

Advanced Technology Consortium (ATC) in Support of Radiation Therapy Clinical Trials

**James A. Purdy, Ph.D.
Department of Radiation Oncology
Washington University Medical Center
St. Louis, Missouri, USA**

**ATC Workshop on Implementing the DICOM 3.0 Standard
for Radiation Therapy Multi-Institutional Trials
St. Louis, MO, April 14, 2004**

What is the Advanced Technology Consortium (ATC)?

April 1992 3DQA Center established at WU-St. Louis to provide QA for RTOG 3DCRT trials.

May 1993 RTOG & 3DQA Center (ITC) awarded NCI grant for Operation/ Statistical Center for prostate dose escalation study (3DOG, became RTOG 94-06).

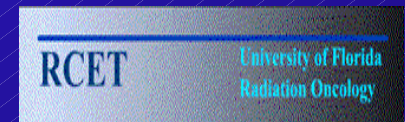
April 1999 NCI funded two Advanced Technology QA Centers

- 3DQA Center (with sub-contracts to RPC, QARC, and RTOG)
- Resource Center for Emerging Technology (RCET) at the University of Florida

What is the Advanced Technology Consortium (ATC)?

In July 2002, NCI funded an Advanced Technology QA Consortium capitalizing on existing infrastructure and strengths of national QA programs

- Image-Guided Therapy Center (ITC – Washington University in St. Louis)
- Resource Center for Emerging Technologies (RCET – University of Florida in Gainesville)
- Radiological Physics Center (RPC – M.D. Anderson Cancer Center)
- Radiation Therapy Oncology Group (RTOG)
- Quality Assurance Resource Center (QARC)



Advanced Technology QA Consortium (ATC)

- **New consolidated approach will help eliminate duplication of developmental effort and facilitate sharing of QA resources among cooperative groups.**
- **ATC will help ensure that appropriate and uniform QA procedures and criteria are developed for advanced technology trials across all cooperative groups.**

ATC's Mission

- **Developmental efforts:**

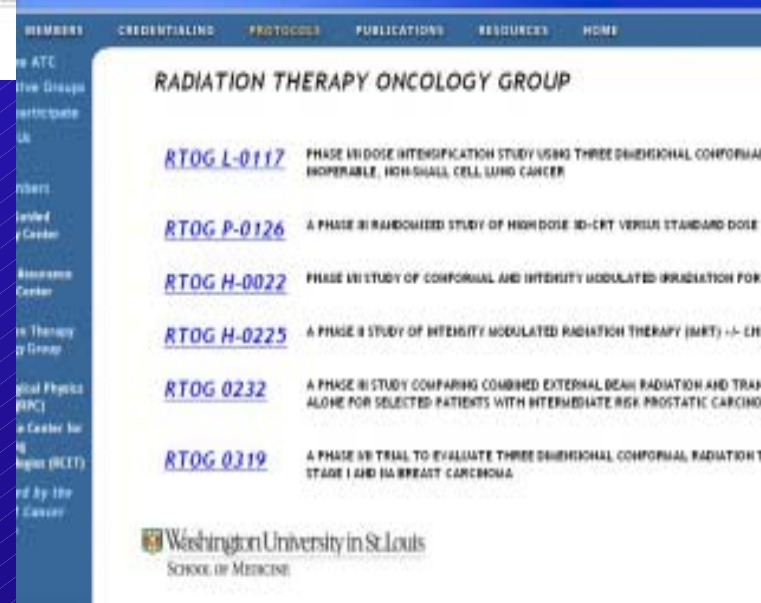
- electronic data exchange of digital planning data between ATC QA Centers and protocol participating institutions;
- web-based software tools to facilitate protocol digital data submissions and QA reviews by RTOG, QARC, and RPC;
- archival treatment planning & QA databases that can be linked with the cooperative group's clinical outcomes database.

- **Service efforts:**

- assist in protocol development, manage/facilitate protocol digital data submissions, credentialing, QA review, and data analysis.

