

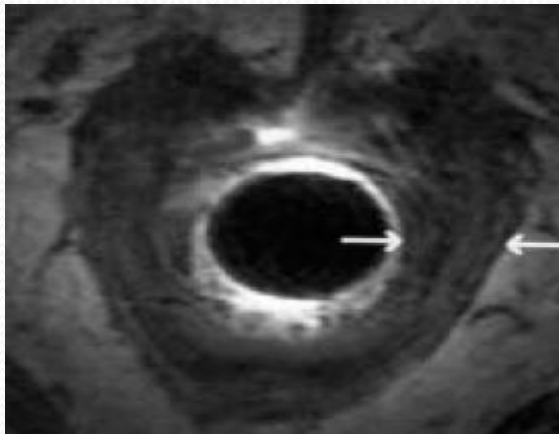
# Comparison of Fat Quantification using 2 point Dixon MRI and MR Spectroscopy in the Gluteus Maximus Muscle

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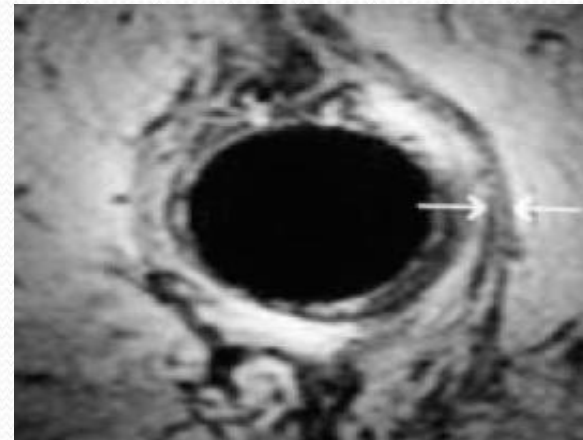


# Introduction

- Fat accumulation in pelvic muscles is an indicator of muscle atrophy
- Associated with neurogenic dysfunction and is accentuated with aging , childbirth and menopause



**Anal Sphincter without muscle atrophy**



**Anal Sphincter with muscle atrophy**

# Fat Quantification techniques

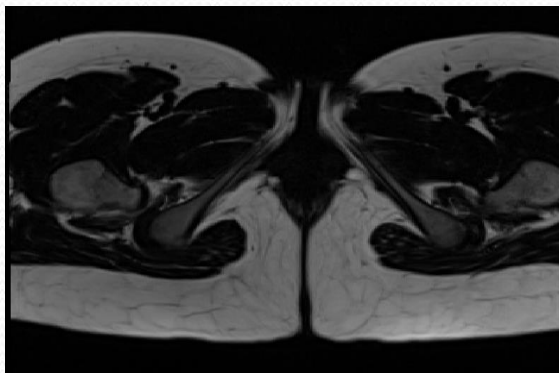
- MR Spectroscopy (MRS) has been shown to be accurate for fat quantification in puborectalis and supraspinatus muscles
- Problem in smaller muscles (anal sphincter) is contamination from extra-voxel fat
- Longer scan time means patient movement is more likely
- Volume Interpolated Breath Hold Examination(VIBE) : a 3D Gradient Echo sequence , previously used for fat quantification in the liver
- Is VIBE a possible alternative in pelvic muscles ?



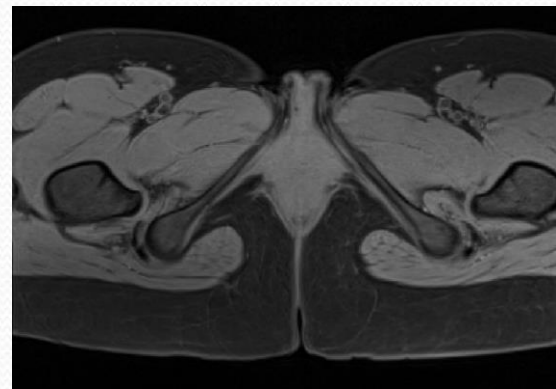
# The 2 Point Dixon Technique

- Incorporated in the VIBE sequence
- In phase image  $I_0$  : Water and fat magnetization are in phase
- Out of phase Image  $I_1$  : fat and water magnetization are  $180^\circ$  out of phase

