Brachytherapy

In Early Oral Cancers

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Oral cancers: Role of Radiotherapy

• Early stage disease:
  • Radical External beam RT
  • Radical Brachytherapy
  • Combined External beam RT+ Brachytherapy

• Advanced Stage disease:
  • Definitive RT+CT
  • Adjuvant RT+/- CT
  • Palliative RT
Brachytherapy

“Placement of sealed radioactive sources into or immediately adjacent to the target tissue is called as brachytherapy.”
Oral cavity: Sites for brachytherapy

- Lip
- Buccal Mucosa
- Tongue
- Floor of mouth
- Hard palate
Types of Brachytherapy

Interstitial Brachytherapy
Radioactive sources are placed directly into the site of the tumor
-Lip, buccal mucosa, tongue, floor of mouth

Surface Mould Brachytherapy
Radioactive sources are placed on the surface of the tumor
Hard Palate
Types of Brachytherapy

- Radical Brachytherapy alone:
  - Lip
  - Buccal Mucosa
  - Hard Palate
  - Tongue

- Boost Brachytherapy:
  - Tongue
  - Floor of mouth

- Low dose rate brachytherapy:
  - Low doses of radiation given over 5-6 days
  - Dose rate: 0.4Gy-2Gy/hr

- High dose rate brachytherapy:
  - High doses of RT given in short time
  - Dose rate: >12Gy/hr
Patient Selection

- T1, T2 tumors
- Node negative
- Accessible for brachytherapy
- Adequate mouth opening
- Lesions not very close to bones
## Patient Selection: Oral Cavity

<table>
<thead>
<tr>
<th>Site</th>
<th>Brachytherapy Alone</th>
<th>Ext RT+ BRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lip</td>
<td>Tumors &lt;5cm</td>
<td>Larger tumors</td>
</tr>
<tr>
<td>Buccal Mucosa</td>
<td>Tumor &lt;4cm, thickness &lt;1.5cm</td>
<td>Larger tumors</td>
</tr>
<tr>
<td>Tongue</td>
<td>Upto 3cm,N0</td>
<td>&gt;3-4cm, N1</td>
</tr>
<tr>
<td>Floor of mouth</td>
<td>T1N0M0</td>
<td>&gt;3-4cm, N1</td>
</tr>
</tbody>
</table>

Mazeron J et al. Radiother Oncol 2009
Pre-Treatment Assessment

Primary Tumor:

Exact extent of tumour to be determined- Tumor Mapping

Clinical examination, EUA- to assess mucosal extensions

Depth assessment important.

Imaging: CT scan/ MRI.

r/o other lesions in the region (synchronous 2\textsuperscript{nd} primary).

- Neck Assessment
  - Clinical examination
  - USG neck
  - CT/MRI
Brachytherapy Procedure

- Procedure done under general anesthesia
- Head extended, ring under head & towel roll under shoulder
- Nasal Intubation (opposite Nostril)
- Cuffed endotracheal tube
- Ryles tube placement before the placement of catheters
- Tongue stitch
- Throat pack (Remember to Remove!)
- Evaluation Under anesthesia
Case Capsule

60 years male, P/w growth over right buccal mucosa since 6 month

O/E: GC good, KPS 90.
Neck - No nodes palpable.

Oral cavity: Mouth opening adequate.
Ulceroproliferative growth of size 3x2cm in the right buccal mucosa from the oral commissure to the 1st molar, superior and inferior GBS free. Skin free.

Hopkins: NED

Final diagnosis: Ca Rt Buccal mucosa cT2N0M0 Stage II
Plan: Radical Brachytherapy.
Technique: Buccal Mucosa Cancer
Care During Procedure

- **Prevent / Treat infection**
  - Meticulous hygiene
  - Prophylactic antibiotics in some cases
  - Topical antibiotics at entry and exit site
  - Change dressing once daily

- **Prevent Bleeding**
  - Careful selection of the needle route
  - Avoid multiple punctures
  - Use pressure to stop bleeding

- **Pain Control**

- **Steroids**
Technique: Tongue cancers

Anteroposterior Loops

HDR source can negotiate well
Brachytherapy Technique For Anterior Tongue
3D CT Based Planning

