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November 9, 1979

TO: M.M. Kligerman, M.D.

FROM: Al Smith, Mike Collier AR8, MC

SUBJECT: Range Shifter Functions

The range shifter function design program has been extensively modified. The program is now much easier to use and produces range shifter functions resulting in depth dose distributions much improved over those previously used. The major changes in the program are:

1. The use of a linear function instead of a quadratic to calculate the shape of the range shifted depth dose curve between the proximal and distal stopping pion distribution;
2. The number of steps is now variable depending upon the size of the spread peak. Previously the number of steps was fixed at 20 for all functions;
3. The step size in the center section of the peak is 0.5 cm. Previously the step size was variable;
4. The time spent at each step is variable. Previously the time was fixed; and, the large initial step from minimum thickness is now four small steps of increasing size and decreasing time for each function.

We have redesigned range shifter functions for tune 16A and are in the process of designing functions for tunes 12B and 23B. (These are tune numbers 23, 56, and 54, respectively.) In doing this we have entered new high LET data as measured by silicon detector and normalized to Rossi chamber measurements. We find that for the medium momentum beam the stated high LET dose is now 65% of the stated high LET dose 2 years ago. Therefore, we have used a criteria of minimum high LET dose of 6.5% instead of 10% used previously, thereby keeping the same amount of actual high LET dose as before. The amount of high LET dose for the low and high momentum beams will be adjusted accordingly, i.e., the measurements of high LET dose for the high momentum beam is 56% of that previously used so the percentage of high LET dose is kept at 5.6%, minimum, of the total dose. In this manner we have adjusted the criteria to give us the same high LET component as before.

You will find that the new range shifter functions are in general much flatter and smoother while maintaining about the same sharpness of of fall-off distally. The following table gives comparison of the approximate distal edge percentage of the new and old functions.

Distal Percentage

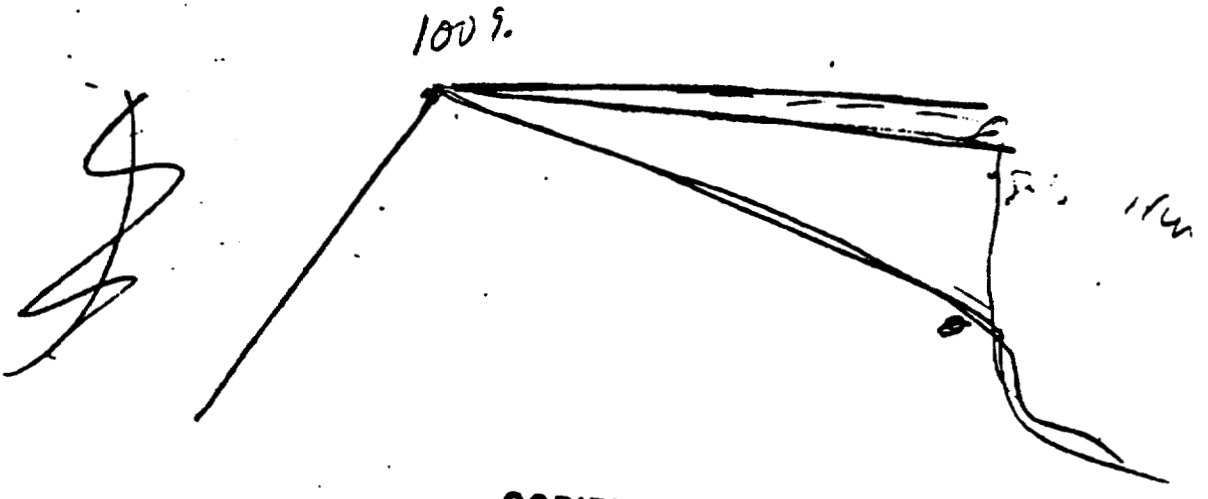
Size (cm)	Old	New
3	100	100
4	100	100
5	98	100
6	95	100
7	93	100
8	90	98
9	82	98
10	84	97
11	65	90
12	62	86
13	57	82
14	57	77

Note that now we can treat much larger treatment volumes with single fields and have a flat dose. Also, because of the much decreased slope of the total dose, which is compensated by an increasing slope of the high LET dose with depth, our single fields will have a much flatter dose equivalent.

We have preserved our old range shifter functions so that anyone wishing to reproduce old biology, patient, or dosimetry data may do so. Also the new rangeshifter functions and calculated depth-dose curves are available for inspection at any time.

ARS/po

cc: All Biomed personnel
[redacted] Bradbury
S. Wilson



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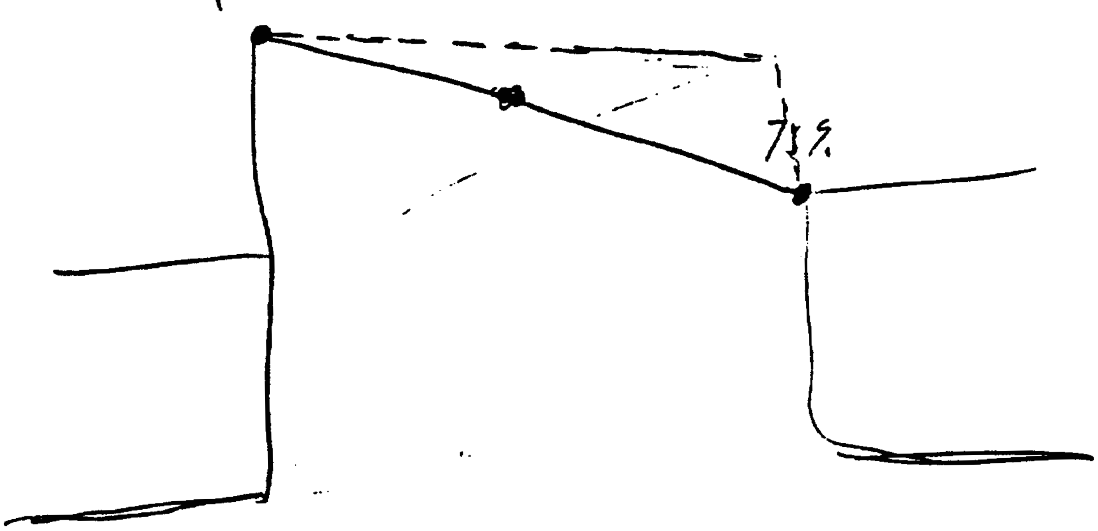
0) All built upon [illegible] measurements - to total dose

1) How did Amos's normalize to total dose / measurements made at [illegible]?

2) Electron contamination

3) How much did Amos differ from Richman?

4)



5) Do kidney - sphere

6) Microdosimetry - Richman 3 beams Total dose and kidney dose done simultaneous - no calibration

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