Update on Task Group No. 253 Report on Surface Brachytherapy

Regina K. Fulkerson, Ph.D.
on behalf of the TG-253 authors

Disclosures

This presentation includes **DRAFT** societal guidance.

TG-253 Members

- Facundo Ballester
- Ivan Buzurovic
- Regina Fulkerson (co-chair)
- Yongbok Kim
- Zoubir Ouhib (ABS liaison)
- Sujatha Pai
- Jose Perez-Calatayud (co-chair)
- Mark Rivard
- Yi Rong
- Bruce Thomadsen
- David Harrington (Varian)
- Yury Niasetski (Elekta)
- Tom Rusch (Xoft, an iCAD subsidiary)
- Frank-Andrea Siebert (ESTRO liaison)
- Frank Weigand (Zeiss)

Charges of TG-253

- Review approaches to surface brachytherapy, including:
  - Physical Characteristics
  - Safe use and handling
  - Dosimetric characteristics
- Develop a rational, risk-based set of QM procedures for the applicators and surface brachytherapy procedures, beyond that appropriate for general brachytherapy. These procedures will include (but not limited to):

a. Definition of the physicists role
b. Recommendations on acceptance and commissioning procedures
c. Definition of a clinical QM procedure and frequency

Content summary

- sources and systems included in the report:
  - radionuclide-based systems (^{192}Ir, ^{60}Co)
    - flaps and molds
    - solid, conical surface applicators
  - electronic brachytherapy systems (eBT)
    - Axxent (Xoft / iCAD)
    - INTRABEAM (Zeiss)
    - Esteya (Elekta)

Content summary

- TG-253 report organization
  - description of sources and applicators
  - review of peer-reviewed literature on dosimetric characteristics
  - clinical considerations (workflow, planning and delivery considerations, radiation safety)
  - TG-100[1] based quality management
  - example output verification worksheets

[1]Huq et al. The report of Task Group 100 of the AAPM: Application of risk analysis methods to radiation therapy quality management. Med Phys. 2016;43(7):4209-4262. doi:10.1118/1.4947547

Content summary - eBT

- eBT systems included:
  Axxent, INTRABEAM, Esteya
- system geometry and energy vary, although all aim to treat non-melanoma skin cancers

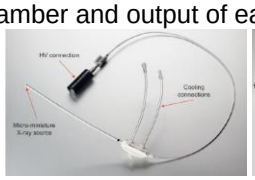
Table 2.1. Example source parameters for the electronic brachytherapy sources included in this report. Half-value layer (HVL) is the nominal HVL specified in air.

	HVL (mm Al)	Accelerating voltage (kVp)
XRS Axxent® Model S700	0.38	50.0
INTRABEAM 4	0.64	40 - 50.0
Esteya	1.8	69.5

7

System summary - Xoft

- Xoft Axxent system includes four cones:
  10 mm - 50 mm diam.,
  SSD~21 mm (50 mm cone has SSD=30 mm)
- each cone has a flattening filter at the apex
- treatment times calculated by controller based on measurement of source strength in well chamber and output of each cone

8

System summary - INTRABEAM

- system first used for IORT applications
- two types of applicators to treat skin lesions:
  - Flat applicators:
    filter creates flat radiation field at 5-mm *depth*
  - Surface applicators:
    flat radiation field produced *at skin surface*
  - 10 mm - 60 mm diam., SSD varies with cone size

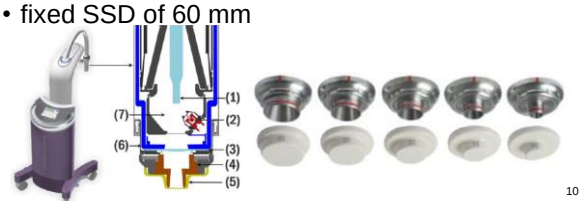

Flat

Surface


9

System summary - Esteya

- Esteya system designed specifically for treating skin lesions
- 10 mm - 30 mm diam. cones
- treatment times calculated by controller based on measured values for each cone
- fixed SSD of 60 mm



10

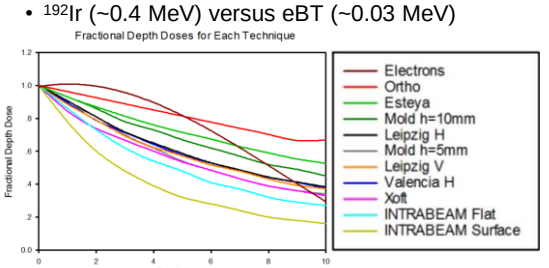
Clinical notes

- eBT prescriptions for skin lesions:
  - ~6 Gy/fx for 42 Gy total at 3-mm depth
  - lesions deeper than 5 mm and larger than 20 mm diam. are not typically suitable for eBT
- treatment planning techniques vary: from verification of times set by controller (hand-calculations) to more complex CT-based planning with heterogeneity corrections

