

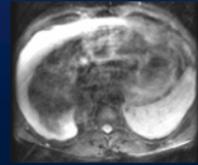
Body MR: Principles

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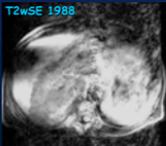
What Makes Body MRI Challenging?

- Motion
- Motion
- Motion



Body MR

T2wSE 1988



T2wFSE 2005



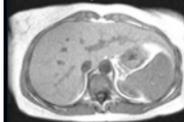
Selecting Receiver Coils

Body or Array Coil?

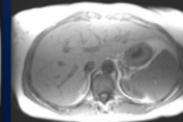


Arrays Have the SNR Advantage

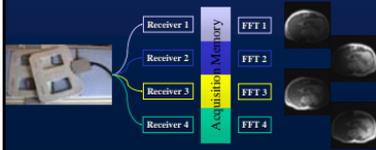
Body Coil



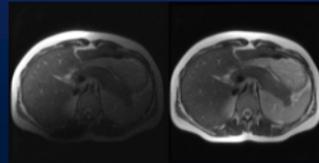
Torso Coil



Phased Array Coil Principles



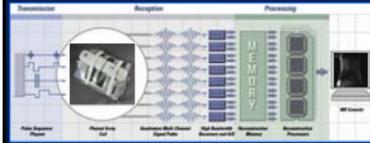
Phased Array Image Combination



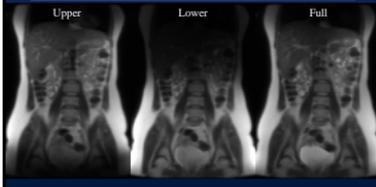
8 Channel Array



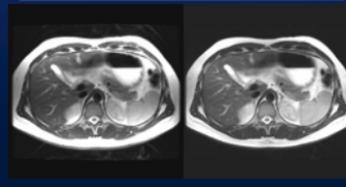
Multi-channel Receiver



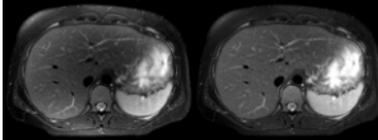
8 Channel Abdo pelvic Array



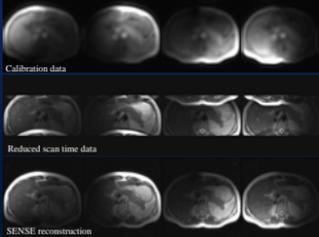
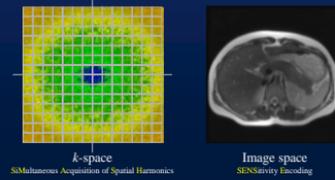
Coil Intensity Correction



Coil Intensity Correction

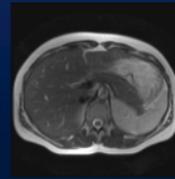


Parallel Imaging Principles



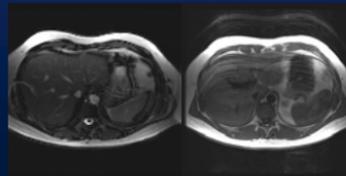
SENSE

- Advantages
 - Faster acquisitions
 - Improved coverage
 - Reduced power deposition
 - Reduced artefacts
- Disadvantages
 - Reduced SNR
 - Calibration needed
 - Reconstruction artefacts

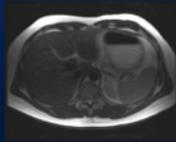
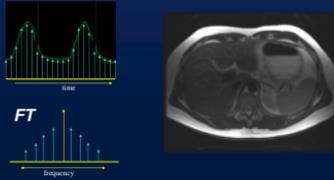


Controlling Motion Artefacts

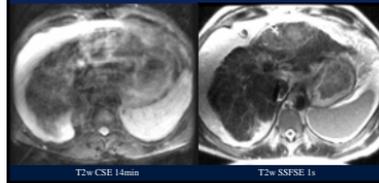
Respiratory Motion



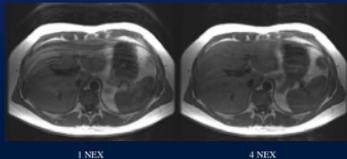
Respiratory Artefacts



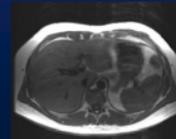
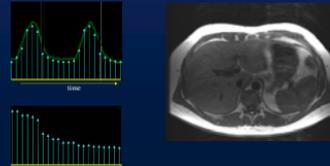
One Solution – Go Faster!



