AUTOMATION OF TLD DOSIMETRY FOR SIMPLE RADIOGRAPHIC PROCEDURES USING THE HARSHAW 6600 MONITORING SYSTEM

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Introduction

Simple radiographic procedures are the most frequently performed x-ray examinations and as a result patient doses should be monitored. In view of the number of examinations performed, it is vital that automated methods of performing direct patient dose measurements are developed. The Harshaw 6600 extremity monitoring system has the potential for use in performing a large scale patient dose survey during radiographic procedures but has not been previously used for this purpose. The potential advantages of this system are, fast readout rate, reproducible time temperature profile, no mechanical contact with the dosemeter and barcode identification allowing individual elemental correction coefficients to be applied to each chip which improves the precision of the result.
Before this system could be used for this purpose, it was rigorously tested. The reproducibility, batch uniformity, detection limit, energy response, fading were all assessed. The overall uncertainty of the results was assessed and compared with the value recommended by the U.K. National Patient Dosimetry Protocol (1). This system has been used to measure fifteen hundred patient dose measurements to date.

Method

The examinations chosen to monitor were chest PA, abdomen AP, pelvis AP, lumbar spine AP and lumbar spine LAT as these are the most frequently performed radiographic exposures. Each department were sent a set of one hundred TLD chips (extremity monitors, x-rads) to use on the patients and ten x-rads to use as background dosemeters, a set of forms to record both patient and examination details. The radiographer placed an extremity monitor in the centre of the field of view, the exposure was taken and the extremity monitor was removed and attached to the patients form. The aim was to collect twenty patients for each category. Once the extremity monitors had been used they were returned to the regional centre where the results were processed and the patient and examination details along with the dose results were entered onto the regional database. A report was generated giving a summary of the dose information.

Results

Table I Performance Testing Results

Test	Results
Reproducibility	2.9%
Batch Uniformity	3.1%
Detection Limit	0.1mGy
Fading (pre-irradiation)	25% over 3 months
Fading (post irradiation)	12% over 3 months
Energy Response	1.6 - 1.3 rel Cs^{137} energy range 45-104keV
Overall Uncertainty at 0.1mGy	20.7%

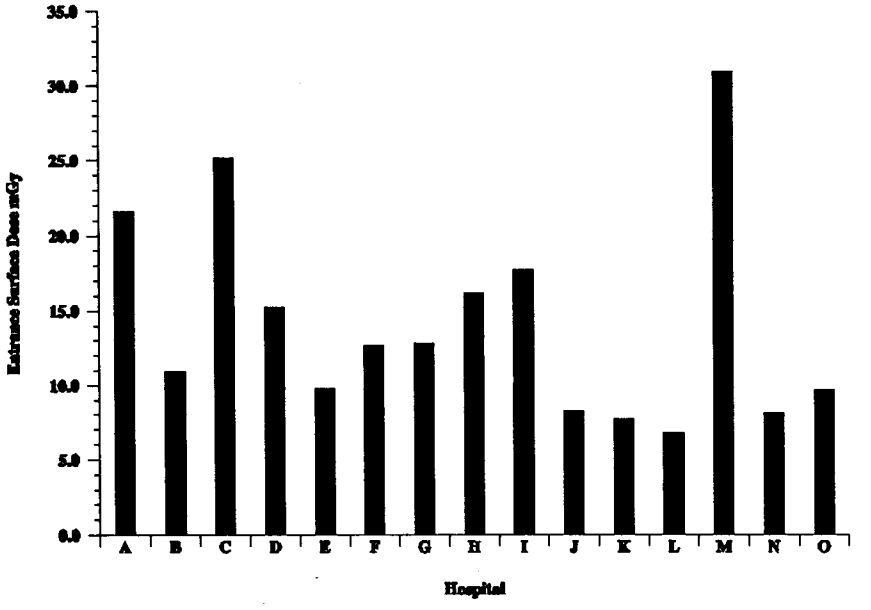

Figure 1 Entrance Surface Dose Results for Lumbar Spine Lateral Examination Throughout the North of England

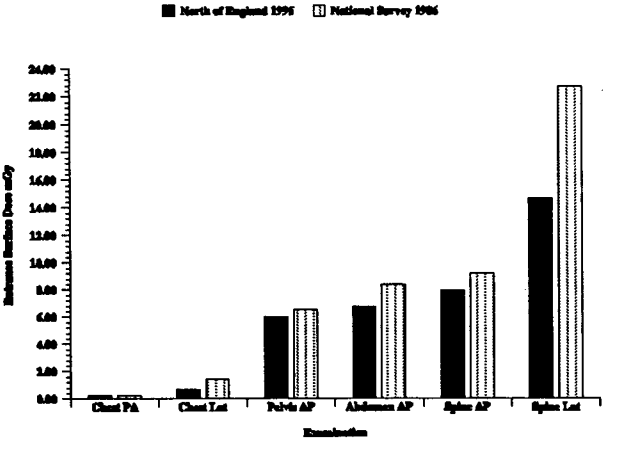

Figure II Mean Doses From the North of England Compared with the National Survey

Table II - Summary of Mean Dose Results and Parameters

Examination	Number of Patients	Entrance Surface Dose mGy			kV	mAs
		Mean	Maximum	Minimum	Mean	Mean
Chest PA	299	0.25	3.63	0.00	71	5.8
Chest Lat	32	0.74	3.59	0.20	80	11.9
Abdomen AP	178	6.77	70.58	0.38	71	35.1
Pelvis AP	291	6.08	65.65	0.23	70	31.6
Lumbar Spine AP	298	8.01	77.43	1.03	74	37.2
Lumbar Spine Lat	291	14.67	92.13	0.48	85	47.5

Figure I illustrates the range in dose values for lumbar spine lateral examination throughout the North of England. Figure II shows the variation in dose between the different examinations and compares results from the North of England with the National Survey [2]. Table I gives a summary of the performance results of the Harshaw extremity monitoring system. Table II lists the mean, maximum and minimum dose results for each examination along with the mean kV and mAs used.
The lumbar spine Lat and abdomen AP results are comparable to the results in [3] of 14 and 5.1 mGy respectively. The chest PA result presented here is higher than the result in [4] of 0.15mGy. There was a broad spread of doses between hospitals for example there was a factor of 4.5 between the minimum mean dose and the maximum mean dose for the lumbar spine lateral examinations. The mean weight of the patients included in this survey was 70.0kg with a standard deviation of 14.8kg.

Conclusion

The Harshaw 6600 personnel monitoring system can be used to monitor patient doses during simple radiographic procedures. The overall uncertainty is within the limits recommended by the National Patient Dosimetry Protocol. One thousand five hundred patient dose results have been presented from seventeen different tubes throughout the North of England. Mean entrance surface dose values are presented for the examinations of chest PA, chest LAT, abdomen AP, pelvis AP, lumbar spine AP and lumbar spine Lat. The results are lower than the results obtained in the last National Survey but are comparable to results from recent surveys.

References

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