Minimally Invasive Brain Port Approach for Accessing Deep-Seated Lesions Using Simple Syringe

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■ BACKGROUND: **Retraction-related injury is a recognized complication in neurosurgery. Use of tubular retractors that distribute the pressure on brain tissue was introduced to minimize brain injury. We developed a modified technique using a simple plastic syringe with a Foley catheter to achieve atraumatic cannulation in accessing deep lesions.**

■ METHODS: **A retrospective pilot study was conducted to assess safety of the syringe transtubular technique for accessing deep lesions as a cost-effective substitute for commercial brain port methods and to identify retraction-related injury using diffusion-weighted magnetic resonance imaging postoperatively. Nine patients were operated on using the syringe technique. Lesions selected were intraparenchymal, deeply located in the supratentorial compartment. Lesions were located in the insula ($n = 2$), thalamus or basal ganglia ($n = 5$), subcortical frontoparietal ($n = 1$) lobe, and right temporal lobe ($n = 1$). Patients with hematomas, intraventricular lesions, superficially located lesions; pediatric patients less than 12 years old; and patients undergoing redo surgeries were excluded.**

■ RESULTS: **Surgical goals were achieved in 8 patients. Three patients had transient deficits; one patient had significant morbidity, which was diagnosed postoperatively as toxoplasmosis. Diffusion restriction was noted in all patients at the surgical cavity but not in the cannulation path.**

■ CONCLUSIONS: **Transtubular approaches have a good safety profile and can help achieve surgical goals. Larger studies are needed to compare this approach with other methods, including its effect on hospital stay and survival. The syringe technique is an alternative safe method that can be used in certain neurosurgical centers where commercial tube systems are unavailable.**

INTRODUCTION

Brain retraction is an important technique in microneurosurgery to visualize deep seated lesions and aid in exposure of difficult corridors. The first self-retaining retractor was introduced in 1981, followed by different systems and techniques. Retraction-related neurologic injury is a recognized complication that has been demonstrated and measured in both clinical practice and animal models.[1-6] Minimally invasive approaches for cranial procedures were proposed to minimize brain injury and safely achieve surgical goals. Techniques using endoscope, exoscope, keyhole approaches, transsulcal approaches, tube systems, and a combination of these along with the traditional microscope have been used with variable results. Minimally invasive neurosurgery using small cylindrical retractors that distribute the pressure around the surrounding brain to avoid brain injury was proposed in 1988 by Kelly.[7,8] The pressure on adjacent parenchyma is less than 10 mm Hg, even in longer surgeries.[9]

Multiple case series using different tube systems to access deep lesions have shown excellent safety profiles and achievement of surgical goals.[9-19] The most common method used in the literature is the METRx System (Medtronic, Minneapolis, Minnesota, USA), which is used primarily for minimally invasive spine

Key words
- Brain port
- Minimally invasive
- Parafascicular
- Transcylindrical
- Transtubular retractors

Abbreviations and Acronyms
DTI: Diffusion tensor imaging
DWI: Diffusion-weighted imaging
ICP: Intracranial pressure
MRI: Magnetic resonance imaging

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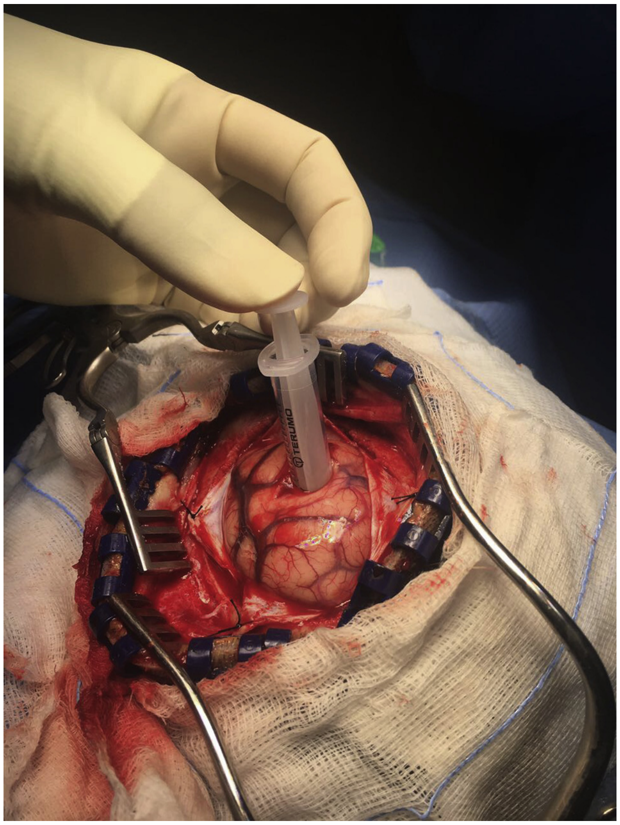

Figure 1. Intraoperative photograph showing syringe cannulation into the brain to serve as a tubular retractor.

