Implant Design and Execution

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Interstitial Implant Techniques

- Radium needles
- Afterloaded angiocaths
- Needle/catheter lead insertion
- Blind end catheters
Needle/catheter lead insertion

- Hollow needle pushed into tissue
- Solid catheter lead threaded into needle
- Needle/catheter lead pulled through
- Catheter pulled through to button end
Needle/catheter lead/catheter insertion

Catheter Positioning

- Closed catheter end secured with button
- Open catheter end secured with friction button or clamp
- Spacers may be used at either end to allow source near skin
Open and blind end catheters, spacers and buttons for interstitial implants
Treatment Planning

- Catheters filled with marked dummy seeds
- Orthogonal or stereo films, CT or other images taken
- Gantry positioned to optimize film quality
Blind End Catheters

- Used for brain, gynecological, and other implants
- Catheters with sharp end and internal stylette inserted into tissue
- Template, CT stereotactic, or other guidance used
Templates

- Used to guide positioning of needles or catheters
- Custom or generic used
- Gives improved catheter/source position relative to freehand
- Possible issues with patient comfort
Syed-Neblett applicator with blind end catheters
Dose homogeneity

- Source placement guidelines seek to improve conformal coverage and dose uniformity.
- Dose uniformity should be monitored for planning and evaluation purposes.
- Various criteria for dose homogeneity:
  
  (a) \( \frac{\text{Vol at 100-150\% Rx}}{\text{Vol inside Rx isodose}} \)
  
  (b) \( \frac{\text{Rx dose}}{\text{Mean Central Dose}} \)
RTOG dose homogeneity criterion: 
Rx dose/Mean Central Dose
Source Placement

- Most systems give guidelines for source placement
- Interstrand distance typically 1.0 to 1.5 cm
- For biplanar LDR implants of target thickness $T$, interplanar separation $s$ is:
  - (a) in most systems, $s=1.5$ cm ($T=2.5$ cm)
  - (b) in Tufts system, tables of $s$ given
- For biplanar HDR implants, $s = T/1.414$
Conclusions

- Target coverage and dose uniformity are goals of interstitial brachytherapy.
- Source placement guidelines aid these goals.
- Brachytherapy systems help in implant design.
- Accurate source placement needed to carry out implant design.
Neither LDR differential loading nor HDR dwell time optimization can salvage an implant with poor source guide positioning.

Careful pre-implant planning and accurate catheter placement are essential to achieving the goals of interstitial brachytherapy (conformal coverage, dose uniformity).