Inter-operator Variability in Defining Uterine Position Using Three-dimensional Ultrasound Imaging - DTU Orbit (24/10/2018)

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In radiotherapy the treatment outcome of gynecological (GYN) cancer patients is crucially related to reproducibility of the actual uterine position. The purpose of this study is to evaluate the inter-operator variability in addressing uterine position using a novel 3-D ultrasound (US) system. The study is initiated by US-scanning of a uterine phantom (CIRS 404, Universal Medical, Norwood, USA) by seven experienced US operators. The phantom represents a female pelvic region, containing a uterus, bladder and rectal landmarks readily definable in the acquired US-scans. The organs are subjected to displacement by applied operator-pressure that mimics an actual GYN patient. The transabdominal scanning was performed using a 3D-US system (Clarity® Model 310C00, Elekta, Montreal, Canada). It consists of a US acquisition-station, workstation, and a 128- element 1D array curved probe. The iterated US-scans were performed in four subsequent sessions (totally 21 US-scans) in a period of four weeks to investigate the randomness of the inter-operator variability. An additionally US-scan was performed as a reference target volume to the consecutive scans. At first, the phantom was marked with ball bearings for daily laser alignment. In each session the US-scans were acquired by the seven operators. The uterus was outlined in each of the US imagesets using Clarity autosegmentation in the workstation. Further, the shifts in the uterine centre of mass relative to the reference were measured for the three orthogonal directions; left (+)-right (LR), anterior (+)-posterior (AP), and inferior (+)-superior (IS), respectively. The same operator delineated the target volumes. The average inter-operator deviation ±1SD of the daily US scans was (in mm); LR: day 1 (-0.4±0.9), day 2 (-0.3±0.6), day 3 (-1.0±1.2), day 4 (1.3±0.5); AP: day 1 (0.0±1.7), day 2 (0.1±0.7), day 3 (-1.0±0.9), day 4 (0.2±1.2); IS: day 1 (-1.5±2.6), day 2 (0.1±1.8), day 3 (0.1±1.1), day 4 (0.5±3.1), respectively. The largest inter-operator discordance was observed to be 4.7 mm in the IS-direction in day 4. Published studies report significantly larger inter-fractional uterine positional displacement, in some cases up to 20 mm, which outweighs the magnitude of current inter-operator variations. Thus, the current US-phantom-study suggests that the inter-operator variability in addressing uterine position is clinically irrelevant.

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