Potential Usefulness of Multiple-Mammographic Views in Computer-Aided Diagnosis Scheme for Identifying Histological Classification of Clustered Microcalcification

Ryohei Nakayama[1], Ryoji Watanabe[2], Kiyoshi Namba[3], Koji Yamamoto[4], Kan Takeda[1], Shigehiko Katsuragawa[5], and Kunio Doi[6]

[1] Department of Radiology, Mie University School of Medicine, 2-174 Edobashi, Tsu,514-8507, Japan
{nakayama, takeda}@clin.medic.mie-u.ac.jp
[2] Hakuaikai Hospital, 1-28-25 Sasaoka, Fukuoka, 810-0034, Japan
watanabe@hakuaikai.or.jp
[3] Breastopia Namba Hospital, 2-112-1 Maruyama, Miyazaki, 800-0052, Japan
k-namba@breastopia.org
[4] Medical Informatics Section, Mie University School of Medicine, 2-174 Edobashi, Tsu, 514-8507, Japan
yamamoto@clin.medic.mie-u.ac.jp
[5] Department of Health Sciences, Kumamoto University School of Medicine, 4-24-1, Kuhonji, Kumamoto, 862-0976, Japan
katsur@hs.kumamoto-u.ac.jp
[6] Kurt Rossmann Laboratories for Radiologic Image Research, Department of Radiology, The University of Chicago, 5841 South Maryland Avenue, Chicago, Illinois 60637
k-doi@uchicago.edu

Abstract. The purpose of this study was to investigate the usefulness of multiple-view mammograms in the computerized scheme for identifying histological classifications. Our database consisted of mediolateral oblique (MLO) and craniocaudal (CC) magnification mammograms obtained from 77 patients, which included 14 invasive carcinomas, 17 noninvasive carcinomas of comedo type, 17 noninvasive carcinomas of noncomedo type, 14 mastopathies, and 15 fibroadenomas. Five features on clustered microcalcifications were determined from each of MLO and CC images by taking into account image features that experienced radiologists commonly use to identify histological classifications. Modified Bayes discriminant function (MBDF) was employed for distinguishing between histological classifications. For the input of MBDF, we used five or ten features obtained from MLO and/or CC images. With ten features, the classification accuracies for each histological classification ranged from 70.6% to 93.3%. This result was higher than that obtained with only five features either from MLO or CC images.

1 Introduction

It is difficult to make correct clinical decisions for biopsy or follow-up on clustered microcalcifications on mammograms. Therefore, many investigators have developed various computer-aided diagnosis (CAD) schemes for assisting radiologists in their

Susan M. Astley et al. (Eds.): IWDM 2006, LNCS 4046, pp. 229 – 236, 2006.

assessment of clustered microcalcifications. Most of these CAD schemes are based on the analysis of single-view standard mammograms.

Routine mammographic projections are mediolateral oblique (MLO) projection and craniocaudal (CC) projection. MLO image is the single most useful mammographic projection for the breast.[1] CC image is generally used for complementing MLO image. Two views can permit an appreciation of three dimensional structures which may be helpful in distinguishing overlapping structures when single-view mammogram is read. In this study, therefore, we investigated the usefulness of multiple-view mammograms in the CAD scheme for identifying histological classification of clustered microcalcification.

2 Materials and Methods

2.1 Database

Our database consisted of MLO and CC magnification mammograms obtained from 77 patients at the Breastopia Namba Hospital, Miyazaki, Japan. It included 48 malignant clustered microcalcifications (14 invasive carcinomas, 17 noninvasive carcinomas of the comedo type, and 17 noninvasive carcinomas of the noncomedo type) and 29 benign clustered microcalcifications (14 mastopathies and 15 fibroadenomas). The histological classifications of all clustered microcalcifications were proved by stereotaxic core needle biopsy.

The magnification mammograms were acquired with a Kodak MinR-2000/MinR-2000 screen/film system. The magnification factor of magnification mammograms was 1.8. The mammographic x-ray system included an x-ray tube with a 0.1 mm focal spot and a molybdenum anode, 0.03-mm-thick molybdenum filter, and a 5:1 reciprocating grid. These mammograms were digitized to a 512x512 matrix size with a 0.0275 mm pixel size and a 12-bit gray scale by the use of an EPSON ES-8000 digitizer.

2.2 Methods

The methods for the segmentation of microcalcifications, the determination of cluster margin and the extraction of five features are the same as those used in our previous study[2]. Therefore, we briefly describe them here.

2.2.1 Segmentation of Microcalcifications and Definition of Cluster Margin

For segmentation of individual microcalcifications within a cluster on mammograms, we first enhanced the microcalcifications by the use of a novel filter bank[3]. A gray-level thresholding technique[4] was then applied to the enhanced image. In order to segment all microcalcifications in our database, we used a 600-pixel value as a threshold value empirically. By using such a fixed threshold value, however, 12 breast tissues were also segmented as the candidates for microcalcifications. In this paper, we employed a manual method to remove these candidates which were not identified as a microcalcification by an experienced radiologist.