# Anthropomorphic Phantoms for Quality Assurance in Radiation Therapy

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## Introduction

Modern conformal treatment planning and delivery, using techniques such as 3D-CRT and IMRT, requires imaging of the patient, delineation of the target volumes and OARs, calculation of dose distributions, and QA procedures before the treatment is delivered as planned. Each step is vulnerable to errors.

To evaluate an institution's ability to deliver the planned dose to patients, four unique anthropomorphic phantoms have been designed and constructed by the Radiological Physics Center (RPC).

## Stereotactic Head Phantom

*Goal:* Verify stereotactic treatment (ACOSOG Z0300)

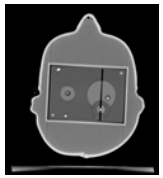
*Parameters under analysis:* dose to the center of the target, treated volume.

*Dosimetry:* TLD in the target and radiochromic film in the coronal and sagittal plane through center of the target

## IMRT Head & Neck phantom

*Goal:* Credentialing for RTOG 0022, 0225 and 0126 and COG ACNS00331

*Parameters under analysis:* dose to the 1º PTV, 2º PTV, OAR, dose distribution over the target, dose gradient between 1º PTV and OAR



CT of phantom

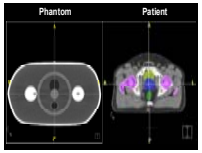
*Dosimetry:* TLD in the targets and organ at risk, and radiochromic film in the coronal and axial planes through center of the target

Gel dosimetry insert

*Investigation:*

Polymer gel dosimetry insert for 3-D dose distribution analysis

## IMRT Pelvic Phantom

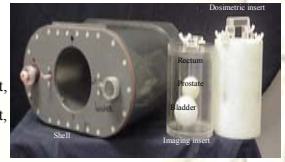


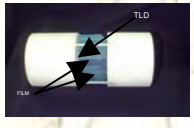

CT comparison: phantom/patient

*Goal:* Credentialing for RTOG 0126

*Parameters under analysis:* dose to the center of the target, dose to the femoral heads, dose distribution over the target, dose gradient over the rectum and bladder

*Dosimetry:* TLD in the target and femoral heads and radiochromic film in the coronal and sagittal planes through center of the target



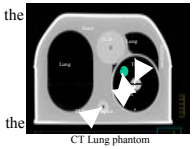

Dosimetric insert

## Heterogeneous Thorax Phantom

*Goal:* Credentialing for RTOG 0236

*Parameters under analysis:* dose to the center of the target and OARs, dose distribution over the target

*Dosimetry:* TLD in the target, heart and cord, and radiochromic film in the axial, coronal and sagittal planes through center of the target



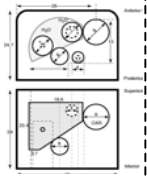

CT Lung phantom

Inserts

*Investigation:*

Reciprocating table

- reciprocating table to simulate breathing cycles
- new location of the target to analyze heterogeneity correction algorithms
- modification to the geometry to verify liver treatments



Liver phantom (under construction)

## General Phantom Design

The phantoms provide realistic geometry for dose constraints used in treatment planning and densities similar to normal tissue densities. The phantom external shell is similar to the actual body contour. TLD dosimetry is used as an absolute dosimeter for point dose determination while film dosimetry is used as a relative dosimeter for dose distribution analysis.

*Alternative configuration:*

hip prosthesis for evaluation of heterogeneity corrections algorithms

Hip prosthesis on femoral head

## Conclusion

The RPC has 4 phantoms that are powerful tools for QA audits for verification of IMRT and 3D-CRT techniques.

Additional phantoms are being designed to incorporate new targets and target motion

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