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## Comparison of various radiation therapy techniques in breast cancer with inclusion of internal mammary nodes by use of a RANDO phantom and thermoluminescent dosimeter

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**Introduction:** Breast cancer treatment techniques include mainly surgery, radiation therapy, chemotherapy, hormone therapy, targeted therapy. Breast cancer patients may experience local-regional recurrence in the chest wall or regional nodes. A combination of surgery followed by radiation therapy significantly reduces the risk of local recurrence. One of the controversial issues of the radiotherapy treatment of breast cancer is irradiation of the internal mammary nodes (IMNs). Indeed, the existence of the IMNs in the target volume may increase the heart or lungs toxicity. The aim of this study was to compare breast cancer radiotherapy techniques including wide tangent (WT), oblique parasternal photon (OPP), and oblique parasternal electron (OPE) techniques in terms of the coverage of left IMNs, left axillary lymph nodes, left supraclavicular nodes, and the chest wall; and the dose received by the heart and left lung.

**Method:** An adult Rando phantom was used as a hypothetical patient. TLD-100 and TLD-700 chips were used for photon and electron dosimetry, respectively. Prior to irradiation TLD chips of both types were annealed and calibrated. First, the organs were contoured, then TP was performed by Prowess Panther version 5.2. Field arrangements in all 3 TPs included a 15MV anterior supraclavicular field and a 15MV posterior axillary field. Furthermore, two opposed tangential 6MV photon beams were planned in the WT technique and the internal tangent included parasternal lymph nodes. The multileaf collimator was used in this technique. In OPP and OPE techniques, tangential 6MV photon beams were covered the tumor bed only. An anterior oblique 6MV photon field and an anterior oblique 15MeV electron field abutted to the internal tangent in OPP and OPE techniques, respectively to cover IMNs. In OPE technique for anterior oblique electron field, a 7.5 mm thick lead shield was also used. For WT and OPP techniques, 28 TLD-100 were placed in pre-selected points of the phantom within the slices No. 10-16 and then the phantom was irradiated. This procedure was repeated 4 times for all techniques and the average of 4 measurements was calculated. The OPE technique was performed in two steps. In the first step, 28 TLD-100 chips were used, similar to the two previous techniques. Then the phantom was irradiated according to the relevant TP only by photons. In the second step, 16 TLD-700 were placed in the region of the parasternal field and its surrounding area, within the slices No.12-16. Also, TLD-700 chips were placed exactly in the same places as TLD-100s in the latter step. Then phantom was irradiated with the anterior oblique electron field. Finally, the dose values obtained from the two steps were added point to point. This procedure was repeated 4 times. For dose values obtained for lymph nodes and chest wall, Tuckey's test and for corresponding results for the heart and left lung, the non-parametric Mann-Whitney U test were used.

**Results:** a) Left supraclavicular nodes: In the WT and OPP techniques, the left supraclavicular nodes were enveloped by the adequate equivalent dose and no statistically significant differences were observed. But the mean absorbed dose received by this nodes in the OPE technique was significantly higher than the other two techniques. b) Left axillary lymph nodes: In all techniques, the left axillary nodes received defined equivalent dose and no statistically significant differences were observed. c) Left IMNs: In WT and OPP techniques, the left IMNs received an adequate equivalent dose, but the OPE technique didn't provide sufficient coverage for the IMNs. Nevertheless, because of the large standard deviation in OPE technique, no statistically significant differences were observed among all 3 techniques. d) Chest wall: In all techniques, left chest wall received

an adequate equivalent dose. So from this viewpoint, the 3 techniques were statistically similar. e) Left lung: The mean dose by the left lung for WT was lower compared with the OPP technique; nevertheless, it was not significant because of the large standard deviation among the WT data. The left lung dose from OPE technique was not significantly lower than WT technique, while it was significantly lower than absorbed dose from OPP technique. The mean dose of the left lung in the OPP technique was more than the lung tolerance dose (20 Gy). f) Heart: The doses received by heart from three different techniques were statistically different. The lowest heart dose was obtained from the WT technique, and the highest from the OPP technique. The results of measurements are shown in the table.

**Conclusion:** Based on the results of this study, WT technique is a better technique compared to OPE and OPP techniques. Because WT technique provides a good coverage for lymphatic nodes, especially for the IMNs and spares critical structures properly.

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