Techniques of Oropharyngeal Brachytherapy

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Oropharynx Brachytherapy

- One of the most challenging site for brachytherapy
- Limited access
- Proximity to critical structures: carotids

- Sites:  Base of Tongue
  Tonsil
  Soft palate
  Ulvula
Challenges in Oropharynx brachytherapy

- limitations of anatomical site,
- small volume of involved structures,
- close location of critical organs (from both surgical and radiotherapy point)
- standard basic geometry not possible,
- intensive post-op care
- modifications required in conventional BRT rules
Intent of Treatment

• **Radical**: Brachytherapy alone as treatment: T1 tumors of uvula, soft palate

• **Boost**: EBRT → Brachytherapy to boost dose to the primary.

• **Palliative**: As salvage in cases irradiated before with recurrences and unfit for surgery.

• In view of high propensity of the neck nodes in the range of 20-30% even in early stage: Combination of EBRT+ Brachytherapy preferred
Pre-Treatment Assessment

**Primary Tumor:**
- Exact extent of tumour to be determined.
- 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
Instruments for brachytherapy
Pre Treatment: Technical Points

- Feasibility for Brachytherapy:
  » Mouth opening,
  » Dental status: Capping of sharp teeth, removal of teeth which can obstruct access
- Proximity of bones to implant site and requirement of dental shields/spacers.
- Requirement of tracheostomy: Epiglottis implants.
- Fitness for anesthesia.
Preparation before brachytherapy

- Appropriate Positioning
- Head extended, ring under head & towel roll under shoulder
- Check patency of airway before induction: Nasal Intubation
- Cuffed endotracheal tube

- Throat pack (Remember to Remove!)

Oedema can cause
  - airway obstruction
  - distortion of implant geometry
  - pain

If there is significant oedema then add steroids along with NSAIDS
Target volume and needle placement

- CTV is usually based upon the original extent of disease before delivery of EBRT or chemotherapy.
- Placement of radio-opaque markers before starting therapy can be very helpful to delineate the target volume, before any shrinkage occurs.
- Brachytherapy catheters should be placed about 0.8 to 1.2 cm apart as equidistant and parallel as possible.
GEC-ESTRO recommendations

GEC-ESTRO recommendations for brachytherapy for head and neck squamous cell carcinomas

Jean-Jacques Mazeron a,*, Jean-Michel Ardid b, Christine Haie-Méder c, György Kovács d, Peter Levendag e, Didier Peiffert f, Alfredo Polo g, Angels Rovirosa h, Vratislav Strnad i

Description of the clinical conditions, including GTV and CTV

Description of the technique (is the application performed following a system?)

Source specification, including RAKR (Reference Air Kerma Rate) and TRAK (Total Reference Air Kerma)

Complete description of the time-dose pattern

Treatment description

Mean central dose (MCD), Minimum Target Dose, Homogeneity Index

Volumes and their dimensions, including PTV, Treated Volume, high-dose regions, low-dose regions, reference volume, irradiated volume (level 2)

Coverage and conformity if possible

Organs at risks
Base of tongue brachytherapy: Loop technique
Antero-Posterior Loops
Base of tongue brachytherapy: Loop technique
Side to side Loops
Technique of Base of tongue brachytherapy: Non Loop techniques
Techniques: Plastic Tube with Beads

- Nasal Intubation for GA
- EUA
- ADVANTAGE: Self retaining assembly, no suturing required

No tubes protruding outside mouth (only threads). Pt. Comfort, Oral Examination.

