

Introduction

Traditionally, deep brain stimulation (DBS) has been completed as a two stage procedure. An awake craniotomy is performed to implant the stimulator leads. Then the patient returns another day for lead extension and generator implantation under general anesthesia. Placing leads in awake patients allows for test stimulation and observation of side effects to supplement earlier, less precise stereotactic localization methods.

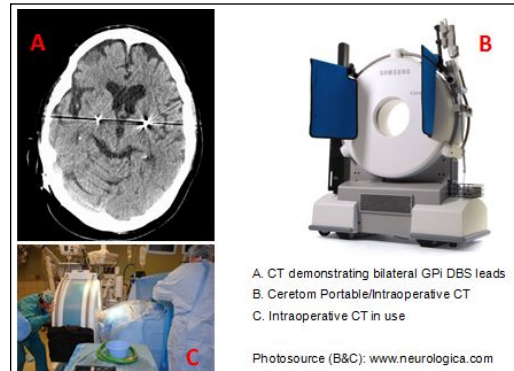
Recent technological advances and honing of older techniques now make safe and effective lead placement in patients under general anesthesia possible. The new ability to complete both the pulse generator implantation and electrode implantation stages of DBS surgery in patients under general anesthesia is cause for us to reexamine the preference to complete this surgery in two stages. It is now feasible for the entire DBS system to be implanted during a single surgery, potentially reducing costs, use of limited healthcare resources, and patient discomfort.

Unfortunately, current Medicare reimbursement provides a disincentive to physicians and hospitals to complete DBS system implantation during a single surgery. The difference in reimbursement would likely result in hospitals losing money every time a streamlined DBS implantation is completed.

Methods for Lead Implantation Under General Anesthesia

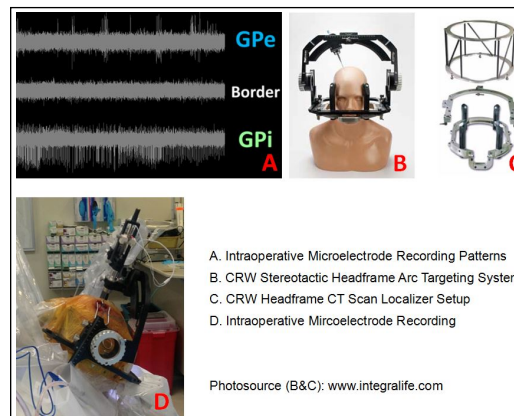
Intraoperative CT Image Guidance

This method can be performed with or without stereotactic frame. Trajectory planning is completed by fusing pre-operative MR images with a day of surgery CT, similar to traditional stereotactic targeting. However, the intraoperative CT imaging allows for lead location confirmation and repositioning.



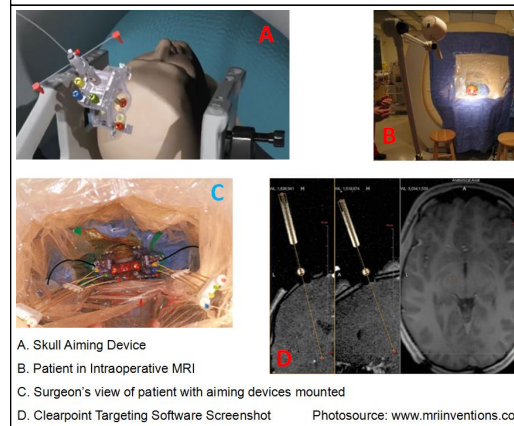
Frame Based Stereotaxis with Microelectrode Recordings

Pre-operative MRIs are fused with day-of-surgery CT scans completed with a patient wearing a stereotactic frame to aid in trajectory planning. Several structures along standard electrode trajectories have recognizable neuron firing patterns. This option requires only standard imaging (in hospital CT scanner and outpatient MRI) which is available at nearly all centers with neurosurgery coverage.

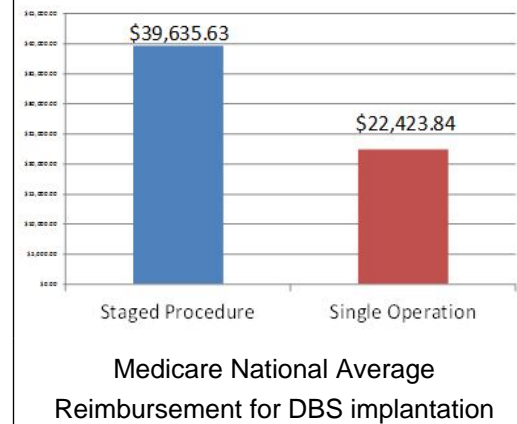


Frameless Intraoperative MRI

This technique does not require a stereotactic head frame, but uses a skull mounted aiming device instead. Some studies boast that real time MRI may provide better accuracy, but this has not yet been directly compared to other techniques. Intraoperative MRI is also not available at many hospitals.



Reimbursement May Discourage Streamlined DBS Implantation



Conclusions

Total DBS system implantation during a single surgery for patients under general anesthesia is now possible using new technology and techniques. Although it would be a more desirable option for patients and a more cost-effective option, reimbursement issues may prove to be a hindrance to surgeons wanting to offer this new treatment option.

Moving Forward

- Compare lead placement efficacy and accuracy using various techniques
- Assess the safety, efficacy, and cost of total DBS system implantation during a single "asleep" operation
- Reconsider current reimbursement strategies that discourage offering a new surgical option to patients despite its anticipated clinical and financial benefits