

1.5T装置における脂肪抑制 (STIR,CHESS)の基礎検討

長野赤十字病院

山城晶弘 神谷直紀 大塚薫

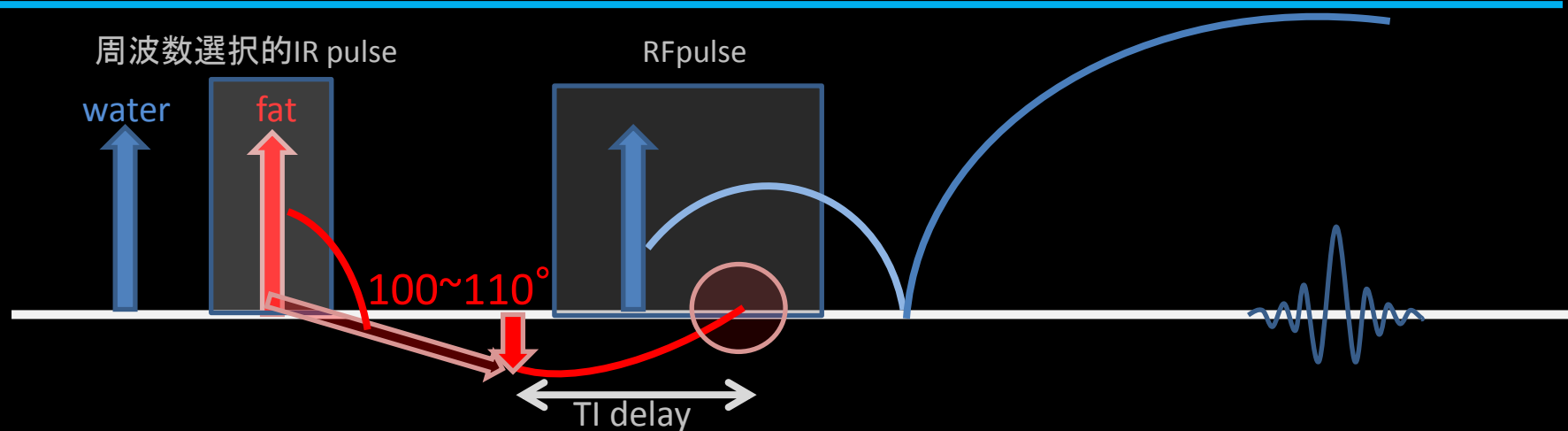
駒津和浩 伊東洋一 久保田展聡 高林融

CHESS(chemical shift selective)

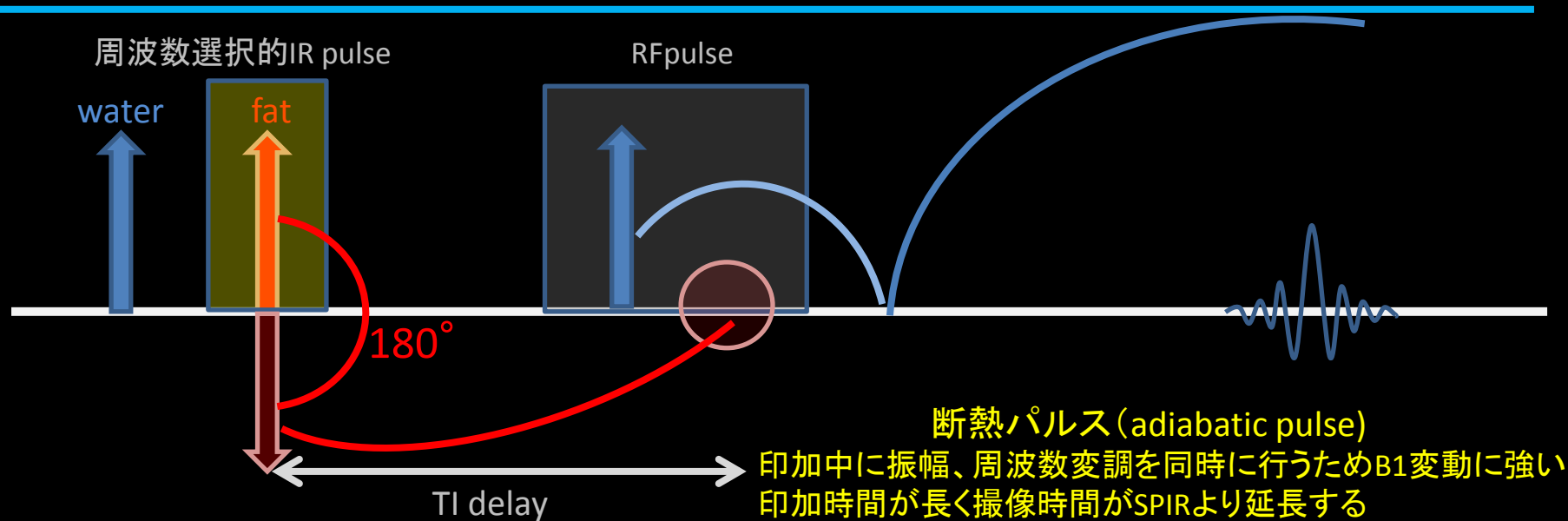
- 磁場不均一の対策
- SPIR SPAIR : B_1 不均一の影響
- SPIR SPAIR : 脂肪抑制効果



SPIR

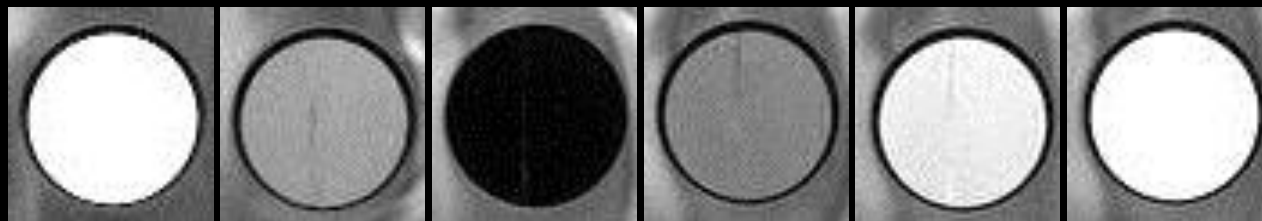


SPAIR



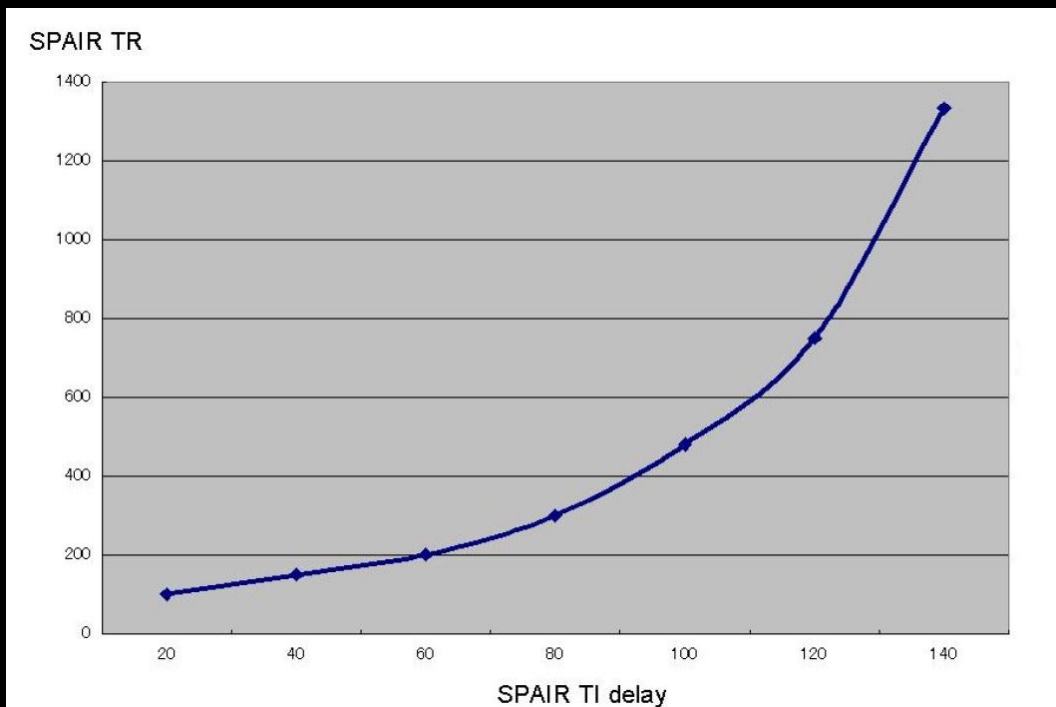
SPAIR TRによる脂肪信号の変化

SPAIR TR : 500ms



TI:30ms TI:60ms TI:90ms TI:120ms TI:150ms TI:180ms

FOV : 250mm matrix 256*256
TE : 7ms TR:500ms
NEX : 1 coil : QD-Head
slice : 5mm ETL:1
BW : 75.4kHz/FOV