RT planning CT scan

Catheter Measurement

Catheter Reconstruction

Dose Distribution
Treatment Delivery

High Dose Rate Brachytherapy
Two fractions given every day
6 hours apart
Dose: 300-400cGy

Total dose:
Radical:
Equivalent of 60-66Gy of low dose rate brachytherapy
350cGy/# bid X 14 (4900cGy), 400cGyx12/13
(4800cGy/5200cGy)

Boost:
Equivalent of 20-30Gy of low dose rate brachytherapy
3Gy per fraction bid X7-8 (2100-2400cGy)
Clinical Outcomes: Lip Cancer

Organ Preservation

Function Preservation

Excellent Cosmesis
Clinical Outcomes: Tongue Cancer
### Clinical outcomes: Lip Cancer

<table>
<thead>
<tr>
<th>Author</th>
<th>n</th>
<th>Dose (Gy)</th>
<th>LDR</th>
<th>HDR</th>
<th>PDR</th>
<th>5 years local control (%)</th>
<th>5 years OS (%)</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beauvois et al. [21]</td>
<td>237</td>
<td>65-68</td>
<td>192Ir</td>
<td>–</td>
<td>–</td>
<td>95</td>
<td>74</td>
<td>9.5% necrosis</td>
</tr>
<tr>
<td>Gerbaulet et al. [22]</td>
<td>231</td>
<td>76</td>
<td>192Ir</td>
<td>–</td>
<td>–</td>
<td>95</td>
<td>n.d.</td>
<td>13.0% necrosis</td>
</tr>
<tr>
<td>Guinot et al. [26]</td>
<td>104</td>
<td>9 x 5.0 bid</td>
<td>–</td>
<td>HDR</td>
<td>IMBT</td>
<td>95.2</td>
<td>64.4</td>
<td>0%</td>
</tr>
<tr>
<td>Lock et al. [173]</td>
<td>51</td>
<td>55</td>
<td>198Au</td>
<td>–</td>
<td>–</td>
<td>97.8</td>
<td>87.9</td>
<td>Good cosmesis 48/51</td>
</tr>
<tr>
<td>Serkies et al. [25]</td>
<td>32</td>
<td>60-70</td>
<td>–</td>
<td>–</td>
<td>PDR</td>
<td>98</td>
<td>58.9</td>
<td>2/32</td>
</tr>
<tr>
<td>Johannson et al. [20]</td>
<td>43</td>
<td>60</td>
<td>–</td>
<td>–</td>
<td>PDR</td>
<td>94.5 (10 yrs)</td>
<td>39.1 (10 yrs)</td>
<td>2% soft tissue necrosis 2% bone necrosis</td>
</tr>
</tbody>
</table>

