Brachytherapy for Oral Cancers

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Opportunities and challenges

• Easily accessible for placement of needles and after-loading catheters
• Critical structures surround the tumour

• However,
  – Access of anatomical site
  – Small volume of involved structures
  – Close location of critical organs (from both surgical and radiotherapy point of view)
  – Standard basic geometry not possible
  – Modifications required in conventional BRT rules
  – Intensive post-op care
  – Operator dependent
Goal of treatment

- Radical: Brachytherapy alone
- Boost: EBRT plus Brachytherapy to boost
- Palliative: As salvage in cases irradiated before with recurrences and unfit for surgery.
Assessment

• PRIMARY TUMOUR:
  – Exact extent of tumour
  – Estimate of treatment/implant volume prior to procedure.
  – Clinical examination in good light (EUA)
  – Submucosal spread/Depth assessment
  – Rule out other lesions in the region
  – Type of lesion: proliferative/infiltrative
    • Ulcerative/proliferative respond better
    • Well defined and hence better delineation
    • Minimal potential margin
    • Infiltrative lesions are less preferred.
  – Imaging: CT scan/ MRI

• NECK:
  – Clinical examination
    • USG neck
    • CT/MRI
Assessment

• Feasibility for Brachytherapy:
  – Mouth opening
  – Response the EBRT, Mucositis (if boost)
  – Proximity of bones to implant site
  – Requirement of dental shields/spacers
  – Fitness for anaesthesia
  – Dental prophylaxis
    • Prevents acute and chronic dental complications
    • Pre and post treatment prophylaxis.
    • Restoration/extraction of carious teeth
    • To rule out bony erosion/involvement
    • Removal of teeth which can cause obstruction during procedure (only if critical)
Sites

- Anterior Tongue
- Buccal Mucosa
- Lip
  - Hard palate
  - Floor of mouth
TONGUE IMPLANT

• Interstitial Volume implants

• Radical Implant
  – Early T1 (superficial lesions)
  – Depth < 4 mm

• Boost Implant:
  – T1-2 N0
  – Approaching midline
  – Microscopic disease in the neck addressed by EBRT.
  – Risk of contralateral nodal recurrence.
  – Reduce EBRT dose to a large volume
Technique

• EVOLUTION:
  – Pre-loaded rigid radium needles (with/without template)
  – HAIR-PIN needles using Guide-gutter technique (Pierquin, Paine)
  – PLASTIC TUBE TECHNIQUE (Henschke, Hillaris)
    • Intra-oral template
    • Non-loop technique
    • Gold Button technique
    • Plastic bead technique (Bhalavat)

• Techniques refined to avoid under-dosage at the dorsum and lateral border
LOOPS/HAIRPINS

• PARIS SYSTEM
• Straight branches of the loops are parallel and not spaced too wide
• Height of the curved portion of loop < half of spacing
• Loop to form a regular semi-circle or flatter
• Branches of loop to be parallel for atleast the distance equal to the spacing between them.
• BDR calculated at a point perpendicular to the center of parallel branches
GUIDE-GUTTER

- Appropriate length guide gutters selected (u shaped)
- Posterior most inserted first just beyond the posterior limit of the lesion.
- Anterior guide then inserted at the anterior limit.
- Additional guides can be inserted in between depending on size of lesion.
- Spacing of 1-1.4 cm maintained.
- Geometry ascertained under fluoroscopy.
- Stay sutures taken.
- Gutters replaced by active hair-pins under appropriate radioprotection.
PLASTIC TUBE TECHNIQUE
(next presentation)

• Afterloading technique
• Suitable for larger lesions
• Percutaneous approach
• Needles inserted through medial and lateral edge of the lesion.
• Replaced by plastic tubes which will subsequently hold radio-active source.
• Loop formed over the surface of tongue
• Maximal separation between branches < 20mm
NON-LOOP TECHNIQUE

- Loops can have challenges
  - Technically difficult
  - Posterior tumours
  - Source may not negotiate the sharp curve of the loop.
- Transverse catheter is eliminated
  - Button-ended catheters tied together to form an apex of functioning loop
  - Extra buttons at the dorsum for better dose
Buccal Mucosa

• Biology different
  • Low propensity for Neck nodes

• Favorable sites are central and anterior portions
  • Avoid for lesions close to RMT or the GBS

• Radical Implant: Early T1-2 (superficial lesions)
• Boost Implant: EBRT + Brachytherapy
Technique and Approaches

• Transoral approach: (Uncommon)
  – For very small lesions without infiltration
  – Direct visualisation of tumour.

