
Ring Badge Position for Nuclear Medicine Technologists

David Adcock, Eileen Harp and Daniel M. Zurosky

Departments of Radiology and Radiation Safety, University of South Carolina School of Medicine, and Nuclear Medicine Service, WJB Dorn Veterans Affairs Medical Center, Columbia, South Carolina

Objective: The authors wish to provide limited data on the differences in exposure to the anterior and posterior sides of the fingers of nuclear medicine technologists during the performance of typical clinical nuclear medicine activities.

Methods: For a 16-month period, two ring badges were worn on the dominant hand with the sensitive portion turned in opposite directions so that radiation exposure could be monitored to both the anterior (palmar) and the posterior sides of the finger.

Results: The accumulated data, although limited, indicate that there is equal or greater exposure to the posterior side of the finger in routine clinical nuclear medicine practice.

Conclusion: Since there were no previously published data and our limited information suggests equal or greater exposure to the posterior side of the finger, additional studies should be performed to measure exposure to the hands. This would also provide data to evaluate the appropriateness of current radiation safety practices and regulatory interpretations.

Key Words: ring badge, position; radiation safety; dosimetry

J Nucl Med Technol 1995; 23:33-35

During a recent Nuclear Regulatory Commission (NRC) inspection, a notice of violation (1) was given for "failure to properly evaluate radiation doses received by the extremities of technologists." The inspector noted that a technologist was wearing her ring badge with the film portion of the badge on the top side of the finger.

It was the contention of the NRC that the part of the fingers most exposed to radiation was the palm and that placing the film away from the palm side while handling radioactive materials could result in a significant (up to 40%) under assessment of extremity dose.

METHODS

To determine what would be the difference in recorded radiation exposure when the dosimeter was worn with the

film turned toward (anterior) or away (posterior) from the palm, two technologists were given extra ring badges allowing one to be worn facing anterior and a second to be worn facing posterior. In addition, a third badge was worn to record the radiation exposure to the posterior of the non-dominant hand. This addition to the study was planned to resolve some questions which had been discussed locally.

Multiple film badges were used for a 16-month period by two nuclear medicine technologists. The records provided 14 mo of usable exposure records for Technologist 1 and 15 mo of usable data for Technologist 2. It is believed that the data accumulated were a reliable indication of finger exposure. There was no change in the routine activities of the technologists during the recording period. The range and frequency of procedures performed during the monitoring period were, after review, not significantly different from the typical pattern for this nuclear medicine facility.

RESULTS

The exposures recorded on the badges are listed in Table 1. From these limited data, there is evidence of equal or greater exposure to the posterior side of the finger when compared to the anterior side. The film badge exposure records for Technologist 1 clearly indicated greater exposure to the posterior side in 12 out of 14 mo. Using a paired t-test, the difference in recorded exposures was significant ($p < .01$). For Technologist 2, the 15 mo of film badge record available showed that in 6 out of 15 mo the anterior exposure was greater. In another 6 out of the 15 mo the posterior exposure was greater, and in the remaining 3 mo, there was no difference in exposure between the two sides. There was slightly greater total exposure to the anterior side of the finger, but this difference was so small that it is unlikely to be significant ($p > 0.1$). There was also evidence of greater exposure occurring to the finger of the non-dominant hand when compared to the dominant.

Although we do not believe these results are conclusive because of the limited amount of data collected, we do believe that, in the absence of contradictory information, there seems to be no compelling argument for requiring the ring badge to be turned toward the anterior (palmar) side of the finger for extremity exposure monitoring.

For reprints contact: David Adcock, MD, MPH, Professor and Chairman, University of South Carolina School of Medicine, Dept. of Radiology, Columbia, SC 29208.

TABLE 1
Extremity Doses of Nuclear Medicine Technologists

Technologist	Location of ring	1992										1993					Total	
		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr		May
1	right-back	120	80	70	130	330		680	430		380	190	170	140	200	70	80	3070
	right-palm	70	70	60	40	190		570	310		80	230	90	70	90	60	80	2010
	left-back	130	120	90	190	560		1030	800		690	340	180	140	210	80	80	4640
2	right-back	80	70	50	50	230		290	300	180	110	220	40	40	70	70	40	1840
	right-palm	70	70	60	40	190		570	310	160	80	230	50	40	60	70	50	2050
	left-back	80	70	50	50	190		300	390	170	100	250	40	50	80	60	60	1940

It is interesting to speculate on how the posterior portion of the finger might receive more radiation than the anterior side of the finger during routine performance of nuclear medicine technologist activities. After observing the technologists' injection techniques using unshielded plastic syringes, which are withdrawn from single-dose, shielded transport containers, the most typical hand position suggests that the posterior side of the finger is actually more directed toward the radionuclide containing portion of the syringe than is the anterior side. This may explain the exposure variation we observed although there is likely to be wide variation in injection techniques among technologists.

DISCUSSION

There is a long history of discussion about correct dosimeter positions for body radiation exposure monitoring. In the early 1970s, there seemed to be considerable interest in radiation exposure to the fingers. Chiswell (2) developed ratios of fingertip to wrist exposure but did not provide data which would answer the question of relative exposure to the anterior or posterior side of the finger. Takaku (3) used a model for finger exposure using various radionuclides in a syringe and from this produced isodose distributions around the syringe. It is not possible to predict from those data what would be the relative exposure to each side of the finger during routine nuclear medicine technology activities. Rudavsky (4) measured wrist and total body exposure and related that to the number of injections done. He also attempted to describe the typical injection technique relative to the geometry of the fingers and the syringe containing radioactivity. There was no attempt to determine the relative exposure of the anterior and posterior aspects of the fingers. Neil (5) placed multiple dosimeters on the hand to determine relative exposure when handling ^{99m}Tc. In this study, most of the dosimeters were located anterior to the hand and, again, it would not be possible to determine relative exposure to the anterior and posterior aspects of the fingers during typical nuclear medicine technology activities.

Currently, the most frequent disagreement about radiation monitoring is related to the issue of wearing dosimeters inside or outside protective aprons during fluoroscopy (6). There is continuing discussion about what sites are important for recording quantitative dosimetric information (7)

and it is likely that these differences of opinion will continue to be a topic of discussion in the future. This continuing discussion from differing viewpoints is probably useful in maintaining a high level of attention to the problem of radiation exposure during clinical work.

In this case, the problem is the result of a directive on the correct position for the dosimeter coming from the representative of the regulatory agency, and there should be a high degree of certainty about the accuracy of the regulatory interpretation.

Unless the regulatory interpretation has been objectively and quantitatively determined, the interpretation should not be the basis for a notice of violation.

CONCLUSION

Based on limited data collected in one typical clinical nuclear medicine facility, it seems that wearing a ring badge dosimeter with the sensitive portion of the ring turned to the posterior side of the finger is acceptable practice and is likely to provide a record of the greatest exposure of that finger.

We suggest that NRC interpretations, which might have serious consequences for the licensee and personnel working under the license, have supporting data for the regulatory interpretations.

With frequent administration of radiopharmaceuticals labeled with ^{99m}Tc, the question of extremity exposure for a nuclear medicine technologist remains an important issue. Currently there are no available data which make it possible to determine conclusively what the relative exposures of different positions are on the hands of nuclear medicine technologists during the routine performance of their duties. We believe that additional studies should be done to determine the relative exposures and how these exposures are related to variations in handling radioactive materials and injection techniques.

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