各撮像条件 (SPAIR TR) により TI 時間の適切な設定が必要になる

SPIR SPAIR（磁場の不均一の対策）

①Shimming

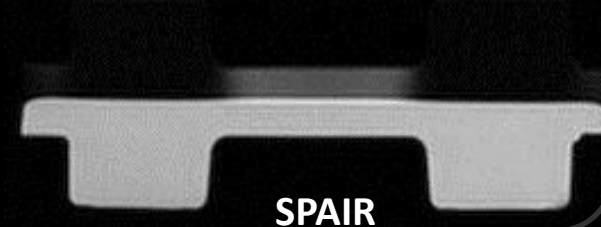
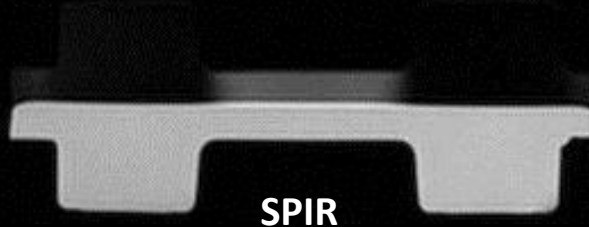
Dumbbell phantom



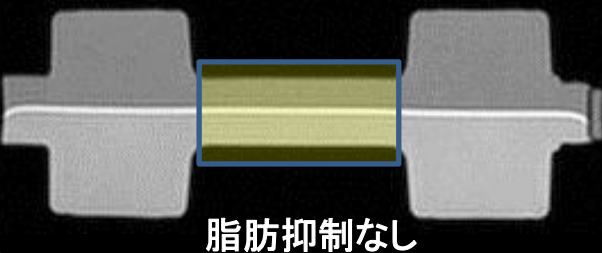
	T ₁ value(ms)	T ₂ value(ms)
oil	247.8	41.4
water	2841.2	2240.1

FOV : 500mm matrix256*256
TE : 100ms TR:3000ms
NEX : 1 coil : Q-body
slice : 5mm ETL:9
BW :26.8kHz/FOV

Shim : auto



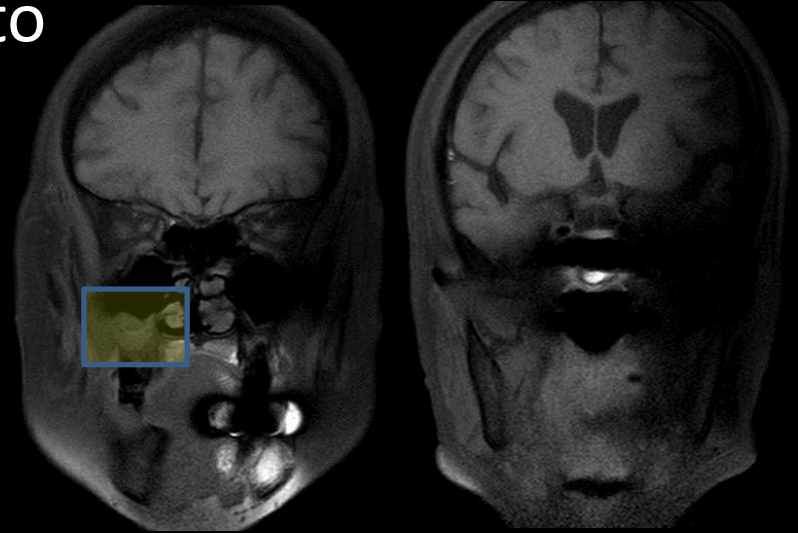
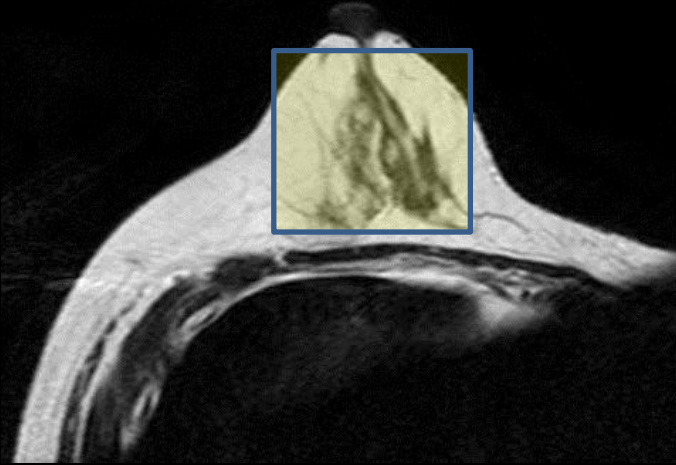
Shim : volume



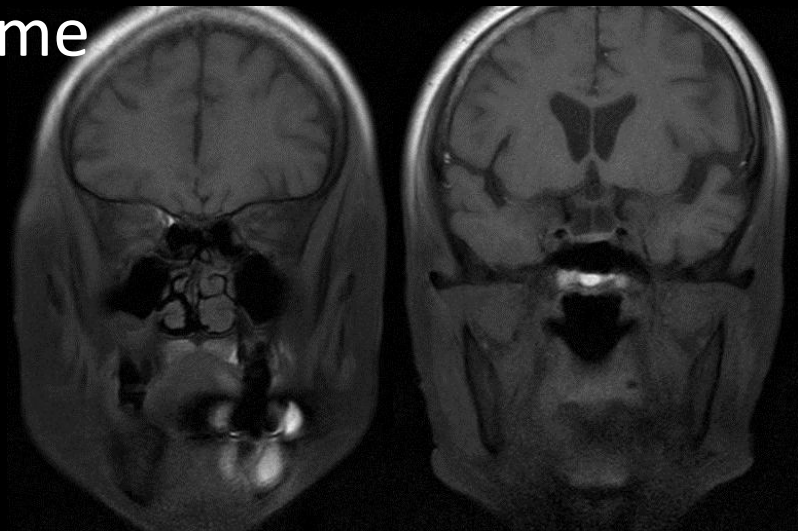
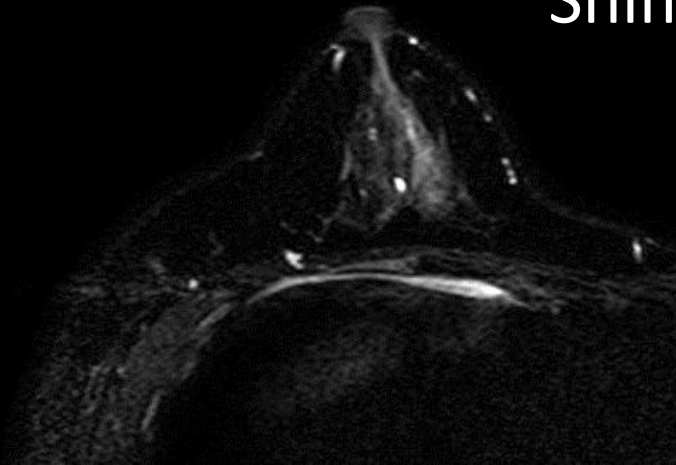
SPIR SPAIR（磁場の不均一の対策）

