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Foreword

A Note from the Editorial Board

Welcome to this year's annual magazine from the Global Scientific Collaboration team.

uInnovation is a scientific magazine published by United Imaging Healthcare that has been successfully distributed for over past three years. It aims to serve as a platform for sharing ground-breaking advancements, emerging trends, and future possibilities in the vast expanse that is oncology.

uInnovation is currently in its fourth edition. This year's edition will inform, engage, and inspire you about the latest developments and applications of United Imaging Healthcare. This journal includes quick read sections for those in a rush, and appealing images to promote visual understanding.

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Clinical application of CT-Linac with Artificial Intelligence for Online Adaptive Radiotherapy in Head & Neck and Pelvic Cancers

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*Shared Authorship

The Challenge

"*Clinics struggle with inefficient workflows. Traditional offline replanning takes days. What's missing is a fast, accurate, daily adaptive solution that fits into busy clinics without overwhelming staff or extending treatment time*"

Delivering precise radiation to tumors is complicated by the fact that a patient's anatomy changes daily — organs shift, tumors shrink, and weight fluctuates. This is especially problematic in cancers like nasopharyngeal and cervical cancer, where targets sit close to sensitive organs. When the original treatment plan no longer matches the patient's current anatomy, tumors may be underdosed, or healthy tissues overdosed leading to poor control or unnecessary side effects like hearing loss, xerostomia, or bowel toxicity.

The Solution

The uRT-Linac 506c — a diagnostic-quality fan-beam CT (FBCT) scanner fully integrated with a linear accelerator, developed by United Imaging Healthcare (UIH) offering these features:

Precision Imaging by FBCT: Same quality as CT Sim, can be used for contouring and dose calculation directly.

All-in-One Platform: Simulation, daily imaging, contouring, planning, and delivery happen on one machine — no patient transfer, no image mismatch.

AI Auto-Segmentation: Uses deep learning to contour targets and 35+ organs in nearly one minute, editable by clinicians.

AI Auto-Planning: Generates deliverable VMAT plans using prior plan knowledge and clinical goals less than 3.5 minutes (nasopharyngeal cancer) and less than 2.5 minutes (cervical cancer).

Real-Time QA: In-vivo EPID dose monitoring with gamma analysis during beam-on.

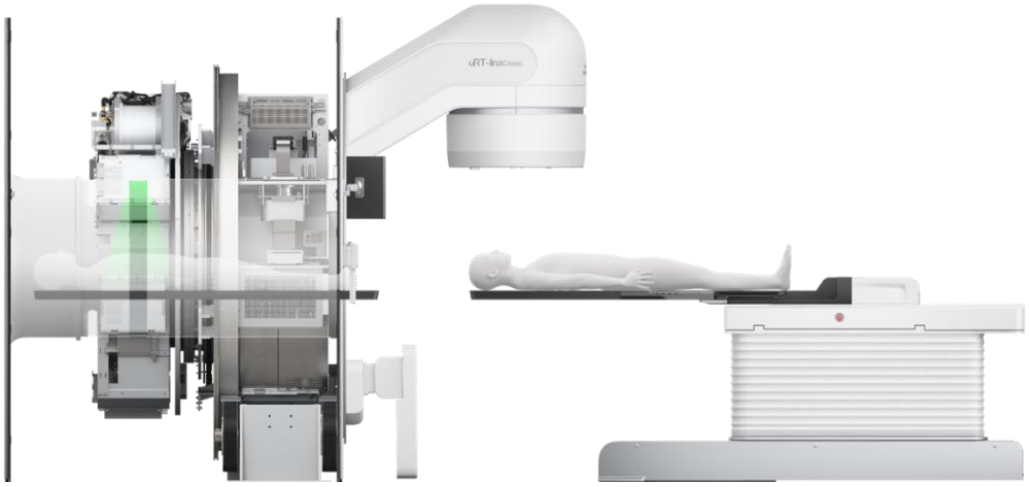


Figure 1. The integrated uRT-Linac 506c from United Imaging Healthcare [#].

[#] No 510k application for uRT-Linac 506c has been filed with the FDA. This product is not available for sale in the U.S. for clinical uses and also may not be available for sales in other countries.

