MAYO CLINIC

SURFACE IMAGE MONITORING FOR AUTOMATED STEREOTACTIC RADIOSURGERY TREATMENT

EFFICIENCY, ACCURACY, AND PATIENT COMFORT

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SGRT
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FINANCIAL DISCLOSURES

- None, beyond my travel costs being paid to get here

SURFACE GUIDANCE AND SRS

- Many centers have been performing SRS treatments utilizing surface guidance
- AAPM report of Task Group 302 lists frameless SRS as one of three items within its scope and one of the reasons Task Group 147 had fallen behind only a few years after its publication in 2012

AAPM task group report 302: Surface-guided radiotherapy

Hania A Al-Hallaq [1], Laura Cerviño [2], Alonso N Gutierrez [3], Amanda Havnen-Smith [4], Susan A Higgins [5], Malin Kügele [6 7], Laura Padilla [8], Todd Pawlicki [8], Nicholas Remmes [9], Koren Smith [10], Xiaoli Tang [11], Wolfgang A Tomé [12]

SURFACE GUIDANCE AND SRS

- Example of recent publications on HyperArc and Surface Guidance
- 981 fractions (819 analyzed) over 14 months
- Median motion from start to finish was 0.24 mm and 0.55mm at non-zero couch angles
- Median magnitudes below 1 mm
- They also concluded it was a viable alternative for replacing mid treatment imaging with X-rays

Surface guided imaging during stereotactic radiosurgery with automated delivery

Elizabeth L Covington [1], Dennis N Stanley [1], John B Fiveash [1], Evan M Thomas [1], Samuel R Marcrom [1], Marcus Bredel [1], Christopher D Willey [1], Kristen O Riley [2], Richard A Popple [1]

BACKGROUND

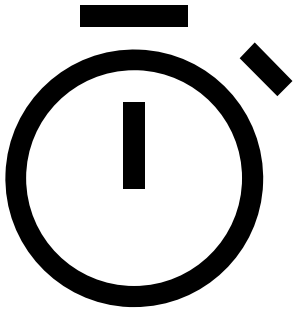
- Mayo Clinic Arizona has been performing frameless SRS since 2012 and frameless fractionated cases (SRT) since 2007
  - Thermoplastic mask
  - ExacTrac Imaging
- Varian released HyperArc circa 2017, but with several caveats to implementation
- In 2020 Mayo Clinic Arizona now met the prerequisites to HyperArc Implementation and commissioned the system
- Based on the experiences of U.A.B. and U.C.S.D., our physics group suggested using the full automation available with H.A. and SG monitoring
- During the clinical implementation and workflow discussion in late 2020 the physician group raised concerns about not using ExacTrac in the HyperArc setting

BACKGROUND CONT.

- A proposed compromise was reached, and a QA study initiated
  - Additional imaging would be taken during the HyperArc workflow
  - VisionRT surface monitoring would be added to the workflow (details later)
  - The information received from SGRT and IGRT would be compared for correlation (accuracy)
  - If the SGRT system was adequately sensitive, the additional imaging would be removed to improve the total time of the workflow (efficiency)
  - As a result, patients lay on the treatment table for less time (comfort)