①Shim 臨床画像

Shim : auto

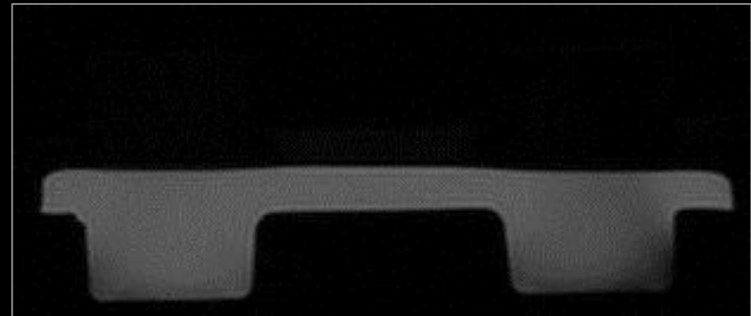
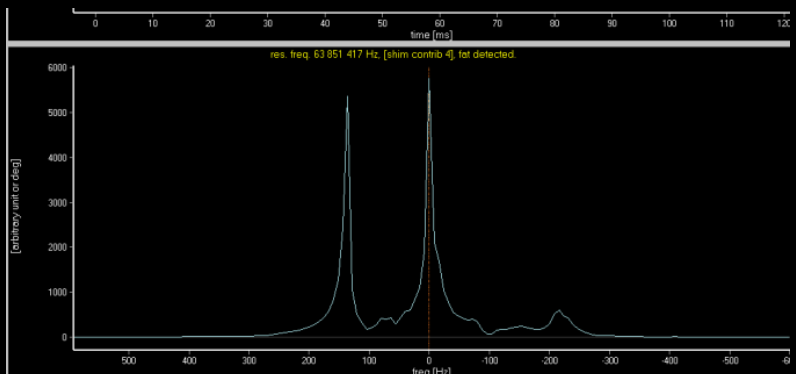
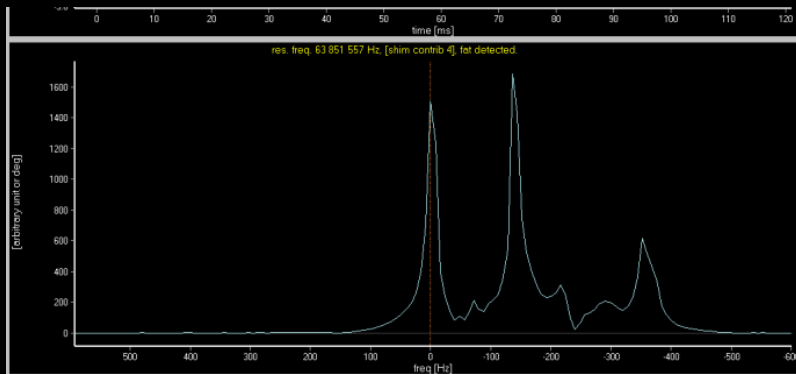
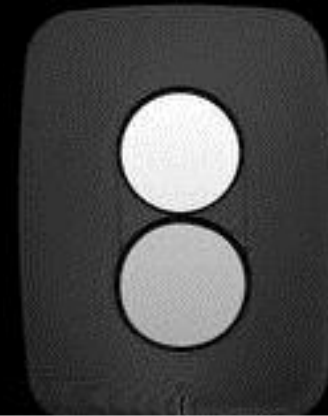
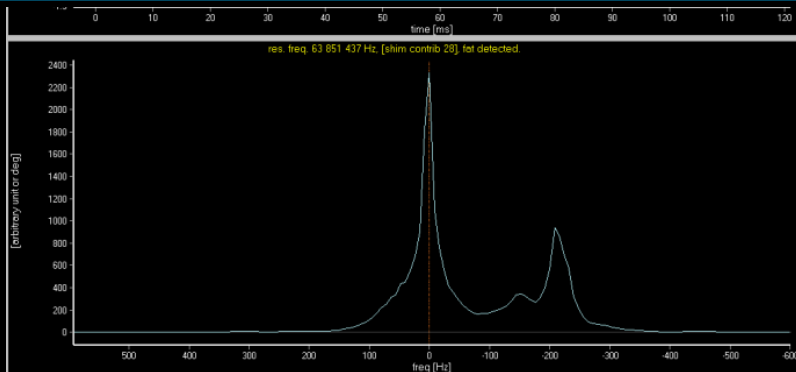


Shim : volume



SPIR SPAIR (磁場の不均一の対策)

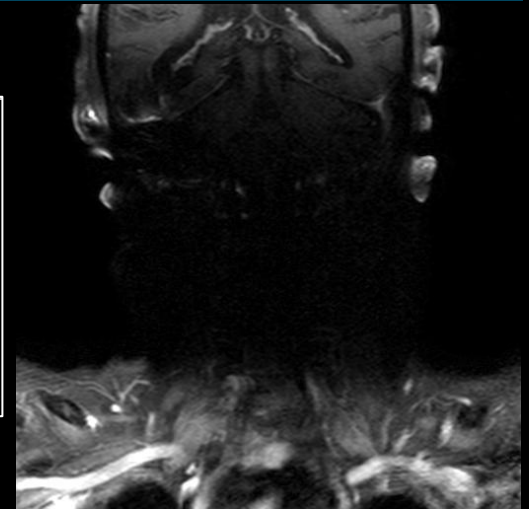
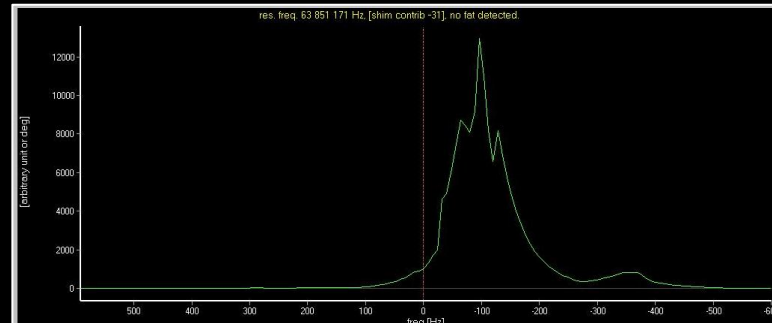
②中心周波数



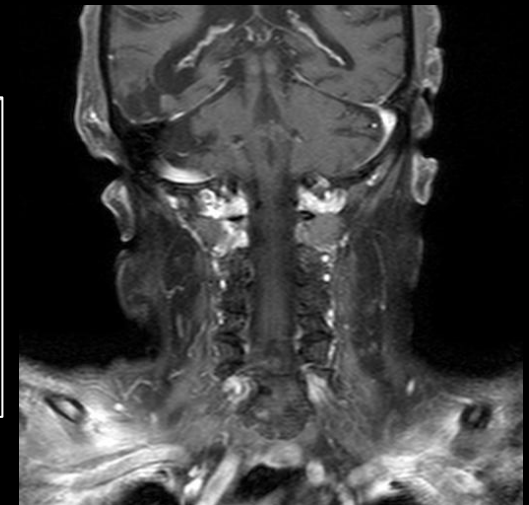
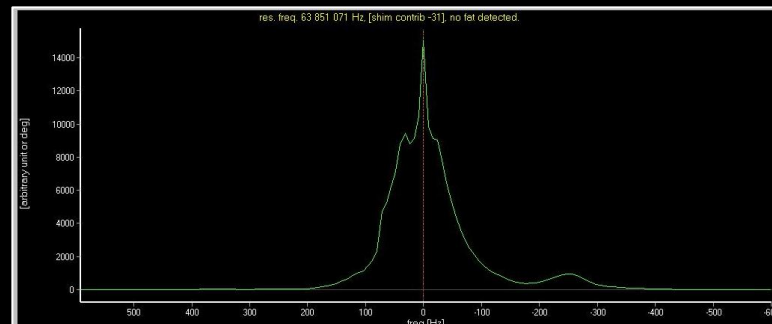
SPIR SPAIR (磁場の不均一の対策)