ATC WEB SITE

<http://atc.wustl.edu>



- T2 forms (document)
- QA Guidelines (by protocol)
- Dry Run Test Guides
- Facility Questionnaires
- Data submission checklists
- Links to RTOG for protocol information

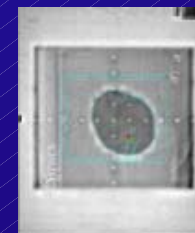
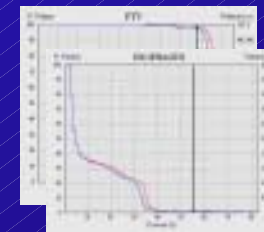
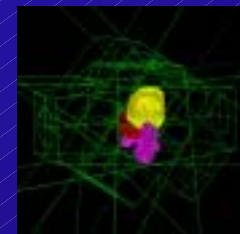
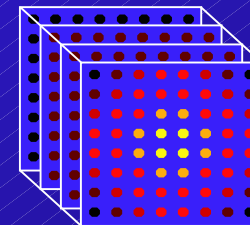
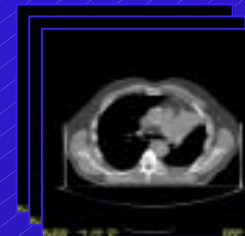
ATC Supported Clinical Trials

- RTOG 94-06: Phase I/II Prostate 3DCRT (closed, data analysis)
- RTOG 93-11: Phase I/II Lung 3DCRT (closed, data analysis)
- RTOG 98-03: Phase I/II GBM 3DCRT
- RTOG H-0022: Phase I/II Oropharyngeal IMRT
- RTOG L-0117: Phase I/II Lung 3DCRT
- RTOG P-0126: Phase III Prostate 3DCRT/IMRT
- RTOG H-0225: Phase I/II Nasopharyngeal IMRT
- RTOG P-0232: Phase III Prostate Brachy Seed
- RTOG 0319: Phase I/II Breast 3DCRT Irradiation Confined to Lumpectomy Cavity

Question: What's different about these type studies?

Answer: Digital Data Submission; Remote Review

- Primary data (patient model, dosimetry)
 - Patient Volumetric Image (CT)
 - Structures: GTV, CTV, PTV, OAR
 - 3-D Dose Distribution (including fractionation information)
- Secondary data (QA of primary data)
 - Beam/Source Geometry
 - Dose-Volume Histograms
 - Digital Simulator and Portal Images

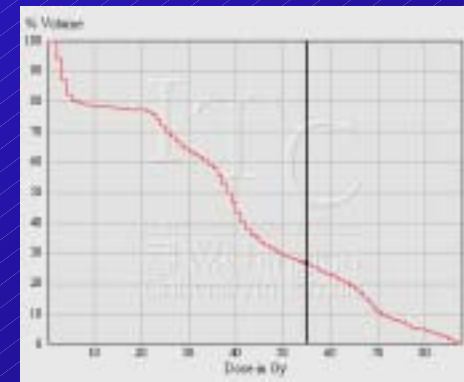
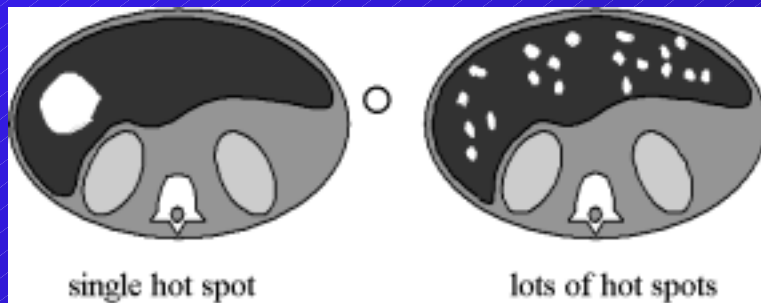


Typical Data Set per Patient ~ 100 MB

Why not just collect the DVH data?

DVHs alone are not sufficient

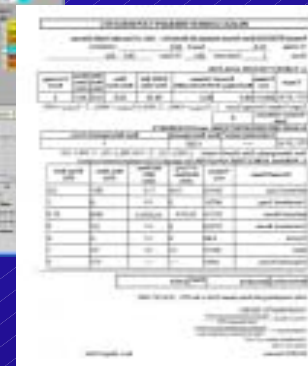
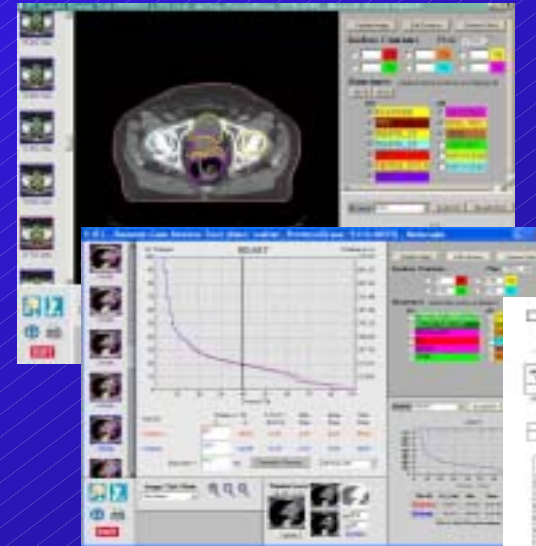
- Different dose distributions throughout an organ may lead to different expectations of toxicity for some organs.
- Loss of Spatial Information in DVHs



