View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Cronfa at Swansea University

Cronfa - Swansea University Open Access Repository

This is an author produced version of a paper published in:
Radiotherapy and Oncology

Cronfa URL for this paper:
http://cronfa.swan.ac.uk/Record/cronfa40427

Paper:
Portakal, Z., Shermer, S., Spezi, E., Perrett, T. & Phillips, J. (2017). EP-1711: Effect of Noise Floor Suppression on Diffusion Kurtosis for Prostate Brachytherapy. *Radiotherapy and Oncology, 123*, S938
http://dx.doi.org/10.1016/S0167-8140(17)32243-0

Released under the terms of a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC-BY-NC-ND).

This item is brought to you by Swansea University. Any person downloading material is agreeing to abide by the terms of the repository licence. Copies of full text items may be used or reproduced in any format or medium, without prior permission for personal research or study, educational or non-commercial purposes only. The copyright for any work remains with the original author unless otherwise specified. The full-text must not be sold in any format or medium without the formal permission of the copyright holder.

Permission for multiple reproductions should be obtained from the original author.

Authors are personally responsible for adhering to copyright and publisher restrictions when uploading content to the repository.

http://www.swansea.ac.uk/library/researchsupport/ris-support/

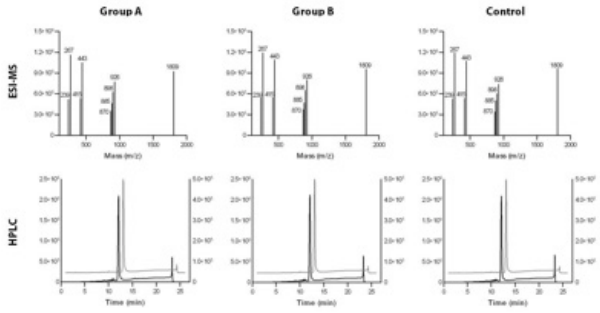

Figure 2. Characterization of BioXmark® markers from Group A (43F/67.4Gy), Group B (1F/155.4Gy) and Control group (non-irradiated) by ESI-MS and HPLC.**Conclusion**
The BioXmark®marker showed no chemical degradation after exposure to normofractionated and extremely hypofractionated proton therapy regimes and may serve as a good alternative to solid fiducial markers used for IGPT.

EP-1711 Effect of Noise Floor Suppression on Diffusion Kurtosis for Prostate Brachytherapy

Z.G. Portakal[1], S. Shermer[2], E. Spezi[3], T. Perrett[4], J. Phillips[5]
[1]*Cukurova University- Institute of Science and Arts, Physics, Adana, Turkey*
[2]*Swansea University- Collage of Science, Physics, Swansea, United Kingdom*
[3]*Cardiff University, School of Engineering, Cardiff, United Kingdom*
[4]*Velindre Cancer Centre, Physics, Cardiff, United Kingdom*
[5]*Swansea University- Collage of Medicine, Institute of Life Science, Swansea, United Kingdom*

Purpose or Objective
Diffusion-weighted magnetic resonance imaging (DW-MRI) and recently diffusion kurtosis imaging (DKI) can be used to characterise prostate tumours and improve the treatment. However, DKI is sensitive to the effects of signal noise due to strong diffusion weightings and higher order modeling of the diffusion weighted signal. The purpose of the study is to evaluate DKI data and the reliability of kurtosis estimates in the existence of noise floor suppression using different sequences and scanners for DW-MRI using gel phantoms with the aim of applying to prostate brachytherapy.
Material and Methods
Six plain agar gel phantoms and five agar gel phantoms containing various amounts of glass microspheres were prepared with a volume of 100 cm^3. Several DW-MRI protocols were tested on the two clinical systems (Optima MR450w 1.5T, GE Medical System, Waukesha, WI and Magnetom Skyra 3T, Siemens Healthcare, Erlangen, Germany) by applying 9 different diffusion weighting 'b values" between 0 and 4000 s/mm^2 in intervals of 500 are summarized in Table 1. Analysis of DKI was performed on a pixel-by-pixel basis in-house software (MATLAB).
Table 1. Imaging Protocols for DKI

	GE 1.5T	Siemens 3T	Siemens 3T	Siemens 3T
Sequence type	*SS SE EPI* Single-shot spin-echo echo planar imaging	*SS SE EPI* Single-shot spin-echo echo planar imaging	*SE ST* modified Stejskal-Tanner spin-echo	*SE ST* modified Stejskal-Tanner spin-echo
FOV (mm) Field of View	100	100	100	64
Matrix size	256 x 256	64 x 64	64 x 64	64 x 32
Slice thickness (mm)	20	10	20	10
TR/TE (ms) Repetition time/Echo time	5000/130	5000/130	3000/120	3000/120
Bandwidth (Hz/px)	1000	1000	130	130
N_A Number of averages	8	8	1	1
b-values (s/mm²)	9 b-values	9 b-values	9 b-values	9 b-values
T_A ***(min)*** Acquisition time	6.45	6.07	27.81	11.97
Coil	Birdcage	Spine, loop	Spine, loop	Spine, loop

Results
The variation of the apparent diffusion coefficient (ADC) of the gel phantoms with and without the microspheres showed the gels are appropriate to represent healthy and diseased tissues with the aim to applying to the prostate. The results show that we obtain similar values for the ADC in all cases but the values obtained for the kurtosis (K) differ substantially. We observe overestimation of kurtosis with the gels containing microspheres due to the noise floor fitting, especially for the conventional diffusion sequences with EPI readout. This is the result of rapid deterioration of signal and the image quality at high b-value for the EPI readout at both magnetic fields but mostly for 1.5T. As seen in figure 1, there is almost no signal after b = 3000 s/mm^2 for both manufacturers' diffusion product sequences but for modified SE ST scan protocol with FOV 100mm a signal can still be obtained even at b = 4000 s/mm^2.

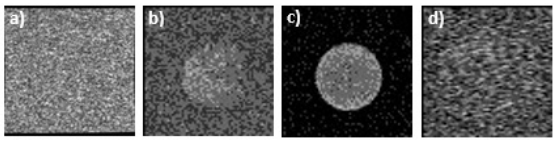

Figure 1. a)SS SE EPI at 1.5T, b)SS SE EPI at 3T, c)SE ST at 3T with FOV=100mm, d)SE ST at 3T with FOV=64mm
Conclusion
We demonstrated the effect of noise floor fitting on the estimation of kurtosis using gel phantoms for the assessment of isotropic diffusion kurtosis to investigate its use in the characterization of prostate cancer treated with brachytherapy. We have shown that the rectified noise floor, which exists in standard magnitude data, increases the systematic error of the diffusion coefficients ADC and K. To minimize the impact of noise floor in DKI, high b-values are needed, which appear to be difficult to access with the conventional EPI sequence. Although conventional readout is unfavorable compared to EPI in terms of acquisition times for single slice imaging, significant gains can be made for multi-slice imaging by interleaving the slices. Also, EPI requires multiple averages and lastly getting results fast is useless if they are not accurate.

EP-1712 Quantification of radiotherapy-induced mediastinum changes using serial CT imaging

C. Veiga[1], D. Landau[2], A. Devaraj[3], T. Doel[1], D. Hawkes[1], J.R. McClelland[1]
[1]*University College London, Centre for Medical Image Computing, London, United Kingdom*
[2]*King's College London, Guy's & St. Thomas' NHS Trust, London, United Kingdom*
[3]*Royal Brompton Hospital, Department of Radiology, London, United Kingdom*