②中心周波数 臨床画像

SPIR



SPIR

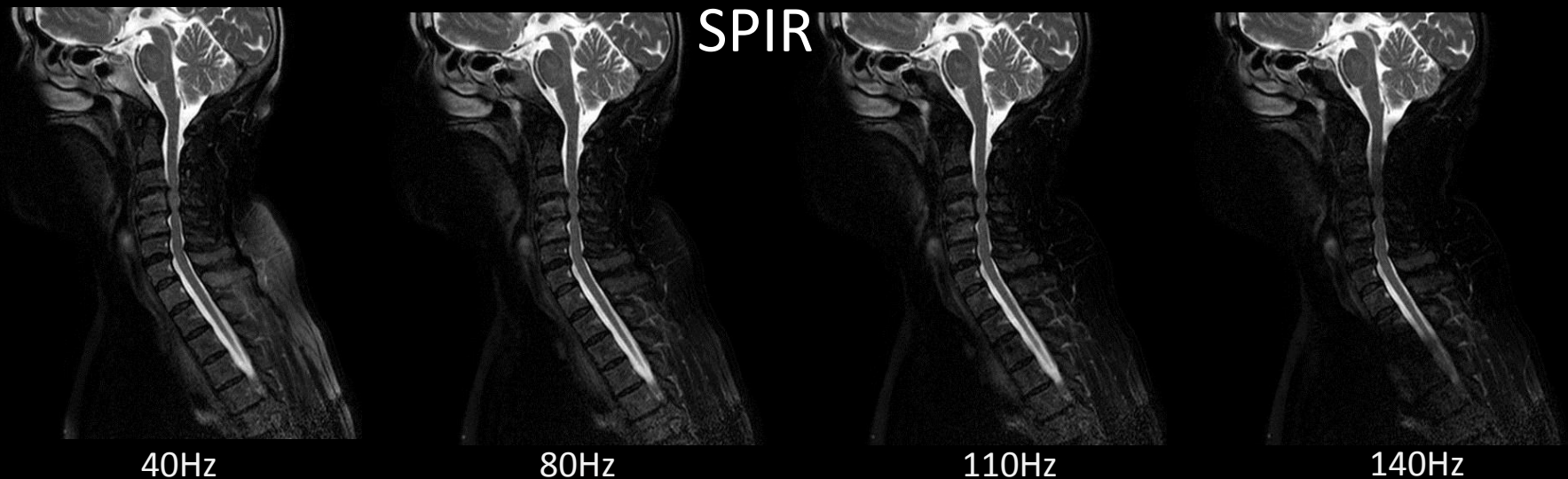
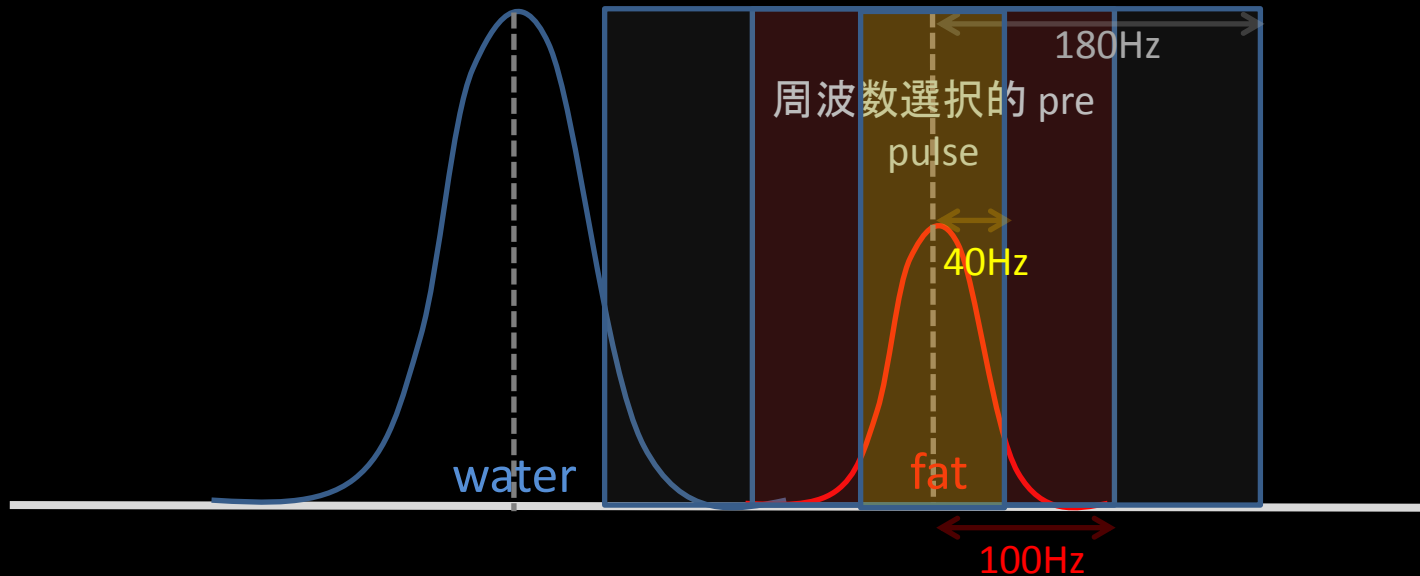


SPIR(peak修正後)

T1W

SPIR SPAIR (磁場の不均一の対策)

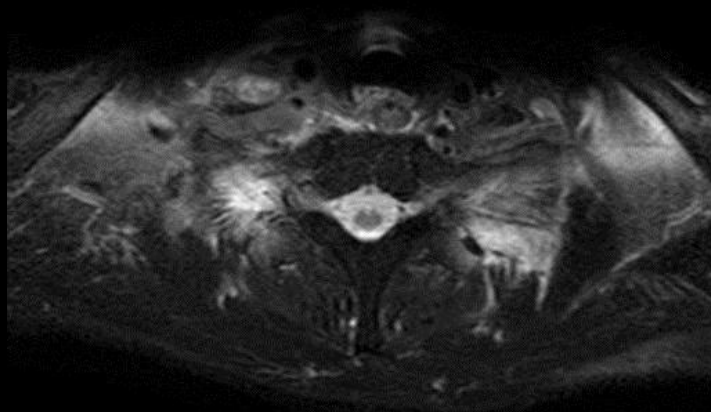
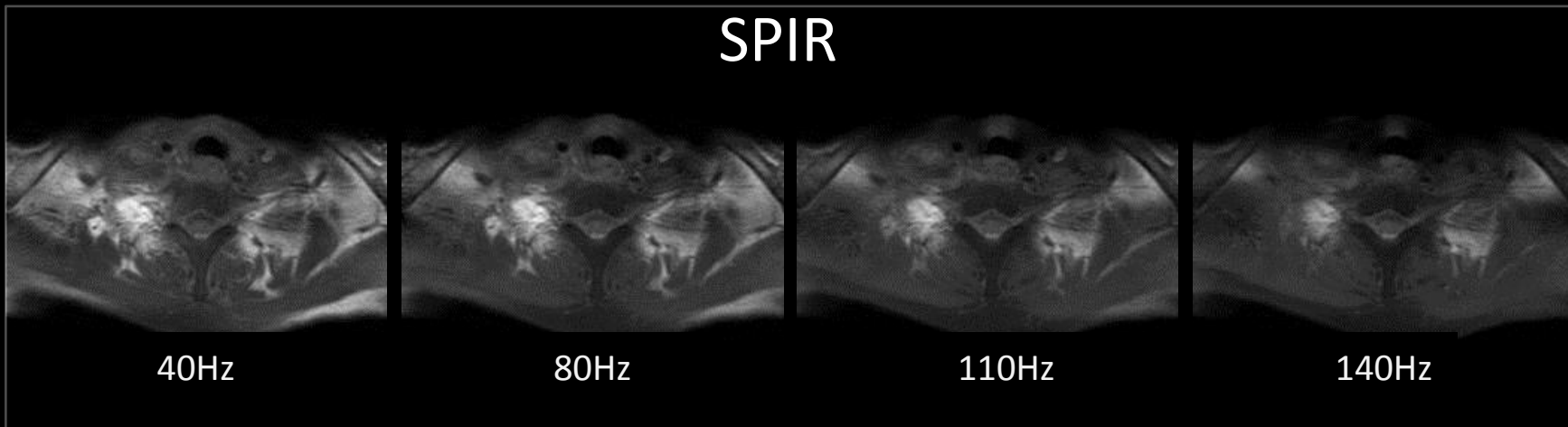
③Frequency offset