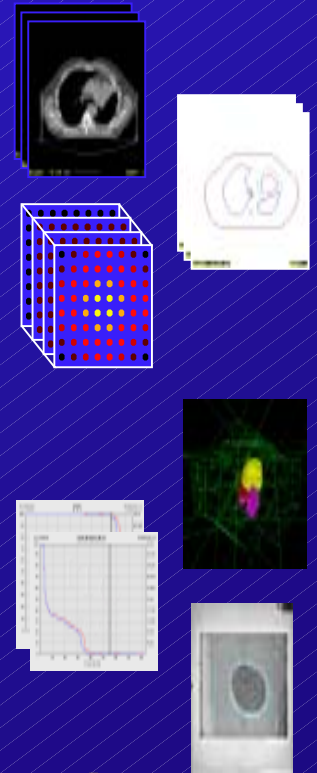
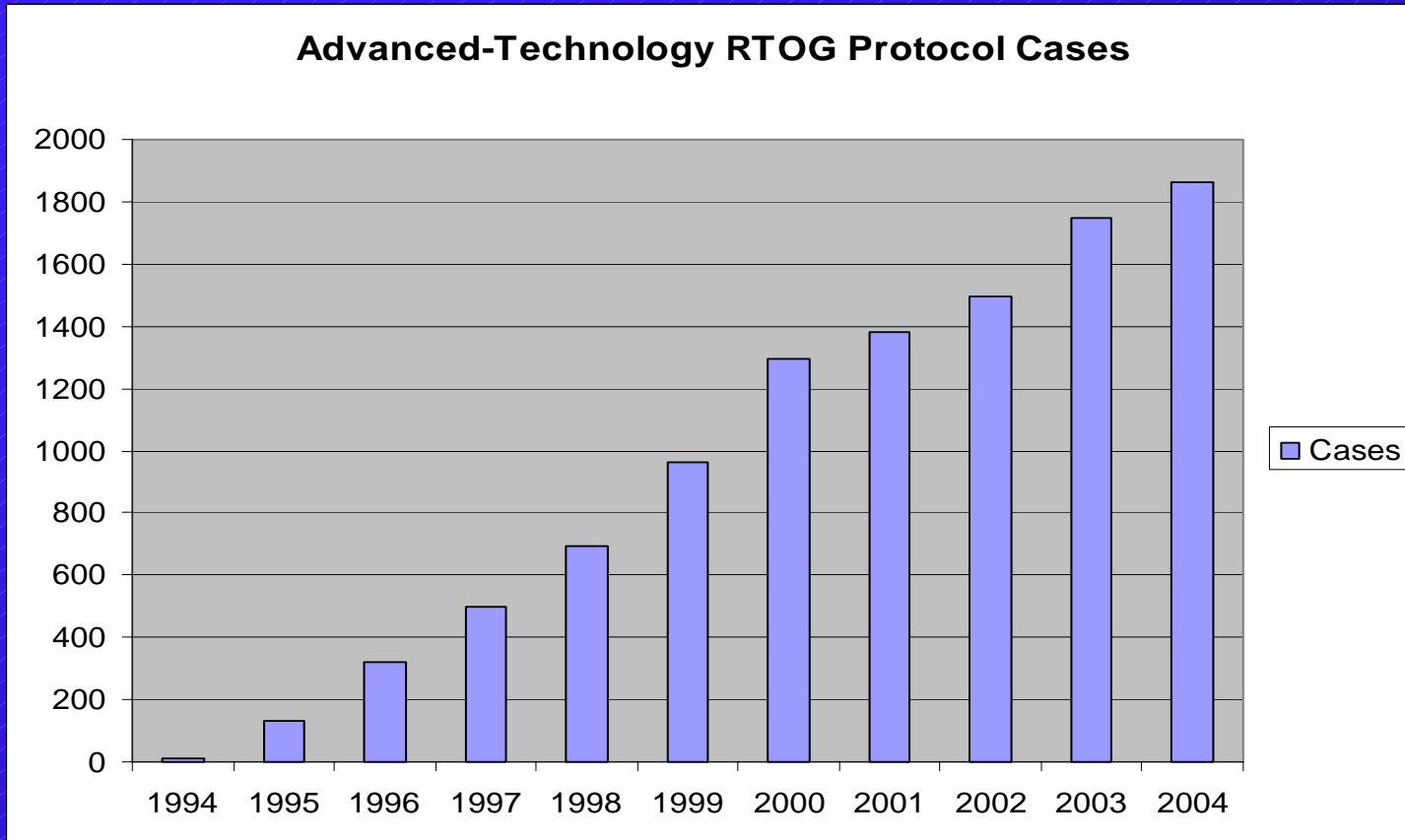
- Need to link treatment planning data to clinical outcomes (Evaluating response statistics and developing dose-response models).