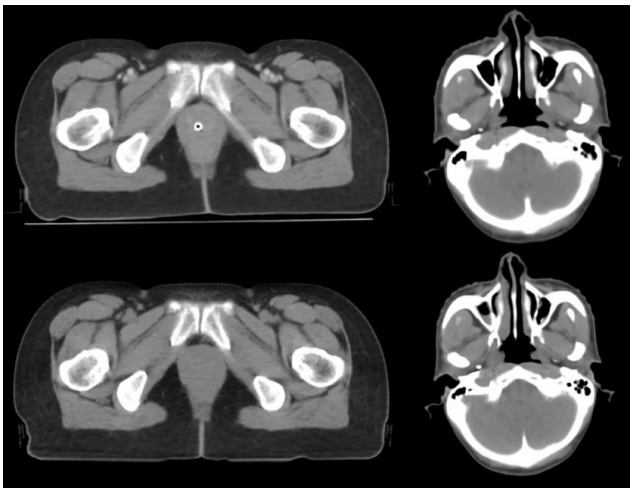


Figure 2. The comparison of simulation CT and FBCT by CT-Linac of a representative patient. The top row is simulation CT and the bottom row is FBCT.

Workflow Summary

The online adaptive radiotherapy (oART) workflow using CT-Linac consists of the following steps:

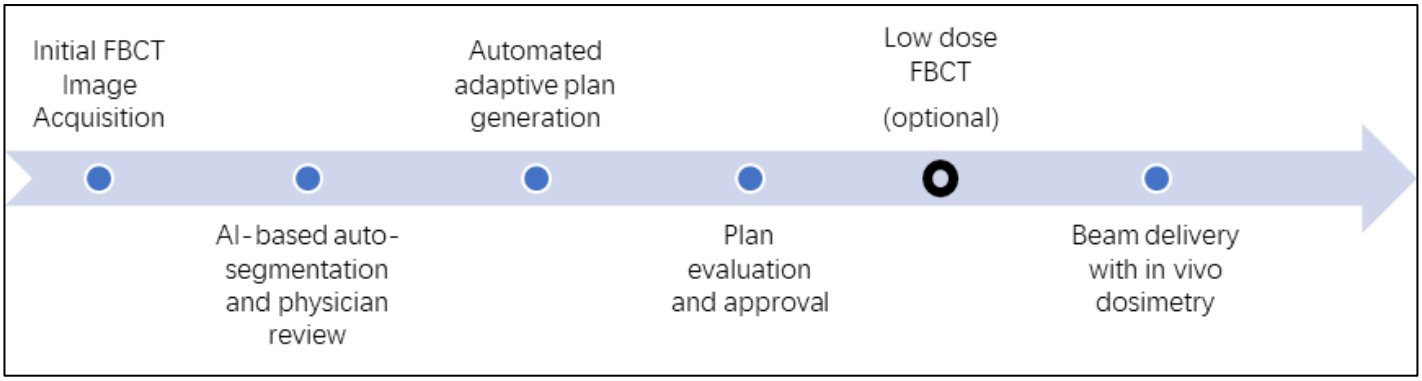
This turns oART from a research-only setting into a clinically feasible daily routine.

Here are the average RT times for two different types of cancer:

i. For Nasopharyngeal carcinoma, the following are the average time fraction:
   - FBCT Scan & Registration: ~3.3 min (16% of time)
   - AI Contouring + Review: ~8.2 min (39% of time)
   - AI Planning + Approve: ~5.0 min (24% of time)
   - Beam Delivery + EPID in Vivo: ~4.4 min (21% of time)

ii. For cervical cancer, the following are the average time fraction:
   - FBCT Scan & Registration: ~2.3 min (10% of time)
   - AI Contouring + Review: ~10.1 min (44% of time)
   - AI Planning + Approve: ~5.0 min (22% of time)
   - Low-dose verification FBCT: ~3 min (13% of time)
   - Beam Delivery + EPID in Vivo: ~2.4 min (11% of time)

This streamlined workflow demonstrates that CT-Linac–based oART can be efficiently integrated into routine clinical practice with acceptable time and dosimetry accuracy.



Did that Work?

