Clinical fMRI & DTI

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Functional MRI (fMRI) is primarily used clinically to map speech and motor function.
Diffusion tensor imaging (DTI) is used to map major white matter tracts.
Clinical fMRI/DTI exam

• 10 min pre-scan assessment and training
• 45 min MRI session
  – 10 min anatomical scans (T1 & FLAIR)
  – 15-20 min fMRI – 3-4 tasks (4 min each)
  – 5 min 30-direction DTI scan
• 30-60 min post-scan image analysis
  – Registration of fMRI and DTI with T1 images
  – fMRI statistical analysis of “active” voxels
  – Overlay of fMRI and DTI on anatomical images
• Neuroradiological interpretation
Tasks involve simple visual cues and alternating block designs

Bilateral hand motion task

Alternating side motion
Language mapping – fMRI for locating brain areas involved in speech

Patients perform a silent sentence-completion task

Old MacDonald had a ________.

vs

Bnd MwjGhdchkj ckr n ________.

The “task” condition makes the patient use “comprehension”, “word finding”, and “expressive” speech areas. It also involves vision and eye movement.

The “control” condition attempts to match vision function and eye movement, but with no language components.
fMRI and DTI maps involve post-processing

Anatomical Images

fMRI statistical maps, overlaid on anatomy or brain surface

Diffusion maps and white-matter tracts from DTI
Summary fMRI maps can combine multiple task areas and pathology

Yellow=Language      Blue=Mouth      Green=Hands
Overlay DTI fiber tracks on anatomy

3-D DTI fiber-tracks are generated interactively using specialized image processing software.
Overlay DTI color-coded FA map on anatomy

Color-coded FA maps are generally produced by MR scanner software automatically at end of scan.
Example fMRI results:
LH 23yo F with cancer

Yellow – 1st sentence-completion map
Green – 2nd sentence-completion map
Blue – hand movement map
RH 10yo F with AVM

Green – hand movement map
Red – mouth movement map
RH 6yo F with Epilepsy

Yellow/Red – storybook language map
Green – hand movement map