11

Comments on published literature

- for systems included in TG-253:
  - wide range of effective energies, geometry and dosimetry standards
  - ^{192}Ir (~0.4 MeV) versus eBT (~0.03 MeV)



12

Comments on published literature

- wide ranging effective energies, geometry and dosimetry standards
  - Flaps/molds – thermoplastic materials and SSDs around 5 mm
  - Solid conical applicators – Tungsten alloys with source positioned parallel or perpendicular to treatment surface, SSDs ranging from ~10-60 mm



13

Comments on published literature

- wide ranging effective energies, geometry, and dosimetry standards
  - air-kerma based or absorbed dose to water based standards for traceable measurements
  - air-kerma: N_K
  - absorbed dose to water: N_{Dw}
  - variable user-access to calibration tools (ion chambers), limited data for appropriate chambers
  - TG-253 approval pending from ESTRO and AAPM

14

Consensus of TG-253 approach

- difficult to create uniform measurement guideline
- TG-253 resolution: provide recommendations of metrics and tools available for creating a QMP, with examples of output verification worksheets, process maps, and risk-analysis examples
- reduce overlap with existing societal guidance (ABS Skin Report, GEC-ESTRO Skin Report)[2,3]

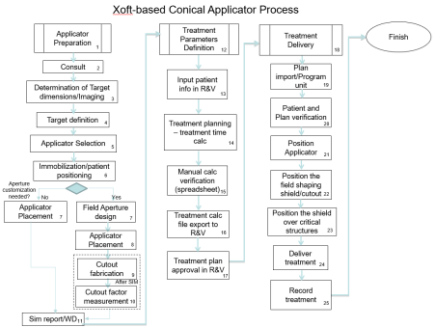
Ouhib et al. Aspects of dosimetry and clinical practice of skin brachytherapy: The American Brachytherapy Society working group report. Brachytherapy, 2015;14(6):840-858. http://dx.doi.org/10.1016/j.brachy.2015.06.005.

Guinot et al. GC-ESTRO ACROP recommendations in skin brachytherapy. Radiotherapy and Oncology, Volume 126, Issue 3, 377-385.

15

Example process map

- provide basis for developing a TG-100 risk-based QMP (which often includes QA tasks)

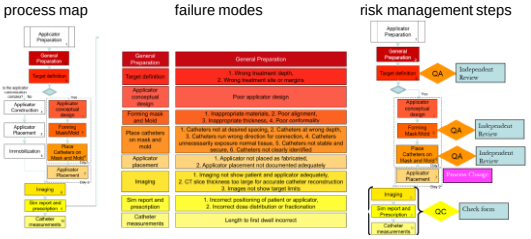


16

Example process map

- using example process maps, readers are guided to establish their own version and determine the failure modes at each step using the TG-100 methodology
- from the failure modes and assigned risk priority number, a comprehensive QMP specific to their institution is developed

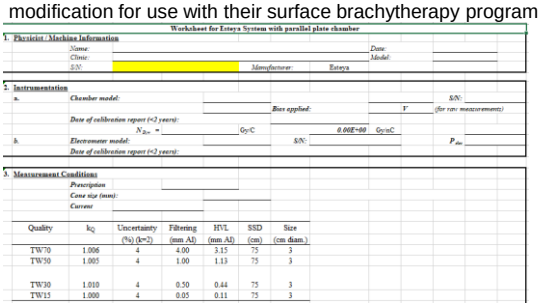
process map | failure modes | risk management steps



17

Example output worksheet

- provides example of method for output verification, based on specific dosimetry standard and measurement tools
- user is expected to understand how example may need modification for use with their surface brachytherapy program



Worksheet for Esteya System with parallel plate chamber

1. Physicist / Machine Information

Name: Date:
Clinic: Model:
S/N: Manufacturer: Esteya

2. Instrumentation

a. Chamber model: S/N:
Bias applied: V (for rate measurements)
Date of calibration report (<2 years):
$N_{D,w}$ = Gy/C 0.60E+00 Gy/nC
b. Electrometer model: S/N: P_{ion}
Date of calibration report (<2 years):

3. Measurement Conditions

Prescription
Cone size (mm):
Current

Quality	k_Q	Uncertainty (%) (k=2)	Filtering (mm Al)	HVL (mm Al)	SSD (cm)	Size (cm diam.)
TW70	1.006	4	4.00	3.15	75	3
TW50	1.005	4	1.00	1.13	75	3
TW30	1.010	4	0.50	0.44	75	3
TW15	1.000	4	0.05	0.11	75	3

18

Status of report

- current report under review with Therapy Physics Committee
- TG members met at AAPM18 to discuss organizational items
- next review cycle: Fall 2018
- future TG updates may consider role of 3D printing for surface applicators and newly available applicators

Thank you!
Questions?