A New Scanning Technique For
Electron Depth Dose Curves
With Beveled IORT Cones

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TASK:

To measure central axis electron depth dose/ionization data on beveled IORT cones. Data collected perpendicular to the beveled surface and along the true beam axis is compared to determine which measurement procedure is proper.

PROCEDURE:

Using the vector scanning capabilities (see fig. 1) of a commercially available computerized water phantom, measurements were made:

1- perpendicular to the surface of the phantom, and
2- along the true beam axis (i.e.: bevel angle of the cone),

for a series of plastic IORT cones, fabricated for a Philips SL 75/20 accelerator at UMDNJ, Newark, New Jersey.
Fig. 1A: Vector Scanning

Data is collected in the direction of incident radiation. Direction of scan, number of data points, distance between data points and positioning speed are selectable.

Fig. 1B: Conventional System

Typical water phantom scanning configuration:
Data can ONLY be collected in direction "A" or direction "B", regardless of the direction of incident radiation.
DATA FILE:  VEC_06

6 Mev electrons,
30 degree bevel,
8 x 12 cm cone,
100 cm SSD.

Vector scan angle:
Perp. = 0 deg to water surface,
dashed line.
Vec. = -30 deg to water surface,
solid line.

Rp    d50    E0
(mm)  (mm)   (MeV)

Perp. 22.73  15.19  3.54
Vec.  26.62  17.33  4.04
DATA FILE: VEC_20

20 MeV electrons,
30 degree bevel,
8 x 12 cm cone,
100 cm SSD.

Vector scan angle:
- Perp. = 0 deg to water surface, dashed line.
- Vec. = -30 deg to water surface, solid line.

<table>
<thead>
<tr>
<th>Rp (mm)</th>
<th>d50 (mm)</th>
<th>E0 (MeV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perp.</td>
<td>53.28</td>
<td>66.08</td>
</tr>
<tr>
<td>Vec.</td>
<td>94.80</td>
<td>82.45</td>
</tr>
</tbody>
</table>
Beam profiles at 50 and 60 mm depths.

100 cm SSD.
15 deg bevel.
14 MV electrons.

Data files: I15B14MREC
DATA FILES: I30B14MREC

Beam profiles at 50 and 60 mm depths.
5, 10, 20, 30, 40, 50 cm SSD.
8 x 12 cm cone.
30 deg bevel.
14 MV electrons.
ANALYSIS:

Since \( C_{AX} \) represents the true path length of electrons, and

\[
\cos(\text{bevel}) = \frac{\text{perpendicular distance}}{\text{slant distance}}
\]

where "bevel" is the angle of the cone with the water surface.

Then for a 30 degree beveled cone:

\[
\cos(30) = \frac{R_p - \text{perpendicular scan}}{R_p - \text{slant scan}}
\]

<table>
<thead>
<tr>
<th>06 Mv:</th>
<th>22.73</th>
<th>26.62</th>
<th>.854</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 Mv:</td>
<td>55.39</td>
<td>63.31</td>
<td>.875</td>
</tr>
<tr>
<td>20 Mv:</td>
<td>83.28</td>
<td>94.80</td>
<td>.878</td>
</tr>
</tbody>
</table>

ave. = .869

\[
\cos(30) = .866
\]

\[
\frac{|.869 - .866|}{.866} \times 100 = 0.3\%
\]
CONCLUSIONS:

By comparing the ratio of Rp-perpendicular to Rp-vector it is readily apparent that the central axis data for beveled electron cones is a function of angle. Hence, electron depth-dose or depth-ionization data should only be collected along the true beam axis.

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1 - BeamScan™, PTW/Nuclear Associates, division of Victoreen, Carle Place, New York.