery procedures between July 2009 and July 2011 were searched in the operating room database of the University Hospital of San Ignacio (HUSI). As with the patient lists for the Neurosurgery Service, some patients weren't on that base. All of the data described in this work, including the difficulties that arose following each treatment, were subsequently obtained by the program from the SAHI, the HUSI medical records. As previously stated in the objectives, HE attempted to obtain data regarding the postoperative outcomes of the aforementioned patients. Populace. All patients who had undergone stereotaxy-guided neurosurgery procedures between July 2009 and July 2011 made up the study population. Both gender and age There was no patient exclusion. by gender or age.

Observation

Through the consultations held following the procedures, the patient's follow-up was monitored. These were completed in the HUSI's outpatient clinic, allowing for a medium- and short-term assessment. Data were collected on the following procedures based on the indicated indications: stereotaxic brain biopsy, craniotomy-guided implantation of an intracranial stimulation electrode, drainage of intracerebral accumulations guided by stereotaxy plus biopsy, brain resection due to stereotaxy-induced brain tumours. Symptoms and indicators Before the patients were carried to surgery, information on their signs and symptoms was gathered to assess their postoperative state. Functional scale before surgery The Glasgow scale for preoperative coma was used as the initial functional reference for evaluating the functional scale.

RESULT: 50 males and 28 women (range M: H 1.79:1) made up the 78 patients who had stereotaxy-guided neurosurgery procedures. Patients were treated ranging in age from 7 to 7. 81 years of age. Stereotaxy-guided biopsies accounted for 56% of procedures performed, followed by deep stimulation or neurostimulator implantations (24%), accumulation drainage (4%), arteriovenous malformation resections (3%), and tumour malformation resections (1%). Figures 1, 2, and 3 show that 13% of the scheduled procedures were not completed.

FIGURE 1: Between July 2009 and July 2011, HUSI was the location of stereotaxy-guided surgeries.

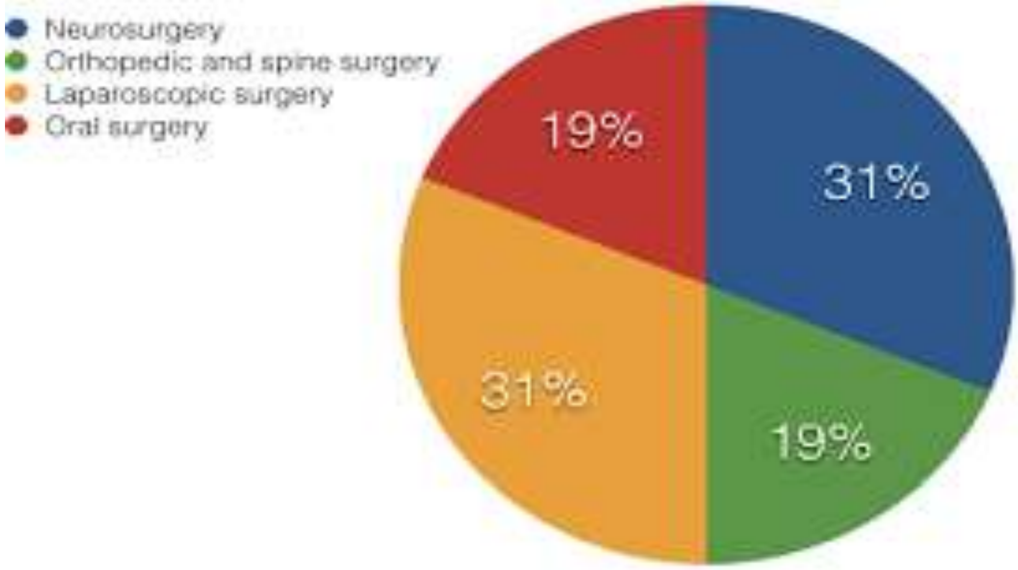


FIGURE 2: Biopsies assisted by stereotaxy that were carried out at the HUSI between July 2009 and July 2011

