Effects on Patient Positioning: Using Precise Bite for Head & Neck

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Challenges of Head & Neck Radiotherapy

- High dose gradients + closely spaced critical structures
- Large target volume
- Many degrees of freedom
- Treat on 3D couch

→ Immobilization is critical ←
Precise Bite reduces motion?

- Limit head rotation, flexion/extension?
Methods

- Patient characteristics
  - Post-surgery
  - Bilateral disease
- Radiotherapy
  - 6000-7000 cGy
  - 200 cGy per fraction $\rightarrow$ 30-35 fxs
- Immobilization device
  - 5-point thermoplastic mask
  - With OR without Precise Bite
Daily 2D-2D manual matching
Daily 2D-2D manual matching

No PB

PB
Methods (cont.)

• Quantify changes in patient position
  • Interfraction motion
  • Intrafraction motion

• Two sites
  • Bony anatomy near isocenter
  • Embedded gold fiducial markers
    • Dental carriers
    • Precise Bite
Margins to define the PTV from the CTV

- Recommended margins (van Herk 2004 SRO)
  - Margin = \(2.5\sigma + 0.7\int\)
    - \(\sigma\) = SD of Systematic Error
    - \(\int\) = RMS of SD\(_{SysErr}\) (Random Error)
- Ensure 90% of patients receive at least 95% Rx dose
For example...

<table>
<thead>
<tr>
<th>Fiducials</th>
<th>S/I</th>
<th>R/L</th>
<th>A/P</th>
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<tr>
<td>Σ, SD of Syst Error</td>
<td>1.0</td>
<td>1.1</td>
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<tr>
<td>σ, Random error</td>
<td>1.2</td>
<td>1.8</td>
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<td>Margin</td>
<td>3.3</td>
<td>4.1</td>
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Bar chart showing margin (mm) with PostTx near mouth.

- S/I
- R/L
- A/P

PostTx near mouth

PB
No PB: Setup uncertainty is location dependent

PreTx near iso

PostTx near iso

PreTx near mouth

PostTx near mouth

Distance (mm)

S/I  R/L  A/P

S/I  R/L  A/P

S/I  R/L  A/P

S/I  R/L  A/P

No PB
PB: Positioning near mouth improves

PreTx near iso

PostTx near iso

PreTx near mouth

PostTx near mouth
PB improves setup precision near PB

**PreTx near iso**
- No PB: S/I, R/L, A/P
- PB: S/I, R/L, A/P

**PreTx near mouth**
- No PB: S/I, R/L, A/P
- PB: S/I, R/L, A/P

**PostTx near isocenter**
- No PB: S/I, R/L, A/P
- PB: S/I, R/L, A/P

**PostTx near mouth**
- No PB: S/I, R/L, A/P
- PB: S/I, R/L, A/P
Results

• On average, Precise Bite has minimal effect on intrafraction motion

Bone (iso): 2.3 ± 0.2 mm  
Seeds (mouth): 2.1 ± 0.3 mm

Bone (iso): 1.9 ± 0.1 mm  
Seeds (mouth): 2.0 ± 0.4 mm
Conclusions

- Effects of Precise Bite:
  - No noticeable effect at isocenter
  - Improved positioning precision near PB
  - Does not appear to affect intrafraction motion
Acknowledgements

- R.L. Foote, MD
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- D.H. Pafundi, PhD
- S.M. Lacey, PhD
- J.A. Antolak, PhD
- D.H. Brinkmann, PhD
## Prelim Findings: Adaptive Proton Planning

### CTV 70 PTV 3mm

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**IMRT plan CTV 70 coverage**

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Preferred plans for Adaptive seems to be inverse of preferred for base plan.

Slide from Chris Beltran