• Transcutaneous approach:
  – Needle inserted about 2-3 mm below the mucosa with entry and exit wounds on skin
  – Best suited for larger lesions with minimal infiltration (<5mm) so that larger depth is treated.

• Treated volume should include about 1 cm of normal appearing mucosa.

• Parallel needles extending beyond the margins of gross disease are usually used for complete target coverage.
• Interstitial Planar implants.
• Single plane: tubes mid-way between mucosa and skin.
• Double plane: Submucosal + subcutaneous
• Crossing needles for coverage: anteriorly or posteriorly.
LIP IMPLANT

- Surgery Vs Brachytherapy
- Radical Brachytherapy Vs EBRT + Boost
  - Better cosmetic outcome
  - Equivalent local control
- Choosing the right patient/tumour
  - T1-2
  - N0
  - Mid lip vs angle of mouth
  - Bone/GL Sulcus

- Standard Paris system rules to be applied
  - Single/Double plane implant
  - Plastic tube
  - Rigid needles with template
DOSE FRACTIONATION: HDR

• Radical: LDR equivalent of 60-70 Gy.
• Boost: LDR equivalent of 16-20 Gy.

• Various fraction sizes used in literature
  – Reasonable Option: 3.5-4 Gy/fraction x 2 fractions/day

  – Radical: 45.5 Gy/13# @ 3.5 Gy/# twice a day
## Outcome: Literature

<table>
<thead>
<tr>
<th>AUTHOR</th>
<th>N^{\text{\textdegree}} CASES</th>
<th>DOSE (Gy)</th>
<th>5 YEARS LC</th>
<th>FUNCTIONAL AND ESTHÉTICS</th>
<th>COMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beauvois et al. (13)</td>
<td>237 (T1-T4)</td>
<td>65-68</td>
<td>99%</td>
<td>198 Slight telangiectasia, 5 moderate retraction and depigmentation.</td>
<td>11% ulceration, 0.5% necrosis</td>
</tr>
<tr>
<td>Farrús et al. (12)</td>
<td>72 (T1-T3)</td>
<td>62-67</td>
<td>85%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Finestres (21) HDR</td>
<td>56 (T1-T3)</td>
<td>60-70</td>
<td>96.5%</td>
<td>Good and excellent 94%, Moderate 6%</td>
<td>4 ulceration 4 hyperpigmentation 2 telangiectasia 2 fibrosis</td>
</tr>
<tr>
<td>Fongione et al. (14)</td>
<td>69 (T1-T3)</td>
<td>65</td>
<td>99%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gerbaulet et al. (22)</td>
<td>231 (T1-T3)</td>
<td>Mean of 76 Gy</td>
<td>95%</td>
<td>Good 70%, moderate 16%, poor 4%</td>
<td>13% necrosis (T3)</td>
</tr>
<tr>
<td>Guinot et al. (20) HDR</td>
<td>39 (T1-T4)</td>
<td>40.5-45, 8-10 fx, 2 fx / day, 6 hours. interval</td>
<td>87%</td>
<td>Similar to LDR</td>
<td>Similar to LDR</td>
</tr>
<tr>
<td>Mazeron et al. (9)</td>
<td>1870 (T1-T3)</td>
<td>60-70</td>
<td>T1 98.4%, T2 96.6%, T3 89.9%</td>
<td>Normal: T1 82%, T2 51%, T3 27%. Acceptable: T1 17%, T2 44%, T3 64%. Unfavorable: T1 1%, T2 5%, T3 9%</td>
<td>4% necrosis 11% pigmentation 1% localized edema 5% slight retraction</td>
</tr>
<tr>
<td>Petrovich et al. (23)</td>
<td>91 (T1-T3)</td>
<td>7000 rads</td>
<td>95.5%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Clinical course

• During the first 3 weeks after treatment a progressive mucositis appears in the treated area.
• Usually resolves in 4-6 weeks.
• The treatment is based on topical analgesics / anti-inflammatory.
• Lesion/induration disappears in 2 months after brachytherapy.
• 4-6 months Follow up:
  – Scarring in the area
  – Cosmetic outcome depends on the initial size and tissue loss
  – Hypopigmentation: If skin involved