SURFACE MOULD
BRACHYTHERAPY
Brachytherapy

Brachytherapy consists of placing sealed radioactive sources very close to or in contact with the target tissue.

**TYPES**

1. Intracavitary
2. Interstitial
3. Intraluminal
3. Surface-Application
First **surface application** 1901
Dr Henri Danlos (Hospital St-Louis, Paris),
**Lupus** rather than for **skin cancer**

Dr. William (USA) reported his experience 1904
“one of acne, two of psoriasis, five of lupus vulgaris, two of lupus erythematosus, two of eczema, one of keloid, **five of rodent ulcer, 28 of epidermoid carcinoma and four breast cases.**”

“I never did a day's work in my life, it was all fun“

SURFACE APPLICATION

Consists of **applicator containing an array** of radioactive sources usually designed to deliver a uniform dose distribution to a skin/mucosal surface

- To deliver a reasonably homogenous dose to a surface.

- To give dose up to a particular depth with steep dose fall beyond $\implies$ Particle therapy ? Electron therapy
SURFACE APPLICATION

Why Still Attractive!

PATIENT FRIENDLY

Patient is not restricted to bed
No anesthesia
No pain or trauma
Better cosmesis
Easy convalescence

OTHER BENEFITS

No tissue injury
No risk of tissue sepsis
No risk of transplantation of tumour cells
Dose is more uniform than interstitial implant
SURFACE MOULD APPLICATION

PRE-REQUISITES

Tumour

Accessible site
Well defined margins.
Superficial (2-3mm)
No regional or distant spread
**SURFACE MOULD APPLICATION**

**PRE-REQUISITES**

**Surface Applicator/Carrier**
- Light Weight
- Snugly/Accurate Fit,
- Retained In Place
SURFACE MOULD APPLICATION

PRE-REQUISITES

Securing of Radiation Source/ Catheters
Source to surface distance must be maintained accurately all throughout

Mould = Carrier & Source
The carrier radium times.... Preloaded era

1. Press wool, elastoplasts
2. Wax – not preferred as source got stuck !!
3. Perspex : hard; shape prepared as per area required
SURFACE MOULD APPLICATION
Radium dosage...

Amount of Radium depends on:

✓ Desired Exposure
✓ Area treated
✓ Treating Distance (h)

• 1000R (Roentgen) was taken as clinical working unit
• Charts were prepared to show in milligram-hrs the amount of radium required on applicators to give 1000R over an area to a treating distance (h)
**SURFACE MOULD APPLICATION**

Radium dosage...

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**FIG**: Milligram Hours per 1000R for moulds of different areas and treating distances

<table>
<thead>
<tr>
<th>AREA (sq cm)</th>
<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1</td>
<td>30</td>
<td>119</td>
<td>268</td>
<td>476</td>
<td>744</td>
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<tr>
<td>2</td>
<td>97</td>
<td>213</td>
<td>375</td>
<td>598</td>
<td>865</td>
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<td>4</td>
<td>141</td>
<td>278</td>
<td>462</td>
<td>698</td>
<td>970</td>
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<td>6</td>
<td>177</td>
<td>333</td>
<td>536</td>
<td>782</td>
<td>1066</td>
</tr>
<tr>
<td>8</td>
<td>206</td>
<td>384</td>
<td>599</td>
<td>855</td>
<td>1155</td>
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<td>10</td>
<td>235</td>
<td>433</td>
<td>655</td>
<td>923</td>
<td>1235</td>
</tr>
</tbody>
</table>
SURFACE MOULD APPLICATION

Radium dosage...Example?!

If an area of 8 sq cm is to receive 6000R over 50 hours for a mould for which $h = 1.0 \text{ cm}$;

$mgh$ per 1000R for 8 sq cm and $h = 1$ is $384$

Thus, for 6000 R : $6 \times 384 = 2304 \text{ mgh}$ is needed

Thus, radium reqd. for 50 h treatment $= 2304/50$

$= 46.08 \text{ mg}$
SURFACE MOULD APPLICATION

Classes of Moulds: Basis of Geometry

Classically the Rules were defined according to Manchester system for distribution of Radium source.

