

Technical report for the upgrade of the visual guidance patient-controlled respiratory gating system for magnetic-resonance image-guided radiation therapy

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Purpose: This study aims to report the technical improvement of the visual guidance patient-controlled (VG-PC) respiratory gating system for magnetic-resonance image-guided radiation therapy (MR-IGRT). In addition, we also introduces a new web-based respiratory training program based on a commercial real-time respiration measurement device.

Materials and Methods: Due to the limitation of the projection angle between the beam projector and the screen (here in this configuration of the system, the screen is the upper side of the bore of the ViewRay system), the aspect ratio of the MR images became larger than the original MR images displayed in the control room. This large aspect ratio of images on the bore resulted in poor image quality so that the patients who had blurry vision often have difficult to discern the target drawings from the MR images. Therefore, we designed a screen holder attached to the patient couch to adjust the projection angle between the projector and screen. The MR images on the screen were magnified, which the patients can only focus on the movement of target drawings. In addition, we blocked the part of the projected beam so that the unnecessary information (i.e., parameters related to the treatment rather than the MR images) could not be shown in the screen. Furthermore, we developed the web-based respiratory training program based on a commercial respiration measurement device (Go Direct® Respiration Belt, Vernier). This program displayed real-time respiration signals via Bluetooth and showed the representative MR images with target drawings.

Results: The target drawings were clearly discriminated from the magnified MR images by using the screen holder. This technical improvement is expected to be helpful especially for the patients who have blurry vision. The training program was able to measure the real-time response from respiratory motion via Bluetooth. When the signal height was greater than a prefixed threshold, the MR images of ‘beam on’ was displayed. The MR images of ‘beam off’ was displayed when the measured signal was lower than the prefixed threshold.

Conclusions: The VG-PC respiratory gating system was technically improved in terms of the quality of MR images on the screen by using the screen holder attached to the patient couch. Furthermore, the web-based respiration training program was also successfully developed.

Keywords: Visual guidance, patient-controlled, respiratory gating system, magnetic-resonance image-guided radiation therapy