Stochastic Pattern of Motion In the Prostate

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Introduction

The Micropos 4DRT is an electromagnetic positioning system being developed to provide accurate, precise, objective, and continuous target localization throughout the course of clinical radiotherapy. Here we present the first *in vivo* test of continous system tracking capability with the goal of evaluating possible patterns of motion in prostate movement.

Aim of Study

To evaluate *in vivo* the real-time prostate target localization functionality of the Micropos 4DRT system.

Materials & Methods

The Micropos Medical 4 dimensional (4D) localization system was recently used in a pilot *in vivo* technical feasibility study (ref. 1). An electromagnetic positioning marker was temporarily inserted in the prostatic urethra (Fig.1B) of 13 patients scheduled to recieve external radiotherapy for localized prostate cancer. A receiving sensor plate (antennae system) was placed at a known position in the treatment tabletop (Fig.1A). After initial system calibrations were performed, 10 patients were included in a descriptive feasibility study that compared radiographic transponder location to radiotransponder location. In this study, transponder position was determined with a 3-D resolution (±SD) of 1.7mm (as compared to 2 orthogonal 2-D radiographic positioning). In addition to simultaneous acquisition of Micropos system data and orthogonal X-ray images, continous positioning data was recorded during a 10-20 minute study session in the last 5 patients.

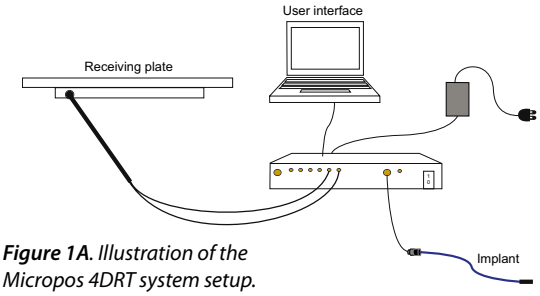


Figure 1A. *Illustration of the Micropos 4DRT system setup.*

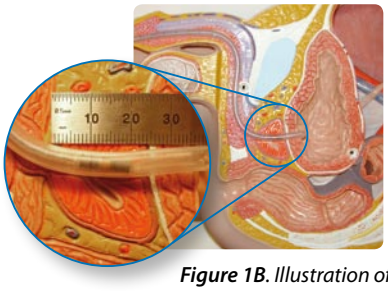


Figure 1B. *Illustration of transponder positioning in the prostatic urethra by use of a dilation catheter.*

Results

Continuous monitoring of transponder motion using the Micropos system was successfully performed in all study patients for a time period of ten to twenty minutes. All study patients displayed movements of the target (range 1 – 15 mm). Real-time tracking demonstrated unpredictable transponder motion patterns in several patients, ranging from a persistent drift to transient rapid motion in the range of 0-15mm. Examples of transponder motion pattern recorded in two separate sessions are given (pat #9 and #10) in figure 2.

Figure 2A. *in vivo target movement during 16 min*

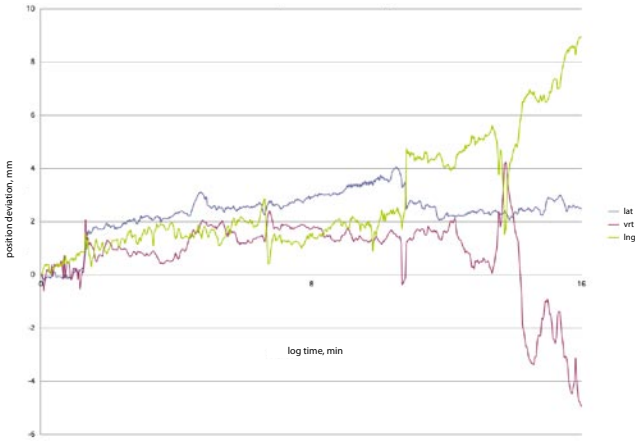
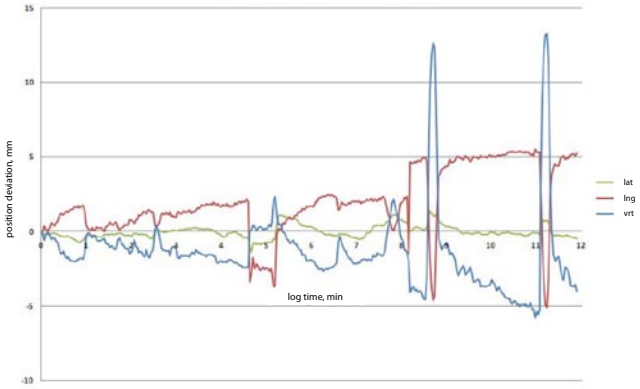


Figure 2B. *in vivo target movement during 12 min*



Conclusions

- *The Micropos 4DRT positioning system demonstrates real-time tracking functionality in vivo.*
- *Prostate target motion is of a stochastic nature and individual patients could display significant target displacement during treatment sessions.*

References: *1. High precision transponder localization using a novel electromagnetic positioning system in patients with localized prostate cancer. Kindblom J. et al. Accepted for publication, Radiotherapy & Oncology August 17 2008*