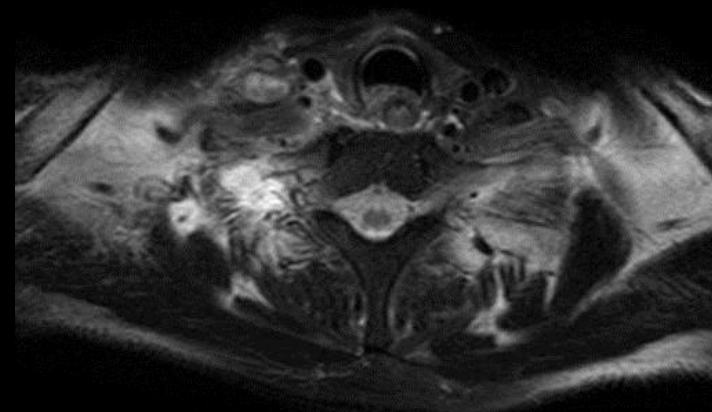
SPIR SPAIR（磁場の不均一の対策）

③Frequency offset 臨床画像

SPIR



100Hz



60Hz

SPIR vs SPAIR B1不均一の影響

周囲充満物質を変化

Baby-oil

Sarada-oil

	T1value (ms)	T2value (ms)
Baby-oil	216.3	54.2
Sarada-oil	247.2	41.9

FOV : 250mm

TE : 10ms

NEX : 1

slice : 5mm

coil : QD-Head

matrix 256*256

TR:500ms

BW : 75.4kHz/FOV

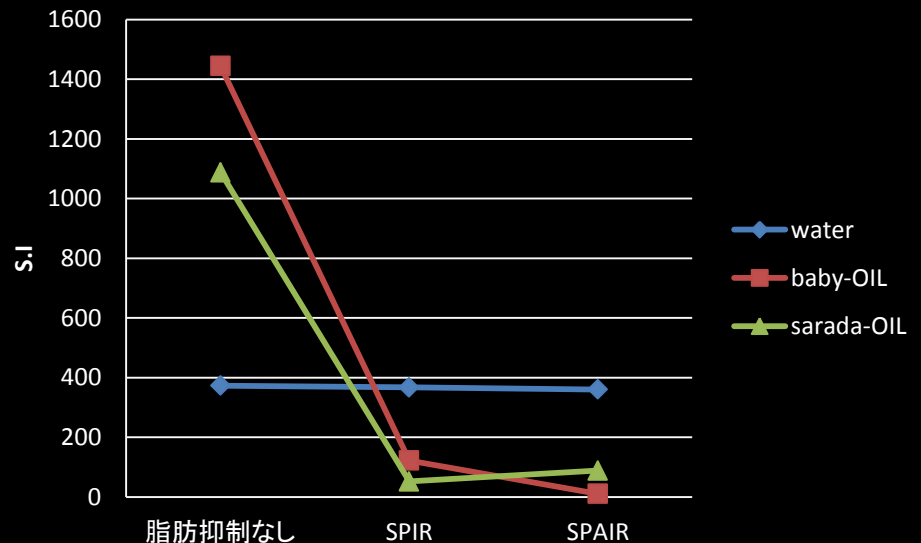
ETL:1

周囲充満物質 : water

脂肪抑制 : なし

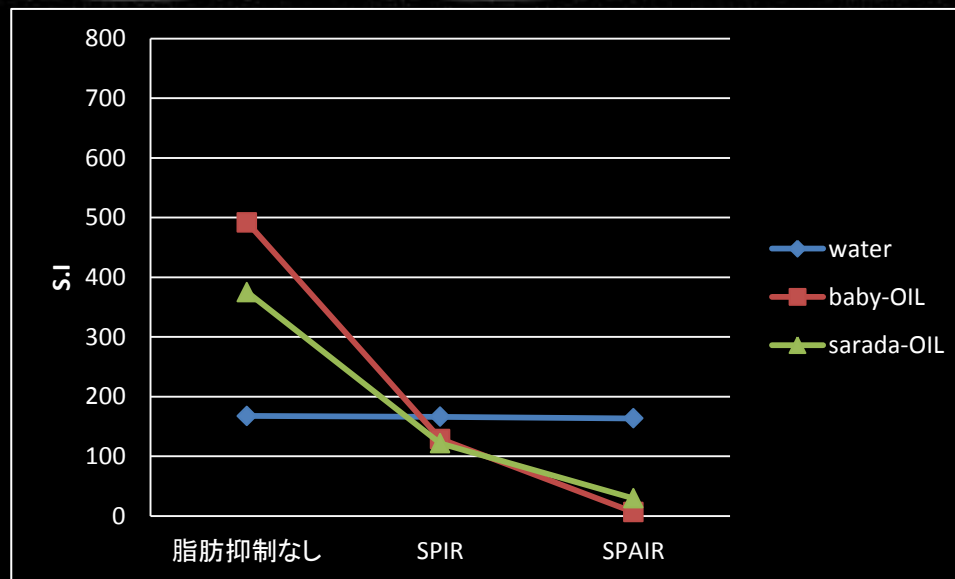
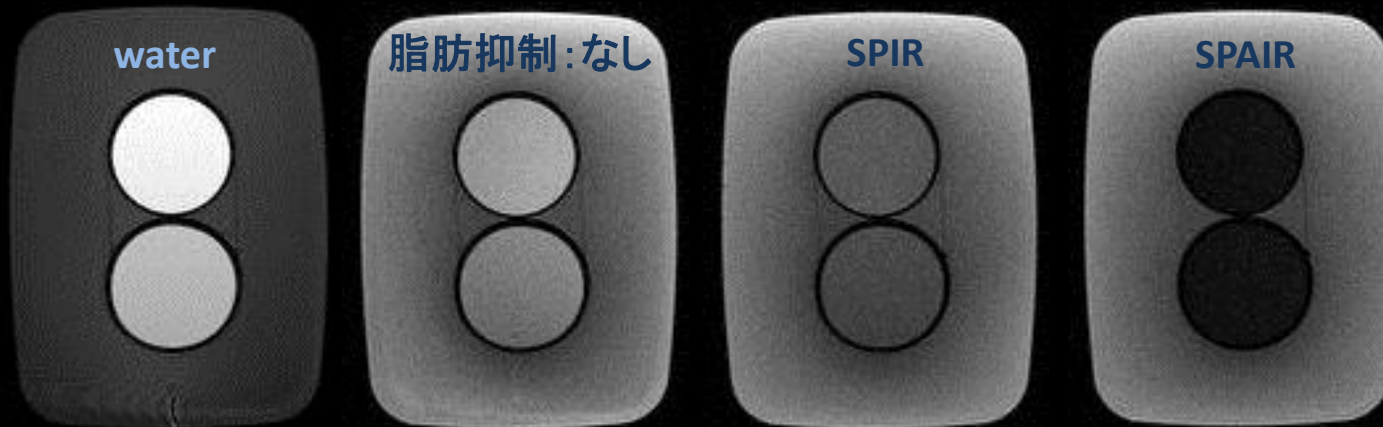
SPIR