Digital Data Submissions to ATC

- **ATC Method 1 (Current ITC method) :**
 - FTP of DICOM or RTOG files to ITC server, or shipment of DICOM or RTOG files on CD-R or tape cartridge media to ITC
 - ITC Remote Review Tool
- **ATC Method 2 (in development):**
 - RCET NetSys/WebSys (IJROBP 57, 1427-1436, 2003)
 - ITC Remote Review Tool



1861 complete digital data sets submitted over past 10 year period



- 11 commercial RTP systems have implemented export capability
- 130+ institutions able to submit data

Digital Data Exchange Status

ATC Compliant Treatment Planning Systems Per Modality

Treatment planning systems deemed to be *ATC Compliant* and listed in the table below are those with which ATC protocol participants have submitted *complete, protocol compliant* data sets.

Treatment Planning Systems			Exchange Format	Supported Treatment Modality			
Vendor	System	Version *		3DCRT	IMRT	Seed Brachy	HDR Brachy
CMS	FocusXiO	3.1	RTOG	yes	yes	yes	no
Varian	Eclipse	7.1	DICOM	yes	yes	no	no
	VariSeed	7.1	DICOM	no	no	yes	no
Philips	Pinnacle ³		RTOG	yes	yes	no	no
	AcqPlan	4.9	RTOG	yes	no	no	no
Elekta	RenderPlan 3D		RTOG	yes	no	no	no
	PrecisePlan	2.01	DICOM	yes	no	no	no
Nucletron	Helax TMS		RTOG	yes	yes	no	no
	TheraPlan Plus		RTOG	yes	no	no	no
	PLATO RTS	2.62	DICOM	yes	no	no	no
Nomos	Corvus		RTOG	no	++	no	no

* Earliest compliant version of treatment planning system.