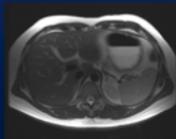
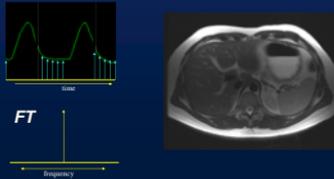
Old Solution (c.1990) - Averaging



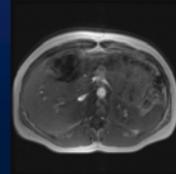
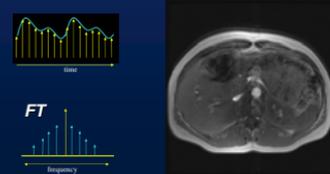
Respiratory Compensation (c.1995)



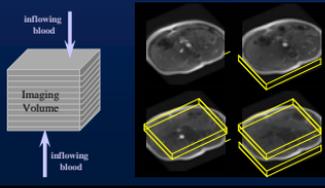
Respiratory Triggering with FSE



Flow Artefacts

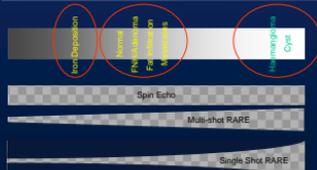


Spatial Presaturation



Principles of T2w Imaging

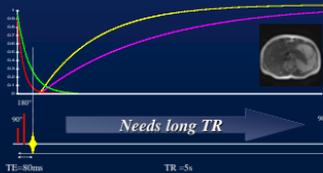
T2 Spectrum of Liver Pathology



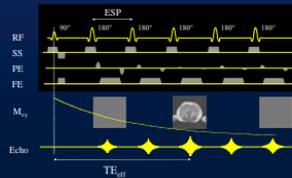
T2w Sequences

Generic	Brand Names	Tumour Contrast	Time	Artifact	Suscept.
T2w SE		T2+++		+++	+
Multi-shot RARE	FSE, TSE	T2++ (long T2 values +++)	Minutes	+	0
Single shot RARE	HASTE, SSFSE	T2+ (long T2 values +++)	Sub second	+	0
Multi-shot EPI		T2++		Breath hold	++
Single shot EPI		T2++	Sub second	++	+++
T2/T1w GE	True-FISP, HFFE FIESTA	Mixed - and limited for tumours	Sub second	+	++

T2w Conventional Spin Echo



RARE (ETL=5)



RARE Data Acquisition

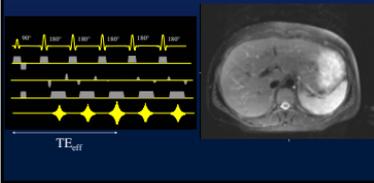


Image Blurring in RARE

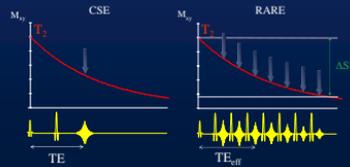
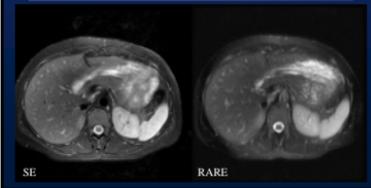


Image Blurring in RARE

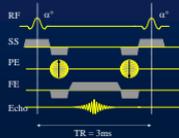


T2w Spin Echo

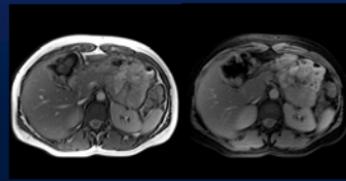
- CSE
 - Slower ($TR \cdot N_{PE}$)
 - Respiratory motion
 - Best contrast
- RARE
 - Faster ($TR \cdot N_{PE}/ETL$)
 - Respiratory triggering/breath-holding
 - Reduced susceptibility artefacts
 - Echo train blurring
 - Reduced contrast
 - Bright fat

True-FISP

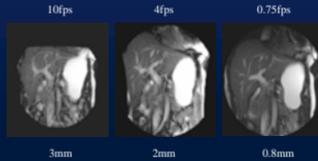
- Advantages
 - Time efficient
 - Independent of TR
 - Good flow characteristics
 - T2/T1 contrast
 - Sub-second imaging
- Disadvantages
 - Susceptibility artefacts



