

Electromagnetic Frameless Stereotaxy (EMFS) for Intraoperative MRI – First Report

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Introduction

Electromagnetic stereotaxy was adapted as a new technique to allow intraoperative MRI capabilities without the need for cranial fixation to the table. To the best of our knowledge, this has not previously been undertaken and there are no reports in the current literature. Stereotactic localisation has been used to increase safety and planning for complex cranial operations. Intraoperative MRI (iMRI) using a pinning system allows the data to be updated during the procedure so that the data sets remain current thus increasing accuracy, safety and clinical outcomes. However, there are some operations where pinning in a clamp is not desired. This includes transphenoidal surgery, ventriculo-peritoneal shunts, paediatric patients and neuro-endoscopic procedures. We have successfully pioneered a new technique of using electromagnetic (EM) stereotaxy in conjunction with iMRI.

Methods

Validation of the EM systems safety with the MRI was completed by the manufacturer. There were no anticipated problems in using the patient tracker in conjunction with the Intraoperative MRI system. The technique was validated without complication and then utilised with consent on a case series of transphenoidal operations without the requirement of pinning the head for the procedure.

Results

Nine procedures were completed successfully and safely without the need for head fixation. These procedures comprised 7 transphenoidal resections of pituitary macroadenoma and 2 transcranial resections of primary brain tumours. Of the two transcranial cases one case was electively returned to theatre after iMRI for further debulking of the tumour. Electromagnetic Stereotaxis allowed accurate localisation and image merging for re-registration after an intraoperative scan in all cases. There was no image degradation. The use of the Electromagnetic Stereotaxis provides a safe and cost effective technique as an alternative to using iMRI head fixation.

Conclusions

Frameless EM Stereotaxy allows safe, reliable and accurate non-invasive surgical navigation in conjunction with iMRI. Whilst the case series was limited to planned iMRI utilising an MRI compatible patient table and an MRI neighbouring the operative theatre, this novel application of EMFS could be extrapolated to any MRI machine to evaluate intraoperative concerns.

Learning Objectives

By the conclusion of this session participants will identify that Frameless EM Sterotaxy is MRI compatible and allows re-registration during surgery without image degradation.

Figure 1. Patient positioning for transphenoidal resection of pituitary macroadenoma

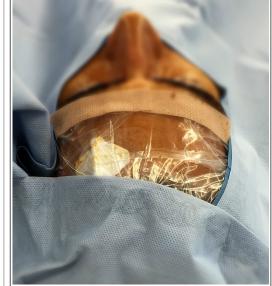


Patient positioning with patient tracker secured for stereotaxy registration and with supporting foam donut and surface coil in preparation for iMRI.

Technical Vignettes

- Operative positioning involved placing the patient's head on an MRI-compatible foam donut and surface coil (*Figure 1*). MRI compatible earplugs were placed. The noninvasive patient tracker was secured with an adhesive dressings.
- Careful draping and protection of the patient tracker lead with non-adhesive drapes (*Figure 2*) preserved the patient tracker position and allowed for stereotactic merging of images rather than re-registration without loss of accuracy (see video)
- A safety checklist was completed prior to transfer to MRI evaluating staff entering the room, the anaesthetic equipment and patient monitoring equipment for MRI compatability.

Figure 2. Draping for transphenoidal resection of pituitary macroadenoma



Patient tracker and lead protected by nonadhesive drape to preserve tracer position when taking drapes down for transfer to iMRI.



References

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