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SCRIPTS

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BRAIN SURGERY: UPDATE ON MINIMALLY INVASIVE TECHNIQUES

By: Tariq Javed, MD
member since '94

Minimally invasive neurosurgery encompasses numerous neurosurgical technologies and surgical interventions to reduce approach-related morbidity and collateral damage by sparing normal anatomical structures. Over the last three decades many areas of surgery have incorporated minimally invasive surgery such as laparoscopy, endovascular techniques, and arthroscopic procedures. Simultaneously, the general principle of minimal access surgery has led to a new era in which the neurosurgical playing field is changing. Several areas of research have converged, including advances in high speed miniaturized computers that led the way to improved preoperative evaluation of 3-D anatomy with high-resolution CT and MRI scanning, and neurovascular imaging. Improvement in optics and the development of 3-D high definition endoscopy has aided the transition from the traditional open microsurgical techniques to endoscopic techniques through smaller openings. The development of intraoperative CT-MRI imaging has facilitated the propagation of stereotaxis and intraoperative navigation, which has helped advance the field of neurosurgery into the 21st century. This paradigm shift in how surgery is performed will ultimately result in improved outcomes and faster recovery in our patients.

The field of minimally invasive surgery can be summarized in the following categories:

Keyhole Endoscopic/Endoscopic-Assisted Surgery :

Rigid fiber optic endoscopes with various angled lenses can be used with standard microscope-based approaches to assist with visualization around corners to allow a panoramic view of the local anatomy. This has improved the safety and efficacy of clipping aneurysms and tumor resection in the brain. The endoscope can be held in position rigidly and easily maneuvered using a pneumatic endoscopic holder. This allows two-handed manipulation of specially designed microsurgical instruments. With the aid of intraoperative navigation a short, direct and precise route to the brain and skull pathology can be selected without manipulating or exposing unaffected areas of the brain. Key-hole approaches using small incisions made in the gabella, eyebrow, occipital or retrosigmoid region allow approaches using the endoscope for pathology of the anterior, middle, and posterior cranial fossa.

Intraventricular Endoscopic Surgery:

Small endoscopes, with up to three working channels are passed through a burr hole into the ventricles using intraoperative navigation to treat intraventricular pathology such as biopsy/resection of intraventricular tumors, drainage of cysts, removal of intraventricular hematomas, and treatment of hydrocephalus with endoscopic third ventriculostomy. The endoscopic removal of intraventricular tumors is an evolving neurosurgical technique and - with advances in endoscopic chip-tip technology - will replace most microsurgical approaches. The endoscopic approach is less invasive and yet similarly effective as microsurgical approaches.

Endoscopic / Endonasal Approach:

Introduction of the endoscopic endonasal approach to pituitary tumors has offered a less invasive alternative to access the pituitary gland and parasellar area, providing superior intraoperative visualization by virtue of angled lenses that allow a panoramic view of the surgical anatomy, not provided by standard microscope-based techniques. Although pituitary tumors are only at the forefront of this surgical revolution, it is becoming increasingly apparent that a variety of skull-based pathologies such as CSF leaks, meningo-encephalocele repair, craniopharyngiomas, chordomas, meningiomas, orbital apex tumors, and craniocervical junction pathology can be addressed using the endonasal endoscopic approaches.

Stereotactic Approaches for Functional Surgery:

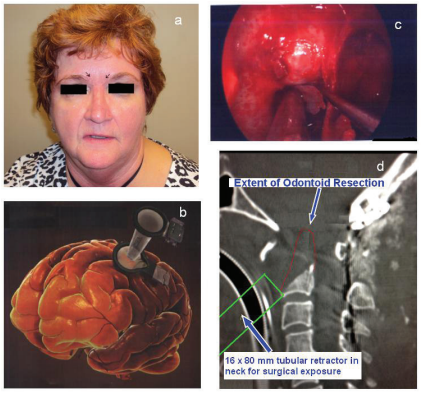
Deep brain stimulation (DBS) is a safe and effective surgical therapy for relieving the motor symptoms of movement disorders including essential tremor, Parkinson's disease, dystonia, various psychiatric disorders, and for refractory pain management procedures. Motor cortex stimulation can be used for treatment of refractory pain syndromes. Lesioning of deep brain structures such as pallidotomy using either electrodes or radiosurgery can be used in treatment of various movement disorders.

Endovascular Treatment of Vascular Lesions in the Brain:

Endovascular techniques are being used more frequently to treat brain aneurysms and vascular malformations of the brain and embolization of vascular tumors prior to surgery. Endovascular treatment has also become an important aspect of treatment of strokes using angioplasty, intra-arterial delivery of drugs, and stenting, as well as treatment of vasospasm after subarachnoid hemorrhages.

Radiosurgery Techniques:

Stereotactic radiosurgery is used by neurosurgeons to destroy an intracranial target through the precise image-guided focus of ionizing radiation in a single procedure or over a limited number of sessions. Radiosurgery is the most minimally invasive technique applied to treat brain lesions. Radiosurgery works at a micro molecular level through damaging nucleic acid strands. Radiosurgery has been used as a primary treatment or as an adjuvant for residual tumor after surgical resection. Tumors frequently treated with radiosurgery include skull-based tumors, meningiomas, pituitary tumors, gliomas, and acoustic neuromas. Radiosurgery is also used to treat vascular malformations of the brain, functional brain surgery, and trigeminal neuralgia.



a.Scar of transgabella keyhole craniotomy to remove 2.5 cm frontal meningioma.
b.Use of endoport for surgery on deep brain pathology.
c.Endonasal endoscopic exposure of pituitary macroadenoma.
d.Odontoid resection from foramen magnum using a tubular retractor in the neck.

Tubular Retractors for Brain and Spinal Surgery:

Tubular retractors are being routinely used for minimally invasive spine surgery and are beginning to become used in performing brain surgery. Transparent tubular retractors (endoport) when combined with advanced neuro-navigation techniques are used for treating deep-seated brain lesions such as tumors and evacuation of deep-seated hematomas. Their use causes less damage to surrounding structures since the retraction pressure on the surrounding structures is evenly distributed. The endoport surgery may also be used in the future for treatment of larger and vascular intraventricular tumors. This will circumvent the drawback of operating through fiber optic channel endoscopy by allowing bimanual microsurgical technique under direct endoscopic visualization in an air medium.

Minimally invasive techniques are being rapidly adopted and accepted in the field of neurosurgery with many potential areas of application. However, as with any new field, it requires skills that are not always intuitive to a neurosurgeon who is not trained in endoscopic minimal access techniques. Future development will predominantly be technical and will incorporate image guidance, the ability to perform endoscopy during microsurgical procedures with great ease, and the ability to deliver drugs, stents, clip aneurysms, remove brain tumors, and so on through minimally invasive procedures.

Tariq Javed, MD is a neurosurgeon in Marietta since 1994, who specializes in minimally invasive brain and spine surgery. He has been named Top Doctors by Atlanta Magazine, US News and World Report, Americas Top Doctor and Surgeon by the Consumer Research Council of America.