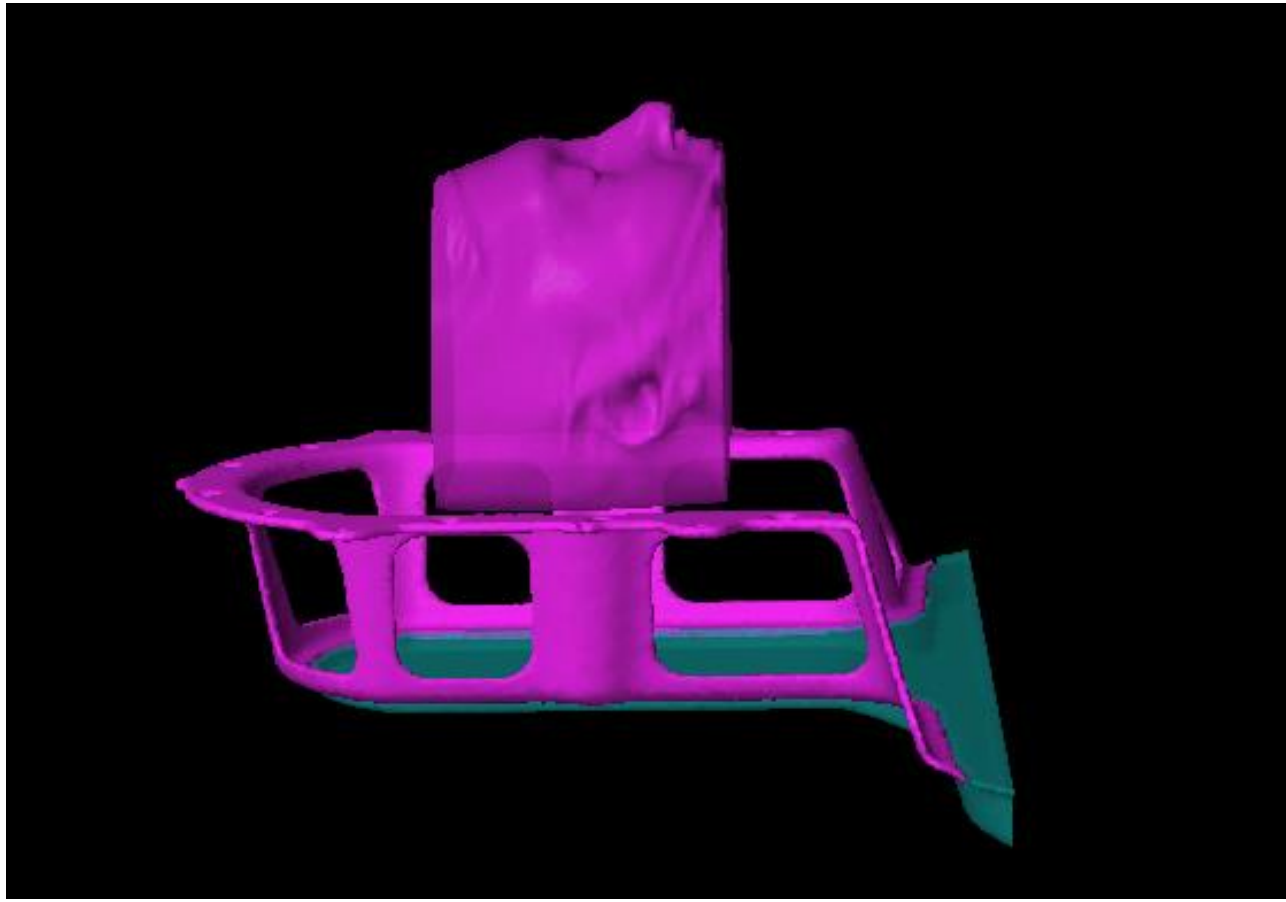
EFFICIENCY AND COMFORT SIDENOTE

- Random sampling of 10 patient each
  - Times quoted from finish of CBCT to finish of last treatment beam
  - Excludes a couple of patients where the workflow was interrupted
- HyperArc plans plus SGRT
  - Range 5 to 13 minutes
  - Average 7.4 minutes
- Comparable VMAT plans without automation + ExacTrac
  - Range 9 to 27 minutes
  - Average 16.2 minutes
- Approximately 9 less minutes on a hard flat couch top!