Uniform dose coverage of whole lesion with margin in all directions by single isodose (< 10% variation)

Ralston Paterson and H. M. Parker
A DOSAGE SYSTEM FOR GAMMA RAY THERAPY
PART I
By Ralston Paterson, M.D., F.R.C.S., D.M.R.E.
(Received June 7, 1934)
SURFACE MOULD APPLICATION

BASICS OF THE RULES

Dimensions Of Rx Area To Be Treated = Lesion + Margin  
(Approx Circular Area Of Diameter D)

D= diameter  
h= applicator thickness  
d= depth to be treated

For all classes;
1. **Thickness** of carries = distance of source to surface, depends on depth to be treated  
   (assessed clinically)
1. Approx **distance** = 2 x **depth**  
   (h=2 Xd)
SURFACE MOULD APPLICATION
Planer Geometry Of Arrangement

CIRCLES
Optimal technique
The Radium sources (RAS) placed circumferentially around lesion

h = applicator thickness
d = depth to be treated
D = diameter

<table>
<thead>
<tr>
<th>D/h % Radium</th>
<th>&lt; 3</th>
<th>3 to &lt;6</th>
<th>6 to &lt;7.5</th>
<th>7.5 to &lt;10</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer circle</td>
<td>100</td>
<td>95</td>
<td>80</td>
<td>75</td>
<td>70</td>
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<tr>
<td>Inner circle</td>
<td>0</td>
<td>0</td>
<td>17</td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td>Centre spot</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
SURFACE MOULD APPLICATION
Planer Geometry Of Arrangement

Square … Rectangle

RAS in line around the periphery with uniform linear density
If length of one side = 2 h, NO further radium needed.
Additional lines are added parallel to the side to divide area
into strips of width=2 h

One added line : Linear density 1/2 of periphery
Two added lines: Linear density 2/3 of periphery

Ratio of sides of rectangle . . . 2 : 1 3 : 1 4 : 1
Percentage to be added . . . 5% 9% 12%
SURFACE MOULD APPLICATION
Planer Geometry Of Arrangement

SPECIAL SITUATIONS : Curved Surface
SURFACE MOULD APPLICATION
Planer Geometry Of Arrangement

SPECIAL SITUATIONS: Sandwich Technique

Tissue Open On Both Sides: Lip, Pinna

Fall in intensity of doses can be from one mould balanced by other
SURFACE MOULD APPLICATION
Modern Times ....... Need for a Change!!!

Change In Carriers Material Polyacrylate/ Polymethylmethacrylate Preloaded To Afterloading
Change In Sources : Radium To Iridium ( LDR <>HDR)

Human Safety And Precision

• Free style
• Based on Manchester system of rules
• Stepping source dosimetry: optimize (Effective Activity, Time)
• Rules – parallel catheter with STEP source loading : distance (0.8 – 1.2 cm gap). Approx 1 cm beyond the lesion in all direction, follow the contour of lesion equidistant from surface at all levels
• Total dose – 60 Gy (LDR EQUIVALENT)
• Fractionation – 3-4 Gy / # with 2 # per day 6 hr gap
SURFACE MOULD APPLICATION
Modern Times .......How do we do it !!!

55 Yr /Male / Chronic tobacco chewer/
2X2 cm well defined ulcer in hard palate, no nodes
Bx- squamous carcinoma
Diagnosis : Ca Hard Palate T1N0M0

Explain Procedure/ Informed consent
Communicate with Team >>>>>>

Comfortable patient positioning
Lesion to be marked with indelible ink
Impression of lesion and surrounding structures taken with dental compound
Ensure accurate fitting of the surface applicator
SURFACE MOULD APPLICATION
Modern Times .......How do we do it !!!

