

BrachyNext



Working Together to Shape the Future of
Brachytherapy

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Surface brachytherapy for squamous and basal cell carcinoma of the skin

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Potential Conflict of Interest Disclosure

- Consulting fees : Nucletron / Elekta
 - Training Sessions
 - Roundtable Discussions



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Skin Function

- First line of defense; keeps body in homeostasis- protects from germs, dehydration, injury.
- Regulates body temperature
- Protects from UV radiation
- Synthesizes Vitamin D
- Temporary storage of glucose, fat, water and salt.
- Can absorb chemical substances (e.g. Nitroglycerin patch, ointment for rashes, pain patches, etc.)
- Site of many nerve endings/ major sensory organ





Scope of the problem

- 1 in 5 Americans will develop skin cancer in their lifetime.
- Annual new cases exceed totals of breast, prostate, lung and colon cancers.

Estimated Skin Cancer Incidence

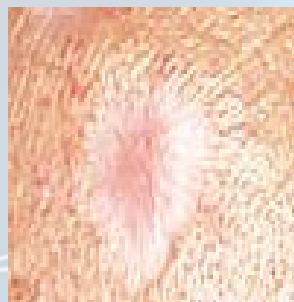
- Basal cell ca: > 2,800,000
- Squamous cell ca: > 700,000
- Malignant Melanoma: > 76,000



Basal Cell Carcinoma

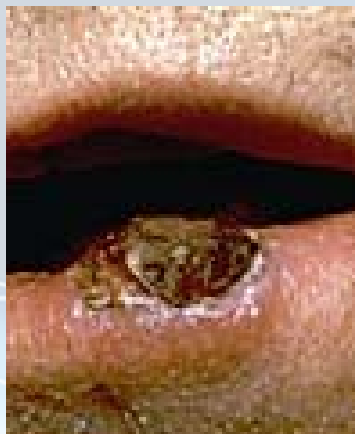


Nodular BCC



Sclerosing BCC

Squamous Cell Carcinoma





Role of radiotherapy in the management of skin cancer

What is the role of radiotherapy in the management of skin cancer?

Role of RT in Tx of Skin Cancer

- Dermatology controls the skin cancer patients
- Radiation oncology controls radiotherapy (changing?)
- Data suggest that when multidisciplinary teams including dermatologists and radiation oncologists are involved in the treatment of NMSC patients in 19% of cases radiotherapy is prescribed (Culleton 2011)

	Synovate current situation	Multidisciplinary team, Culleton 2011
excision	45%	31%
Moh's surgery	24%	24%
ED&C	24%	4%
Topical	7%	11%
RT	1-2%	19%
observation		7%
None/other		3

Culleton S, et al., 5-year review of a unique multidisciplinary nonmelanoma skin cancer clinic. J Cutan Med Surg. 2011 Jul-Aug;15(4):220-6.



Indications to Consider RT

- Fixation to underlying structures, i.e. cartilage or bone
- Perineural involvement
- Poorly differentiated subtypes
- Recurrent disease
- Positive margins
- Infiltrative growth patterns
- Rapid growth

Indications to Consider RT

- **Challenging anatomic locations**
 - larger, less well demarcated lesions of the nose, ears or lips
 - pre-tibial skin in patients with PVD
- **Patients with surgical contraindications**
 - co morbidities
 - blood thinners
 - lower extremities in diabetics



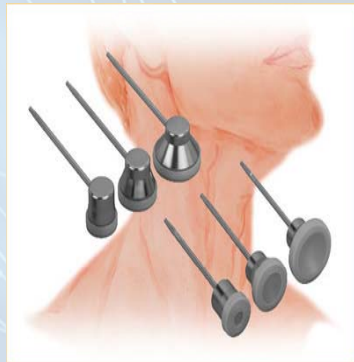
Brachytherapy applicators for skin cancer

