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DOES THE URETHRAL ANGLE CHANGE WITH LEG POSITION? IMPLICATIONS FOR URETHRAL-BASED CT-PLANNED TRANSPERINEAL PROSTATE IMPLANTS

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Purpose: CT based treatment planning for transperineal prostate implants allows for angulation of transperineal needles to avoid the pubic bones by changing the template angle. It requires fluoroscopic guidance and utilizes identification of the urethra by radiopaque markers inside the Foley catheter at the time of the implant. The needle trajectory is relative to the urethral angle as visualized by lateral fluoroscopic views. Patients who have a treatment planning CT in preparation for a transperineal prostate implant are typically scanned in the leg-down/straight position. However, the implant is done in the lithotomy position and changes in the template angle to adapt to the new urethral angle are often required. We have evaluated the relationship between leg position and the position of the prostatic urethra to predict the change in the planned template angle.

Material and Methods: To duplicate the lithotomy position a custom designed foot holder was constructed that attached to a flatbed CT scanner. A Foley catheter was inserted with radio-opaque contrast placed in the balloon. Bladder contrast was also utilized. A catheter with 1 cm spaced dummy seeds was placed inside the Foley catheter. A radio-opaque catheter was inserted into the rectum. Fifteen patients had pre-implant scans performed in the leg-down/straight and lithotomy position. The prostate, urethra, bladder and rectum were contoured utilizing a 3D-brachytherapy software system and analyzed.

Results: Fourteen of the patients (93%) had changes in urethral angle when evaluated in the lithotomy relative to the led-down/straight position. The mean angle change was - 9.8 degrees (Std. Error 1.47 degrees; $p < 0.0001$) when in the lithotomy position. The changes were not correlated with prostatic volume or clinical stage. All patients who had urethral angle changes would have required adjustments in the template angle.

Conclusions: 1) The objective of treatment planning for prostate implants is to accurately define the target and surrounding normal structures. 2) Leg position significantly affects the prostatic urethral angle. 3) We have constructed a device that can be attached to the CT table and holds the legs in a position comparable to that in the operating room. 4) Current work is underway to evaluate whether planning in the lithotomy position results in better reproducibility in setup at the time of implant in the operating room.

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AN ARTIFICIAL-VISION RESPONSIVE TO PATIENT MOTIONS DURING COMPUTER CONTROLLED RADIATION THERAPY

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Purpose/Objectives: Automated precision radiotherapy using multiple conformal and modulated beams, requires monitoring of patient movements during irradiation. Immobilizers relying on patient cooperating in cradles have somewhat reduced positional uncertainties, but others including breathing are largely unknown. We built an artificial vision (AV) device for real-time vision of patient movements, their tracking and quantification.

Method and Materials: The Artificial Vision System's "acuity" and "reflex" were evaluated in terms of imaged skin spatial resolutions and temporal dispersions measured using a mannequin and a fiduciated harmonic oscillator placed at 100cm isocenter. The device traced skin motion even in poorly lighted rooms without use of explicit skin fiduciation, or using standard radiotherapy skin tatoos.

Results: The AV system tracked human skin at vision rates approaching 30Hz and sensitivity of 2mm. It successfully identified and tracked independent skin marks, either natural tattoos or artificial fiducials. Three alert levels triggered when patient movement exceeded preset displacements (2mm/30Hz), motion velocities (5m/sec) or acceleration ($2m/sec^2$).

Conclusion: The AV system trigger should suit for patient ventilatory gating and safety interlocking of treatment accelerators, in order to modulate, interrupt, or abort radiation during dynamic therapy