**Fat image** =  $\frac{1}{2}(I_0 - I_1)$

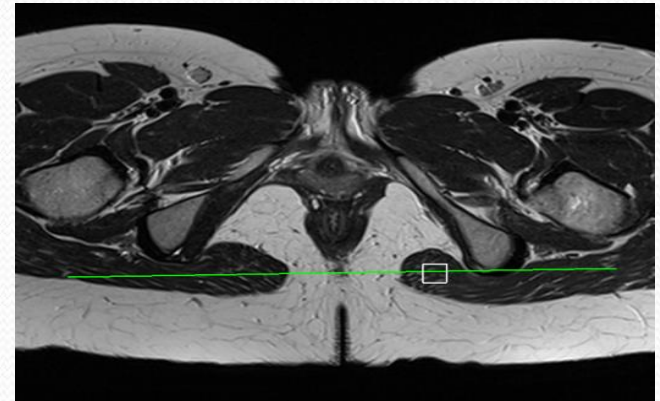


**Water Image** =  $\frac{1}{2}(I_0 + I_1)$

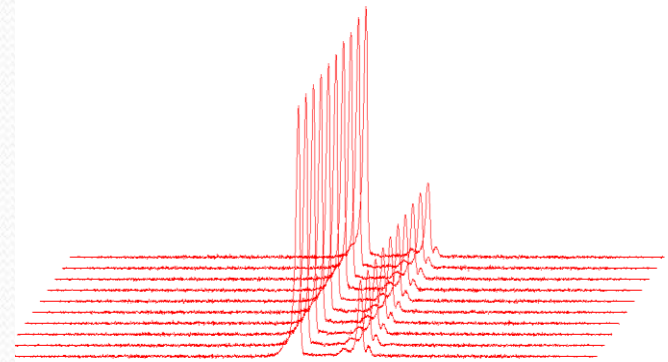


# Protocol

- 10 female controls (23-35 years) scanned on a Siemens 1.5 T system
- 10 mm cubic voxel in the gluteus maximus muscle in a T2 TSE axial scout of the pelvis
- Spectra acquired using PRESS  
(TE<sub>1</sub>/TE<sub>2</sub> = 30/50 ms , TR = 5000ms)
- 2 sets of 3D VIBE scans for each control  
(TE<sub>in phase</sub>/TE<sub>out of phase</sub> : 4.76/7.14 ms,  
TR : 11.1 ms, Flip angle : 10°)



Voxel position in the scout image

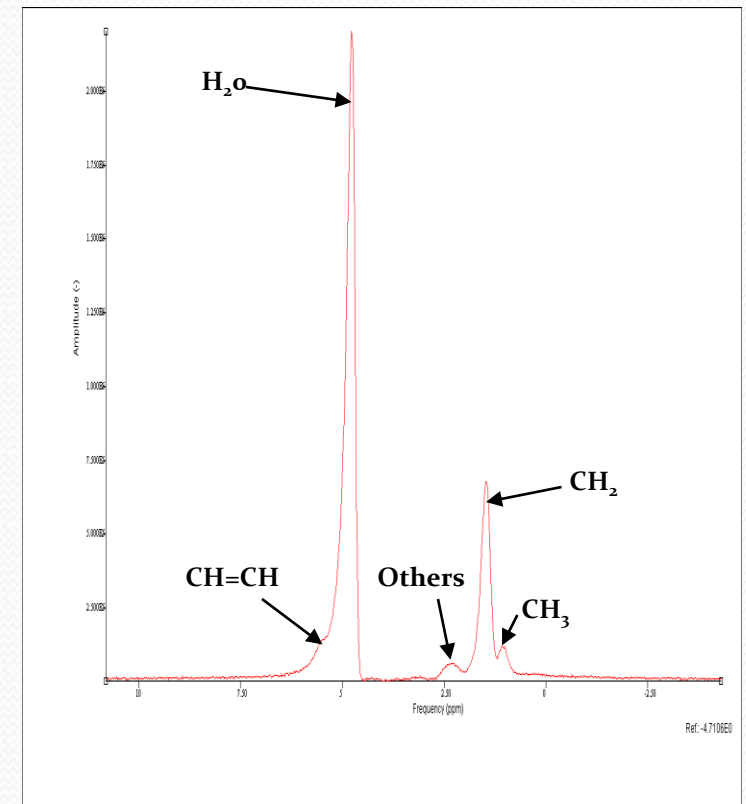


10 spectra with 8 averages each



# MR Spectroscopy -Calculation of the Fat Fraction

- Fat Fraction =  $\frac{\text{Amplitude}_{\text{fat}}}{\text{Amplitude}_{\text{fat}} + \text{Amplitude}_{\text{water}}}$
- Normally in the range of 10 – 16 %
- Maximum of 22 % for one volunteer
- The higher fat fraction reveals more fat components at TE = 30ms