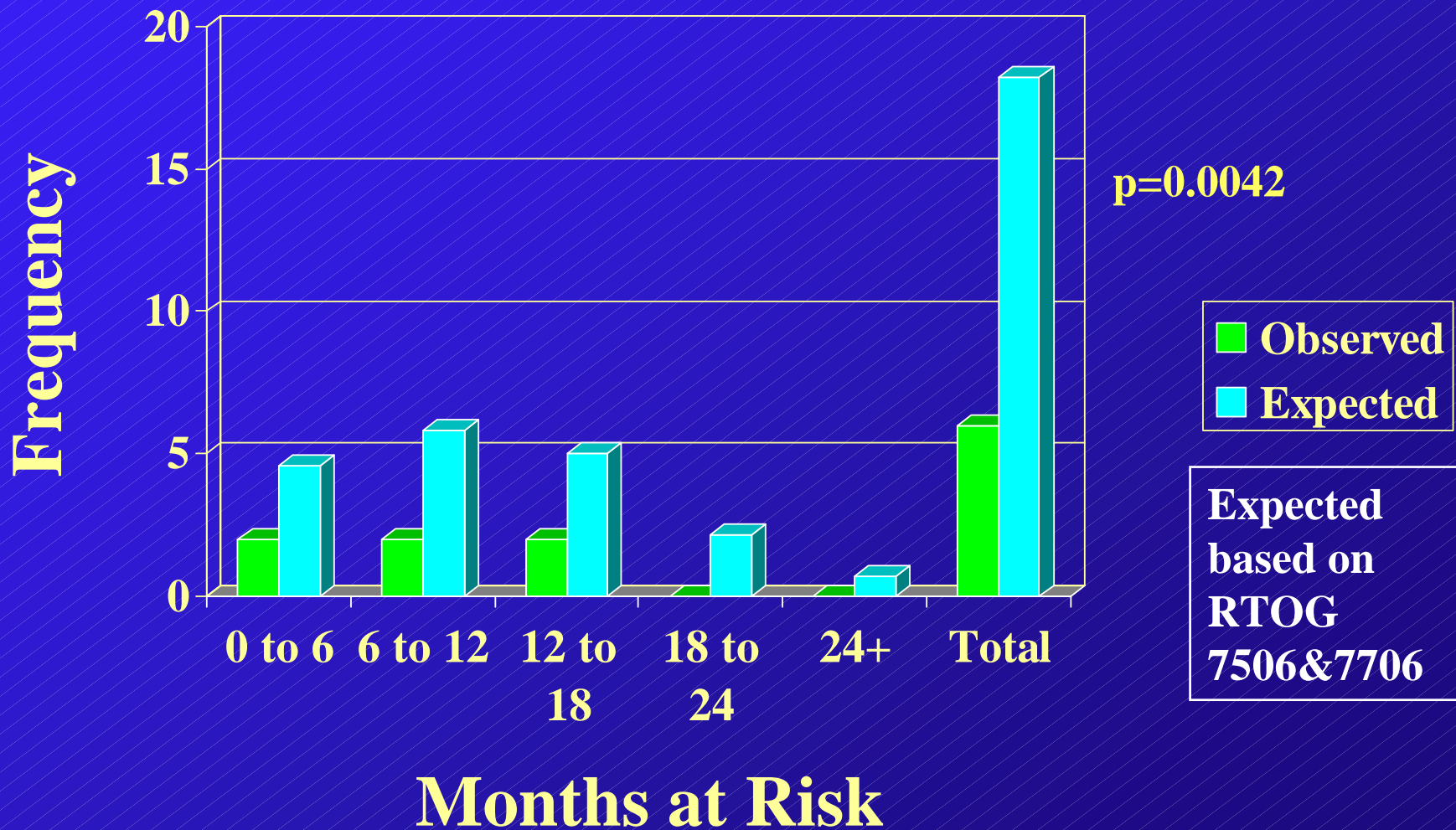
++ Nomos Corvus is temporarily suspended (effective 11/7/02) pending resolution of digital data submission problems. Corvus users should consult special [submission guidelines](#) for workaround instructions