

Corpus Callosotomy Using Laser Interstitial Thermal Therapy

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Methods

Retrospective chart and MRI review was performed on all cases undergoing LITT callosotomy at one center. Seizure outcomes were followed for 18 months. Diffusion tensor imaging (DTI), resting functional magnetic resonance imaging (rfMRI) and electrophysiological connectivity analysis including corticocortical evoked potential (CCEP) and resting electrocorticogram (ECoG) were performed.

Introduction

Corpus callosotomy is a palliative procedure for the treatment of epilepsy which is particularly effective for drop attacks and generalized seizures[1,2]. Seizure lateralization after callosotomy has also been described[3,4]. Callosotomies have been successfully performed using traditional, endoscopic, CO2-laser, and radiosurgical approaches. Magnetic resonance imaging (MRI)-guided laser interstitial thermal therapy (LITT) is a minimally invasive procedure that is gaining increasing use to treat a variety of brain abnormalities associated with tumor and epilepsy[5]. Here we report corpus callosotomy performed in four patients using LITT.

Clinical characteristics and seizure outcomes of patients undergoing MRIguided LITT corpus callosotomy

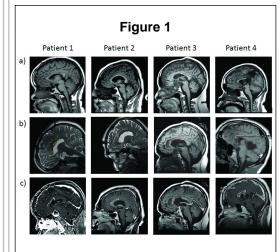
Patient	Sex	Age	Preoperative Generalized Seizure Frequency	% Reduction of Generalized Scizures	Predominant Seizure Semiology	Drop Attacks?	Preoperative MRI findings	Neurocognitive Impairment	Post callesotomy procedures	Concur SEEG I Electro Placed
ī.	F	29	1/day	100	CPS with secondary generalization	No	Prior Craniotomy	Mild	Right frontal lobectomy	22
2	м	44	1/month	83	CPS with secondary generalization	No	Prior left frontal hemorrhage	None	None	20
3	F	23	1/day	100	CPS with secondary generalization	No	Right frontal venous infarction, craniopharyngioma, partial callosotomy	None	Right frontal lobectomy	18
4	F	24	15/day	100	GTC, CPS, tonic, atonic scizures	3/day	Partial agenesis of corpus callosum	Severe	None	No

Results

- sEEG electrode or scalp EEG recording prior to surgery showed either bilaterally synchronous seizure onsets or rapid bisynchronous secondary generalization.
- Ablation of the anterior corpus callosum was successfully complete as a single procedure in three patients. Patient 1 required a second LITT procedure due to a misplaced device. (Figure 1)
- Diffusion tensor imaging showed anatomical disconnection of the anterior corpus callosum (Figure 2)
- Functional separation of the cerebral hemispheres was characterized using resting state fMRI (rs-fMRI) and cortico-cortical evoked potentials and resting electrocorticographyic connectivity. (Figure 3)
- sEEG monitoring post-callosotomy revealed lateralized seizure foci in 3 patients. Two elected for resection of epileptic focus and are seizure free at 18 months. The remaining patients experienced an 83% and 100% decrease in generalized seizure frequency.
- No neurological morbidity encountered.

Conclusions

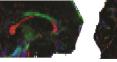
MRI-guided LITT provides a viable minimally-invasive alternative approach to corpus callosotomy in the treatment of medically intractable epilepsy. Functional connectivity measurements may aid in demonstrating the extent of callosotomy.



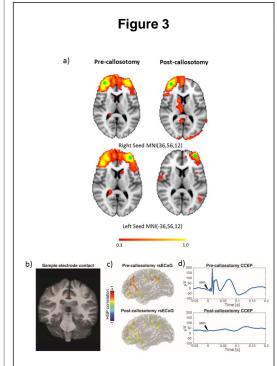
Sagittal MRI images of patients 1-4. (a) Pre -callosotomy T1-weighted MRI. (b) Intraoperative MRI with placement of probes within the corpus callosum demonstrated by red dotted lines. The green dotted line represents the deflected fiber of patient 1. (c) Post-callosotomy contrast-enhanced T1 MRI.

Figure 2





Representative DTI demonstrating large decrease in fractional anisotropy (FA) within the corpus callosum postcallosotomy.



(a) Representative rs-fMRI pre- and postcallosotomy demonstrating decreased
resting state interhemispheric connectivity.
(b) Sample electrode contact for CCEP
(red dot) (c) High gamma power correlation
of rsECoG recorded in left hemisphere preand post-callosotomy showing decrease in
HGP correlation in diffuse fronto-parietal
locations (d) Representative mean corticocortical evoked potential showing loss of the characteristic shape implying direct functional connectivity between the two regions was disrupted.

References

Tanriverdi T, et al. JNS 110(2):332-342.
 Bower RS, et al. Neurosurgery 73(6):993-1000.
 Clarke DF, et al. Seizure 16(6):545-553.
 Matsuzaka T, et al. Epilepsia 40(9):1269-1278.
 Medvid R, et al. AJNR 36(11):1998-2006.