Endovaginal magnetic resonance imaging of Stage 1A/1B1 cervical cancer with a T2- and diffusion-weighted magnetic resonance technique: Effect of lesion size and previous cone biopsy on tumor detectability

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Introduction: Tumor detection within the cervix is dependent on T2-W contrast, with endovaginal imaging offering significant improvement in spatial resolution [1]. Often, the cone or large loop excision of the transformation zone (LLETZ) biopsy on which the diagnosis is made removes a large amount of the disease. The determination of residual disease is crucial in treatment planning: fertility sparing procedures demand a precise knowledge of the site and extent of any residual disease in order to ensure a curative and optimal surgical strategy. The use of diffusion-weighted imaging has potential to discriminate between tumor and granulation tissue in patients following cone biopsy [2]. The purpose of this study therefore was to evaluate the effect of previous cone biopsy and lesion size on the accuracy of detection of Stage 1a/1b1 cervical cancer using endovaginal T2- and diffusion-weighted magnetic resonance imaging.

Method: 113 patients with cervical tumor were imaged using an endovaginal coil with T2-W and diffusion-weighted single-shot echo-planar sequences; 85 (60 with prior cone biopsy/LLETZ) treated with extended cone biopsy /LLETZ (24), trachelectomy (29), hysterectomy (32) were evaluated. ADC maps and T2-W images viewed simultaneously were scored positive or negative for tumor and compared with histology at surgery. MRI tumor volumes (summed areas of regions of interest around lesion on each T2-W slice multiplied by slice thickness); maximum radiological and histological dimensions were recorded. ROC analysis was used to determine cut-off volumes for detecting tumor in those without and with prior cone biopsy/LLETZ and the maximum histological dimension correctly identifiable with MRI. Mean apparent diffusion coefficients (ADCs) calculated from tumor and adjacent normal epithelium were compared.

Results: T2-W and DW-MRI images in patients without (Figure 1) and with (Figure 2) previous cone biopsy are illustrated. Sensitivity and specificity for detecting tumor in those without and with prior cone biopsy/LLETZ (Table 1) were significantly different (p=0.001). Following cone biopsy/LLETZ, MRI tumor volume of 83 mm^3 detected tumor with 80% sensitivity, 94.7% specificity; a 5.3 mm maximal histological dimension was detected on MRI with 100% sensitivity, 100% specificity. Tumor ADCs were significantly lower (p=0.001) than paired normal epithelial tissue (median, 988×10^{-6} mm^2/s vs. 1564×10^{-6} mm^2/s) but neither tumor nor epithelial ADCs differed significantly between patients with or without prior cone biopsy/LLETZ (p=0.48 and 0.15, respectively, Figure 4).

	TP	TN	FP	FN	Sens %	Spec %	PPV %	NPV %
Cone (n=58)	16	31	7	4	80.0	81.6	69.6	88.6
No cone (n=27)	26	1	0	0	100	100	100	100

Table 1 Sensitivity, specificity, positive and negative predictive values for identifying invasive cervical carcinoma using T2-W and ADC maps in patients without or with previous cone biopsies.

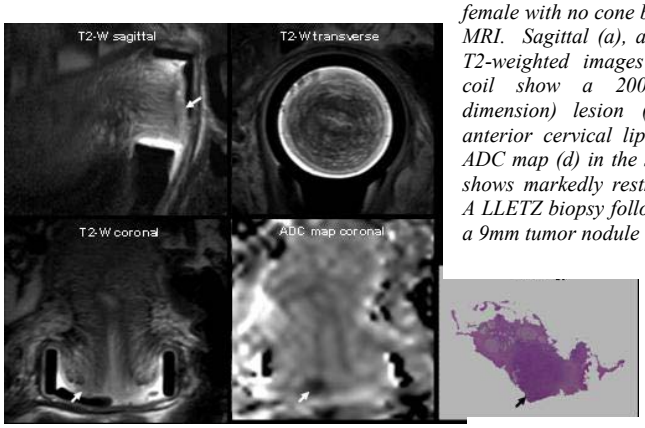

Figure 1 *Cervical cancer in a 28 year old female with no cone biopsy or LLETZ prior to MRI. Sagittal (a), axial (b) and coronal (c) T2-weighted images using an endovaginal coil show a 200mm³ (8mm maximum dimension) lesion (arrows) on the right anterior cervical lip which, on the coronal ADC map (d) in the same slice position as c, shows markedly restricted diffusion (arrow). A LLETZ biopsy following MRI (e) confirmed a 9mm tumor nodule (arrow).*

