

Treatment-plan optimization for soft-tissue sarcomas using a genetic algorithm

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The treatment of soft-tissue sarcomas using interstitial brachytherapy entails placing catheters at regular intervals in the target and then loading them with ribbons containing Ir-192 or I-125 seeds. The prescription (typically 45 Gy) is given on the hull that surrounds the catheters approximately 0.5-1-cm away. The catheter surface has an irregular shape; thus the single-plane approximation is inapplicable. Furthermore, employing single-strength sources would result in unsuitable plans. The solution adopted at MSKCC is to use combinations of several seed strengths. If the plan is designed manually it may take up to 6 hours to complete. This is inadequate because a manual plan is suboptimal, and because a 24-hour treatment delay is likely (ribbons ordered after 4pm cannot be delivered next day). As an alternative, we have designed software that selects the distribution of seeds needed for optimal coverage of the target. The input consists of seed coordinates (reconstructed from isocentric films), prescription points, and a list of available seed activities. The optimization is performed using a genetic algorithm. A typical plan obtained in an hour produces better than 80% coverage (against 50% in manual planning). If the prescription hull is more than 7.5-mm away from catheters 95% coverage can be routinely achieved.