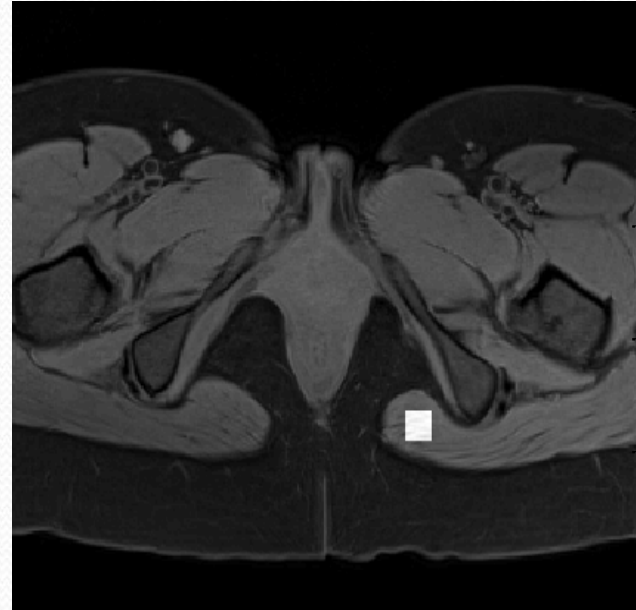


# VIBE Analysis

Voxel position copied from T2 image onto VIBE and analysed using custom code in MATLAB