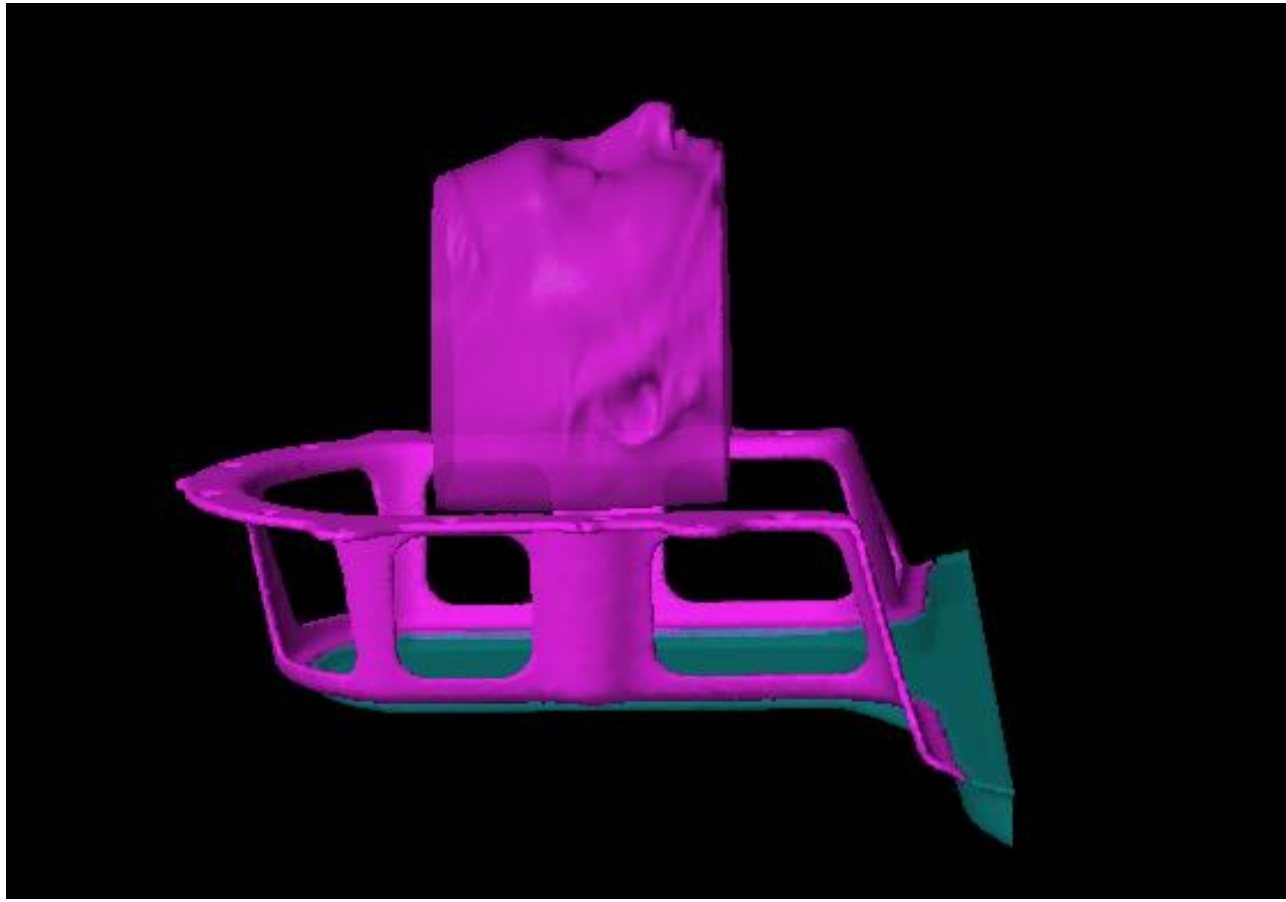
HOW SGRT WAS USED PART 1

1. HyperArc utilizes an open-faced mask from Q-Fix
2. A high-resolution structure is made in the TPS (zBodyVRT)
3. Surface guidance was used for initial patient setup within the mask
4. The HyperArc workflow starts with CBCT based image guidance
5. After IGRT, a surface is captured as reference for the remainder of the treatment



