Radiotherapy and Oncology 88 (2008) 88–94
www.thegreenjournal.com

Randomised trial

A randomized comparison of interfraction and intrafraction prostate motion with and without abdominal compression

Tara Rosewall[a,b,*], Peter Chung[a,b], Andrew Bayley[a,b], Gina Lockwood[c] Hamideh Alasti[a,b], Robert Bristow[a,b], Vickie Kong[a], Michael Milosevic[a,b], Charles Catton[a,b]

[a]*Radiation Medicine Program, Princess Margaret Hospital, Toronto, Ont., Canada,* [b]*Department of Radiation Oncology, University of Toronto, Toronto, Canada,* [c]*Department of Biostatistics, Princess Margaret Hospital, Toronto, Ont., Canada*

Abstract

***Background and purpose*: To quantify inter- and intrafraction prostate motion in a standard VacLok (VL) immobilization device or in the BodyFix (BF) system incorporating a compression element which may reduce abdominal movement.**

***Materials and methods*: Thirty-two patients were randomly assigned to VL or BF. Interfraction prostate motion >3 mm was corrected pre-treatment. EPIs were taken daily at the start and end of the first and last treatment beams. Interfraction and intrafraction prostate motion were measured for centre of mass (COM) and individual markers.**

***Results*: There were no significant differences in interfraction ($p \geqslant 0.002$) or intrafraction ($p \geqslant 0.16$) prostate motion with or without abdominal compression. Median intrafraction motion was slightly smaller than interfraction motion in the AP (7.0 mm vs. 7.6 mm) and SI direction (3.2 mm vs. 4.7 mm). The final image captured the maximal intrafraction displacement in only 40% of fractions. Our PTV incorporated >95% of total prostate motion.**

***Conclusions*: Intrafraction motion became the major source of error during radiotherapy after online correction of interfraction prostate motion. The addition of 120 mbar abdominal compression to custom pelvic immobilization influenced neither interfraction nor intrafraction prostate motion.**
Crown copyright © 2008 Published by Elsevier Ireland Ltd. All rights reserved. Radiotherapy and Oncology 88 (2008) 88–94.

Keywords: Radiotherapy; Prostate cancer; Interfraction motion; Intrafraction motion; Abdominal compression

Interfraction prostate motion was first described by Ten Haken et al. [1] who demonstrated that prostate position varied in response to changes in bladder and rectal filling. Since then, interfraction prostate motion has been extensively studied and successfully incorporated into planning target volume margins [2]. Although interfraction errors have been reduced using image guidance and custom immobilization devices [3–5], motion of the prostate that occurs during a treatment fraction (intrafraction motion) is not reduced using these techniques and has proven difficult to quantify.

Various modalities have been employed to quantify intrafraction motion such as MRI [6–8], kV radiographs [9–12], MV portal imaging [13–15], trans-abdominal ultrasound [16–18] and electromagnetic tracking systems [19]. Some of these studies measured the range of intrafraction motion with only a small number of patients. Others monitored intrafraction motion continuously on a small number of occasions. Conversely, some studies monitored prostate position infrequently during the treatment fraction but during multiple fractions. Ideally, to describe the full range of intrafraction motion, the measurement should be obtained continuously during multiple treatment fractions for a large number of patients but this is often very resource-intensive.

Prostate intrafraction motion has also been related to changes in bladder and rectum filling [7] and diverse methods have been proposed to reduce its magnitude, such as anti-peristaltic medication [6], intra-rectal balloons [20], indwelling urinary catheters [21] and standardized bladder and rectal preparation [3]. Respiratory motion of the diaphragm has also been linked to intrafraction prostate motion [22,23]. This motion may be the result of cyclical changes in intra-abdominal pressure, and it is often visualized in planning CT scans as an intermittent shifting of the abdominal surface and organs (Fig. 1a). If intra-abdominal pressure can be stabilized through external compression, intrafraction prostate motion may also be reduced. Therefore, a randomized study to quantify interfraction and intrafraction prostate motion was undertaken to determine whether there is a difference between custom pelvic immo-

0167-8140/$ - see front matter Crown copyright © 2008 Published by Elsevier Ireland Ltd. All rights reserved. doi:10.1016/j.radonc.2008.01.019

