Performance of Three-Dimensional Sonoelastography in Prostate Cancer Detection: A Comparison Between ex vivo and in vivo Experiments

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Abstract—In this paper, we evaluate and compare the performance of three-dimensional (3D) sonoelastography for prostate cancer detection ex vivo and in vivo. Ultrasound (US) B-mode and sonoelastographic volumes were acquired from eleven prostate glands before and after radical prostatectomy. Semi-automatic algorithms were used to segment the surface of the gland from the US B-mode volume and the tumors from sonoelastographic data. To assess the detection performance, 3D sonoelastographic findings were compared in size and position to 3D histological data. One gland was discarded due to poor contact. In the remaining ten, both, in vivo and ex vivo sonoelastography showed similar performance in prostate cancer detection: over 80% accuracy for tumors larger than 4mm in estimated diameter. These results are an improvement over US B-mode but not yet sufficient to replace biopsy. However, 3D

II. METHODS

The ex vivo and in vivo studies involving human prostate glands presented in this paper were approved by the Institutional Review Board of the University of Rochester Medical Center and compliant with the Health Insurance Portability and Accountability Act. In all cases, it was verified that the patients were not treated with radiation or hormonal therapies which alter the gland stiffness and the amount of residual tumor.

A. In vivo experiments

Eleven patients underwent a TRUS examination the day

Axial histological cross-secti

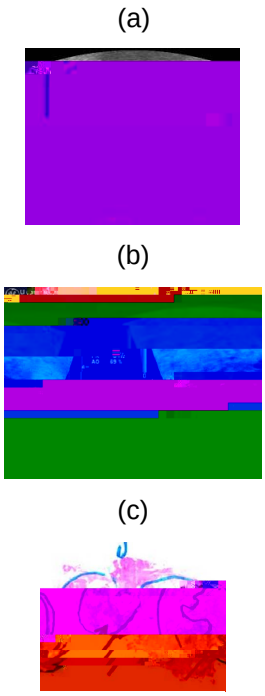

Figure 2. Corresponding (a) B-mode US image, (b) sonoelastographic image, and (c) histological image from an ex vivo prostate case. The sonoelastographic image depicts two deficits to the right and to the left of the gland (shown in red and yello arrows). These deficits correspond to BPH nodules and to a cancerous tumor.

Figure 3. Comparison between sonoelastographic volumes and histology for ex vivo (a) and in vivo (b) data. In both cases the deficit found by sonoelastography is shown in green, the tumor outlined in histology is shown in red, and the intersection of sonoelastography and histology is shown in white.

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