Accuracy of Longest Diameter Measurements of Ductal Carcinoma in Situ: a Comparison Study Between MRI and X-ray Mammography

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Introduction When diagnosed the current clinical management for ductal carcinoma in situ (DCIS) is surgical removal. However, this poses a challenge to the surgeon since in most cases DCIS is non-palpable and cannot be visual distinguished from normal breast tissue. Consequently, surgical guide wires are inserted under imaging control prior to surgery and the breast surgeon removes tissue based on the location of this wire and importantly the extent of disease provided by x-ray mammography. If histopathological examination reveals DCIS up to the surgical margin then the patient must undergo additional surgical procedures until a clear margin is evident. In the UK around 3000 cases of pure/micro invasive DCIS are reported annually. The Sloane project[1] reported a re-operation rate of ~30% for DCIS patients undergoing breast conserving surgery. Consequently, in the UK ~1000 patients annually are undergoing additional breast surgery. MRI is widely reported[2] to provide a superior estimate of disease extent than both x-ray mammography and US when imaging invasive disease. The aim of this study was to determine if MRI can more accurately report the extent of DCIS than x-ray mammography in a cohort of biopsy proven DCIS patients.

Methods Following biopsy proven diagnosis of pure/micro invasive DCIS participants were recruited into this study. Once consented patients underwent a 3.0T breast MR consisting of axial 3D T1W SPGR, axial DWI, 3D T1W VIBRANT acquired dynamically (1 pre and 7 post gadolinium injection phases) with a 60 second temporal resolution (voxel volume 1.07mm^3), high spatial resolution (voxel volume 0.30mm^3) post contrast T1W 3D VIBRANT. The hypothesis underpinning the protocol development was that high spatial resolution images, both dynamic and post contrast, would allow the detection of fine morphological details that would differentiate DCIS from normal breast parenchyma whilst still providing functional dynamic information. The MR reporting radiologist was blinded to the x-ray mammography images but could utilise all MR sequences in estimating the MR longest diameter (LD) measurement. Mammographic LD measurements of DCIS extent were recorded from the pre-biopsy x-ray mammography. DCIS LD measurements from both MR and x-ray mammography were compared to the histopathological 'gold standard' via the Bland Altman plot methodology[3]. Additionally, LD measurements were compared between the following clinically important categories: Grade (intermediate or high), growth pattern (cribriform, solid or mixed) oestrogen receptor status (negative or positive), progesterone receptor status (negative or positive), necrosis (present or absent), micro-invasion (present or absent).

Results LD measurements for both MR and x-ray mammography were available for 31 participants. Overall, both MR and x-ray mammography underestimated the extent of DCIS, however, MR demonstrated a greater agreement with histopathology measurements with a mean difference of -13.1mm (95% CI -21.7 to -4.4mm) as opposed to x-ray mammography, see Table I. Further, differences were noted for clinical categories grade and necrosis. Similar levels of accuracy were noted for MR LD for both intermediate and high grade DCIS. However, accuracy differed between intermediate and high grade DCIS for x-ray mammography measurements with intermediate grade lesions having a higher mean difference, see Table I. Similarly, there was a disparity in x-ray mammography accuracy between DCIS cases with and without necrosis, greater accuracy was noted for lesions with necrosis. Whereas accuracy did not seem to be related to necrosis status for MR, see Table I.

Category	Dichotomy	n	Mean difference	Mean lower 95% CI	Mean upper 95% CI
MRI	None	31	-13.1	-21.7	-4.4
XRM	None	31	-21.0	-34.4	-7.6
DCIS grade MRI	Intermediate	9	-19.0	-38.6	0.6
	High	22	-10.6	-20.8	-0.5
DCIS grade XRM	Intermediate	9	-41.2	-79.8	-2.7
	High	22	-12.7	-24.5	-0.9
Necrosis MRI	Non	11	-18.1	-35.6	-0.6
	Present	20	-10.3	-20.7	0.1
Necrosis XRM	Non	11	-41.1	-74.2	-8.0
	Present	20	-9.9	-20.0	0.2

Table I. Mean difference (mm) and 95% confidence intervals (mm) for various clinical categories.

Conclusions These results demonstrate that both x-ray mammography and MR underestimated the extent of DCIS. Nevertheless, MR estimates of LD were more accurate than x-ray mammography when compared to the histopathological 'gold standard'. Additionally, unlike x-ray mammography it appears that the accuracy of MR measurements of DCIS LD were less affected by certain histopathological features such as intermediate grade and necrosis. A lower grade and the absence of necrosis are in keeping with a less aggressive phenotype. The reduced level of accuracy noted for x-ray mammography for intermediate grade and non-necrotic lesion categories may indicate an inability for x-ray mammography to differentiate between normal breast parenchyma and less aggressive phenotypes accurately. Further, the results from this study appear to suggest that MR's ability to distinguish between normal breast tissue and less aggressive phenotypes is superior to x-ray mammography. However, a larger study would be necessary to confirm these results.

References [1]British Journal of Cancer (2010) 102, 285–293. [2]Magn Reson Imaging Clin N Am (2006) 14, 339–349. [3]Lancet (1986) 307-310.