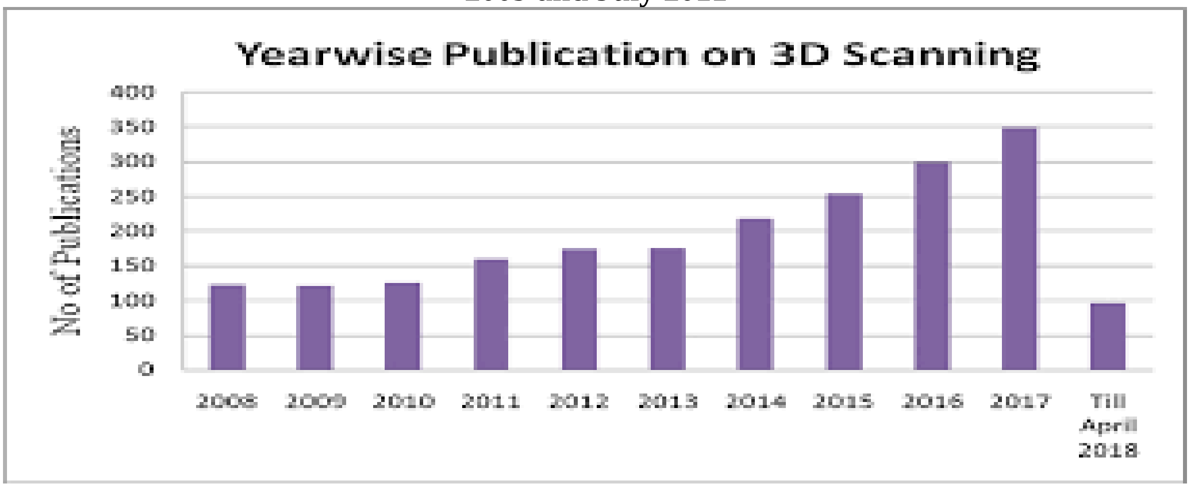
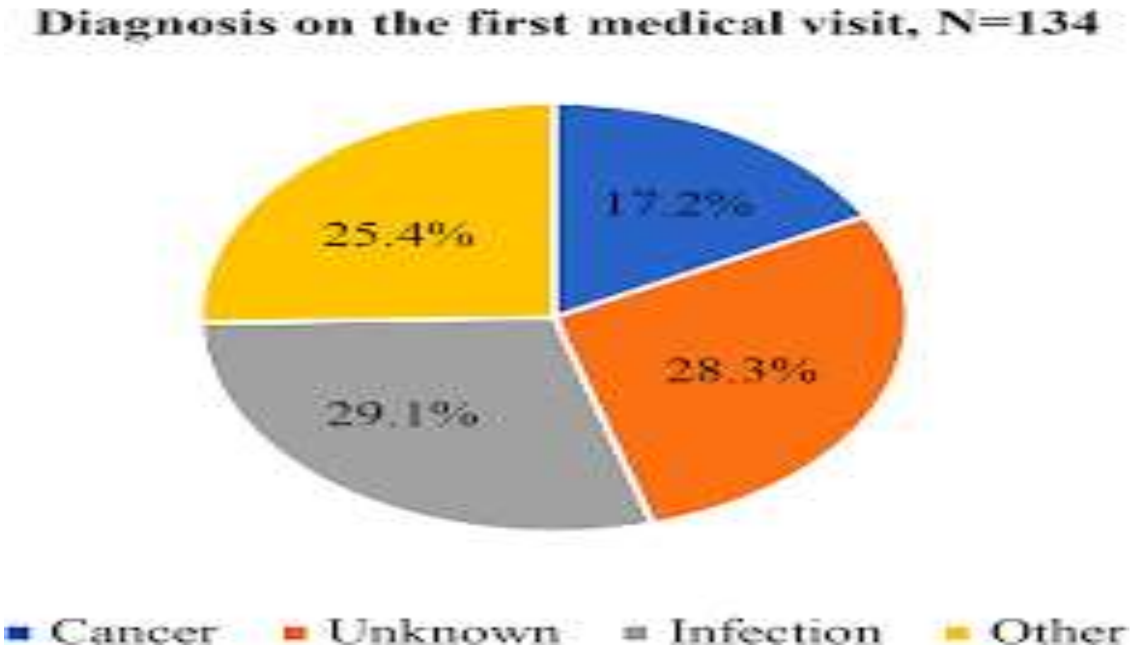
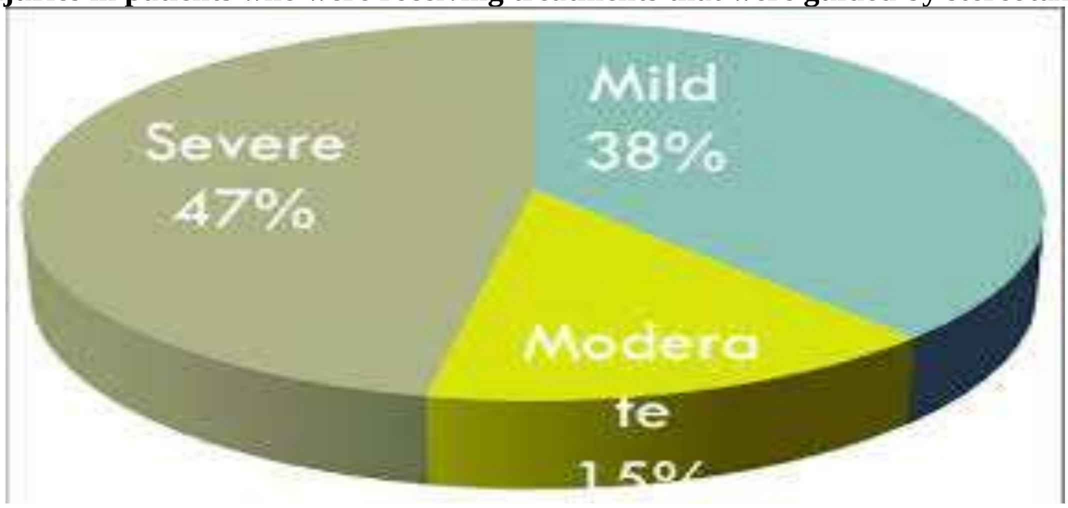