Kovacs G. Jour Contemp Brachy 2014
## Clinical Outcomes: Tongue/FOM

<table>
<thead>
<tr>
<th>Author</th>
<th>n</th>
<th>Anatomic Site</th>
<th>Dose (Gy)</th>
<th>LDR</th>
<th>HDR</th>
<th>PDR</th>
<th>5 years local control (%)</th>
<th>5 years OS (%)</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pernot et al. [35]</td>
<td>552</td>
<td>Mobile tongue</td>
<td>70-75</td>
<td>$^{192}$Ir, wire</td>
<td>–</td>
<td>–</td>
<td>St. I: 95</td>
<td>St. I: 71</td>
<td>Grade I: 20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>St. II: 65</td>
<td>St. II: 43</td>
<td>Grade II: 9%</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>St. III: 54</td>
<td>St. III: 33</td>
<td>Grade III: 4%</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>St. IV: 36</td>
<td>St. IV: 23</td>
<td>Grade IV: 0.2%</td>
</tr>
<tr>
<td>Pernot et al. [35]</td>
<td>207</td>
<td>Floor of mouth</td>
<td>70-75</td>
<td>$^{192}$Ir, wire</td>
<td>–</td>
<td>–</td>
<td>St. I: 97</td>
<td>St. I: 74</td>
<td>Grade I: 20%</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>St. II: 74</td>
<td>St. II: 46</td>
<td>Grade II: 9%</td>
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<td></td>
<td></td>
<td></td>
<td>St. III: 64</td>
<td>St. III: 39</td>
<td>Grade III: 4%</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>St. IV: 0</td>
<td>St. IV: 0</td>
<td>Grade IV: 0.2%</td>
</tr>
<tr>
<td>Yoshida et al. [46]</td>
<td>70</td>
<td>Mobile tongue</td>
<td>70</td>
<td>$^{197}$Ir, $^{226}$Ra, $^{60}$Co</td>
<td>–</td>
<td>–</td>
<td>78</td>
<td>80 CSS</td>
<td>n.d.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>71 (10 yrs)</td>
<td>72 (10 yrs) CSS</td>
<td></td>
</tr>
<tr>
<td>Inoue et al. [39]</td>
<td>58</td>
<td>Mobile tongue</td>
<td>6 x 10</td>
<td>–</td>
<td>HDR</td>
<td>–</td>
<td>T1/T2 = 82/79</td>
<td>T1/T2 = 83/82, CSS</td>
<td>10%</td>
</tr>
<tr>
<td>Inoue et al. [39]</td>
<td>341</td>
<td>Mobile tongue</td>
<td>70</td>
<td>$^{192}$Ir, $^{226}$Ra</td>
<td>–</td>
<td>–</td>
<td>T1/T2 = 85/80</td>
<td>T1/T2 = 85/79, CSS</td>
<td>6%</td>
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<tr>
<td>Marsiglia et al. [49]</td>
<td>160</td>
<td>Floor of mouth</td>
<td>60-70</td>
<td>$^{192}$Ir, wire</td>
<td>–</td>
<td>–</td>
<td>T1/T2 = 93/88</td>
<td>76</td>
<td>18% bone necrosis</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>10% soft tissue necrosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strnad et al. [62]</td>
<td>67</td>
<td>Floor of mouth</td>
<td>50-64</td>
<td>–</td>
<td>–</td>
<td>PDR</td>
<td>Approx. 87</td>
<td>Approx. 77</td>
<td>9.7% soft tissue necrosis</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>7.2% bone necrosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strnad et al. [62]</td>
<td>103</td>
<td>Mobile tongue</td>
<td>50-64</td>
<td>–</td>
<td>–</td>
<td>PDR</td>
<td>Approx. 78</td>
<td>Approx. 67</td>
<td>9.7% soft tissue necrosis</td>
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<td></td>
<td></td>
<td></td>
<td>7.2% bone necrosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guinot et al. [43]</td>
<td>50</td>
<td>Mobile tongue</td>
<td>11 x 4</td>
<td>–</td>
<td>HDR IMRT bid</td>
<td>–</td>
<td>79</td>
<td>70</td>
<td>4% bone necrosis</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>16% soft tissue necrosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yamazaki et al. [45]</td>
<td>80</td>
<td>Mobile tongue</td>
<td>6 x 10</td>
<td>–</td>
<td>HDR bid</td>
<td>–</td>
<td>T1/T2/T3 = 82/79/89</td>
<td>T1/T2/T3, CSS</td>
<td>17%/20%/0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86/78/1/89</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## BT in Tongue Cancers

