Clinical experience of real-time tracking with the RayPilot system in patients with prostate cancer

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Aim

To evaluate the intrafraction displacement of the prostate gland position using the RayPilot® system throughout the whole treatment course of clinical radiotherapy in patients with localized prostate cancer.

Conclusion

The extent and frequency of prostate intrafraction motion can be detected in real-time with the RayPilot tracking system throughout the EBRT treatment period up to 8 weeks.

Method

The electromagnetic positioning system, RayPilot® system (Micropos Medical, Göteborg, Sweden), was used for continuous monitoring during dose escalated external beam radiation therapy (EBRT) of prostate cancer. The system works as an add-on to existing linear accelerators and consists of a transmitter that is implanted in the region of interest, a receiving system which is placed on the treatment table and software (Fig. 1).

In this study the transmitter was implanted together with fiducial markers via perineum in the prostate for 10 patients. The intrafraction motion of the prostate gland was tracked during the whole treatment course of 39 fractions. The vertical (vrt), longitudinal (lng) and lateral (lat) position displacements were sampled simultaneously with the angle displacements, pitch (rotation about lateral axis) and yaw (rotation about vertical axis).

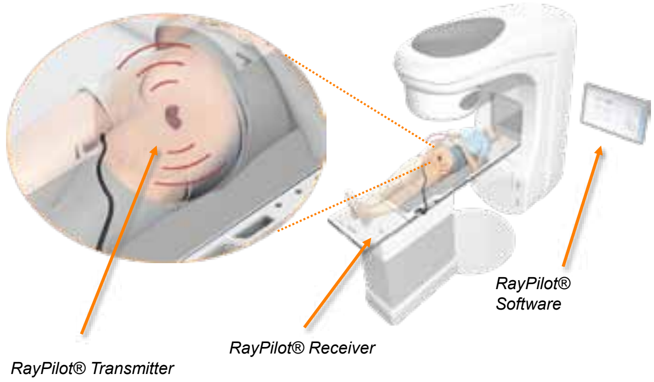

Fig 1. Illustration of the RayPilot® system

Results and Discussion

Real-time tracking demonstrated unpredictable prostate motion patterns in several patients, ranging from a persistent drift to transient rapid motion. For one representative patient, rapid motion was observed in 5 fractions out of 39 mainly in vrt (5-12mm), lng (3-5mm) and pitch (10-25°). The motion lasted for 10-30 s with a remaining shift in vrt (1-5mm), lng (2-3mm) and pitch (3-13°). Example of such a rapid movement during one fraction is illustrated in Fig. 2. The overall motion during the other fractions for this patient was within 4mm and the variation in pitch angle was within 7° . In most cases, a rapid motion in vrt and lng was combined with a rapid motion in pitch.

The variability in both drift and rapid motion observed between different fractions and individual patients highlights the potential advantage of monitoring prostate movement during radiation delivery. The use of real-time tracking systems is of particular importance in hypofractionated treatments. Fewer fractions with higher dose per fraction increase the importance of the accuracy of the prostate gland positioning. Furthermore, with conventional treatment techniques the treatment time per fraction increases and thereby the probability of intrafractional movement of the prostate gland.

The stability of the transmitter position in relation to fiducial markers and the tolerability including implantation, explantation and patient experience will be further investigated in an ongoing clinical study.

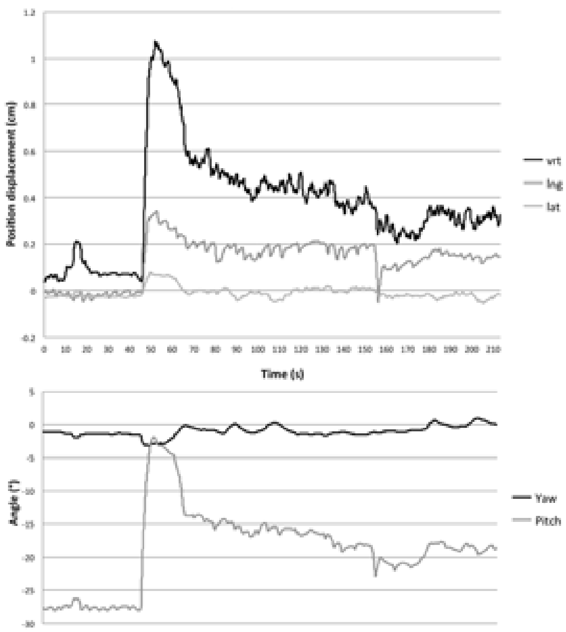

Fig 2. In-vivo prostate movement during a treatment session

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