Skin Applicators

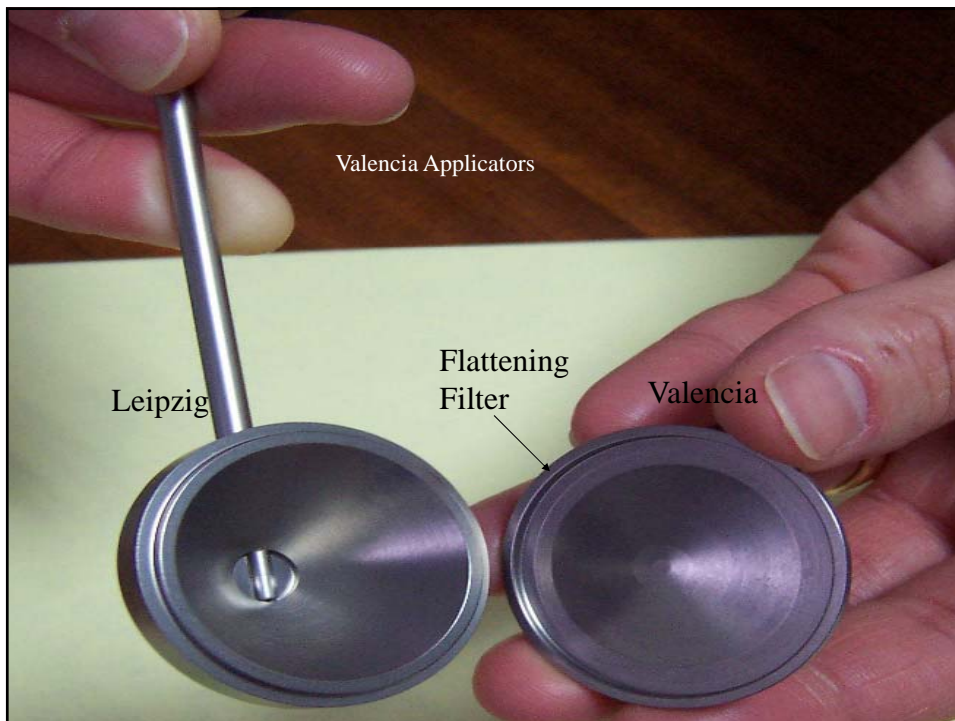




Leipzig Applicators



- Inner diameters of 1, 2, and 3 cm
- SSD of approx 15 mm
- 1 mm thick plastic cap
- Fixed diameter, tungsten steel surface applicators





Electronic Brachytherapy

Electronic Brachytherapy is a method of radiation therapy using an electrically generated source of ionizing radiation to deliver a radiation dose at a distance of up to a few centimeters by intracavitary, intraluminal or interstitial application, or by applications with the source in contact with the body surface or very close to the body surface.



Axxent Skin Applicator System





Axxent Skin Applicator System

- Applicator development of 10mm, 20mm, 35mm, 50 mm
- Xray source : 50 kV
- Stainless Steel:
 - Easily sterilizable
 - Applicator cone and source channel (shown with V-Groove SC)
 - Flattening filter integrated in Cone



ESTEYA





Esteya applicator size options



10mm 15mm 20mm 25 mm 30mm

Esteya Specs

- The system uses electronically generated X-rays through a small end-window type X-ray source, proprietary design
 - Dose rate: 2.7 Gy / min @ 3mm
 - X-ray source operating range: **69.5 kV**
 - X-ray radiation, defined by x-ray source; with 69.5 kV and the 1.6 mm Aluminum filter at an **SSD of 60 mm.**
 - Source maintenance interval: **4,000 fractions**
 - **Dose profile designed to mimic HDR Valencia**



Treatment Margins

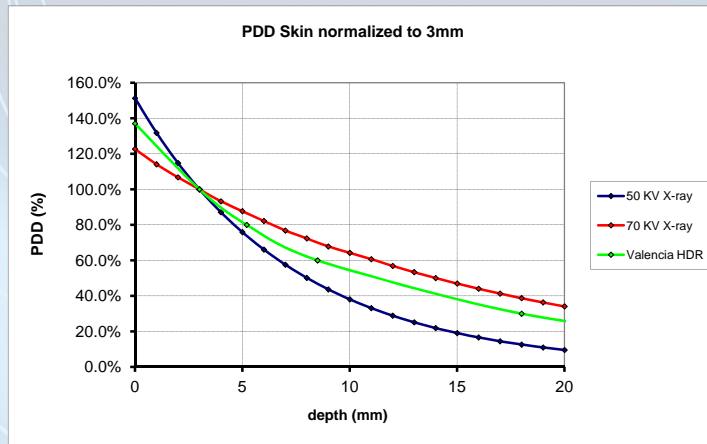
- 4mm – low risk lesions
- 6mm- high risk lesions
- Minimum margin necessary to achieve >95% tumor clearance by Mohs surgery
- -Zitelli and Brodland

Risk Stratification

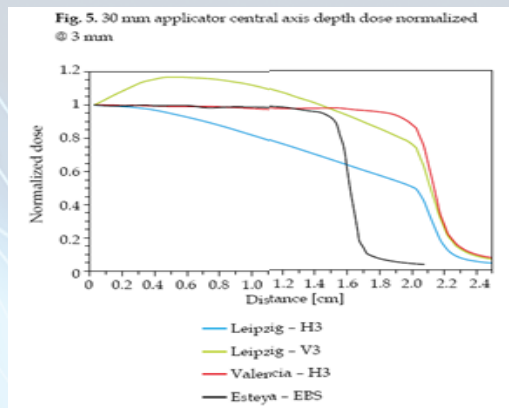
- Zitelli and Brodland criteria for **high risk**
 - Tumor diam > 2 cm
 - Mod or poorly diff histology
 - >2mm subcutaneous tissue invasion
 - High risk locations
scalp, nose, ears, lips, and eyelids



Depth Dose Considerations



Beam Profile



Garcia- Martinez, et. al, *Journ. Contemp. Brachy.* 2014.



