

Prostatic swelling and shift of intra-prostatic target during HIFU: Implication for targeted focal therapy

S. Shoji¹, T. Uchida², N. Masahiko¹, A. Abreu¹, S. Leslie¹, Y. Sato³, I. Gill¹, O. Ukimura¹

¹ USC Institute of Urology, Keck School of Medicine, University of Southern California, Los Angeles, USA

² Department of Urology, Tokai University Hachioji Hospital, Hachioji, Japan

³ Department of Radiology, Osaka University Graduate School of Medicine, Suita, Japan

Introduction: Prostatic swelling during high-intensity focused ultrasound (HIFU) during whole gland therapy can be intra-operatively observed, but has not been quantitatively documented. The objective of our study is to quantify (a) intra-operative swelling of the prostate and (b) shift of intra-prostatic targeted points during HIFU.

Methods: Forty patients with clinically localized prostate cancer (without neoadjuvant hormonal therapy or transurethral resection) underwent whole gland HIFU (Sonablate 500[®], version 4 or TCM, Focus Surgery, IN, USA). Whole gland HIFU consisted of 3 consecutive treatment sessions to focus initially on the anterior zone, followed by the middle zone, and finally on the posterior zone of the prostate. Three-dimensional (3D) models of the prostate were reconstructed from the routinely acquired 3-mm step-sectional images of the intra-operative transrectal ultrasound (TRUS) before and after each of the treatment sessions. The 3D models were compared to identify changes in prostate volume and any positional change of identical intra-prostatic calcifications.

Results: Mean prostate volume increased from 30 ml to 36 ml (20% increase) during the anterior zone treatment ($p < 0.001$), from 40 ml to 41 ml (2.5% increase) during the middle zone treatment ($p = 0.027$), and from 41 ml to 43 ml (5% increase) during the posterior zone treatment ($p < 0.001$). The volume of the transition zone (TZ) during the anterior zone treatment significantly increased from 16 ml to 20 ml (25% increase) ($p < 0.001$), while the peripheral zone (PZ) did not change during the posterior zone treatment ($p = 0.5$). The mean shift of the identical targeting point measured 3.6 mm in TZ ($n = 88$), and 4.1 mm in PZ ($n = 102$) ($p = 0.2$).

Conclusions: Significant intra-operative swellings of the prostate and definitive shifts of the intra-prostatic points were observed during HIFU. This suggests a need for intra-operative adjustment of the treatment plan during energy-based targeted ablative treatment of the prostate such as focal HIFU therapy.

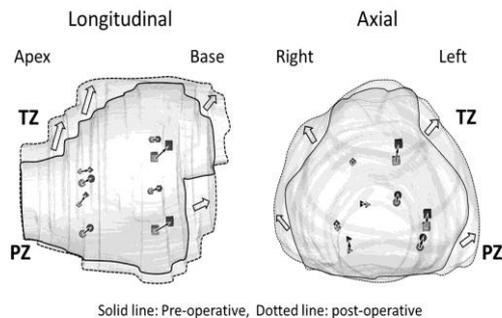


Figure : Change in prostate volume (\Rightarrow) and vector (distance and direction) shifts of the identical target (\rightarrow).