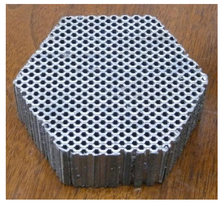
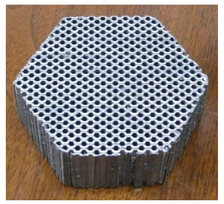


Detector to Target Distance and its Effects on Visual and Quantitative Resolution



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Introduction

Spatial resolution (SR), a camera's ability to distinguish small details of an image in the field of view. SR is a crucial aspect technologists and physicians rely on to make appropriate diagnoses and treatments. SR is affected by scattered photons which can be limited by decreasing the radiation source to detector distance. However, it can be difficult to obtain the desired distance when accommodating patient comfort and possible obstructions. Technologists have access to protocol guidelines on how to perform a procedure, but most protocols do not recommend an appropriate patient to detector distance.

Purpose

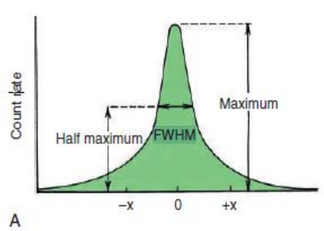
The purpose of this research is to assess varying detector to target (patient) distance and its effects on the visual and quantitative resolution.

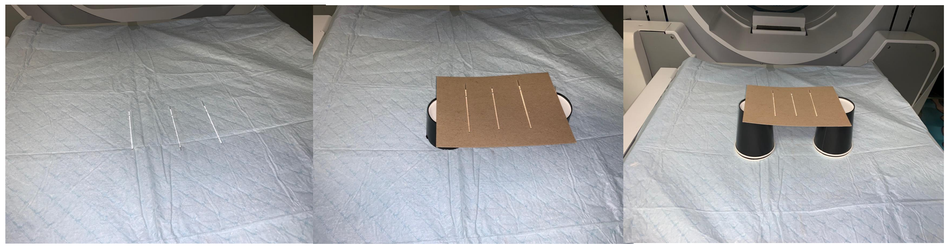
Methods

- A dual headed GE camera used to take posterior static images of three technetium-99m capillary filled tubes using parameters similar to the bone scintigraphy protocol.
- The capillary filled tubes were placed on cardboard and cups to create the desired source to detector distance.
- Approximately 15 images were taken at the surface, 5cm source to detector distance. 9 images were taken for the 10cm distance.
- Images were assessed subjectively by evaluating them visually and comparing them to one another. Objective measures were obtained by evaluating the line spread function (LSF) of the resultant count profiles generated by the DICOM system, but can be done manually with the equations below.
- FWHM is the width at 50% of the height of the line spread peak for each image acquired.

Pixel size = FOV(mm)/matrix dimension

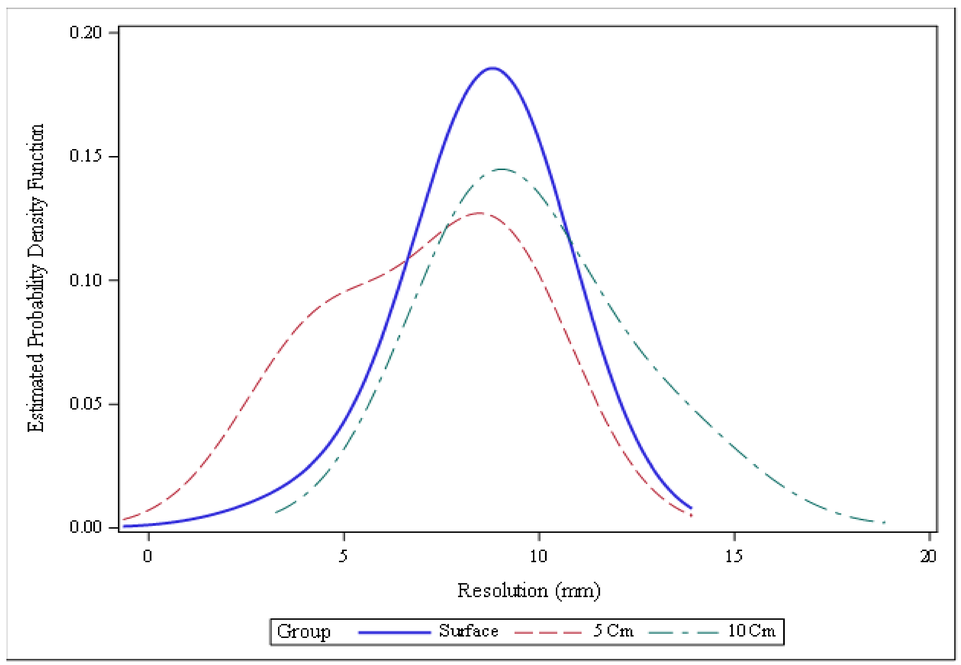
Resolution = # of FWHM pixels x pixel size





Surface **5cm** **10cm**

Estimated Probability Density Functions for Resolution (mm) for each of the Three Distances from the Gamma Camera



Descriptive Statistics for Resolution (mm) for Gamma Images, Estimated from a Line Spread Function at Three Distances from the Camera Face.

Analysis Variable : RES_MM RES_MM						
Group	N Obs	Mean	Std Dev	Median	Minimum	Maximum
Surface	15	8.5	1.1	8.8	4.4	8.8
5 Cm	15	7.1	2.2	8.8	4.4	8.8
10 Cm	9	9.8	1.9	8.8	8.8	13.3

Results

- The visual assessment of the images revealed the best resolution to be at the surface source to detector distance.
- The 5cm image revealed to be less resolute than the acquired image at the surface, however the 10cm distance revealed to be the least resolute image overall.
- The quantitative assessment of resolution using LSF revealed overall resolution did differ with distance.
- After adjusting for multiple testing, interestingly, the surface measurements did not differ from the 5 Cm measurements or the 10 Cm measurements. (p=0.0854 and p=0.1333 respectively).
- The 5cm measurements did show better resolution compared to the 10Cm measurements. (p=0.0263).

Conclusions

- Overall, the smaller detector to target distances gave better resolution results both visually and quantitatively. The images acquired showed the surface measurement image with the best resolution due to better sharpness and detail.
- Quantitatively, resolution was similar when the surface was compared to the other two varying distances, however there were slight differences in the comparison between the 5cm and 10cm detector to target distance.
- This study may lead to further assessment of resolution using varying methods besides LSF and possible recommended detector distances that should be referred to for specific nuclear medicine procedures.

Acknowledgements

The authors acknowledge the nuclear medicine department at OU Children's hospital to let us use their equipment to take the images for this research.