HOW SGRT WAS USED PART 2

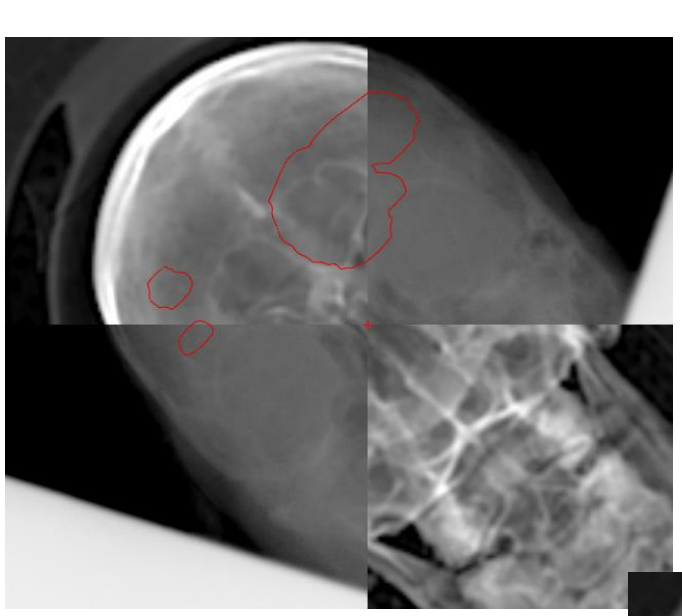
5. Tolerances were set to 0.1cm in the X,Y,Z directions
6. Magnitude of 0.15 cm and angle of 1 degree
7. Auto Beam-hold disabled*

