Abstract Title: Atlas-augmented ultrasound guidance of lumbar epidural needle insertions
Primary Author: Abtin Rasoulian MSs. - University of British Columbia
Additional Author(s):

Allaudin Kamani MD - British Columbia Women's Hospital and Health Centre
Purang Abolmaesumi PhD - University of British Columbia
Robert Rohling PhD - University of British Columbia

Background: There is increasing interest in ultrasound to guide epidural needle insertions. The interpretation of ultrasound can be difficult because of the presence of imaging artifacts and complexity of the ultrasound echoes from the spinal anatomy. In other image guided surgical interventions, pre-operative imaging, such as computed tomography, is available so that the fusion of pre-operative imaging with intra-operative ultrasound can aid ultrasound interpretation and guidance. For obstetric epidural anesthesia, only ultrasound imaging is normally available. The development of statistical computer-based anatomical atlases has the potential to provide the context for image interpretation.

Methods: We propose to augment 3D ultrasound images with a registered patient-specific atlas of the vertebrae. We instantiate and register the atlas to a spine surface extracted from the ultrasound images. Validation is performed on ultrasound data collected from tissue mimicking patient-specific phantoms of vertebrae L1 to L3 (n=3) and 3D ultrasound captured from single lumbar vertebrae of human subjects (n=3). The ultrasound images are captured in the transverse plane with the spinous processes centered in the image. 100 registrations were performed per vertebrae.

Results: The average alignment error achieved for individual vertebrae of the spine phantoms is 3.50 mm. Registration was successful in 74% of cases. The average distance error achieved for three human subjects is 3.27 mm. Registration was successful in 77% of cases.

Conclusions: The ultimate aim is to provide a guidance system that can guide the selection of an appropriate puncture site, trajectory of the needle towards the epidural space, and depth of needle insertion. This is particularly important in training, and is meant to augment the traditional loss of resistance technique.

Fusion of the patient-specific atlas with ultrasound images of the lumbar vertebra