1: [Strahlenther Onkol. 1999 Apr;175\(4\):170-4.](#)

[Related Articles, Links](#)

[The indications for and results of HDR afterloading therapy in diseases of the skin and mucosa with standardized surface applicators (the Leipzig applicator)]

[Article in German]

[Kohler-Brock A, Prager W, Pohlmann S, Kunze S.](#)

- 520 pts. since 1987
- Sites: skin of face, oral cavity, perianal and external genitalia
- Mostly BCC and SCC of the skin but also others
- Dose: 30 to 40 Gy in 5 to 10 Gy fxs, once or twice/wk
- 92% local control rate; no severe late reactions

Gauden,S. et al. BRACHY Vol 7, April 2008

- 85 pts / 92 lesions tx'd with the Leipzig Applicator
- Histology – 43 BCC, 41 SCC, 1 Merkel Cell
- Sites – 78 H&N, 10 Extremity and 4 trunk
- Dose – 36 Gy / 12 fx
- Median F/U – 37 mo
- Local Control – 90/92 (97%)
- Cosmesis – good to excellent 81/92 (88%)
- Late hypopigmentation in 10 pts (11%)



Valencia Data

- 33 pts / 48 lesions (45 BCC, 3 Bowens)
- Median F/U 47 mo (range 31-60 mo)
 - 93% of pts had at least 36 mo f/u
- Gr 1 or less toxicity in all but 1 case
 - The Gr 2 case took 2 months to resolve
- 47/48 lesions NED with Median F/U 47 mo

Electronic Brachy Tx Results

Bhatnagar,A. BRACHY:2013

- 122 patients with 171 NMSC lesions were treated with EBS (Xoft)
- 40 GY / 8 fractions
- No recurrences after a mean f.u. of 10 months (range 1-28 months)
- 46 lesions (42 patients) had a f.u. of more than 1 year
- Cosmesis was excellent in 93% and good in 7%

Bhatnagar A. Nonmelanoma skin cancer treated with electronic brachytherapy: results at 1 year. Brachytherapy. 2013 Mar-Apr;12(2):134-40.



Acute Effects

SCC Treated with Valencia App





BCC of Lower Lip



3 wks s/p 42Gy/6fx

BCC of Lower lip



2 mo S/P 42 Gy / 6 fx



SCC Pre-tibial skin



IMTRT U
3mo s/p 42 Gy/6 fx

LATE EFFECTS /RESULTS



BCC Left Nose



5 yrs, 3 mo s/p 42 Gy/6 fx

Nodular BCC of Forehead



NED 30 mo S/P 42 Gy/6 fx



Nodular BCC



NED 28 mo
S/P 42 Gy / 6 fx

SCCA Left Medial Ankle

Pallor 29 mo s/p 42Gy/6 fx





Skin Surface Flaps and Molds

Catheter Flap

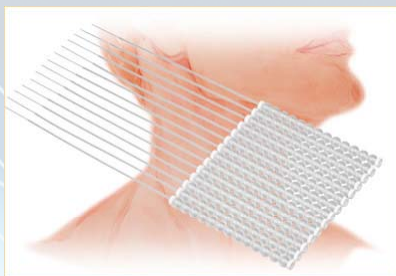




Surface Mould



Freiburg Flap





Freiburg Flap

Silicone rubber applicator material

- 5 mm distance between catheter plane and skin
- Predrilled holes 1 cm apart for embedding HDR catheters
- Can easily be cut to size to fit lesion
- Use 2 cm beyond lesion in all directions

HDR Surface Molds and Flaps Characteristics

- HVL for IR-192 is 3 mm Pb, allowing easy shielding selected areas of treatment field
- Treats more superficially than electrons
- Faster dose fall-off than superficial X-rays (100kVp)



