



## Magnetic resonance imaging-guided navigation with a thermoplastic shell for breast-conserving surgery

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### Abstract

**Background:** The aim of this study was to evaluate the accuracy of a magnetic resonance imaging (MRI) marking technique with a drape-type thermoplastic shell for planning breast-conserving surgery (BCS).

**Methods:** A prospective review was performed on 35 consecutive patients who underwent MRI in the supine position and used the specified MRI marking technique. Eleven cases underwent pre-operative chemotherapy and 24 cases did not. After immobilizing the breast mound with a drape-type thermoplastic shell, patients underwent MRI, and the location of the lesion was marked on the shell. Resection lines were dyed blue by indigo carmine, which was pushed through the pores of the shell. Specimens obtained during BCS were sliced into 5-mm contiguous sections, and the margin was assessed for each specimen. Cancer foci less than 5 mm from the margin were classified as positive.

**Results:** Of 35 patients, 33 were included in the analysis; 2 were excluded due to a lack of effect of pre-operative chemotherapy. Of these 33 patients, 25 (75.8%) had negative margins and 7 (21.2%) had positive margins.

**Conclusions:** Our MRI marking technique may be useful for evaluating the extent of tumors that were determined by MRI alone. Long-term outcomes of this technique should be evaluated further.

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**Keywords:** Breast cancer; Preoperative marking; MRI; Image navigation; Preoperative chemotherapy

### Introduction

Accurate localization and techniques are needed to facilitate breast-conserving surgery (BCS). The number of impalpable, clinically occult breast lesions is increasing. Generally, image-guided wire markings are an important tool for planning surgical resection margins. The hooked wire (wire marking for breast-conserving surgical therapy) is the most commonly used technique and has proved very reliable, but is associated with several inherent problems.<sup>1</sup> The wire is deployed under ultrasound (US) or stereotactic techniques (for mammographic lesions only) within a rigid over-sheath cannula, which is removed once positioning is satisfactory. The more challenging surgical procedures involve wide local excisions for ductal carcinoma in situ

(DCIS) with no mass lesions. In such cases, in which the distribution of disease is difficult to determine, careful three-dimensional excision planning is necessary. Makita et al.<sup>2</sup> devised a new dye injection method with a drape-type thermoplastic shell under computed tomography (CT) navigation in 2004. This new method has advantages over the dye marking that is usually used under US in Japan, but the rates of positive surgical margins are high (50%).<sup>2</sup> The reason for such a high rate of positive margins may be because studies focused on patients with breast cancer with nipple discharge and used CT image navigation. After BCS of DCIS or invasive breast carcinoma with an extensive intraductal component, tumor-positive surgical margins are frequently found.<sup>3</sup> MRI is capable of detecting small foci of breast cancer that were previously only evident on detailed pathology evaluations. We developed a new dye injection method with a drape-type thermoplastic shell under MRI navigation to demarcate breast cancer for

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