The Use of Directional Interstitial Sources to Reduce Skin Dose in Breast Brachytherapy

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Abstract

The use of interstitial brachytherapy sources for breast cancer treatment has led to excellent tumor control and good to excellent cosmesis. However, the use of high-dose rate (HDR) brachytherapy results in a large volume of skin receiving doses in excess of 10 Gy (V100), which increases the risk of late subcutaneous fibrosis. To investigate the feasibility of reducing the skin dose with temporary LDR multicatheter breast implants with the use of directional sources, a study was conducted using directional 125I sources in comparison to conventional HDR interstitial breast brachytherapy.

Methods and Materials

The effectiveness of directional sources was compared to HDR conventional sources using (1) target volume coverage, (2) dose homogeneity index (DHI) defined as 1 - (V150/V100), and (3) the skin surface areas receiving 30%, 50%, and 70% of the prescribed dose. The results show that using directional sources can significantly reduce the skin dose while maintaining the same target volume coverage and dose homogeneity.

Results and Discussion

The directional sources can be used for one of three purposes: (1) to reduce skin dose (D10), (2) to improve dose uniformity within the transverse plane of the source, and (3) to shield regions in the transverse plane of the source. The optimized design will henceforth be referred as uniformly treated half and sufficiently shielded quarter and can be accomplished with a simple design as in Fig. 1.

Conclusion

In summary, the study elegantly balances the interplay of the various factors contributing to the skin dose. It is clear that the use of directional sources can reduce the skin dose while maintaining the same target volume coverage and dose homogeneity. This work has significant implications for the optimization of breast brachytherapy treatment plans.