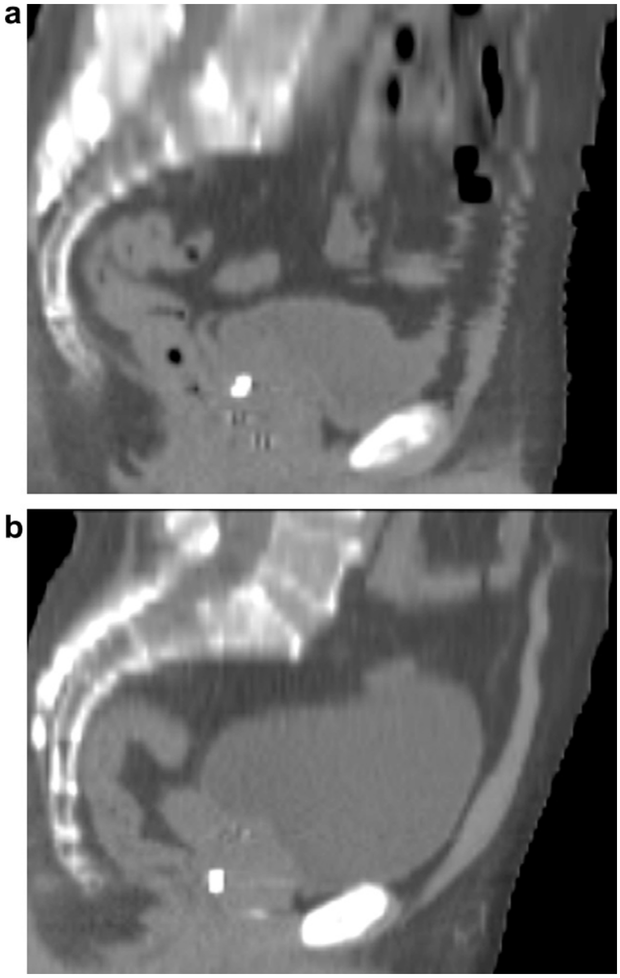

Fig. 1. Sagittal planning CT image with patient in VacLok (a) or BodyFix (b) device. Note the differences between the abdominal motion on the position of the anterior abdominal surface and musculature, and the anterior aspect of the bladder.

bilization with and without a component for anterior abdominal wall compression

Materials and methods

This research was a single centre study, with local research ethics board approval. All eligible patients were approached regarding entry into the study. These were men who had three intra-prostatic fiducial markers (IPFMs) inserted trans-rectally under ultrasound guidance as part of the standard pre-radiotherapy preparation (apex, base and posterior aspect of mid-gland). After providing informed consent, the patients were randomly assigned to either VacLok (VL) or BodyFix (BF) immobilization using the sealed envelope method to eliminate selection bias. All patients were planned and treated as allocated during randomization.

The VacLok® system (MedTec. Orange City, IA) was a cushion vacuum-formed from the iliac crest to mid-femur, with standard foam leg stocks abutting the inferior border of VL cushion. The BodyFix® system (Medical Intelligence. Schwabmünchen, Germany) was a cushion vacuum-formed from mid-thorax to below the feet. A thin polythene sheet was attached to three sides of the whole body cushion. During all radiotherapy appointments, Styrofoam bead pads were placed across the patient's abdomen, knees and ankles to distribute a vacuum pressure of 120 mbar between the patient's anterior surface and the polythene sheet. When the vacuum was applied, the polythene sheet exerted an even downward pressure, firmly holding the patient within the device (Fig. 2). In addition, the Styrofoam pad across the abdomen formed a rigid structure that restricted abdominal motion associated with respiration. This stabilized intra-abdominal pressure through external compression, confirmed by the lack of anterior abdominal wall or organ motion seen when using the BodyFix during the planning CT (Fig. 1b).

Fig. 2. Patient positioned in BodyFix system.

Patients presented for all radiotherapy appointments with an empty rectum and full bladder. Planned position CT images were obtained with the patient in the supine position, immobilized within the designated device. Daily radiotherapy was delivered using a 7-field conformal technique (gantry = 0°, 45°, 90°, 115°, 245°, 270°, 315°). Pretreatment correction was performed prior to each daily fraction by comparing the position of the IPFM in a digitally reconstructed radiograph (DRR) to their position in the corresponding portal image (EPI). Interfraction prostate motion of >3 mm from the planned position was corrected using manual translations of the treatment couch.

Quantifying prostate motion

In addition to the standard pre-treatment imaging required for setup correction (as described above), lateral ciné EPIs were taken using 18 MV and an amorphous silicon portal imager. These images were acquired every 4 MU during the right and left lateral treatment field delivery, on each fraction throughout the treatment course. This resulted in 26,880 study images.

Download English Version:

https://daneshyari.com/en/article/2160227

Download Persian Version:

https://daneshyari.com/article/2160227

Daneshyari.com