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# Novel Adaptation of the AxiEM Electromagnetic Neuronavigation System for Intraoperative Tracking of Neuroendoscope During Intraventricular Surgery

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**Abstract:**

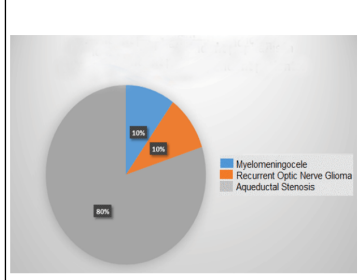
Introduction: Endoscopic third ventriculostomy is a minimally invasive neurosurgical procedure which is the most commonly used to treat hydrocephalus via creating an opening in the floor of the third ventricle which allows excess cerebrospinal fluid to flow into surrounding basal cisterns by bypassing obstructions. Use of electromagnetic (AxiEM) neuronavigation to assess precise anatomical landmarks intraoperatively is gaining more importance to achieve accurate results. Endoscopic third ventriculostomy and neuroendoscopic intraventricular surgery overcome the persistent risk of infection and hardware failure associated with ventriculoperitoneal shunting for the treatment of hydrocephalus. However, the surgical technique is associated with endoscopic third ventriculostomy (ETV) risks neurovascular catastrophe.

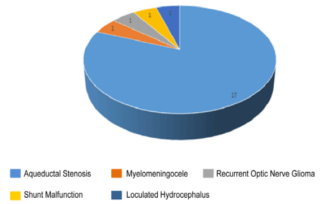
Case Series: The aim of this case series is to assess the safety and effectiveness in surgical outcomes of adding neuronavigation tracking to endoscopic visualization for intraventricular surgery. A retrospective chart review (case series) of adult and pediatric patients treated with neuronavigation-guided endoscopic third ventriculostomy (ETV) or intraventricular cyst fenestration for radiographically confirmed and clinically significant congenital or acquired hydrocephalus in university hospital setting between 2012–2014; n = 21 patients was performed. Herein, we present our surgical outcomes and complications with an average follow-up of 20 months.

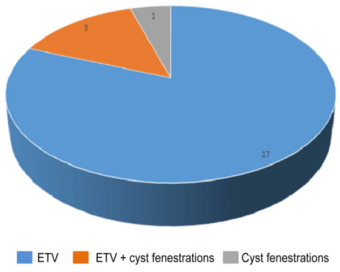
Conclusion: Intraoperative neuronavigation provides a safe corridor for neuroendoscopy and avoids the complications of skull fixation in both adult and pediatric patients. Adding image guidance to neuroendoscopy increases safety margins for targeting accuracy, especially for patients with challenging anatomic landmarks.

References:
http://www.ijcasereportsandimages.com/archive/2018-pdfs/2018100003Z01100094IS_say/100003Z01100094IS.pdf

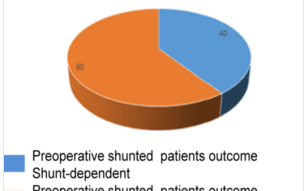
## Data analysis 1



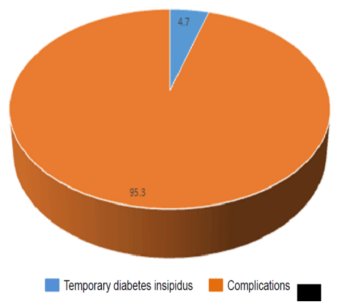



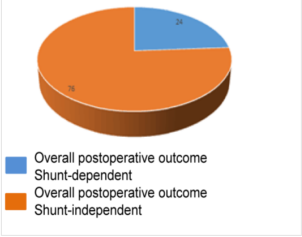

(A) Preoperative shunted patients outcome in percentage (n=10)




(B) Preoperative non shunted patients outcome in percentage (n=11)


(C) Overall postoperative outcome (percentage)




## Data analysis 2

Table 1: Case series data

| Patient Number | Age range | Previous Shunt | Previous Infection | Procedure | Outcome | First Post operative Follow Up (months) | Latest Post Operative Follow Up (months) | Complications | Surgical Indication | ETVSS |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 year to 10 year | N | N | ETV + Cyst Fenestration | SI | 5 | 18 | N | OH + recurrent optic nerve cystic glioma | 60 |
| 2 | >10 years | Y | Y | ETV | SD | 4 | 24 | N | OH | 60 |
| 3 | >10 years | Y | N | ETV | SD | 5 | 24 | Temporary DI | Shunt Malfunction and congenital hydrocephalus | 60 |
| 4 | >10 years | Y | Y | ETV + Cyst Fenestration | SD | 5 | 24 | N | OH | 60 |
| 5 | >10 years | N | Y | ETV | SI | 4 | 18 | N | OH | 70 |
| 6 | >10 years | Y | Y | ETV | SI | 5 | 24 | N | OH | 60 |
| 7 | >10 years | Y | N | ETV | SI | 5 | 24 | N | OH | 60 |
| 8 | >10 years | Y | Y | ETV | SI | 5 | 24 | N | OH | 60 |
| 9 | >10 years | Y | Y | ETV | SI | 5 | 18 | N | OH | 60 |
| 10 | >10 years | Y | N | ETV | SI | 5 | 18 | N | OH | 60 |
| 11 | >10 years | Y | N | ETV + Cyst Fenestration | SI | 3 | 16 | N | OH | 60 |
| 12 | >10 years | N | N | ETV | SI | 5 | 18.5 | N | OH | 70 |
| 13 | >10 years | Y | N | Cyst Fenestration | SD | 5 | 14 | N | Loculated Hydrocephalus | 60 |
| 14 | >10 years | N | N | ETV | SI | 5 | 19.5 | N | OH | 70 |
| 15 | >10 years | N | N | ETV | SI | 5 | 21 | N | OH | 70 |
| 16 | 1 year to 10 year | N | N | ETV | SD | 5 | 23.5 | N | OH | 60 |
| 17 | 6 months to 1 year | N | N | ETV | SI | 5 | 22.5 | N | OH + Myelomeningocele | 50 |
| 18 | 6 months to 1 year | N | N | ETV | SI | 5 | 24 | N | OH | 50 |
| 19 | 1 year to 10 year | N | N | ETV | SI | 4 | 17.5 | N | OH | 60 |
| 20 | 6 months to 1 year | N | N | ETV | SI | 5 | 15 | N | OH | 50 |
| 21 | 1 month to 6 months | N | N | ETV | SI | 5 | 17 | N | OH | 30 |
| | | | | | | 4.761904762 | 20.21428571 | | | |

SI: Shunt Independent, SI: Shunt Independent, SD: Shunt Dependent, OH: Obstructive Hydrocephalus

## Conclusion:

-Adapting frameless electromagnetic neuronavigation provides real-time, multi-planar orientation during neuroendoscopic intraventricular surgery and reduces the risk of injury to critical brain structures such as the fornix and intracerebral vessels, which are typically vulnerable during standard endoscopic third ventriculostomy techniques.

-Intraoperative navigation provides a safe corridor for neuroendoscopy and avoids many complications of skull fixation in both adult and pediatric patients. Adding image guidance to neuroendoscopy increases safety margins for targeting accuracy, especially for patients with challenging anatomic landmarks. This available, safe addition to the recent advances in endoscopic neurosurgery will augment our access to critical regions of the brain for tumor resection and treatment of hydrocephalus, while reducing the risk of known common complications such as basilar artery rupture, cerebrospinal fluid leak and infections.