Updating the Planar Patterson-Parker Table Using the TG-43U1 Recommended Dosimetric Parameters

Cs-137 and Ir-192 sources were introduced in the field of brachytherapy in order to eliminate some of the problems existed with Radium-226, such as the production of Rn-222. However, milligram (mg) of radium equivalent continued to be one of the quantities used for clinical procedures. Different classes or systems of radiation dosimetric techniques such as Paterson-Parker and Quimby created tabulated values of mghrs assuming that all of these sources have the same tissue attenuation. In this project, the accuracy of this assumption has been evaluated by updating the planar Patterson-Parker Tables using the published TG-43U1 dosimetric parameters for Cs-137 and Ir-192 sources.

Dose distributions of planar implants with Flexisource Ir-192 and 3M Cs-137 have been calculated in this project. The integrated doses were calculated at several points above a planar implant, containing a matrix of n × m sources (where n and m =2, 3, 4… 10), using their most recently published TG-43U1 parameters. The spacing between the sources on each row was selected to be 1 cm for Ir-192 and 2 cm for Cs-137 source. The larger spacing for Cs-137 was chosen in order to avoid the overlap of the sources. However, the spacing between the rows, for both source types, was chosen to be 1 cm. A comparison of dose profiles along the two orthogonal directions (X and Z axes), for several different distribution of the source strengths in the peripheral and middle of the implants, were utilized to achieve the maximum dose coverage from a given implant. The results of these distributions were compared with the values obtained using Patterson-Parker’s recommendations. The updated Paterson-Parker tables have been generated for planar implants with Cs-137 and Ir-192 sources by two independent methods, namely, Monte Carlo simulation technique and using a commercially available treatment planning system.

Figure 1 shows the schematic of the diagram of the source arrangements and calculation points for a planar implant, used in this project. Table 1, shows a comparison of the Monte Carlo simulated dose profiles for a 5 × 5 source arrangement implant with Ir-192 as compared with the calculated data using the TG-43U1 parameters, using the 2/3 × 1/3 source strength distribution scheme on the peripheral and central parts of the implant. Figures 2 and 3 show the dose profiles of the Cs-137 and Ir-192 implants as a function of the loading scheme. These figures were obtained at 0.5 cm and 1.0 cm height from a 7 × 7 Ir-192 implant area. These graphs are used to select the best loading schemes that are providing dose profile with ±10% of the central dose. These results indicate that at 1 cm height, the length of the area covered by the prescribed dose (1000 cGy ±10% in this case) is 4.2, 6.2, and 7.0 cm for 1/2 × 1/2, 2/3 × 1/3, and 3/4 × 1/4 loading schemes, respectively. However, for 0.5 cm height, the coverage is 4.6 cm and 6.2 cm for 1/2 × 1/ and 2/3 × 1/3, loading scheme, respectively, and 3/4 × 1/4 is not suitable. Dose profiles of both Cs-137 and Ir-192 for the same implant area and different distribution of the source strengths have been investigated in this project. Figure 4 the mghrs of Cs-137 and Ir-192 that are needed to produce 1000 cGy at the reference point, as a function of the implanted area. This figure indicates that the mghrs needed to produce a given dose with Cs-137 is not identical to the one with Ir-192 sources. The differences are attributed to the differences in the attenuation coefficients (i.e. radial dose function) of the two sources. Table 2 shows the differences between the updated and the published PP Table for Cs-137 and Ir-192 sources, as a function of the implanted area. These differences are also attributed to the differences of the tissue attenuations and possibly anisotropy of the sources.

In summary, an updated Paterson-Parker Table has been generated using the most recently published TG-43U1 dosimetric parameters of Cs-137 and Ir-192 sources. In addition to the central axis, dose profiles in two orthogonal directions were utilized to extract a better coverage of the treatment area. The results indicated that the mghrs used for Cs-137 source in a planar implant is less that the mghrs needed for Ir-192 in order to achieve the same dose coverage. In
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addition, for the same implanted area, less mghrs is needed to produce the required dose distribution that PP Table

Table 1: comparison of the integrated dose on the central axis and several off axis points of 5 × 5 (20cm2) implant with Ir-192, calculated using the published TG43U1 parameters and Monte Carlo and a commercially distribution treatment planning system. These calculation were performed 2/3 × 1/3 source strength distribution.

Figure 1: schematic diagram of the brachytherapy source arrangements used for updating the Paterson and Parker’s planar Table. In this arrangements the spacing between the sources (s) were chosen to be 1 cm and 2cm for the Ir-192 and Cs-137 sources, respectively

Table 2. Comparison of the updated and original PP Table for Cs-137 (upper panel) and Ir-192 (lower panel).

References:

