Stereotactic Radiofrequency Thermocoagulation of Hypothalamic Hamartoma Using Robotic Guidance (ROSA) Coregistered with O-arm Guidance—Preliminary Technical Note

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■ INTRODUCTION: **Treatment options for hypothalamic hamartoma (HH) include microvascular surgery, stereotactic radiofrequency thermocoagulation (SRT), laser interstitial thermal therapy, or Gamma Knife surgery. During SRT, thermographic monitoring cannot be performed and therefore highly accurate placement of electrode and confirmation of its position are required. We have used robotic guidance (ROSA) and coregistered it with O-arm for performing ablation of hamartoma.**

■ METHODS: **Five patients with HH and gelastic seizures underwent SRT. Robotic guidance (ROSA) was used for placement of electrodes. An O-arm was used for coregistering and confirming the robotic trajectory with real-time intraoperative imaging. Intraoperative computed tomography was merged with preoperative magnetic resonance imaging to confirm the exact position and trajectory of the electrode. Ablation was performed using a radiofrequency generator (70°C for 60 seconds). Multiple target sites were ablated to achieve proper ablation and disconnection.**

■ RESULTS: **Most patients (4/5) had International League Against Epilepsy class I outcome. One patient 2 sittings of lesioning. All but 1 electrode could be placed in the planned trajectories. One electrode was detected to have a medial deviation, and it had to be revised. No permanent complication was observed.**

■ CONCLUSIONS: **SRT is a cost-effective method of treating HH when compared with laser interstitial thermal therapy. With the use of a robotic arm we have demonstrated accurate placement of electrodes. Intraoperative computed tomography acquired using an O-arm can be merged with preoperative magnetic resonance imaging. This confirms electrode location and trajectory on a real-time basis by performing intraoperative imaging. This method is safe and can be used for radiofrequency ablation of HH.**

INTRODUCTION

Gelastic seizures (GSs) are the typical semiology of hypothalamic hamartomas (HH). The available treatment options for HH include microscopic surgery (MS),[1,2] endoscopic disconnection (ED),[3] stereotactic radiofrequency thermocoagulation (SRT),[4,5] laser interstitial thermal therapy (LITT),[6,7] and Gamma Knife surgery (GKS).[8,9] MS and ED are invasive and involve dissection around critical structures. Higher rates of complications have been reported for MS, and this procedure is rarely performed currently.[5] GKS is not a suitable option for big hamartomas. Minimally invasive SRT and LITT have been shown to be effective alternatives to MS.[5,10] LITT requires intraoperative magnetic resonance imaging (MRI) thermographic imaging, which is not readily available at many centers across the world. In addition, it involves disposable laser electrodes, which

Key words
- Hypothalamic hamartoma
- O-arm
- Radiofrequency
- Robotic
- Stereotactic
- Technical report
- Thermocoagulation

Abbreviations and Acronyms
CT: Computed tomography
ED: Endoscopic disconnection
EEG: Electroencephalography
GKS: Gamma Knife surgery
GS: Gelastic seizure
HH: Hypothalamic hamartoma
LITT: Laser interstitial thermal therapy
MRI: Magnetic resonance imaging
MS: Microscopic surgery
SRT: Stereotactic radiofrequency thermocoagulation

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are expensive, especially for countries with financial constraints. SRT for HHs has also been shown to be an effective treatment option.[5,11-13] We used robotic guidance (ROSA, Medtech, Montpellier, France, approved by the U.S. Food and Drug Administration) for stereotactic placement of the SRT electrode. Intraoperative computed tomography was acquired using O-arm (Medtronic Inc., Minneapolis, Minnesota) and merged with preoperative MRI, showing superimposed electrode and preoperative trajectory. Accurate placement of an electrode using a robot and its intraoperative validation improves the safety profile of this procedure. Use of these technologic adjuncts (ROSA and O-arm) are being reported for the first time in this case series.

MATERIAL AND METHODS

Five patients with HHs, aged 6 months to 13 years, presented with GS ± behavioral disorder (BD), precocious puberty (PP), and delayed milestones. Seizures were refractory to antiepileptic drugs. We performed MRI T1, T2, 2-FLAIR and contrast-enhanced MRI in 1-mm slices, 0-gap, 1-mm increment, and square matrix in all patients. SRT was performed under robotic (ROSA) and O-arm guidance. A proper, informed consent was taken for each patient, as per our institutional policy. Ethics committee approval was not deemed necessary as the radiofrequency ablation for hypothalamic hamartoma is a well-established treatment modality.