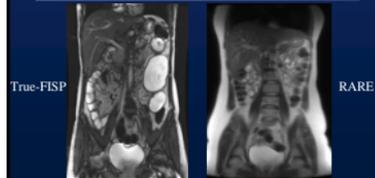
True-FISP



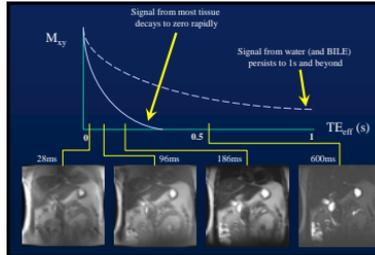
Interactive True-FISP



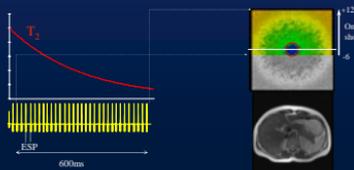
Susceptibility Artefacts



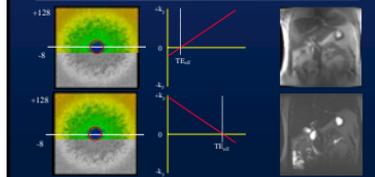
Hydrographic Imaging



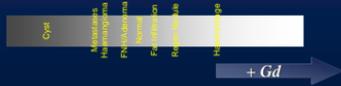
Single Shot RARE



ssRARE Phase Encode Ordering



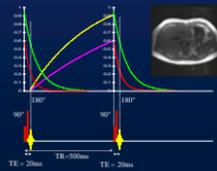
T1 Spectrum of Liver Pathology



T1w Sequences

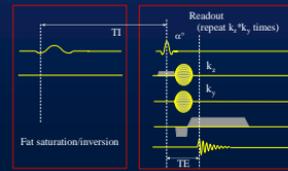
Generic	Brand Names	Tumour Contrast	Time	Artefact	Suscept
T1w SE		T1 ++	Minutes	++	-
Spin echo T1w GE	FLASH, ESPGR, FASTE	T1 +	Breath hold	+	++
IR prep T1w GE	Turbo FLASH, IR-EGRE, FIRM, FFE	T1 ++	Sub second	++	++
1.0 Phase Spoiled T1w GE		Presence of fat and water mixture in the same voxel	Breath hold	-	++
3D image T1w GE	VIBE, FAME, LAVA, THRIVE	T1 + designed for Gd multiphase	Breath hold	+	+

T1w Spin Echo



- TR too short for respiratory triggering
- TR too long for breath-hold
- TE/TR unsuitable for RARE

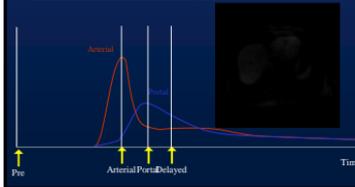
Contrast Enhanced 3D T1w FGRE



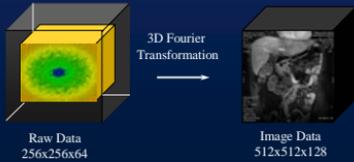
Contrast Administration and Timing



Multiphase Dynamic Acquisition



Zero Interpolation Processing



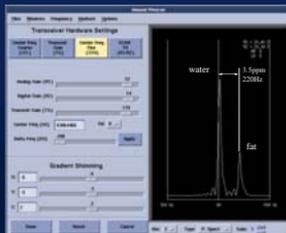
ZIP Phantom



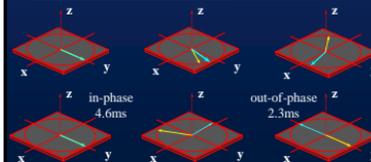
ZIP Phantom



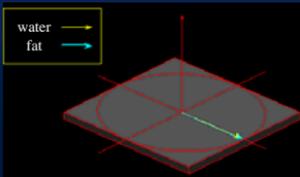
Dual echo FGRE



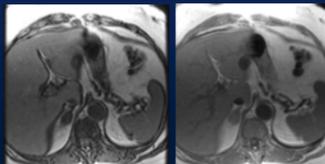
In/Out-of-Phase



In/Out-of-Phase



Adrenal Adenoma



out-of-phase

in-phase