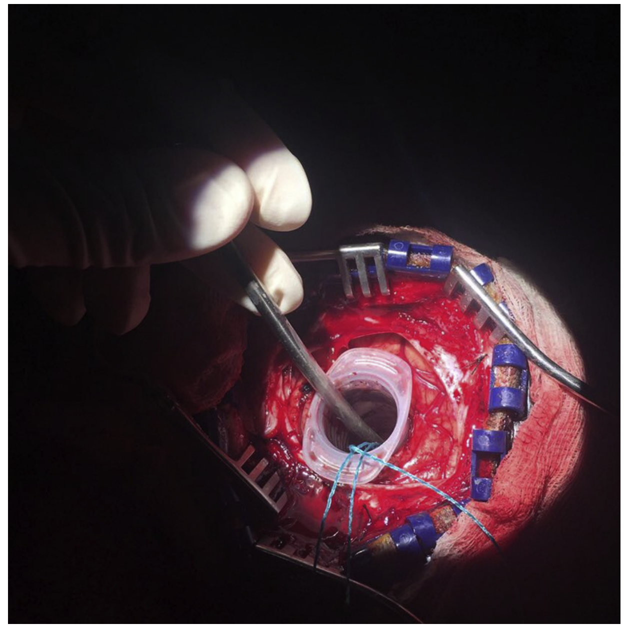

Figure 2. Resection starts after reaching the desired depth; the width of the syringe is 17 mm, which is enough to accommodate 2 instruments.

surgery. Almenawer et al.[11] reported their series using the METRx System on intracranial deep-seated brain lesions in 30 patients with a complication rate of less than 1%. They added a Foley catheter to their technique to stabilize the system. BrainPath (NICO Corporation, Indianapolis, Indiana, USA) is a cylindrical port system that was designed for transtubular approaches to deep brain lesions. The system is attached to an exoscope that provides better illumination than the microscope and a panoramic view of the field. Eliyas et al.[17] published their experience with this system for resecting intraventricular and periventricular lesions with the use of preoperative diffusion tensor imaging (DTI) to preserve subcortical white matter fasciculi. The ViewSite Brain Access System (Vycor Medical Inc, Boca Raton, Florida, USA) is a transparent cylindrical sheath designed for the same purpose. Raza et al.[16] used this system with frameless neuronavigation and did not report any significant surgical morbidity. Other handmade modified tools have also been used.[9,20] The tube has also been used as an alternative to or combined with the endoscope to resect intraventricular tumors. Bimanual instrument use aids in more aggressive safe resections, particularly for colloid cysts.[15] We report our experience of the transtubular approach for deep-seated intraparenchymal lesions in nine patients using a simple plastic syringe, with description of the technique, its safety profile, and short-term outcome.

METHODS AND MATERIALS

A retrospective review was performed of hospital medical records and radiologic imaging of all adult patients who underwent a minimally invasive transtubular approach for deep-seated/periventricular intraparenchymal lesions. Approval from the institutional review board was obtained. Cases of hematomas, intraventricular surgeries, repeat surgeries, and simple biopsies were excluded.

All patients underwent brain magnetic resonance imaging (MRI) and DTI/tractography. Neurophysiology monitoring was done for selected patients. All patients had 3-point head fixation and registration with neuronavigation. The selection of the trajectory depended on preoperative DTI and location of the lesion. The depth from the cranial surface to the tumor was measured using the tip extension feature in the neuronavigation system.

A linear incision was always used, and a small craniotomy was done to accommodate the tube diameter and its manipulation in all directions (typically 3 cm). The dura mater was opened in a cruciate fashion. The pial surface was coagulated with bipolar cautery and cut with microscissors, and then the tube was introduced either through a transsulcal or a transgyral approach. The aim was to insert the tube through the axis of the lesion to its depth, allowing the resection to start from there in an inward-outward fashion driving the lesion into the