Beads create a space with palate reducing dose delivered to palate (spare minor saliv gl)
Steps of Procedure: Base of tongue

- Tongue stitch
- Needle insertion: Guided with intraoral palpation
- Completed implant
- Re-enforcement in palstic tubes
Planning of Brachytherapy

- X ray based planning
- CT based planning
After completion of External RT to a dose of 50-56Gy

Dose of brachytherapy: 20-28Gy LDR equivalent
Interstitial Brachytherapy for oral and oropharyngeal malignancies (N=1344)

- Patients treated between 1973-1992
- Oropharynx
  - Base of tongue (N=72)
  - Tonsil, soft palate, posterior pillar (N=271)
  - Anterior pillar, glossopharyngeal sulcus (N=90)

Pernot M. Otolaryngology 1996.
Outcome with interstitial brachytherapy for base of tongue cancer

<table>
<thead>
<tr>
<th>First author, year</th>
<th>No. patients</th>
<th>% patients with T3-4</th>
<th>Median EB Dose, Gy</th>
<th>Median implant Dose, Gy</th>
<th>Technique</th>
<th>Chemotherapy</th>
<th>Primary control</th>
<th>Time point</th>
<th>Osteonecrosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housset,¹³ 1987</td>
<td>29</td>
<td>0</td>
<td>45</td>
<td>30–35*</td>
<td>Loop</td>
<td>None</td>
<td>80%</td>
<td>8 y</td>
<td>3%</td>
</tr>
<tr>
<td>Puthawala,¹⁴ 1988</td>
<td>70</td>
<td>74%</td>
<td>45–50</td>
<td>20–25 (T1–2)</td>
<td>GB-V†</td>
<td>None</td>
<td>83%</td>
<td>5 y‡</td>
<td>3%</td>
</tr>
<tr>
<td>Crook,¹² 1988</td>
<td>48§</td>
<td>0</td>
<td>48.6</td>
<td>32*</td>
<td>Loop/Hairpin</td>
<td>None</td>
<td>75%</td>
<td>5 y</td>
<td>6%</td>
</tr>
<tr>
<td>Lusinchi,¹⁵ 1989</td>
<td>108</td>
<td>47%</td>
<td>45</td>
<td>43.8*</td>
<td>Loop</td>
<td>None</td>
<td>64%</td>
<td>5 y</td>
<td>None</td>
</tr>
<tr>
<td>Horowitz,¹⁶ 1986</td>
<td>20</td>
<td>45%</td>
<td>54</td>
<td>27</td>
<td>GB-VI</td>
<td>25%</td>
<td>90%</td>
<td>5 y</td>
<td>None</td>
</tr>
<tr>
<td>Harrison,¹⁷ 1998</td>
<td>68</td>
<td>28%</td>
<td>54</td>
<td>20–25 (T1–2)</td>
<td>Loop</td>
<td>13%</td>
<td>89%</td>
<td>5 y</td>
<td>3%</td>
</tr>
<tr>
<td>(T3–4)</td>
<td></td>
<td></td>
<td></td>
<td>25–30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demanes,¹⁸ 2000</td>
<td>25</td>
<td>48%</td>
<td>54</td>
<td>19.2–36.9</td>
<td>GB-V</td>
<td>None</td>
<td>92%</td>
<td>5 y</td>
<td>None</td>
</tr>
<tr>
<td>Robertson,¹⁹ 2001</td>
<td>20</td>
<td>35%</td>
<td>50–54</td>
<td>28.7</td>
<td>Loop</td>
<td>None</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
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<tr>
<td>Gibbs,²⁰ 2003</td>
<td>41</td>
<td>50%</td>
<td>50</td>
<td>26</td>
<td>Loop</td>
<td>5%</td>
<td>82%</td>
<td>5 y</td>
<td>5%</td>
</tr>
<tr>
<td>Karakuyon-Celik,²</td>
<td>40</td>
<td>54%</td>
<td>61</td>
<td>17.4</td>
<td>GB-V</td>
<td>60%</td>
<td>78%</td>
<td>5 y</td>
<td>5%</td>
</tr>
</tbody>
</table>

Karakuyon Celik. Head and Neck 2005
Outcome with interstitial brachytherapy for oral cavity and oropharyngeal tumors