regarding the use of Corvus for IMRT protocols.

Compliant 8/8/2003
Compliant 8/11/2003

Compliant 10/6/2003

Compliant 3/15/2004

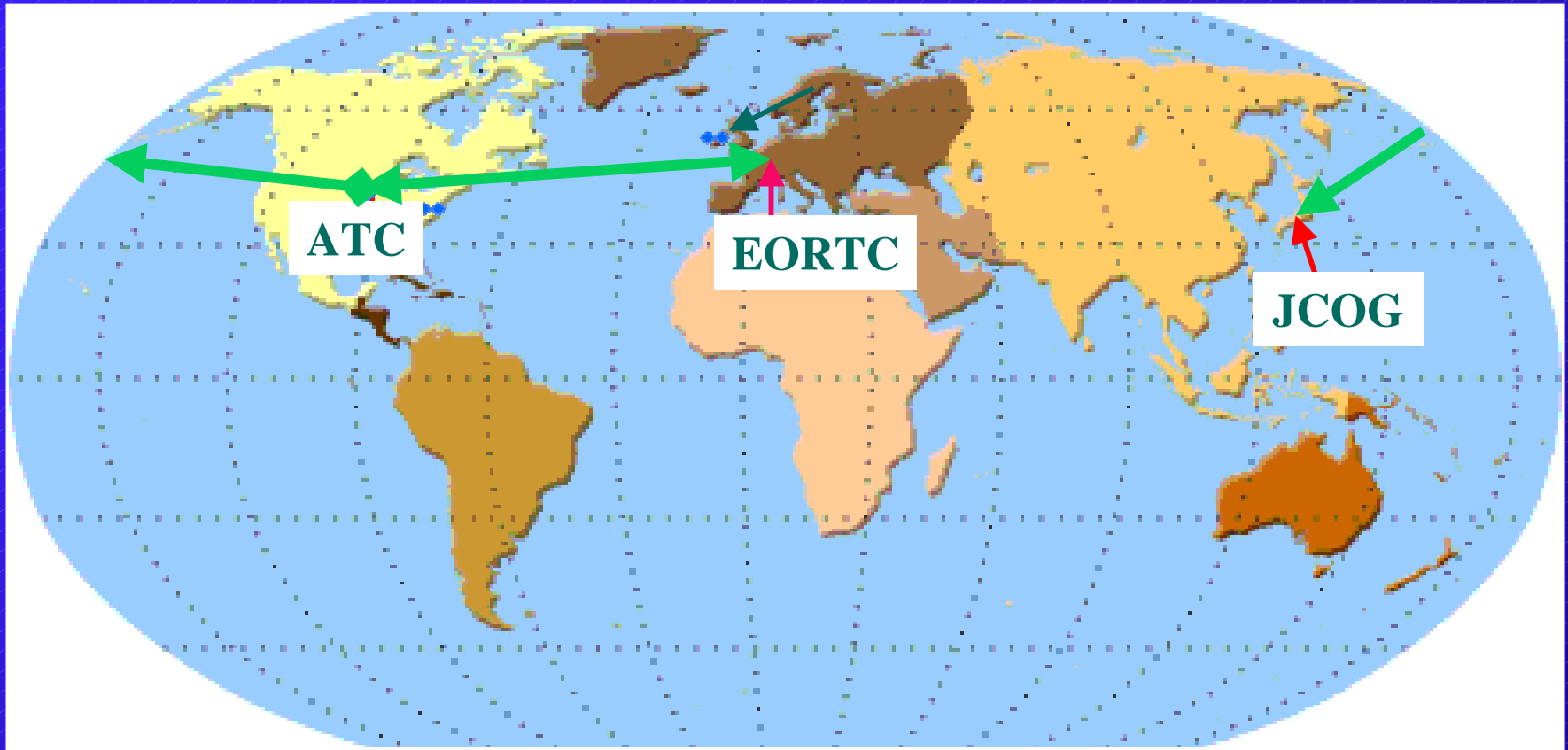
RTOG 9406 Dose Level V (78 Gy, 2Gy/fx), Disease Group 1, Late Grade 3+ Toxicity