**T2 TSE axial image**

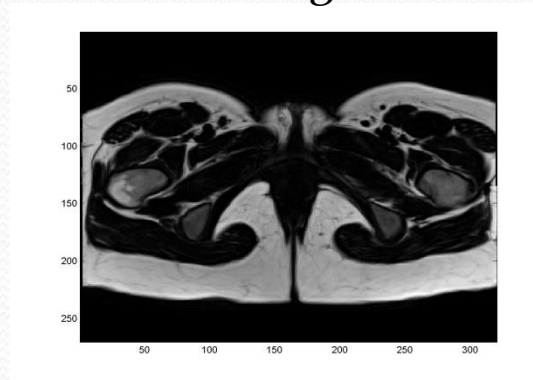


**VIBE image**

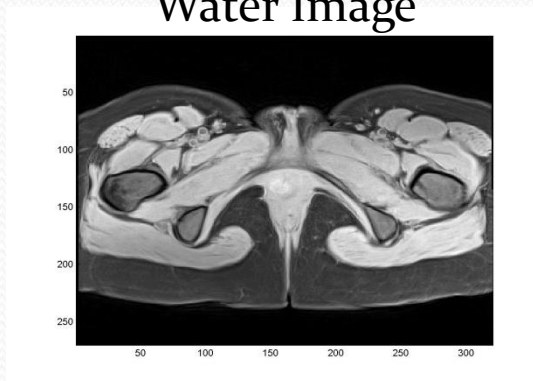


# Calculating the fat fraction

Fat Image

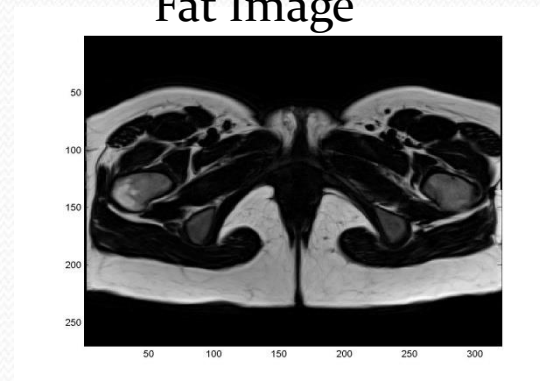


Water Image



+

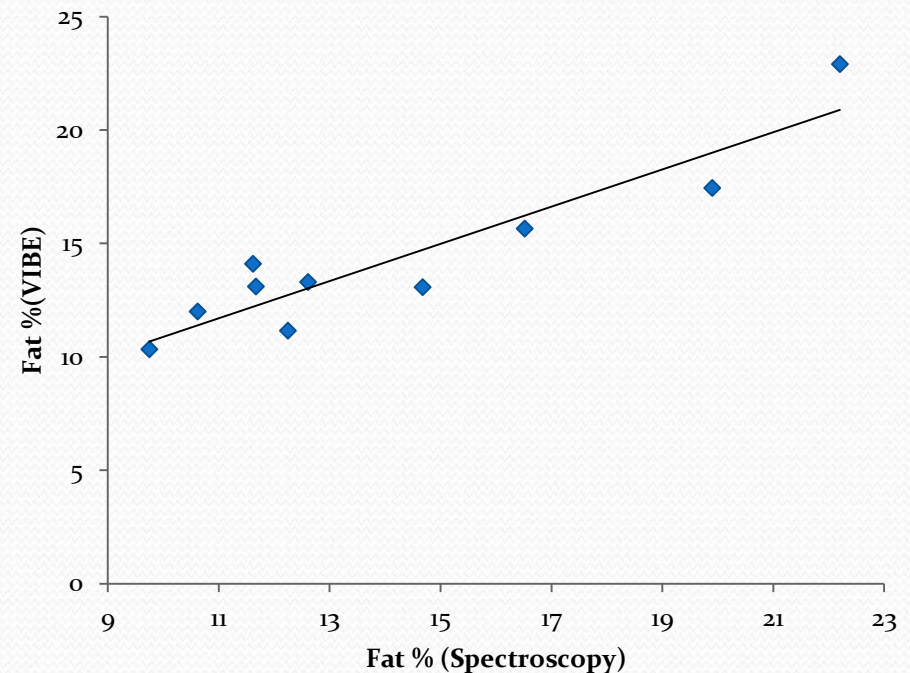
Fat Image





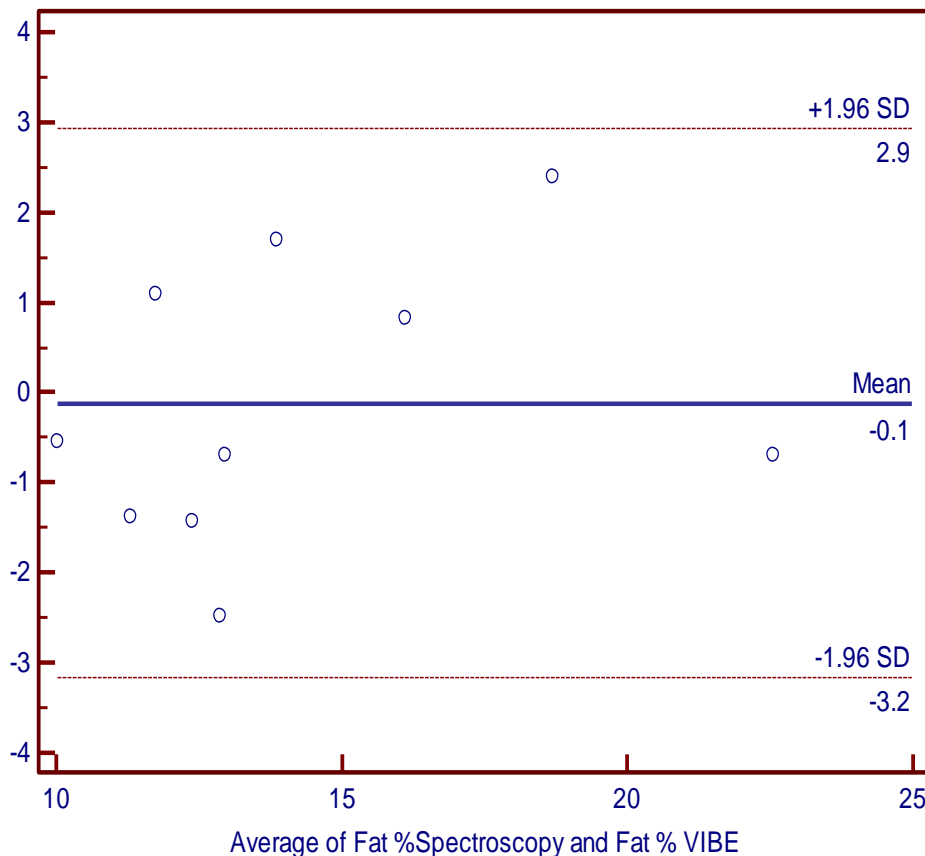
# Results(1)

- Mean Fat Fractions calculated for the 10 subjects using spectroscopy and 2D Dixon were 14.2% and 14.4 % respectively
- Linear Regression Analysis shows good correlation between the two methods ( $R^2 = 0.86$ )
- Paired t test showed no significant difference between fat % for MRS and VIBE(  $p=0.81$ )



# Results(2)

Bland Altman Plot shows good agreement between the two methods



Method A : Fat % Spectroscopy

Method B : Fat % VIBE

Differences:

Sample size	=	10
Arithmetic mean	=	-0.1210
95% CI	=	-1.2332 to 0.9912
Standard deviation	=	1.5547
Lower limit	=	-3.1682
95% CI	=	-5.1372 to -1.1993
Upper limit	=	2.9262
95% CI	=	0.9573 to 4.8952

# Conclusions and Future Directions

- The Dixon technique may be a possible alternative and a promising objective measure of pelvic muscle atrophy
- Useful for fat quantification in smaller muscles where spectroscopy is difficult to carry out
- Assessment of the spatial distribution of fat content
- Acquisition of more controls and two groups of patient data