



# IMPROVED LOCALIZATION OF EXTRATEMPORAL ICTAL ONSET-ASSOCIATED BLOOD FLOW CHANGES USING A 72-DETECTOR SCANNING FOCUSED COLLIMATOR SPECT SYSTEM

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## 1. SPECIFIC AIMS

High resolution (3-4 mm) single-photon emission computed tomography (SPECT) has been recently developed using a 72-detector spiral scanning focused collimator system (InSPira, NeuroLogica Corp). Two goals of this study were as follows:

- The resolution of this technology was compared with a conventional 2-detector fan beam collimator system (Siemens, 8-10 mm resolution). Ictal and baseline SPECT series were acquired to visualize extra-temporal +/- temporal ictal onset-associated blood flow changes.
- Novel **Relative Ictal SPECT CO-registered to MRI (RISCOM)** was compared with conventional Subtraction Ictal SPECT (SISCOM) post-processing. Concordance of post-SPECT acquisition processing with semiology, MRI, positron emission tomography (PET), MEG & electrocortigraphy (ECOG) facilitated delineating targets for resective surgery.

## 2. METHODS

Eight subjects with medically refractory extratemporal +/- temporal epileptic sources were enrolled in this investigator-initiated IRB-approved study prior to resection.

**A.** 3T gapless pre- and post-gadolinium volumetric MRI of the brain and non-infused head CT were completed for each subject.

**B.** 27-32 scalp contacts were applied for presurgical long-term video-EEG monitoring.

**C.** A single injection of Ceretec (Tc99m-HMPAO) in 5cc 09% NaCl was completed (mean time to injection from clinical or electrocerebral seizure onset=32 seconds +/- 8 seconds). Each subject was scanned on the Siemens (2-detector) system followed by the InSPira (72-detector) scanner.

**D.** An interictal SPECT scan on both systems was completed for each subject about 24 hrs following the last seizure.

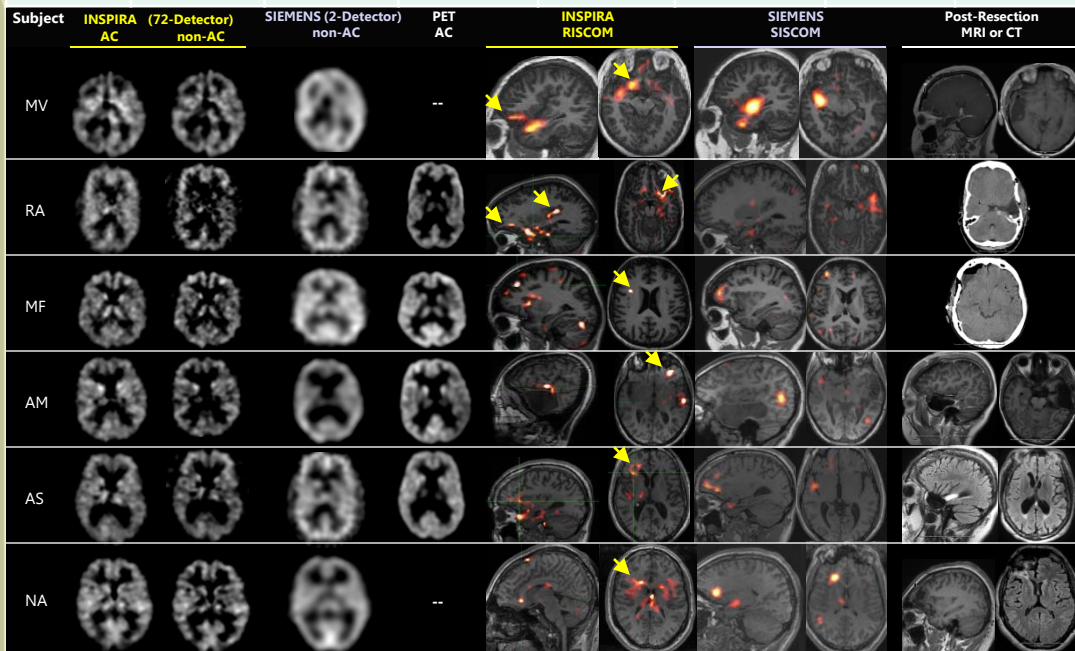
**E.** SISCOM analyses of the Siemens 2-detector datasets were performed using the Analyze® version 10 software package.