Protocol design, credentialing, QA,...

- **ATC Interactions with Cooperative Groups other than RTOG**
 - **COG**
 - **PBTC**
 - **NCIC**
 - **NSABP**

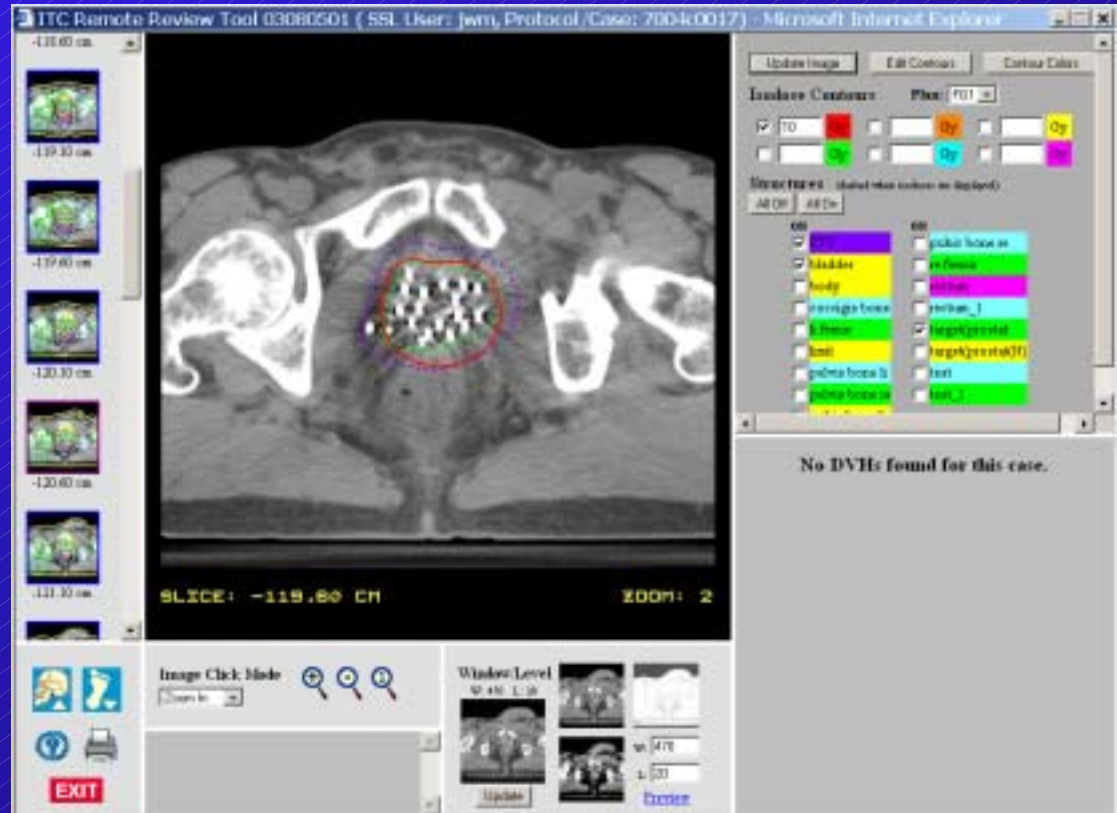
ATC INTERACTIONS - WORLD-WIDE



- EORTC (Dr. Bernard Davis, UniversitätsSpital Zürich at ASTRO)
- JCOG (Dr. Satoshi Ishikura, National Cancer Center Hospital East, Kashiwa, Japan)

Challenges for ATC Supported Clinical Trials

- HDR Brachytherapy
 - No ATC compliant RTP systems
 - RTOG 0321 in development
 - NSABP/RTOG partial breast irradiation protocol in development



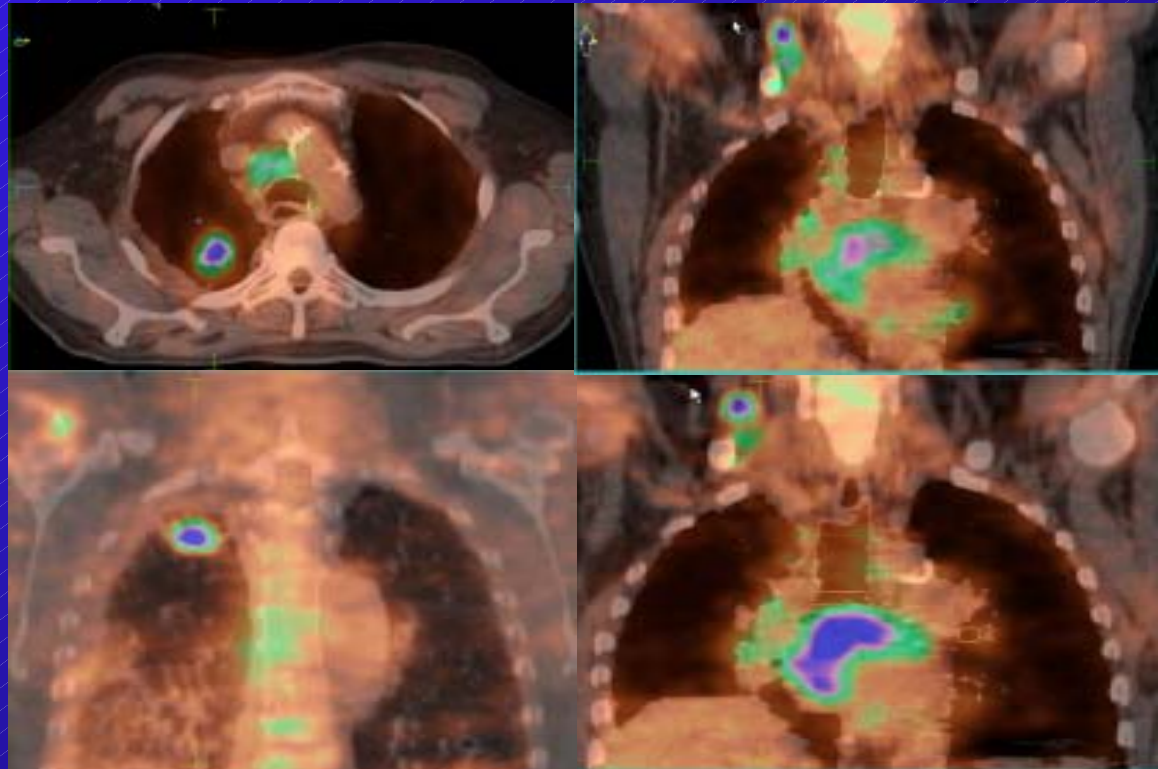
Challenges for ATC Supported Clinical Trials

- **Stereotactic Radiosurgery and Radiotherapy**
 - No ATC compliant stereotactic RTP systems
 - RTOG Lung 0236 in development
 - RTOG Liver 0245 in development



New Challenges for ATC Supported Clinical Trials

- PET (Quantitative)
- Image fusion QA
 - RTOG Lung 0238 in development



New Challenges for ATC Supported Clinical Trials

- **Adaptive Radiotherapy, Image-Guided Therapy
(Cone beam CT, Helical Tomotherapy)**
- **Daily Confirmation
and Adjustment**
 - **On-Board Imaging
(EPID, Cone Beam
CT)**