FIGURE 3: From July 2009 to July 2011, definitive diagnoses were obtained from stereotaxy-guided biopsies that were positive for the HUSI.



The following findings were discovered about the location of the lesions that were taken for intervention: the thalamus (10.1%), the subthalamic nuclei-basal ganglia (34.8%), the temporal (15.9%), the frontal (18.8%), the frontotemporal (2.9%), the parieto-occipital (2.9%), the occipital (2.9%), the cortico-subcortical junction (4.4%), the parietal (1.5%), the brain stem (4.4%), and the skull base (1.5%) (figure 41).

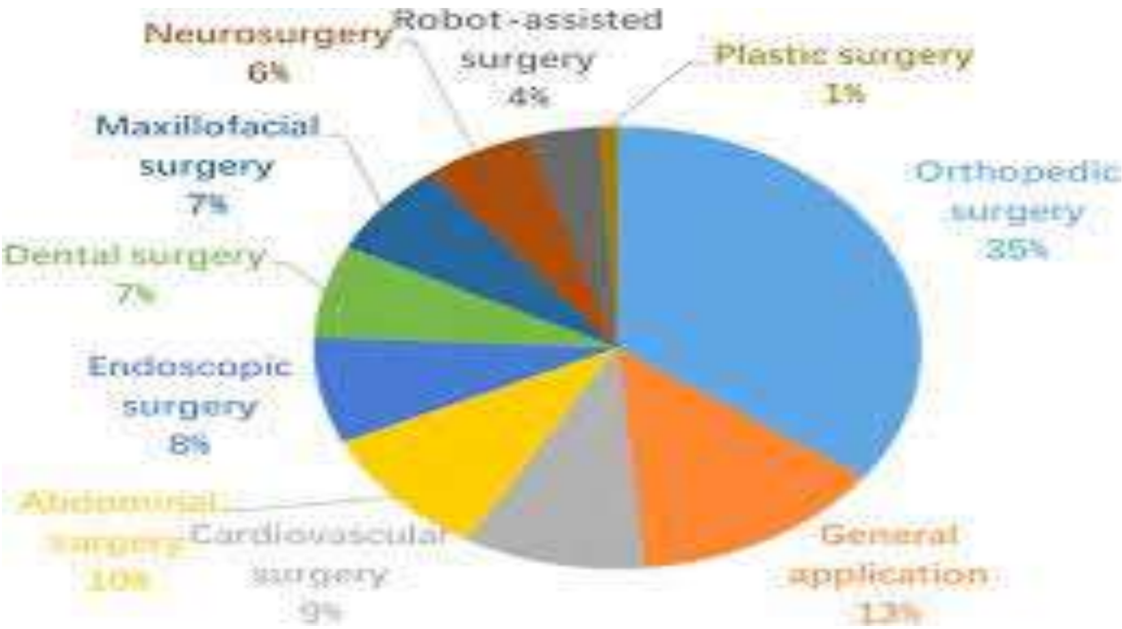
FIGURE 4: From July 2009 to July 2011, the HUSI was used to determine the location of injuries in patients who were receiving treatments that were guided by stereotaxy.