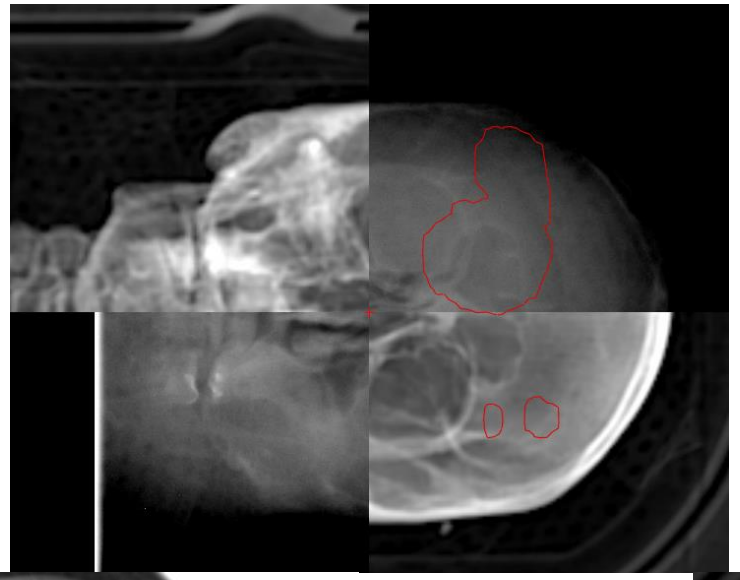


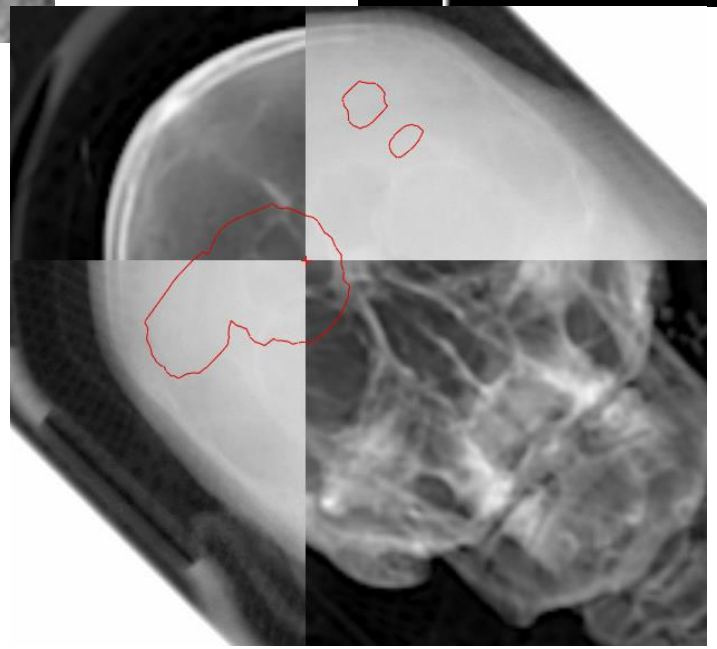
STUDY INFORMATION

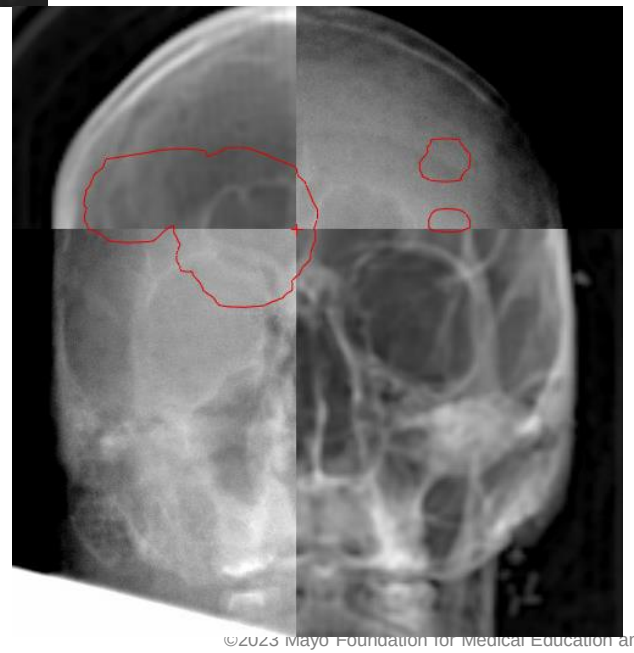
- 24 Patients treated within this period
  - 1 to 5 Fractions per patient
  - No additional restrictions on # of targets
  - 46 Total fractions
- 184 MV images were acquired
  - All images were assessed “live”
  - Additional measurements made after treatment to attempt to measure any deviations that surface monitoring could have missed

SAMPLE IMAGES









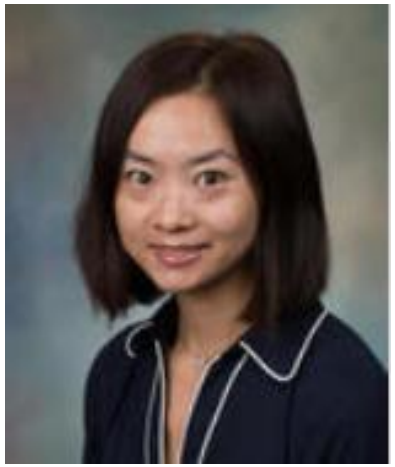
RESULTS

- No MV images were measured off by more than 1mm, same as the surface monitoring
  - No false negatives detected
- Independent of the MV images, 2 patients did have surface deviations detected
  - Per our protocol, patient returned to Couch angle 0 and new CBCT acquired
  - In both cases, VRT alerts were confirmed as True Positives
  - IGRT is performed on the new CBCT and treatment resumes

DISCUSSION

- These results were adequate for us to remove additional IGRT during treatment and replace it with SGRT monitoring
- Additional changes to our workflow were implemented to better support SGRT
  - “Sterile Cockpit” concept was introduced
    - No talking during procedure, beam on to beam off
    - Control room has additional privacy (curtain on door)
  - Not even the imaging begins until the entire team is present
  - We increased the frequency of MV isocenter calibrations to be a standard part of our monthly QA, not “as needed”

ACKNOWLEDGEMENTS



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QUESTIONS & ANSWERS