Geometric Evaluation of Intrafraction Motion during Frameless Intracranial Stereotactic Radiosurgery (SRS)
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Objective

To quantify intrafraction motion during frameless intracranial SRS using the six-degree-of-freedom stereoscopic x-ray imaging system.
Methods

• Patient immobilization
  – Orfit mask system
    • Orfit Industries, Wijnegem, Belgium
• Frameless positioning was based on online 6DOF stereoscopic x-ray (ExacTrac) imaging
• Subsequent online volumetric image guidance (CBCT)
  – Residual error assessment
• At least one mid-treatment ExacTrac acquisition was performed for motion assessment.
Methods

• Intrafraction motion definition
  – The difference between the patient’s position at the time of pre-treatment ExacTrac and at the time of re-assessment

  – Action level was 1 mm
Results

- A cohort of 180 sequential patients
- In total, 350 intrafraction ExacTrac image sets were evaluated
  - Mode 1
  - Range 1-3
Results

The box plot shows the distribution of displacement (mm) or rotation (°) across different directions:

- Vert (Vertical)
- Long (Longitudinal)
- Lat (Lateral)
- Vert/Yaw
- Long/Roll
- Lat/Pitch

The plot indicates variability in the data with outliers marked by asterisks (*) and the median represented by a horizontal line in the box.
Results (Summary)

• Frequency of absolute motion in any direction
  – >1 mm, 33%
  – >1.5 mm, 15%
  – >2 mm, 5%

• Frequency of 3D vector motion
  – >1 mm, 48%
  – >1.5 mm, 25%
  – >2 mm, 10%
Conclusion

- Intrafraction motion during frameless SRS delivery is typically small, albeit non-negligible.
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- While motion along one or more room axes and 3D motion vectors >2 mm were observed no more than 10% of times, this finding may provide a rationale for development of planning target volume margins.
Conclusion

• Intrafraction motion during frameless SRS delivery is typically small, albeit non-negligible

• While motion along one or more room axes and 3D motion vectors >2 mm were observed no more than 10% of times, this finding may provide a rationale for development of planning target volume margins

• Frequent intra-treatment positioning assessment can significantly contribute to the precision of frameless intracranial SRS
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