<table>
<thead>
<tr>
<th>Author (year) Institute</th>
<th>n</th>
<th>T category</th>
<th>Schedule</th>
<th>Local control</th>
<th>Toxicity</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yamazaki (2003) [22]</strong></td>
<td>58 HDR</td>
<td>22T1, 36T2</td>
<td>Bx only: 6 Gy × 8–10</td>
<td>84%</td>
<td>S2%, B2%, both 1%</td>
<td>HDR ≈ LDR in T1-2</td>
</tr>
<tr>
<td></td>
<td>341 LDR*</td>
<td>171T1, 170T2</td>
<td>Bx only: 70 Gy (6–84 Gy)</td>
<td>80%</td>
<td>S3%, B3%, both 1%</td>
<td></td>
</tr>
<tr>
<td><strong>Yamazaki (2007) [23]</strong></td>
<td>80 HDR</td>
<td>24T1, 47T2, 9T3</td>
<td>EBRT: 37 Gy ± Bx: 6 Gy × 6–10</td>
<td>87%T1, 79%T2, 89%T3</td>
<td>Bx 19%, Bx + EBRT 29%</td>
<td>HDR ≈ LDR in T1–3</td>
</tr>
<tr>
<td></td>
<td>217 Ra–226</td>
<td>77T1, 108T2, 37T3</td>
<td>EBRT: 29 Gy ± Bx: 72 Gy (59–94 Gy)</td>
<td>85%, 75%, 62%</td>
<td>Bx 9%</td>
<td>EBRT elevated toxicity</td>
</tr>
<tr>
<td></td>
<td>351 Ir–192</td>
<td>111T1, 202T2, 38T3</td>
<td>EBRT: 30 Gy ± Bx: 72 Gy (59–94 Gy)</td>
<td>79%, 73%, 64%</td>
<td>Bx 10%, Bx + EBRT 28%</td>
<td></td>
</tr>
<tr>
<td><strong>Kakimoto (2001) [24]</strong></td>
<td>14 HDR</td>
<td>All T3</td>
<td>EBRT: 30 Gy (12.5 – 60 Gy) ± Bx: 6 Gy × 10</td>
<td>71% (2 y)</td>
<td>S21% B0%</td>
<td>HDR ≈ LDR in T3</td>
</tr>
<tr>
<td></td>
<td>61 LDR Ir–192</td>
<td></td>
<td>EBRT: 30 Gy (12.5–60 Gy) ± Bx: 72 Gy (5–94 Gy)</td>
<td>67% (2 y)</td>
<td>S5% B20%</td>
<td></td>
</tr>
<tr>
<td><strong>Akiyama (2012) [25]</strong></td>
<td>17</td>
<td>54 Gy arm</td>
<td>7T1, 10T2</td>
<td>Bx only: 6 Gy × 10</td>
<td>88% (2 y)</td>
<td>S0%, B6%, both 12%</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>60 Gy arm</td>
<td>16T1, 18T2</td>
<td>Bx only: 6 Gy × 9</td>
<td>88% (2 y)</td>
<td>S3%, B3%, both 6%</td>
</tr>
</tbody>
</table>

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GEC-ESTRO/ACROP recommendations

GEC-ESTRO ACROP recommendations for head & neck brachytherapy in squamous cell carcinomas: 1st update – Improvement by cross sectional imaging based treatment planning and stepping source technology

György Kovács a,⁎,1, Rafael Martinez-Monge b,1, Ashwini Budrukkar c,1, Jose Luis Guinot d,1, Bengt Johansson e,1, Vratislav Strnad f,1, Janusz Skowronek g,h,1, Angeles Rovirosa i,1, Frank-André Siebert j,1, on behalf of the GEC-ESTRO Head & Neck Working Group
Surface Mould Brachytherapy
Clinical outcomes with high-dose-rate surface mould brachytherapy for intra-oral and skin malignancies involving head and neck region

Ashwini Budrukkar, MD,1 Archya Dasgupta, MD,1 Prakash Randit, MD,1 Sarbani Ghosh Laskar, MD,1 Vedang Murthy, MD,1 Ritu Raj Uperti, MSc1, Tejpal Gupta, MD1, Kanchan Dholam, MDS2, Jai Prakash Agarwal, MD1
1Department of Radiation Oncology, 2Department of Medical Physics.

35 patients –surface tumors of head and neck region

21 Intra-oral, 14 Skin tumors

Intra-oral: EBRT+Boost

Skin: Radical Brachytherapy

Brachytherapy doses:

Radical : 49Gy/14# @ 3.5Gy bid regimen

Boost: 21Gy/7fraction@ 3Gy bid regimen

5 year LC

Skin tumors: 94%

Intra-oral: 76%

Median follow up: 52 months
Surgery vs Brachytherapy

Brachytherapy
- Angle of mouth
- Lower lip
- Anteriorly placed buccal mucosa lesions
- Hard palate
- Better functional and cosmetic outcome

Surgery
- Posteriorly placed lesions
- Lesions close to bone
- Lesions involving upper/ lower GBS
- Comparable control rates
Acknowledgements

• **Radiation Oncology**
  • V Murthy
  • JP Agarwal
  • SG Laskar
  • M Swain
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  • RL Bhalavat

• **Medical Physics**
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  • R Upereti
  • U Upereti
  • P Sahoo

• **Head and Neck Surgeons**
  • P Pai
  • G Pantvaidya
  • A Deshmukh

• **RT Technologist**
  • V Somesan
  • K Patil
  • S Kolhe

• **RT Residents**