IMPROVEMENTS IN PATIENT SETUP AND TREATMENT EFFICIENCY ADVANCES USING SGRT

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DISCLOSURES

• I have nothing to disclose.

OVERVIEW

• Implementing SGRT to decrease setup errors
• Implementing SGRT to decrease setup time
• Advancements in treatment efficiency
• Reduced imaging frequency
• Increased throughput
• Real-time motion management
• Volume change evaluation
TRADITIONAL SETUP TECHNIQUES

- Visual based Clinical Setups
- Permanent or non-permanent subcutaneous marks
- X-Ray Orthogonal imaging
- Volumetric Imaging
- Gold standard

SGRT COMPLEMENTS TRADITIONAL TECHNIQUES

- Increased temporal visualization
- X-ray based = Snapshots in time
- Decreased initial errors
- Movement verification
- Reimage thresholds
- Automatic readjustment
- Ability to quantify movements

SGRT serves as the link that correlates the initial imaging throughout the course of treatment.

CAN SGRT DECREASE INITIAL SETUP ERRORS?

- Historically, the process of positioning a patient prior to imaging verification used a set of permanent patient marks, or tattoos, placed subcutaneously.
- Surface-based imaging systems
    - Alternative method of verifying initial positioning
    - Utilizes entire skin surface
    - Non-ionizing
    - Non-invasive
    - Increased clinical efficiency
PROBLEMS WITH SUBCUTANEOUS TATTOOS

- Body habitus changes
- Localized radiation induced swelling/shrinking
- Time difference between placing of marks and treatment
- Psychological impact of permanent marks
- Pediatrics
  - Breast
  - H&N
- Ink Allergies
- Religious Preferences


Over a 24 month period
- 6000 individual fractions were analyzed
- 60–900 Fxs Per Site Per Method
  - Pelvis/lower extremities
  - Abdomen
  - Chest/Upper extremities
  - Breast


SGRT VS SUBCUTANEOUS TATTOOS

DECREASE IN INITIAL SETUP SHIFTS

Average magnitudes of the post-CBCT 3D shift vectors and the standard deviations both techniques are listed in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Three Point Localization</th>
<th>Surface Imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelvis/lower extremities</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Abdomen</td>
<td>1.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Chest/Upper extremities</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Breast</td>
<td>1.4</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Statistically significant differences (p<0.01) in the post-CBCT 3D shift vectors were found for all four sites.

Sample size of 6000 individual fractions (>600 per site per method) over a 24 month span.
DECREASE IN OVERALL TREATMENT TIME

• Proton postmastectomy chest wall patients
• SGRT vs traditional orthogonal xrays
• ~50% decrease setup time

Batin et Al. PRO V6I6 2016

• 16,835 treatments
• MVCT with Tomotherapy vs SGRT
• SGRT has significantly lower setup deviation as compared to in-room lasers based setup.
• Reduction of ~5-10 min of imaging and total time across all sites

Surface guided tomotherapy reduces treatment time: A retrospective analysis of 16,835 treatments

DECREASE IN OVERALL TREATMENT TIME

MOVEMENT VERIFICATION

• Intrafractional isocenter variation during DIBH
• Bony anatomy alignment
• Differences observed in isocenter location due to respiration and breast motion

Kuegle et Al. DOI: 10.1002/acm2.12214
MOVEMENT VERIFICATION FOR DIBH

• Intrafractional isocenter variation during DIBH
• Stable bony anatomy ≠ stable isocenter in DIBH
• Unadjusted movement resulted in large dosimetric effects, primarily for the OARs
• Failure to account for respiratory motion and breast motion resulted in statistically significant OAR dose increases
• Movement due to inspiration and needs continuous monitoring

Kuegle et Al. DOI: 10.1002/acm2.12214

IMPROVEMENTS IN TREATMENT EFFICIENCY WITH SGRT

• Reduced imaging frequency
• Reduced immobilization
• Increased throughput
• Realtime motion management
• Volume change evaluation

Conventional Setup
• Initial Setup: 5–15 min
• Rotational posture correction: 3–10 min
• Sets of images acquired: ~1–5
• ~65% > 1 session
• Trips into room for adjustment: 1–4
• Total Treatment time: 30–55 min

Surface Imaging
• Initial positioning: 1–3 min
• Posture correction: 1–5 min
• Imaging sessions: 1–2
• 95% verification images < 5mm threshold
• Total Treatment time: 15–25 min

*Based on clinical data prior to and after implementation of a SGRT system

REDUCED IMAGING FREQUENCY AND INCREASED THROUGHPUT
REAL-TIME MOTION MANAGEMENT
• Quantification and visualization of patient motion
• Anticipation of patient movement
• Real-time positional feedback for patients*

VOLUME CHANGE EVALUATION
• Visual indication of volume change
• Offline evaluation of percent reduction
• Establishment of resimulation thresholds
• Quantification of follow-up anatomical changes

CONCLUSIONS
• SGRT has been shown to improve accuracy and decrease setup uncertainties and time
• Implementation of SGRT has shown an improvement in overall treatment time
• SGRT offers the ability to evaluate and quantify unique clinical aspects not previously achievable

*Current abstract from T Chiu et Al