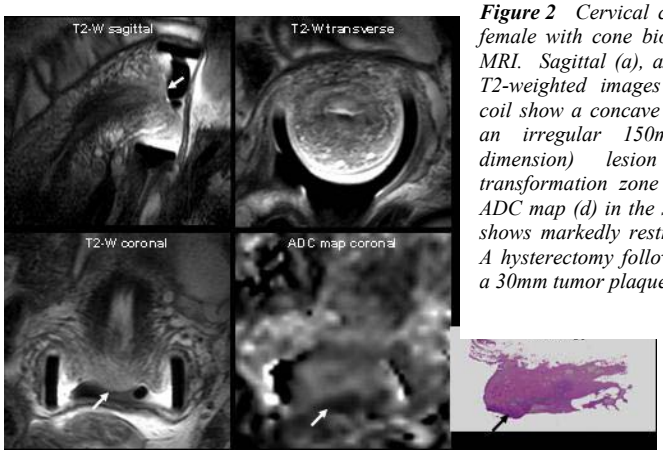

Figure 2 *Cervical cancer in a 38 year old female with cone biopsy or LLETZ prior to MRI. Sagittal (a), axial (b) and coronal (c) T2-weighted images using an endovaginal coil show a concave LLETZ defect in a with an irregular 150mm³ (17mm maximum dimension) lesion (arrows) at the transformation zone which, on the coronal ADC map (d) in the same slice position as c, shows markedly restricted diffusion (arrow). A hysterectomy following MRI (e) confirmed a 30mm tumor plaque (arrow).*

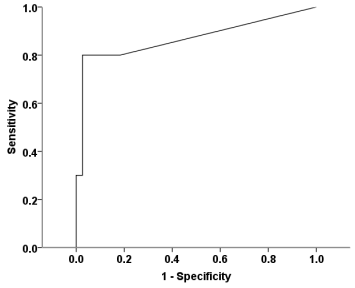

Figure 3 *ROC curve of tumor volume in patients who had cone biopsy/LLETZ prior to MRI. True and false positives identified using both T2- and diffusion-weighted endovaginal images give an area under the curve (A_z) of 0.87.*

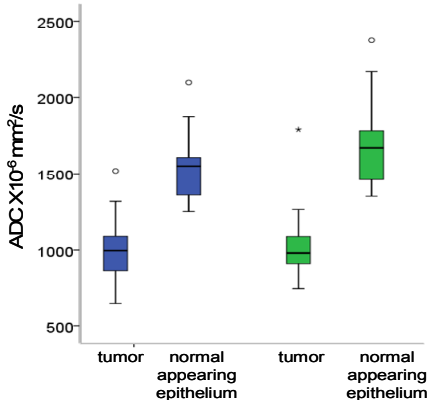

Figure 4 *ADC values of invasive cervical carcinoma and adjacent normal appearing epithelium in patients without (blue) and with (green) cone biopsy/LLETZ prior to endovaginal T2- and diffusion weighted MRI show significant differences between tumor and normal appearing epithelium in both groups. However, tumor values and normal appearing epithelial values are similar between groups.*

Discussion and Conclusion: A combination of T2-W with diffusion-weighted imaging using an endovaginal technique is invaluable for detecting small cervical cancers, prior to fertility sparing procedures although sensitivity and specificity are lower following a previous cone biopsy/LLETZ procedure. However, the size of tumors detected even post cone/LLETZ is of the order where fertility sparing surgery remains a major management option. This procedure remains to be evaluated in multicentre trials, but offers enormous potential in the pre-operative management of this group of patients.

References [1]deSouza NM *et al* Gynecol Oncol., 2006, 102; 80-85. [2] Charles-Edwards E *et al* Radiology 2008, 249; 541-550.

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