SPAIR



SPIR vs SPAIR B1不均一の影響

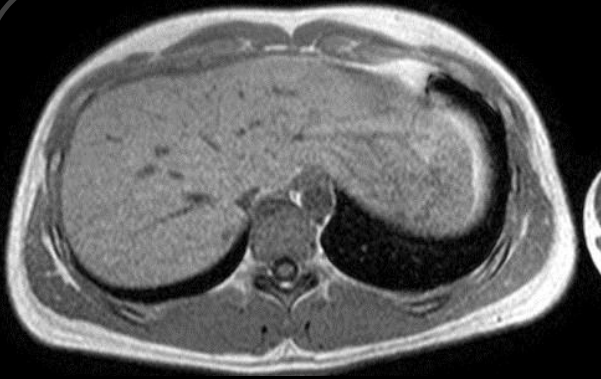
周囲充満物質：高誘電率物質



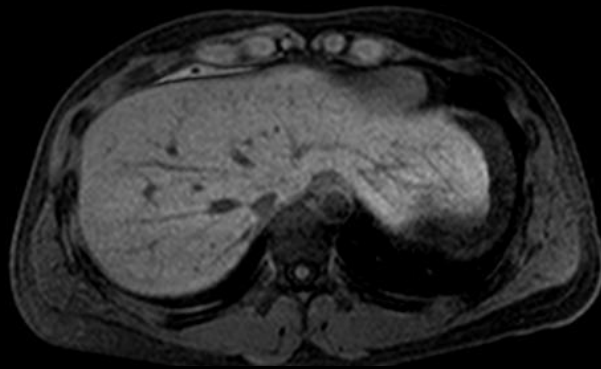
SPIR vs SPAIR B1不均一の影響

臨床画像

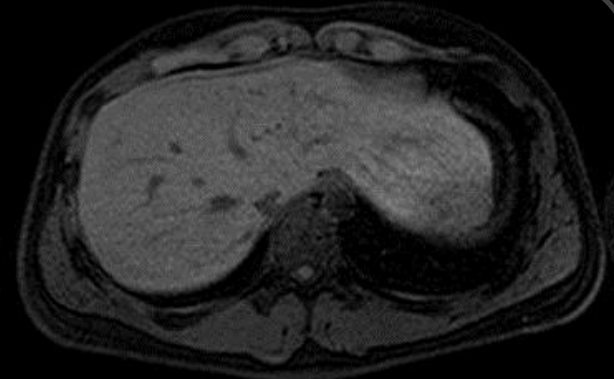
健常ボランティア 男性 70kg



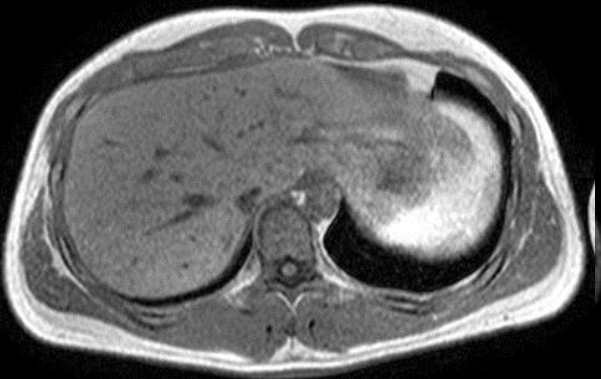
In phase



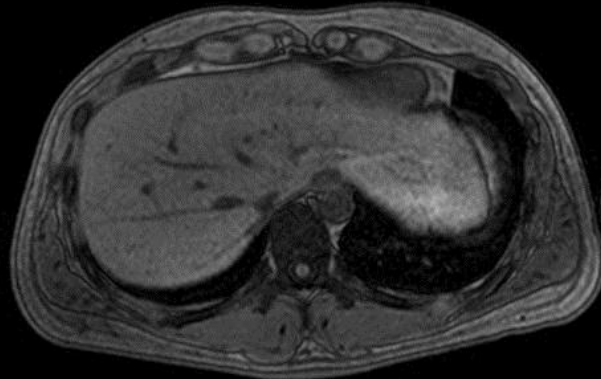
SPIR



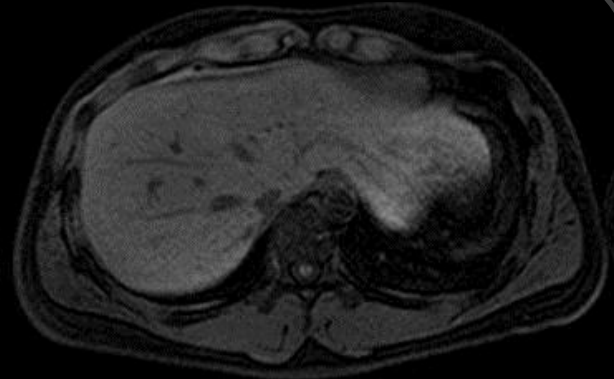
SPAIR



In phase



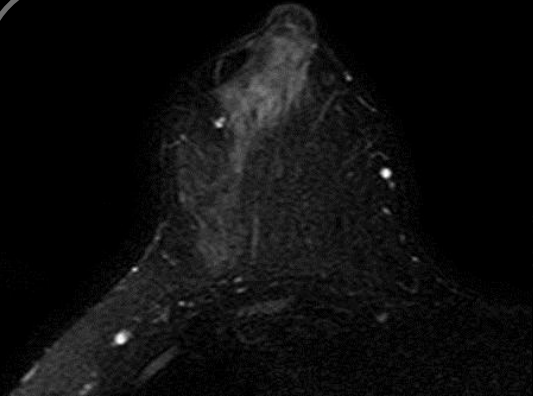
SPIR



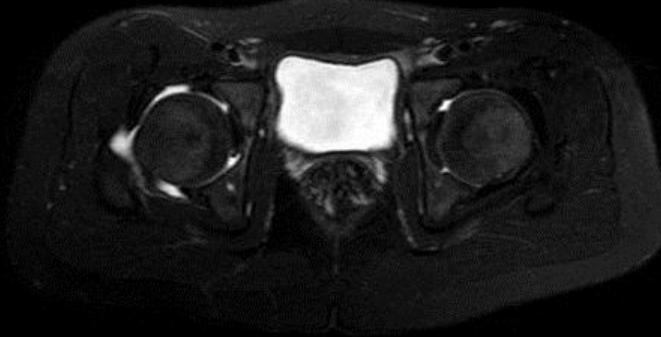
SPAIR

SPIR vs SPAIR 脂肪抑制效果

SPIR



3m02s

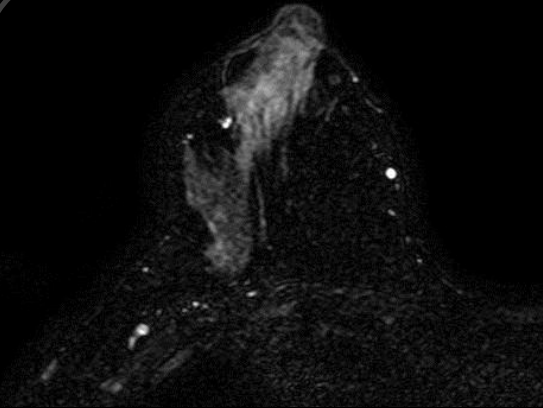


2m36s



2m04s

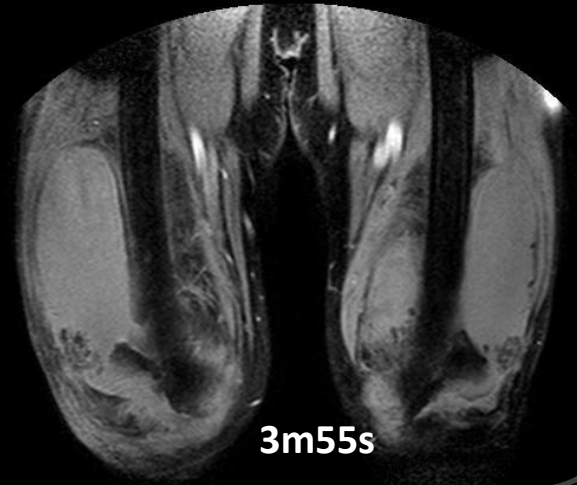
SPAIR



3m02s



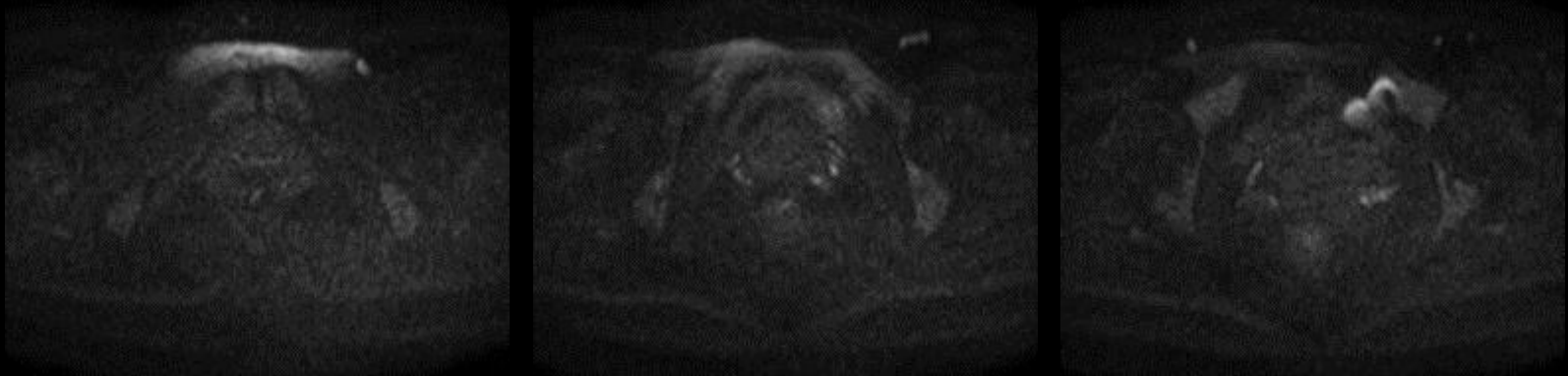
3m19s



3m55s

SPIR vs SPAIR 脂肪抑制效果

SPIR



2m44s

SPAIR (SPAIR TR:250ms Tl:90ms)



3m25s

まとめ(CHESS)