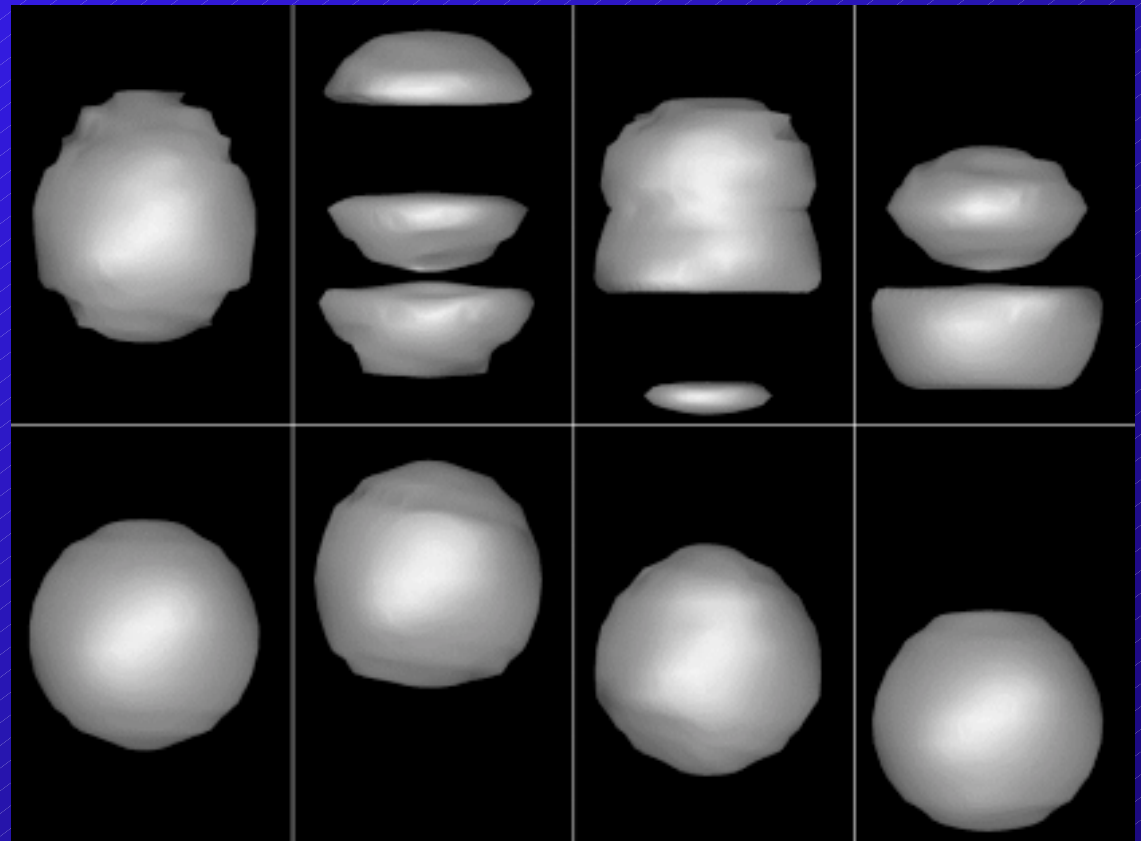


Elekta Synergy System

New Challenges for ATC Supported Clinical Trials

- 4-D CT (several 100 MB)

Moving Ball
“Light
Breathing”



New Challenges for ATC Supported Clinical Trials

- 4-D CT (several 100 MB)



Std light breathing scan



0% Phase of 4D scan

SUMMARY AND CONCLUSIONS

- **The ATC continues to pioneer the submission of digital data for clinical trials by fine-tuning the established Method 1 (FTP upload), while completing the development, testing, and deployment of Method 2 (WebSys secure upload to ATC Production Server).**
- **The ATC is working with RTP manufacturers and urging them to give the highest priority to implementing digital data submission capability on their systems.**

SUMMARY AND CONCLUSIONS

- ATC has provided RTOG the unique ability to conduct 3DCRT, IMRT, and prostate brachytherapy clinical trials in which volumetric 3D treatment planning digital data is collected, reviewed, analyzed, and linked to clinical outcomes
 - over 1800 data sets have been successfully submitted.
- ATC is now in a strong position to extend these capabilities to other cooperative-groups planning to conduct advanced-technology clinical trials.