Automatic treatment planning and quality assurance for gynecological high dose-rate brachytherapy

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Disclosure

This work is supported by Varian Medical Systems
Outline

- Motivation
- AutoBrachy system
  - Treatment planning
  - Treatment plan QA
  - Database
- Conclusion

Motivation

- Conventional practice
  - Treatment planning
  - Pre-treatment QA

  Screen captures
  ~10 captures for different purposes

  Run secondary dose calculation
  A dose report

  Bind to a single pdf
  Upload to MOSAIQ

- Documentation
  - Record plan information in a spreadsheet
Motivation

- Problems:
  - Human errors
  - Low efficiency
  - Plan quality variation
  - Organized and comprehensive data documentation
    - Document 7 variables per minimum standard for reporting (Level 1)
    - 33 variables per advanced standard for reporting (Level 2)
    - ~100 per research-oriented reporting (Level 3)


An automated workflow

1. Data server
2. AutoBrachy web interface
3. AutoBrachy planning module
4. AutoBrachy QA
5. AutoBrachy database

CT scan

FDA approved TPS

Treatment delivery
Tandem and Ovoid

Polynomial Fitting of Cluster

Automatically Segmented Applicators

Rectum Pt PosteroInferior Border of the pubic Symphysis (PIBS pt) is found using projections through subregion.

Threshold based clustering

Adaptive threshold starting from primary clusters.

AutoBrachy

Auto Brachy

Patient Database

- Treatment Plan QA
- Secondary Dose Calculation
- Tandem and Ovoids Plan QA
- Cylinder Plan QA

Auto Planning

- Cylinder Auto Planning
Secondary dose calculation

- Export Dicom-RT data to QA server
- Launch dose calculation in web and generate a PDF report

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**QA**

- Export plan data
  - Standard DICOM-RT format
- Auto QA
  - Comprehensive tests
  - Generate a report
- Upload to MOSAIQ
- Secondary physics check and approval

- Comprehensively validate the plan from over 20 dosimetric and geometry aspects
- Summarize QA results with suspicious issues highlighted
- A streamlined work flow with ~3 min
**HDR database**

- A database containing:
  - Patient name and MRN, connected to MOSAIQ
  - External beam therapy dose and HDR treatment images/plans
  - Treatment toxicity

- Estimate HDR + External beam therapy dose for treatment planning

- Automatically document dosimetric results, when QA report is generated

- Document treatment toxicity

- Query and report for research purpose
Ongoing works

- New (AI-based) modules
  - Syed and Y-tandem treatment planning
  - Syed preplanning
  - Automatic organ contouring