- 磁場不均一の対策

自施設でのCHESS脂肪抑制効果の改善策を有することが重要

- SPIR SPAIR : B₁不均一の影響

SPAIRはSPIRよりB₁不均一に強く、適切な脂肪抑制効果が得られた。高磁場装置において更に有用な可能性

- SPIR SPAIR : 脂肪抑制効果

SPAIRはSPIRより脂肪抑制効果が高い例が多い。但し撮像時間の延長を伴う。

CHESS(chemical shift selective)

- 磁場不均一の対策
- SPIR SPAIR : B_1 不均一の影響
- SPIR SPAIR : 脂肪抑制効果

STIR(Short TI Inversion Recovery)

- 1.5T装置でのnull point
- 臨床画像

STIR fat nullpoint (TR変化)

$$TI(\text{null}) = (\ln 2) * T_1 = 0.693 * T_1$$

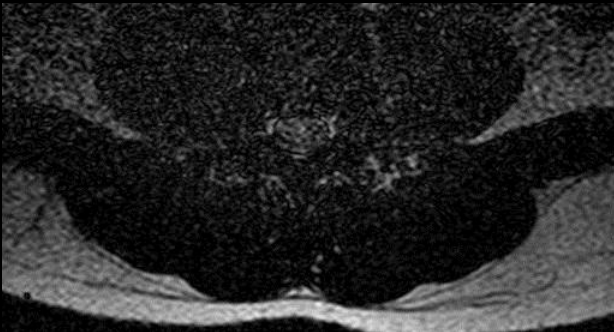
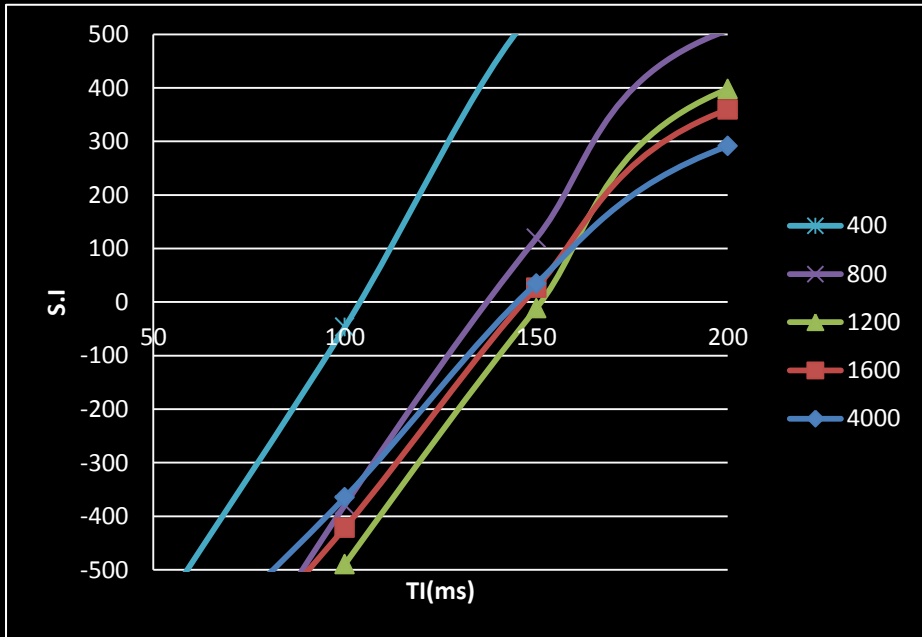
1.0T $T_1\text{value}(\text{fat})=230\text{ms}$ $TI(\text{fat null})=0.693*230=159\text{ms}$

1.5T $T_1\text{value}(\text{fat})=250\text{ms}$ $TI(\text{fat null})=0.693*250=173\text{ms}$

3.0T $T_1\text{value}(\text{fat})=290\text{ms}$ $TI(\text{fat null})=0.693*290=201\text{ms}$



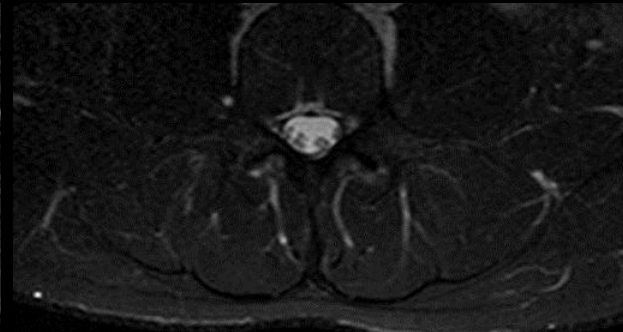
静磁場強度により脂肪のnullpointは異なる



TR 400ms



TR 800ms



TR 4000ms

STIR contrast



	T1value(ms)	T2value(ms)	Rho (%)
①CSF	2101.6	221.4	75.5
②mass	998.7	84.1	56.2
③muscle	671.9	45.4	48.1
④bone marrow	420.5	62.3	32.5

FOV : 200mm

TE : 可変

NEX : 2

slice : 5mm

coil : QD-Head

matrix128*160

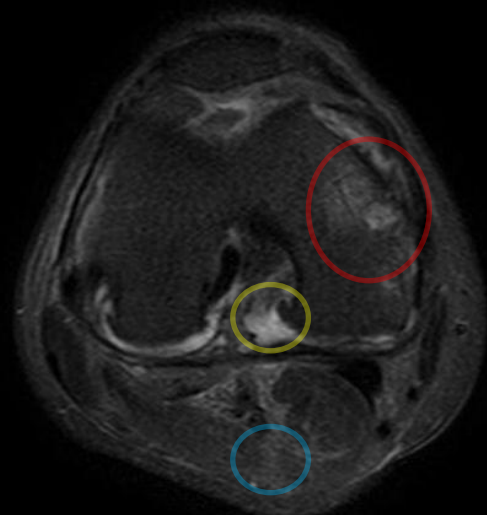
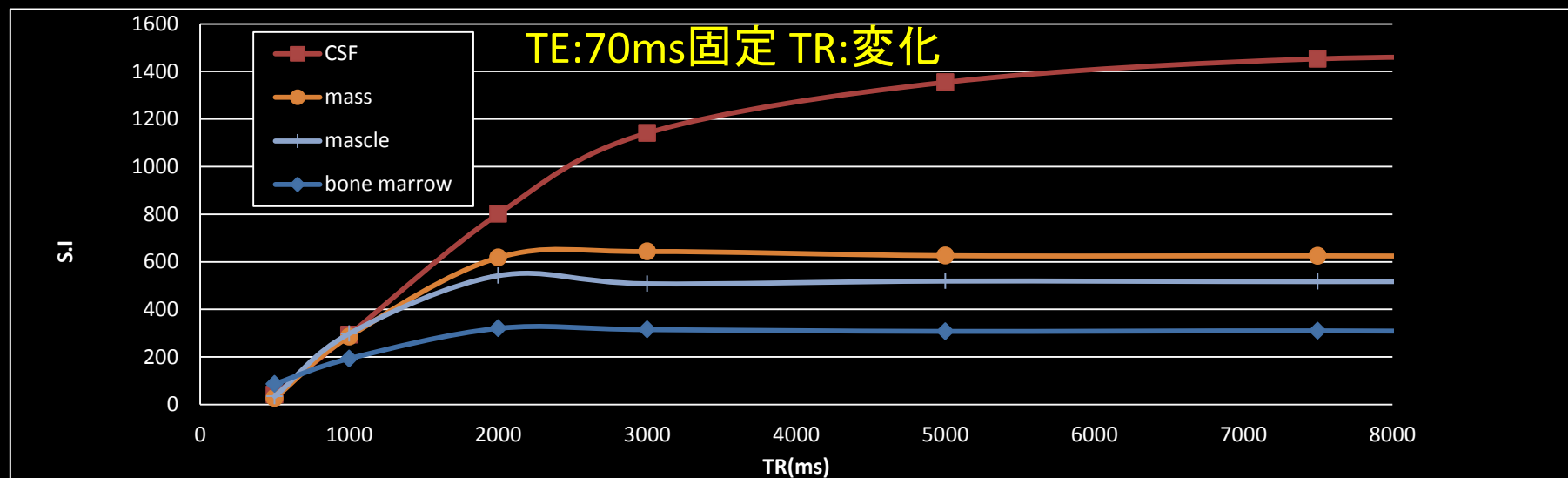
TR:可変