**G.** RISCOM image processing for the InSPira datasets was performed where:  
RISCOM voxel value=Weighting factor\*(Ictal/Baseline)  
Weighting Factor = (Ictal-Baseline voxels)/(Maximum(Ictal-Baseline)).

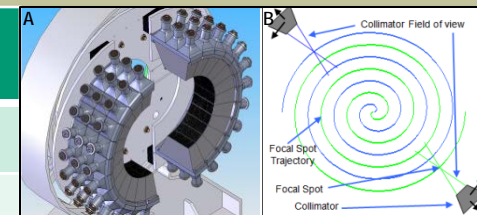
**H.** Presurgical baseline <sup>18</sup>FDG-PET & interictal MEG were incorporated into the workflow.

**I.** Pre-resective chronic and/or intraoperative ECOG further refined the ictal onset regions & validated the transient blood flow changes.

Subject Identifier	Ictal Semiology	Epileptic Source Region	Localizing inSPira HD 72-Detector	Localizing Siemens Gamma 2-Detector	Concordant Evaluation	Surgical Resection Date	Treatment Outcome
TS	CPS with persistence of nausea/emesis	Right temporal + NeuroPace depth lead in left temporal	✓+	✓	ECoG, Cortical Thickness, MEG	11/6/2010	Class Ia Seizure Free
MV	CPS	Right basal frontal + anterior temporal lobe	✓+	✓	ECoG, MEG	8/1/2011	Class Ia Seizure Free
RA	Loss of vision preceding CPS	Left temporal + basal frontal	✓+	✓	ECoG, MEG, PET	11/21/2011	Class Ia Seizure Free
MF	Subclinical status epilepticus	Right frontal antero-lateral	✓+	✓	ECoG, MEG, PET	12/12/2011	Class IIb
RM2	Left facial clonic activity + GTC	Right lateral frontal region	✓+	✓	ECoG, Cortical Thickness, MEG, PET	11/05/2011	Class IIa
AM	Hypermotor seizure	Left posterior temporoparietal+mesial temporal	✓+	✓	ECoG, MEG, PET	2/23/2012	Class IIc
AS	Hypermotor seizure	Right anterior temporal tip	✓+	✓	ECoG, MEG, PET	2/13/2012	Class IIb
NA	GTC seizures without aura	Right frontal resection	✓+	✓	ECoG, MEG	2/29/2012	Class IIb



**FIGURE 1.** Comparison examples from the table are shown demonstrating attenuation correction (AC) and non-AC using the patient's own non-infused CT of the head for the 72-detector SPECT system in columns next to the patient's non-AC 2-detector SPECT datasets. Scanning on both systems were completed following the same injection of Ceretec. The SPECT datasets are compared with the patient's baseline AC-PET data. MRI or CT scans immediately post-resection are shown in the last column. The arrows represent additional regions of hyperperfusion at the ictal onset.



**FIGURE 2.** (A) The 72-photomultiplier tube-based SPECT scanner system (InSPira) uses (B) spiral scanning focused collimation. Standard gamma cameras (Siemens) perform angular increments around a center of rotation.

## 3. RESULTS

• RISCOM datasets using the 72-detector system demonstrated a concordant overlap of transient regions of hyperperfusion seen with the SISCOM data obtained with the 2-detector SPECT scanner.

• The InSPira RISCOM data also demonstrated regions of hyperperfusion not seen with the Siemens SISCOM datasets (see ✓+ in TABLE).

• For all 8 patients, these new regions of hyperperfusion were concordant with chronic and/or intraoperative ECOG. These additional regions were included in the extent of resection in 4 patients.

• All 8 patients demonstrated an Engel's class I-II outcome after a 9-25 mo. follow up (median=13 mo, see TABLE).

## 4. CONCLUSIONS

• RISCOM processing using the 72-detector collimator SPECT scanner facilitated identifying the ictal onset in extensive epileptic circuits not visible with the Siemens 2-detector fan beam collimator system.

• More data are required to determine if the extent of resection overlapping early ictal-associated RISCOM blood flow changes is associated with treatment outcome (see FIGURE 1, post-resection MRI/CT).

• Application of this novel SPECT technology coupled with RISCOM can help better clarify the extent of the ictal onset zone for strategic placement of intracranial electrodes for resective surgery.

## 5. ACKNOWLEDGEMENTS

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