TECHNICAL NOTE

Preoperative volumetric sequences of contrast-enhanced MRI and CT were done. T1 weighted and flair-based MRI sequences were merged with contrast CT scan using ROSA planning software to generate a composite image. Trajectory planning was performed on ROSA console. Multiple trajectories were drawn in such a way that once ablation is complete, hamartoma's interface with hypothalamus is sufficiently disconnected. The first lesion was done at the interface and subsequent lesions at 5-mm intervals since the electrode of 2-mm diameter produced a lesion of 5 mm in diameter. Care was taken that the brain-hamartoma interface was ablated to achieve an "ablative disconnection." All trajectories were planned in such a way that there was no transgression of cerebrospinal fluid or vascular space, and entry points were usually centered around a coronal suture. Thereafter, patients were intubated and the head was fixed in a Mayfield clamp and attached with ROSA.

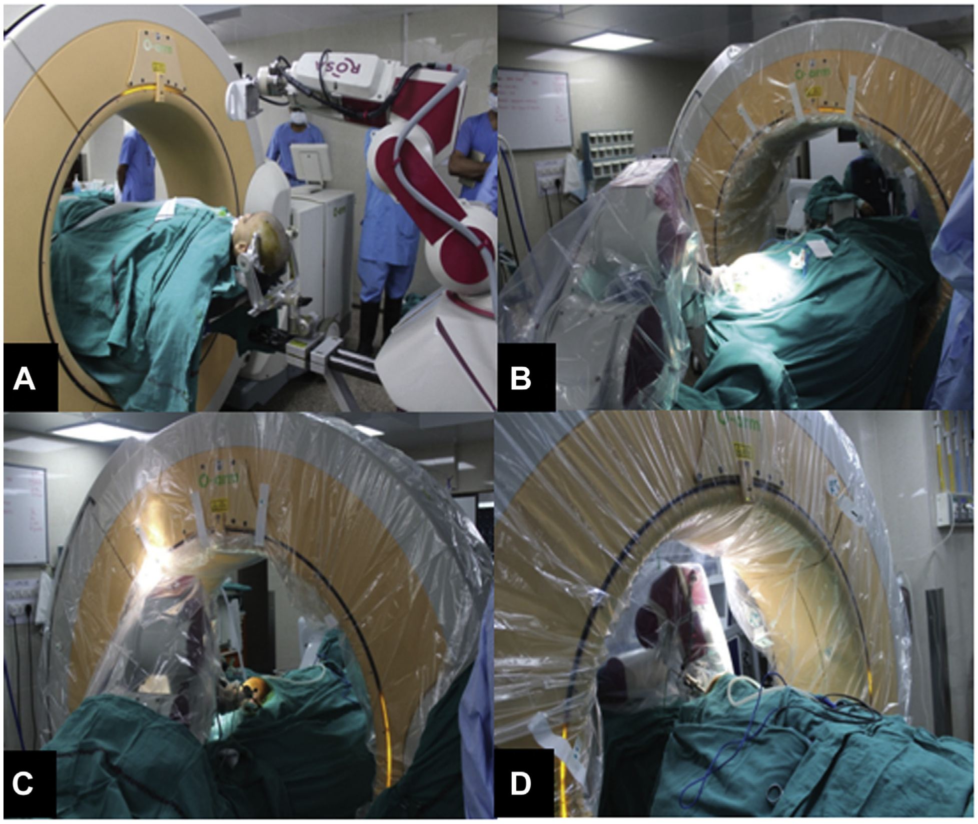

Figure 1. (**A**) Position and height of table in relation to ROSA and O-arm. Mayfield clamp fixation is done in such a manner that a working distance of 75 cm is maintained between the ROSA base and trajectory points. (**B**) Position of O-arm to allow easy access to patient during surgical procedure. (**C**) Memorized position of O-arm in which images are acquired. (**D**) Even in image-acquiring position, a safe distance between ROSA and the O-arm is maintained.