

## **Characterization of an add-on directionally shielding for a gamma probe for use in sentinel node localisation**

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### **Aim:**

Lymphoscintigraphy with  $^{99m}\text{Tc}$ -labeled colloids and subsequent localisation of the sentinel node with a gamma probe has gained widespread acceptance. The procedure is applied to several cancers that have a lymphatic metastatic potential. In many cases the sentinel node basin is localised only a few centimetres away from the tumour/injection site, or close to excreted activity in the ureters or urinary bladder. A high count contribution from such neighbouring accumulations of activity makes detection of sentinel nodes difficult because of reduced signal to background ratio. Effective and selective stopping of the photons coming from such unwanted sources would facilitate the detection of the sentinel nodes. This study characterizes the shielding properties of a directionally selective lead collimator made as an add-on to a gamma probe.

### **Materials & Methods:**

The collimator is a lead shield, constructed to stop gamma rays that arrive from directions extending to  $180^\circ$  of the circumference of the detector crystal. To characterize the shielding efficacy of the collimator, we measured the counts while the probe was moved relative to a point source of  $^{99m}\text{Tc}$ . The probe was fixed to a stereotactic device that enabled precise positioning in three orthogonal directions. To simulate the procedure used during surgery, the probe was submerged in a water tank protected by a thin rubber coating. Scans were obtained parallel to the long axis of the probe and parallel to its surface in various distances from the point source, up to a maximum of 9 centimetres distance. Positions, counts, durations of measurements and points of time were noted systematically and entered into a file that was later fed into a tailored computer program. This program performed decay corrections, standardization to counts per second and MBq, and finally produced curves and sensitivity plots.

### **Results:**

Moving the probe in the axial direction with and without shielding and with the source 0.0, 3.0, 6.0 and 9.0 cm from the probe, we found that in the region where the unshielded background contribution was largest, this contribution was reduced by a factor of more than 10 by the lead shield. This finding was also reflected in 2D isosensitivity contour plots derived from the measurements. The shielding efficacy was at the highest close to the radioactive source.

### **Conclusion:**

The use of a partial collimator of the gamma probe during sentinel node localisation lowers the disturbing background activity without affecting the probe's sensitivity in a  $180^\circ$  circumference in the direction of the lymph node search. The collimator has the potential to effectively reduce unwanted counts from accumulations of radioactivity in the bladder, ureters or at the injection site, and from scatter in the tissue arising from

these origins. This is anticipated to be of particular interest when the sentinel node is located close to the injection site, as it may be in breast cancer, or close to the bladder, as for sentinel node identification in the pelvic and inguinal regions.