DBP: Head and Neck Cancer

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Head & neck cancer: Statistics

- Between 4-6% of all new cancer cases
- About 60,000 new cases per year
- 60% present with advanced disease
- 5 year survival: 57%
- Multimodal treatment
Head & neck cancer sites

Image credit: American Cancer Society (www.cancer.org)
Proton therapy

15MV Photons vs SOBP Protons

Relative Depth Dose [%]

Depth [cm]
Rationale for adaptive radiotherapy
Proton therapy in the news...

**THE WALL STREET JOURNAL.**
Costly Cancer Therapy Dinged
Proton-Beam Treatment for Prostate Tumors No Better Than Radiation, Study Says

**CBS NEWS**
IMRT is best radiation for early prostate cancer, study finds

**npr**
Pricey Prostate Cancer Therapy Raises Questions About Safety, Cost
## Protons for sinonasal cancers

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose</th>
<th>Local Control</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D Protons</td>
<td>71.6 Gy</td>
<td>88% @ 6.6 yrs</td>
<td>Chan 2004</td>
</tr>
<tr>
<td></td>
<td>65 Gy</td>
<td>77% @ 1 yr</td>
<td>Zenda 2011</td>
</tr>
<tr>
<td>IMRT</td>
<td>63 Gy</td>
<td>62% @ 5 yrs</td>
<td>Hoppe 2006</td>
</tr>
<tr>
<td></td>
<td>66 Gy</td>
<td>64% @ 2 yrs</td>
<td>Wiegner 2012</td>
</tr>
</tbody>
</table>
Findings during 2012

- Hot & cold spots in tumor

- 3 Gy
- 5 Gy
Patching

50%

90%

100%
Patching

Pre-treatment

Mid-treatment
Progressive change

% Change in Tumor Volume

Treatment Fraction

$r = 0.75$
$p = 10^{-3}$
Change in parotids

Pre-treatment

Mid-treatment
Progressive change

$r = 0.53$
$p = 0.088$
Plan for year 4

- Hybrid registration
- Atlas-based segmentation
- DICOM-RT improvements
- DIR validation suite
- Dissemination and training
## Hybrid registration

<table>
<thead>
<tr>
<th>Problem Type</th>
<th>3D Slicer Module</th>
<th>Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully Automatic</td>
<td>BRAINS, plastimatch, HAMMER, ...</td>
<td>B-Spline, demons, etc.</td>
</tr>
<tr>
<td>Hybrid</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Fully Manual</td>
<td>LANDWARP</td>
<td>Thin-plate spline, Wendland spline, Gaussian spline</td>
</tr>
</tbody>
</table>
Hybrid registration

\[
\text{Cost} = \text{image metric} + \lambda \text{ landmark metric} + \rho \text{ regularization metric}
\]
Atlas-based segmentation

Peroni, Politecnico di Milano, 2012
Arbisser, MIT, 2012
## Atlas-based segmentation

<table>
<thead>
<tr>
<th>Structure</th>
<th>Overlap %</th>
<th>Overlap % (from literature)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandible</td>
<td>86 (±4)</td>
<td>85-90 [X. Han et al., 2008]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>78±6 [R. Sims et al., 2009]</td>
</tr>
<tr>
<td>Spinal cord</td>
<td>81 (±10)</td>
<td>70-80 [X. Han et al., 2008]</td>
</tr>
<tr>
<td>Left optical nerve</td>
<td>52 (±11)</td>
<td>50±17 [M. A. Deeley et al., 2011]</td>
</tr>
<tr>
<td>Left Eye</td>
<td>80 (±6)</td>
<td>83±9 [M. A. Deeley et al., 2011]</td>
</tr>
<tr>
<td>Left Parotid</td>
<td>70 (±14)</td>
<td>85 ±2 [Faggiano et al., 2011]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>69±9 [R. Sims et al., 2009]</td>
</tr>
<tr>
<td>Brainstem</td>
<td>77 (±11)</td>
<td>83±10 [M. A. Deeley et al., 2011]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>58±20 [R. Sims et al., 2009]</td>
</tr>
</tbody>
</table>
Atlas-based segmentation
DICOM-RT improvements
DIR validation suite

Dissemination and Training

• Documentation and tutorials!
• 3D Slicer user group at AAPM annual meeting
• Module development training
** Thank you from the DBP team **

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UAB: Ivan Kolesov, Allen Tannenbaum

Isomics: Steve Pieper