BW : 7.16kHz/FOV

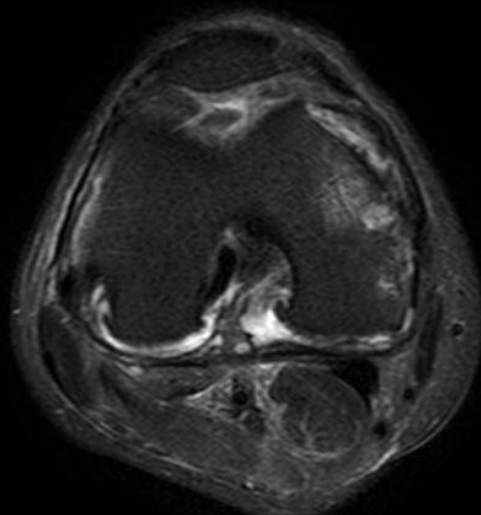
ETL:9

TI:160ms

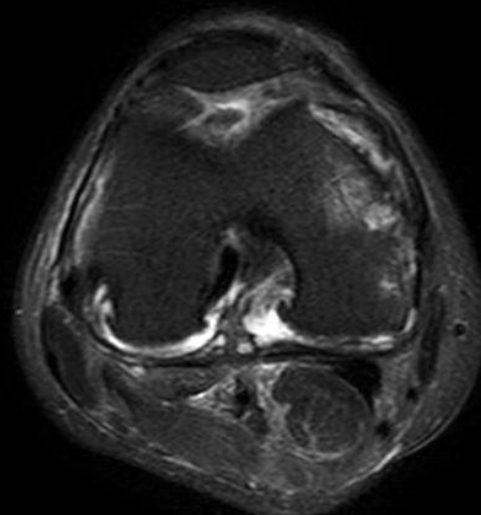
STIR contrast(TR変化)



TR 2000ms



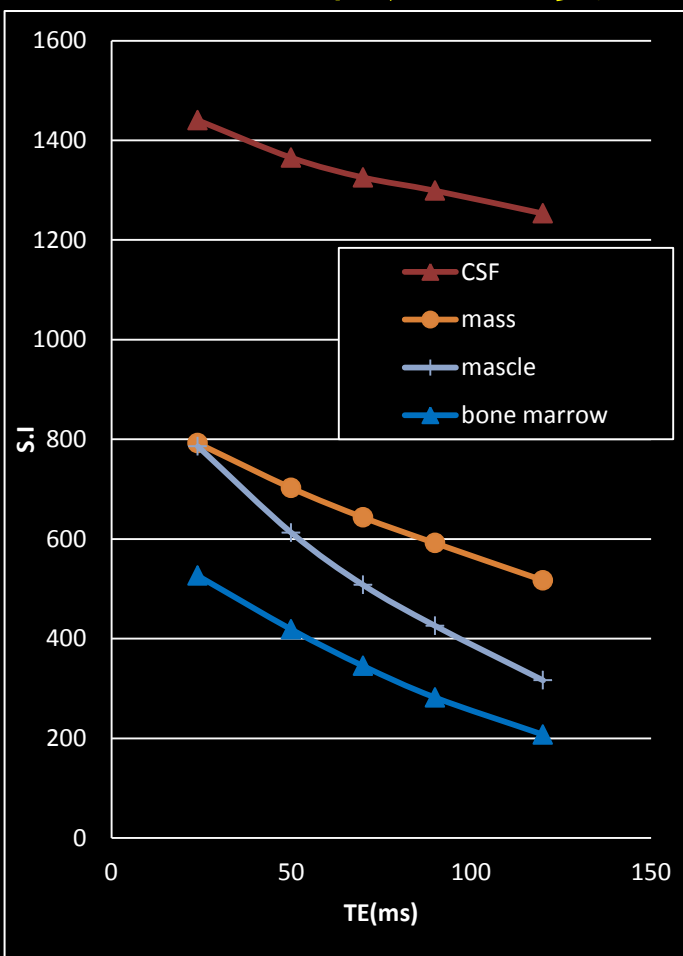
TR 4000ms



TR 6000ms

STIR contrast(TE変化)

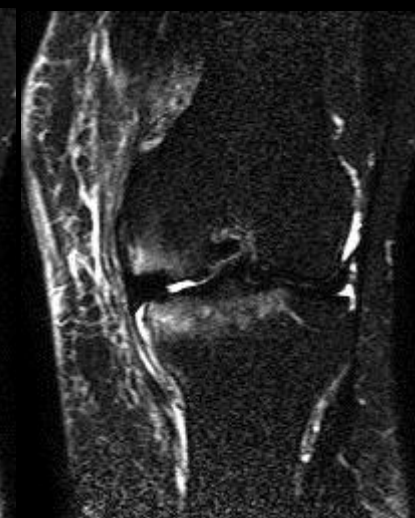
TR:4000ms固定 TE:変化



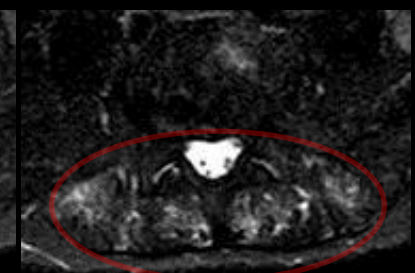
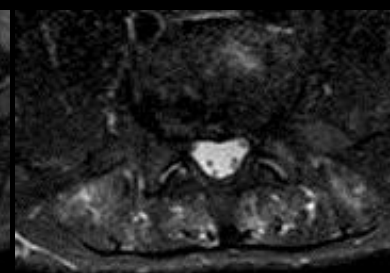
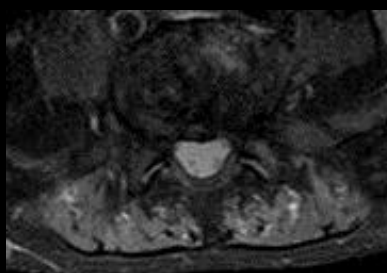
TE 30ms



TE 70ms



TE 120ms



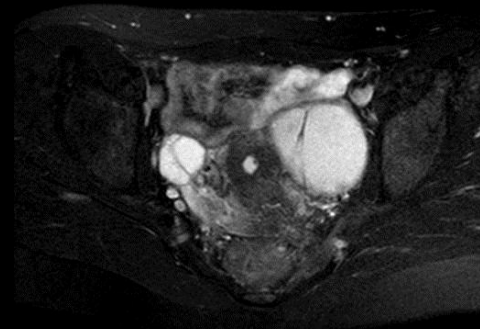
STIR その他



T2W



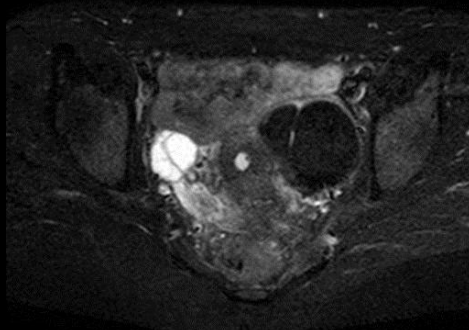
T1W



T2W+SPIR



T1W+SPIR

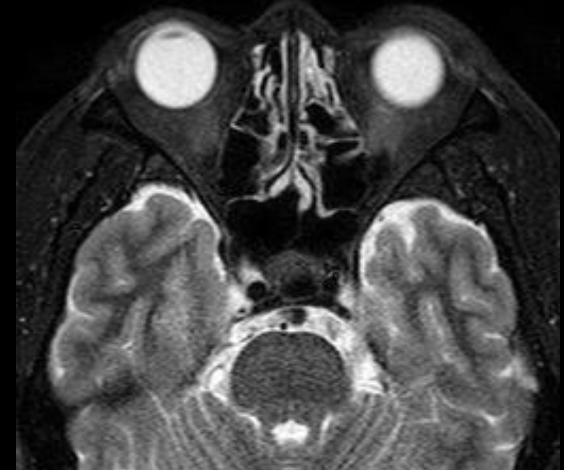


STIR

T2W+SPIR



STIR



まとめ(STIR)

- 1.5T装置でのnull point

静磁場強度、設定TR(TEも)により脂肪のnull pointは変化する。各施設で最適なTIの設定を！

- 臨床画像

TE,TRによりコントラストは変化する。TEはやや長め、TRも同様長めの設定が望ましい。

STIRで信号低下が得られても、脂肪と断定できないことに注意が必要である。