FOR CYLINDRICLAL PHANTOM EFFECTS OF PHANTOM VOLUME ON DOSIMETRIC CHARACTERISTIC OF LDR BRACHYTHERAPY SOURCES

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1. INTRODUCTION

In brachytherapy studies, spherical phantom is used for both TLD and Monte Carlo methods. We have designed cylindrical geometries for I^{125} seed and water phantom in EGSnrc-MP Monte Carlo Code. Aim of determination of dosimetric characteristics is providing uniform dose distribution in a medium that exposure to radiation along seed length.

Instead of solid water used in experimental studies, for Monte Carlo method, liquid water is used as phantom material so we used H_2O data as medium of phantom. Thin 30cmx30cm cylindrical material was divided into equal partition along Z axis by planes. Every partition keeps a dose point. Calculated doses in volumes have been used to obtain radial dos function g(r) and anisotropy function F(r, θ). Functions are,

$$g(r) = \frac{\dot{D}(r,\pi/2).G(l,\pi/2)}{\dot{D}(l,\pi/2).G(r,\pi/2)} \qquad F(r,\theta) = \frac{\dot{D}(r,\theta).G(r,\pi/2)}{\dot{D}(r,\pi/2).G(r,\theta)}$$

To separate points in angular placement this partitions have been divided into thin rings by cylindrical shells. In cylinder profile, a matrix of dose points was obtained. Model 6711 source is symmetric for both axis of cylinder so we studied in quarter partition as 90^0 geometry.

Using acquired dose values on points and reference point. Radial dose function and anisotropy function have been calculated. Function values have been compared with TG-43 Report data. There are some differences for anisotropy function between the report and our values. Different geometrical approaches have given different results on dosimetric parameters around TG-43 Report dose calculating formalism.

2. MATERIAL AND METHOD

Phantom volume has been changed with Radius= 15, 10, 9, 8, 7, 6, 5cm. Phantom volume is chosen in sufficient value to simulate Rayleigh scattering properly. Especially at low energies Rayleigh scattering is more effective event. At several centimeter radial distance, Dose rate decreases to about 1/1000. Therefore at smallest phantom volume there is no large deviation of dosimetric parameters.

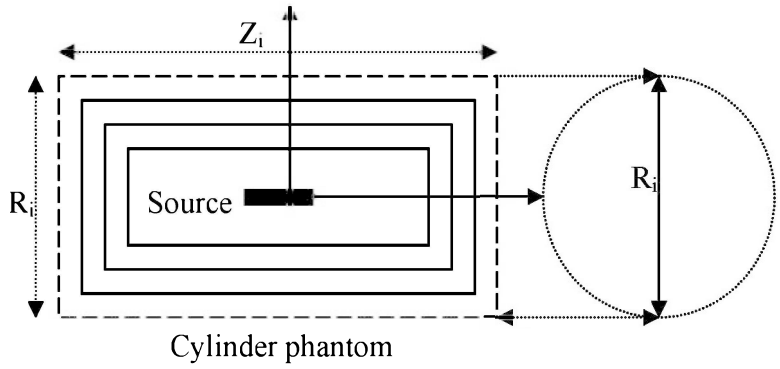


Figure 1. Cylinder profile with different radius of phantom and centered source.

As referred this geometrical design, dose calculations were done for different radius of phantom radius. Instead of comparing results with default geometry data, new data division to values with 15cm radius of phantom were used to show expected changes. Calculations were done for g(3), g(4), g(5)

Table 1. Radial dose function fraction values versus different radiuses of phantom

Phanton radius (cm)	**gR(3)/ g15(3)**	**gR(4)/ g15(4)**	**gR(5)/ g15(5)**
Cylinder(R,Z) R=Z			
5.5	0.996	0.978	0.909
6	1.002	0.990	0.940
7	1.001	0.994	0.971
8	1.000	1.001	0.985
9	1.000	1.002	0.990
10	1.002	1.004	0.991
11	1.003	1.005	0.992
12	1.002	1.002	0.991
13	1.001	1.000	0.997
14	1.001	1.001	1.002
15	1.000	1.000	1.000

There are so small differences for several radiuses for g(r). Also this examining was performed for F(r, θ) function. Any changing did not observe for anisotropy function. Anisotropy function was given in table 2 as compared TG-43 data

Table 2. Anisotropy function dataset compared with TG-43 report values.

Angle	F(this study)	F(TG-43)
10	0.54	0.58
20	0.69	0.727
30	0.82	0.842
40	0.88	0.926
50	0.94	0.97
60	0.95	0.987
70	0.98	0.996
80	0.96	0.999

3. CONCLUSION

Generally in Monte Carlo and TLD (thermo luminescence dosimeter) phantom radius is 15cm as default. It is accepted sufficient for to take in account Rayleigh scattering effects. In this study we show that for LDR sources phantom volume can be smaller for example between 6cm and 10cm. this supplies us shorter running time of Monte Carlo code (simulation program) and economical benefit in experimental works. For smaller volumes dosimetric characteristics does not change over error of values.

4. REFERENCES

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