Purpose: Only bi-lateral fields are used for proton prostate treatment in current practice, often giving less favorable dose conformity and organ sparing than IMRT. Prostate treatment by anterior fields can utilize the sharp distal fall-off of the Bragg peaks to spare the rectum, but this will require an accurate pre-treatment "range check" for every fraction. We have developed and validated a range-guided proton therapy (RGPT) technique for such treatments.

Methods: Our technique utilizes the fact that in treatment by passively scattered beams, the time-resolved dose rate signal at a point in patients encodes the corresponding water-equivalent pathlenght (WEPL). A characteristic relationship between the r.m.s widths of signals and the corresponding WEPLs is calibrated and validated in a water tank. By measuring the signals at critical points with in-vivo dosimeters, the WEPLs to these points can be obtained. An anthropomorphic pelvic phantom with a rectal cavity and water-filled bladder was used in the study. Anterior treatment fields were planned using the CMS/XiO planning system. A detector array (6x3 cm) consisting of 16 diodes was placed directly below the anterior rectal wall supported by an endorectal water balloon. A range-check beam of 18 cm was first used, with the treatment hardware (aperture and compensator) in place, to verify the WEPLs to the detectors and hence the beam range for treatment. Finally the treatment beam with the corrected range was used to deliver the prescribed dose.

Results: The differences in WEPLs between the measured and those calculated by the planning system were <2 mm at points behind the prostate target volume. The dose used for the range verification was <1 cGy. Potential improvements in data acquisition and analysis could achieve millimeter accuracy.

Conclusions: Our study indicates that the RGPT technique is simple, effective and reliable for prostate treatment by anterior fields.