Application of diffusion sensitising gradients to the MR pulse sequence allows water molecular displacement over distances of 1-20µ to be recognised and provides image contrast through measurement of the diffusion properties of water within tissues. The DW-MRI measurement relates to the mean path length travelled by protons within a specific observation time period (its ‘diffusion time’) as a result of thermally driven, random motion. Diffusion can be predominantly uni-directional (anisotropic) or not (isotropic). Combining images obtained with different amounts of diffusion weighting produces an apparent diffusion coefficient (ADC) map. The majority of DW-MRI performed clinically to date has focussed on the measurement of extracellular water where diffusion is hindered by structural interfaces. In a highly cellular tissue, cell membranes hinder diffusion and lead to a reduced ADC. Conversely, in cystic or necrotic portions of tumours with fewer structural barriers present, the longer diffusional path-length is associated with a higher ADC. ADC maps, derived from DW-MRI therefore provide a non-invasive measure of cellularity[1]. In terms of oncological imaging this has obvious potential for diagnosis, treatment planning and monitoring. In the pelvis, DW-MRI has been increasingly exploited to improve tumor detection and inform on prognosis and treatment response. Changes due to cell swelling and apoptosis are measurable as changes in ADC at an earlier stage than subsequent conventional radiological response indicators.

**Prostate Cancer** The extensive branching ductal structure of the normal prostate compared with the highly restricted intracellular and interstitial spaces encountered in prostate cancers produces a substantial differential in ADC and thus the potential for high image contrast. Addition of DW-MRI to conventional T2W imaging significantly improves sensitivity and specificity of tumor detection [2]. Also, the ADC values of malignant prostate nodules appear significantly lower than in non-malignant prostate tissue [3]. This has particular implications for identifying the 30% of cancers that arise within the central gland. Also, ADC values of high risk tumors (requiring treatment) are significantly lower than in low-risk tumors (managed by active surveillance)[4].

**Rectal Cancer** For detecting rectal cancer, single centre studies show that each of two readers achieved more accurate results with T2W combined with DW-MRI than with T2W imaging alone [5]. In patients with locally advanced rectal cancer, low mean pre-treatment tumour ADC predicts for a larger percentage size change of tumours after chemotherapy [6]. Also, adding DW-MRI to conventional MR imaging yields better diagnostic accuracy than use of conventional MR imaging alone in the evaluation of response to neoadjuvant chemoradiotherapy [7].

**Endometrial Cancer** ADC from benign and malignant endometrial lesions is significantly different [8;9] and using a cut-off of 1.15 x 10^-3 mm^2/s has given accuracies of up to 92% for detecting malignancy [8]. However, depiction of myometrial invasion is poorer than for DCE-MRI [9].

**Cervical Cancer** In early cervical cancer, patients are often referred following positive cone biopsies when distortion of the cervix, local haematoma or granulation tissue makes T2W image interpretation difficult. In these cases the ability to detect residual disease within the cervix is of paramount importance in planning further management, particularly if uterine conservation is desirable. DW-MRI used in conjunction with T2W imaging improves sensitivity and specificity of cancer detection in these cases because ADC values in cervical cancer are significantly different to those from non-malignant cervical epithelium or cervical intraepithelial neoplasia. Intraobserver reproducibility is also improved [10]. The role of DW-MRI as a response biomarker or in detecting recurrence in cervical cancer is not established.

**Ovarian Cancer** Transperitoneal dissemination is the main pathway of disease spread in ovarian cancer and documentation of disease extent determines the timing of surgery in relation to chemotherapy. Also, assessment of disease response is critical in planning chemotherapeutic regimens. The value of DW-MRI has been established in the qualitative delineation of peritoneal carcinomatosis [11] and site specific diffusivity profiles have been reported [12]. Early data is also indicating that an early increase in ADC may be useful as a biomarker of subsequent biochemical and RECIST response.

**Summary:** DW-MRI is showing great potential as a diagnostic tool as well as a predictive and a response biomarker in pelvic malignancy, although definitive validation studies and multicentre trials establishing its utility need to be performed.


