

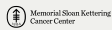


Surface Imaging for Treatment Verification

7/17/2019
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Outline

- Surface imaging for IGRT
- Main clinical applications
 - Patient setup
 - Breast DIBH
 - Intracranial SRS
- Emerging applications
- Summary



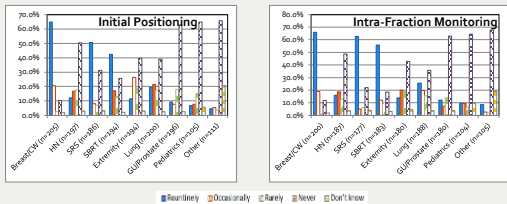
Surface image-guided RT (SIGRT)



- Non-invasive and non-ionizing
- Compares the acquired image with a reference image
- Provides surface motion information – not necessarily tumor motion information.



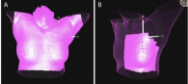
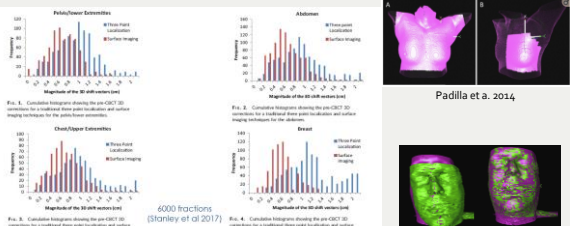
Current use of SGIRT in the United States



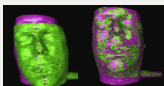
PO-GePV-P-82: A Survey of Surface Imaging Use in Radiation Oncology in the United States. Padilla et al.



General Setup



Padilla et al. 2014



Gopan and Wu, 2012

Courtesy of Hania al-Hallaq

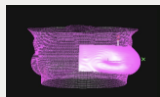


Tattoo-less radiotherapy for breast

The tiny tattoos that mark thousands of cancer patients

They also remain long after the cancer has endured, sometimes stretching and spreading

Psychosocial Impacts of Radiotherapy
A Critical Review
Barbara Clow, Janet Allen



EP-2338 To Evaluate the Accuracy of Delivering Breast Radiotherapy without Tattoos.
J. Risley¹, P. Robertson¹
¹Genesis Care Nottingham, Radiotherapy, Nottingham, United Kingdom

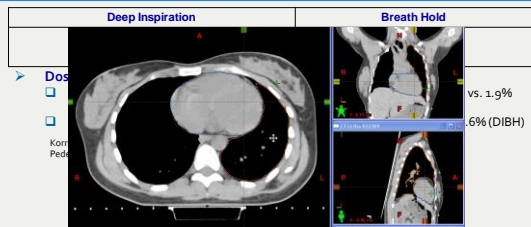
Notts woman the first in Europe to have tattoo-less radiotherapy for breast cancer

The treatment usually involves dots being tattooed onto the body, which can have lasting psychological effects on patients

OC-0190 Surface guided radiation therapy for breast cancer improves accuracy without the need for skin marks
C. Russell¹, H. Mack¹, S. Paul¹, S. Senthil¹
¹The Alfred, Alfred Health Radiation Oncology, Melbourne, Victoria, Australia



Deep inspiration breath hold (DIBH)

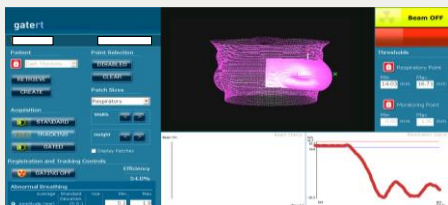


DIBH: Free breathing (FB)+ breath hold at ~100% vital capacity
Courtesy of Catheryn Yashar

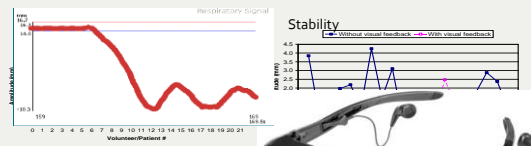


Gated treatment at DIBH with surface imaging

- Treat only when patient is at DIBH



Effect of visual feedback



Reproducibility and stability improve with

Using surface imaging and visual coaching to improve the reproducibility of radiotherapy, LI Cervino, S Gupta, MA Rose, C Yashar, SB Jiang, PMB



Surface-guided SRS

- Open mask immobilization
- Very large dose to brain lesions
 - Single (or hypo-) fraction schemes
- One or multiple lesions
- → Accuracy is crucial
 - Set up (<1mm)
 - Treatment delivery (<1mm, ± 5%)



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Local control and OS in brain metastasis