HDR Surface Molds and Flaps : Advantages

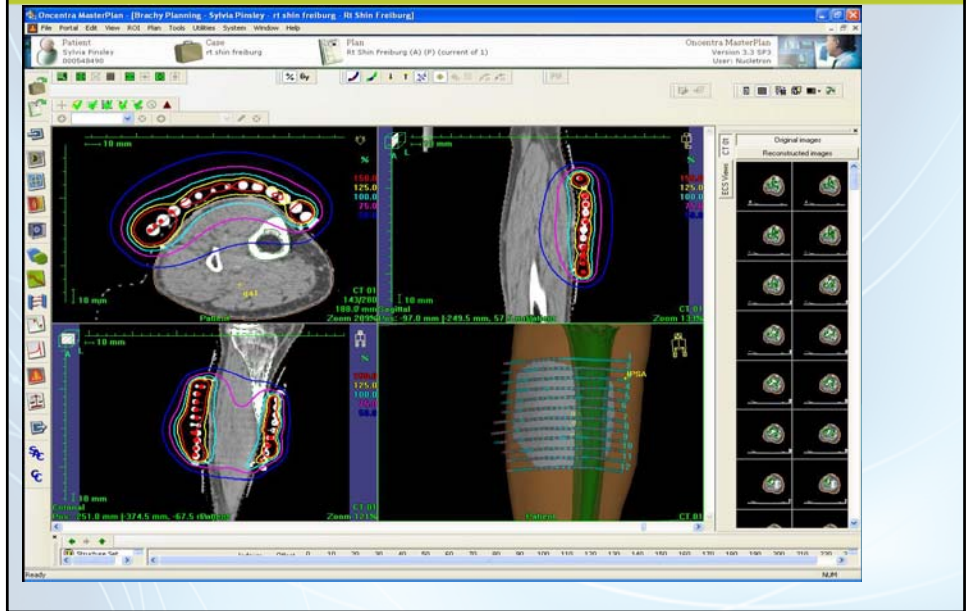
- Conforms easily to curvature of skin
- Optimization algorithms are used to improve dose homogeneity at depth
- Improved radiation safety profile relative to LDR
- Can be useful for sites other than skin, i.e., certain H&N sites and IORT

Large SCCA of Pretibial Skin





CT Planning





SCCA skin of left triceps region



SCCA skin of left triceps region

4 wks s/p 42 Gy/7 fx

5 mo s/p 42 Gy/7 fx





Interpret post-RT biopsies with caution

- False positives occur due to delayed tumor regression
- False negatives can occur due to sampling error (less likely for skin)
- Indeterminate biopsies are common showing radiation effect in residual tumor of uncertain viability
- **Best to wait until clear progression to biopsy**

Thank you

- Questions?



Case study

76 y.o gentleman with hx. of enlarging lesion over 7 mo.
Had been excised 3 times over past 2 yrs.

Now described by Derm. as 2cm with poorly defined borders.

After 3 stages of Moh's, still pos margins and exposed periostium. Prob perineural invasion confirmed by Path consultants at UCSF.

Large Flap reconstruction making area at risk difficult to assess

Large SCC S/P Mohs and Flap

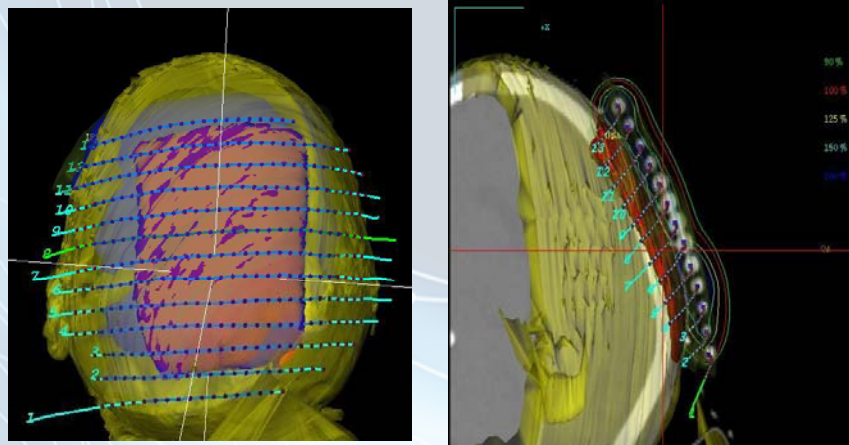




SCC Scalp S/P Mohs: Simulation

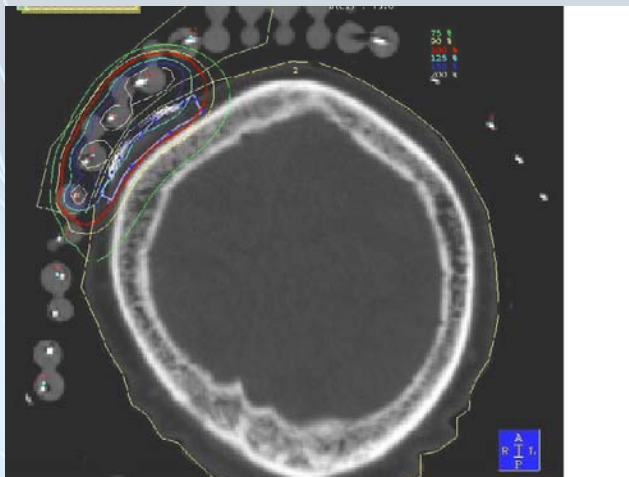


CT Planning 3-D Reconstruction





Treatment Planning



SCC Scalp S/P Mohs and Flap