<table>
<thead>
<tr>
<th>Anatomical site</th>
<th>Patient selection</th>
<th>Implant technique</th>
<th>Safety margin</th>
<th>Dose</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lip</td>
<td>T1-3</td>
<td>RN</td>
<td>5–10 mm</td>
<td>60–75 Gy LDR-PDR</td>
<td>LC: 90–95% N: 2–10%</td>
</tr>
<tr>
<td>Buccal mucosa</td>
<td>&lt;4 cm</td>
<td>PT</td>
<td>5–10 mm</td>
<td>65–70 Gy LDR-PDR (25–30 Gy boost if 45–50 Gy ERT)</td>
<td>LC: 80–90% N: &lt;10%</td>
</tr>
<tr>
<td>Mobile tongue</td>
<td>T1-3</td>
<td>PT</td>
<td>5 mm</td>
<td>65–75 Gy LDR-PDR (25–30 Gy boost if 40–45 Gy ERT)</td>
<td>LR: &gt;90% N: 10–20%</td>
</tr>
<tr>
<td>Floor of mouth</td>
<td>T1-2N0</td>
<td>RN or PT</td>
<td>&gt;5 mm</td>
<td>65 Gy LDR-PDR (10–25 Gy boost if 46–50 Gy ERT)</td>
<td>LR: &gt;90% N: 10–30%</td>
</tr>
</tbody>
</table>

Mazeron JJ. Radiother Oncol. 2009
Clinical Outcome: Base of tongue cancer
Clinical Outcome: Carcinoma soft palate
Clinical Outcome: Carcinoma tonsil
Outcome Analysis
January 1988-December 2004
(N=291)

- Combination of External Beam radiation therapy and boost brachytherapy
- External RT: 60Cobalt : Median dose: 50Gy
- Brachytherapy: 192 Iridium Low dose rate system
- Median dose: 26Gy (15-40Gy)
- Oropharynx: 80%
- Node negative: 84%

Budrukkar A et al. Radiother Oncol 2010 (abst)
Results: Outcome

- Median follow up of surviving patients: 35 months (4-243 months)
- Median time to recurrence: 10 months

3 year local control: 73%

3 year Disease free survival: 66%
3 year overall survival: 63%
High Dose Rate Brachytherapy: TMH Experience

- Audit: January 1996- December 2007
- Number of Patients=88
- Radical radiation therapy+/- chemotherapy
- Combination external RT+ High dose rate brachytherapy boost

- Median age: 54 years
- Oropharynx: 74%
- T2-T3: 71%
- Node negative: 83%
- Median dose of Brachytherapy: 20.25Gy (10-36Gy)
- No of fractions: 5 (2-8)
- Dose per fraction: 450cGy (300-550cGy)

Budrukkar A et al. Radiother Oncol 2011(abst)
Survival

3 and 5 year Local Control rate: 68%
Median follow up of surviving patients: 43 months (2-168 months)
Median time to recurrence: 8.4 months
3 and 5 year disease free survival: 62% and 60% respectively
3 and 5 year overall survival: 70% and 61% respectively
Xerostomia and Dysphagia related Quality of life after brachytherapy

- Patients of head and neck cancer treated with brachytherapy (either alone or combination with external RT)
- Attended follow up clinic and were controlled at last follow up Jan 2008-Jan 2009

51 consecutive eligible patients who attended follow up clinic of a single head and neck unit
- Cross sectional evaluation using XQ and DQ
- Median XQ score : 16 (Low score less xerostomia)
- Median DQ score: 2.4 (Higher score low dysphagia)

<table>
<thead>
<tr>
<th>Radiation</th>
<th>Eisbruch et al</th>
<th>Present study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technique of External RT</td>
<td>IMRT</td>
<td>Conventional</td>
</tr>
<tr>
<td>Median follow up</td>
<td>12 months</td>
<td>50 months</td>
</tr>
<tr>
<td>Median XQ</td>
<td>35</td>
<td>16</td>
</tr>
</tbody>
</table>

Budrukkar A et al. Eur J Cancer.2009 vol 7 (2) abst
3D CT based brachytherapy planning
Jan 2008- May 2010

Number of brachytherapy procedures: 50
Ext RT+ Brachytherapy
HDR
CT based planning with 3 Gy per fraction bid
Base of tongue and tonsil: most common sites
Summary

- Brachytherapy for oropharyngeal tumors challenging
- Expertise is required for good placement
- Plastic tube techniques: Best suited for HDR brachytherapy
- Acceptable local control rates
- Low complication rates