Marking of the exact area to be treated on the mold
Thickness of mould $\leq 2$mm

Wax build up( thickness) applied on inner surface of applicator (total Rx distance 5 mm)

Catheters placed parallel, equidistant beyond lesion (0.8 – 1.2 cm spacing)

Another layer of wax put to cover catheters firmly secured in position & to push normal structures away
Number/ flag the catheters
SURFACE MOULD APPLICATION
Modern Times .......How do we do it !!!

Applicator is applied on to patient check comfort of patient May repeat several times till accustomed.

Planning CT cuts taken(3 mm) the region of interest & transferred to planning system

All catheters are tracked and set in axis

Source loading done from tip end of catheter (stepping source)
SURFACE MOULD APPLICATION
Modern Times .......How do we do it !!!

Evaluate plans

Dose is prescribed at 85% reference isodose level (GREEN)

Or at a certain depth/ dose points

Optimization done to get ideal dose distribution

Remove applicator

Rinse in free flow water

Keep it safe for next application
SURFACE MOULD APPLICATION
Modern Times ...Pictures say it all !!

Explain and reinforce

Oral / Skin hygiene,
Time of onset acute reactions
Medications,
Follow up surveillance
TREATMENT OF SKIN CARCINOMAS OF THE FACE BY HIGH-DOSE-RATE BRACHYTHERAPY AND CUSTOM-MADE SURFACE MOLDS

BENJAMIN GUIX, M.D., PH.D., M.B.A.,* FERNANDO FINESTRES, M.D.,* JOSÉ-IGNACIO TELLO, PH.D.,* CÉSAR PALMA, M.D.,* ANTONIO MARTINEZ, M.D.,* JOSÉ-ROMÁN GUIX, M.D., PH.D.,* AND RICARDO GUIX, M.D., PH.D.*

*Department of Radiation Oncology. Fundació IMOR, Institut Mèdic d’Onco Radioteràpia, CORMEN sl. Universitat de Barcelona, Barcelona, Spain

Fractionated high dose rate brachytherapy moulds — a precise treatment for carcinoma of the pinna

Ernest Allana,*, Anthony Stantonb, David Pyec, Conor Collinsd, Lesley Perryc, Maeve Filbye, John Wilkinson

Treatment of facial cutaneous carcinoma with high—dose rate contact brachytherapy with customized molds

Maria Maroñas¹, Jose Luis Guinot¹, Leoncio Arribas¹, Maria Carrascosa¹, Maria Isabel Tortajada¹, Ruth Carmona², Marian Estornell¹, Rodrigo Muelas¹
## SURFACE MOULD APPLICATION

### Literature review

<table>
<thead>
<tr>
<th>AUTHOR (Pt no.)</th>
<th>MEDIAN FOLLOWUP</th>
<th>LOCAL CONTROL</th>
<th>COSMESIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mazeron et al; 1988 (1676)</td>
<td>24 mths</td>
<td>&lt; 2 cm = 96%&lt;br&gt;2.1 – 3.9 cm = 88%&lt;br&gt;4 cm = 81%&lt;br&gt;Radical = 95%&lt;br&gt;Recurrent = 88%</td>
<td>Not Reported</td>
</tr>
<tr>
<td>Rio et al; 2005 (97)</td>
<td>55 mths</td>
<td>97.4% DFS at 5y&lt;br&gt;Radical = 91%&lt;br&gt;Post op = 80%</td>
<td>Good (70%)</td>
</tr>
<tr>
<td>Svoboda et al; 1995 (130)</td>
<td>9 mths</td>
<td>100%</td>
<td>Excellent</td>
</tr>
<tr>
<td>Allan et al; 1998 (13)</td>
<td>18 mths</td>
<td>100%</td>
<td>Excellent</td>
</tr>
<tr>
<td>Maronas et al; 2010 (51)</td>
<td>45 mths</td>
<td>89% at 5 yrs</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

Adapted from Brachytherapy (10)2011:221-7
SURFACE MOULD APPLICATION

Conclusions

Excellent Non invasive treatment

Short treatment times

Selection of patient is key
   “success and good cosmesis”
Thank You
Food for thought…!
Answer