Study	Treatment system	Patients, n	Crude LC, %	Actuarial 1-yr LC, %	Actuarial 1-yr OS, %
Schomas et al. (19) [2009]	Frame-based LINAC	80	91	89	33
Bhatnagar et al. (18) [2009]	Frame-based Gamma Knife	205	***	71	37 ^a
Bleeker et al. (6) [2009]	Frameless LINAC	53	***	80	44
Nash et al. (7) [2010]	Frameless LINAC	65	89	79	40
Pan et al. (17) [2012]	Frameless, surface-imaging guided LINAC	44	90	79	38
Present series	Frameless, surface-imaging guided LINAC	183	85	79	56

- Local control and overall survival were comparable to previous techniques

Pan, H., Cervino, L. L., Pawlicki, T., Jiang, S. B., Allsne, J., Detorie, N., Russell, M., Carter, B., Murphy, K., Mundt, A. J., Chen, C., Lawson, J. D. (2012). Frameless, real-time, surface imaging-guided radiosurgery: Clinical outcomes for brain metastases. *Neurosurgery*, 73(4), 844-852.

Pham, N. L. L., Reddy, P. V., Murphy, J. D., Sanghvi, P., Hattangadi-Gluth, J. A., Kim, G. G. Y., Cervino, L., Pawlicki, T. and Murphy, K. T., "Frameless, real-time, surface imaging-guided radiosurgery: update on clinical outcomes for brain metastases." *Translational Cancer Research* 3, 4 (2014): 351-357.

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Trigeminal Neuralgia

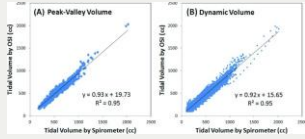
Table 1 Patient characteristics and treatment results

Patient	Age at treatment	Dose (Gy/fraction)	Pre-treat BNI score	Post-treat BNI score	Time to pain recurrence (months)	Length of follow up (months)
1	37	90/1	V	II	-	16
2	82	90/1	V	I	-	28
3	79	85/1	V	II	-	20
4	29	85/1	V	II	-	54
5	82	90/1	IV	I	-	51
6	82	90/1	V	I	52	56
7	81	90/1	IV	I	31	31

Initial clinical experience with surface image guided (SIG) radiosurgery for trigeminal neuralgia
 Anthony J. Paravati, Ryan Manger, Jasmine D. Nguyen, Sofia Olivares, Gwe-Ya Kim, Kevin T. Murphy

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Emerging: Surface imaging for respiratory surrogate



Li G, et al. Characterization of optical-surface-imaging-based spirometry for respiratory surrogating in radiotherapy. Med Phys 2016;43 (3):1348-1360.



Emerging: Safety - Collision prediction

Collision prediction software for radiotherapy treatments

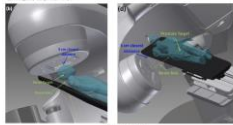
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Madrid, Spain 28002, Spain
Charles A. Pellizzari³
Department of Radiation and Cellular Oncology, The University of Chicago, Chicago, Illinois 60637



Padilla, Pearson, Pellizzari 2015

The development and verification of a highly accurate collision prediction model for automated noncoplanar plan delivery

Victoria Y. Yu, Angela Yuen, Dan Nguyen, Minsong Cao, Dan Pisan, Daniel A. Lee, and Shi Donghai



Yu et al 2015



Emerging: Patient safety - Facial recognition

- Facial recognition system created with Kinect using its facial mapping library; 35 points extracted from 4 poses
- Sensitivity = 96.5%/ Specificity = 96.7%; algorithm affected glasses, scarves, and hair covering the face

- 2016 National Patient Safety Goals requires a minimum of two patient identifiers



Silverstein et al 2017

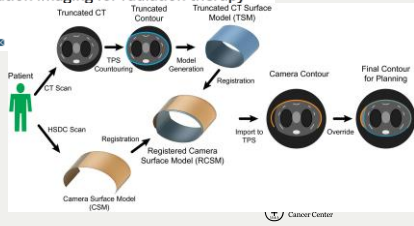
Courtesy of Hania al-Hallaq



Emerging: Limited field-of-view in CT

Using a handheld stereo depth camera to overcome limited field-of-view in simulation imaging for radiation therapy treatment planning

Cesare Jenkins, Lei Xing, Amy Yu



Green – original
Magenta – truncated
Navy – reconstructed

Comparable dose distribution

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Summary

- SGRT's use has increased in the last decade
 - Breast & DIBH, SRS mostly
- SGRT has proven to improve accuracy and efficiency of treatment for a variety of treatment sites
- Changes the patient setup paradigm
 - Can remove the need for tattoos and need for lasers (eg. breast)
- New applications are starting to emerge, including patient safety applications

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Thank you!

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