The Praezis program was used for 41% of the biopsies, while the Praezis software was not used for 59% of the biopsies. It was discovered that the majority of the biopsies produced positive results (84%) and that only a minority of the biopsies produced negative results (16%) (figure 2). **The clinical outcomes in the short-term** When it came to the clinic that the patients presented themselves to before receiving the treatments, it was discovered that 36 per cent of them arrived with sensitive symptoms. These symptoms included headaches (27 per cent), hypoesthesia (2.6%), syncope (2.6%), and blurred vision or hemianopsia (7.7%). Sixty-seven per cent of them also presented with motor symptoms, which included pyramidal syndrome (28 per cent), extrapyramidal

(28 per cent), involvement of the cranial nerve (6.4 per cent), and cerebellar syndrome with five points one per cent. In conclusion, it was discovered that thirty-two per cent of patients who were brought in had either cortical involvement or behavioural symptoms. Concerning the short-term outcomes, the Glasgow Scale was utilized before the surgery to compare the symptoms that were presented by the patients undergoing the procedure. Of all the patients, 99% of them continued to have a Glasgow coma (ECG) score that was equivalent to what it was before surgery, and out of those 99%, 5% of them achieved a higher score than they had before.

FIGURE 5: The frequency with which neurological indications and symptoms are presented in the time leading up to surgery between July 2009 and July 2011, the HUSI was responsible for the performance of procedures on patients who were undergoing procedures guided by stereotaxy.



Within the group of patients who were taken to treatment procedures, the majority of the patients had two points, on average. One hundred per cent of the patients saw an improvement concerning the symptoms that were indicated as a result of the treatment methods. From this one hundred per cent, we were able to acquire a significant partial improvement of 87 per cent, with the majority of the improvement being in motor symptoms, including pyramidal, extrapyramidal, and functional symptoms. Long-term clinical outcomes and findings During the postoperative period, without any significant favourable or unfavourable change in the improvement on the Glasgow scale in the postoperative period, the Glasgow scale remained the same as the scale obtained in the postoperative period before discharge from hospitalization. This was the case while the procedures were carried out in every single case. The functional improvement was observed to have persisted over an extended period, which is consistent with the accounts that were acquired during postoperative control sessions. Added complications Within the group of 78 cases, it was discovered that One patient out of the total number of patients who underwent deep stimulation presented with sepsis as a result of an infection at the surgical site. This patient represented 1.28% of the total number of patients. In a similar vein, it was discovered that one patient in the group exhibited seizures, which occurred as a result of a change in their conscience. This patient accounted for 1.28 per cent of the total patients. It became clear as a result of this that just 2.56% of the 78 patients had experienced any kind of complication that was associated with the treatment.

DISCUSSION:

According to the findings, the proportion of patients who presented with problems was a significant insignificant minority. Because it is less than 5%, the percentage of presentations is practically identical when comparing the World Series. The outcome was virtually always the same, regardless of the characteristics of the patient or the lesions that were present. On the other hand, to have a more comprehensive approach to this study, it is required to undertake studies that compare these statistical data. Studies with bigger samples are also required, and it is recommended that they be conducted at many centres if it is feasible. Stereotaxy-guided biopsies had a high percentage of precision since the vast majority of them produced good results that favoured the diagnosis of the injuries that were carried to surgery. This indicates that the biopsies are highly accurate. As of right now, it is still necessary to conduct procedures that are as least invasive as possible to treat these kinds of intracranial locations. These kinds of results lead one to believe that the outcomes in our medium are favourable and that they support the limited emergence of difficulties that are connected with operations carried out by those who access the cranial vault.

CONCLUSION:

When compared to the rate of complications that were associated with procedures that were guided by stereotaxy in the HUSI between July 2009 and July 2011, the rate of complications was extremely low (2.56%). The rate does not surpass 5%, and it maintains and improves the functioning of the procedure while keeping morbidity and death rates low in this group of patients. This is true regardless of the type of procedure that is guided by stereotaxy.

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