Purpose: To evaluate dosimetric effect of a rectal balloon and calculation accuracy due to dose perturbation by air cavities in the rectum, rectal wall doses with and without a rectal balloon were verified using rolled-up and -out techniques of radiochromic films in prostate cancer cases.

Methods: The prescribed dose of 74 Gy in 37 fractions was delivered to the 6 patients with similar sized-intact prostates using the same plan parameters and constraints in intensity-modulated radiation therapy. The rectum was contoured from the anus to the rectosigmoid flexure for all divided patient groups according to the rectal filling status. Calculated rectal wall doses were evaluated by the analytical anisotropic algorithm (AAA) and the pencil beam convolution (PBC) algorithm. The acrylic inserts dedicated to measure rectal wall doses were developed for simulating the 70 cc air-filled and the empty rectum. Rolled-up Gafchromic EBT2 films are closely placed in the interspaces film layer thick between 2 hollow cylinders and in the innermost inside of the rectal wall 4 mm thick and 4.5 mm in diameter.

Results: The AAA algorithm more accurately yielded perturbed doses near the air-tissue interfaces by describing anterior rectal wall sparing and higher doses at the posterior rectal wall than estimated values in PBC. Delivered doses on rolled-up films showed more than 93% gamma pass rate. Although the air-filled rectum achieved rectal wall sparing at the doses very close to the prescribed one, the rectal wall volumes received 70% or adjacent to the prescribed dose were increased.

Conclusion: Delivered rectal wall doses to the rolled-up films suggested that the AAA algorithm reflected more accurate dosimetric effect by the air cavity in the rectum. The rectal balloon can be useful to spare the small fraction of rectal volume where high doses reaching up to the prescribed level were delivered.