FBCT–guided oART demonstrates clear dosimetric advantages in definitive cervical cancer treatment by ensuring consistent, high-quality target coverage while significantly reducing radiation exposure to critical organs at risk—thereby translating anatomical adaptability into tangible improvements in plan accuracy and safety.

Representative data from Nasopharyngeal carcinoma:

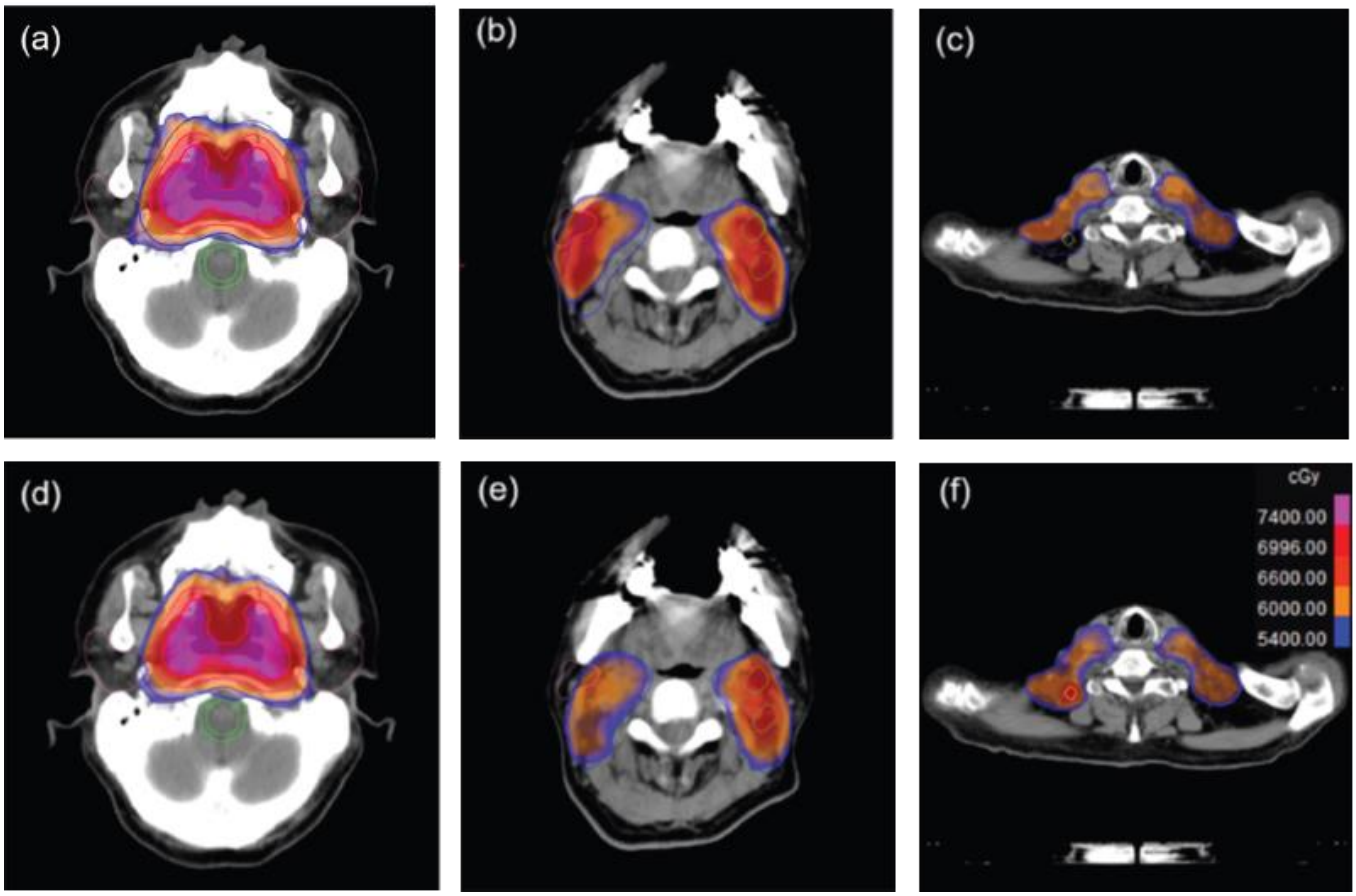


Figure 3. Dose distribution comparison between (a-c) scheduled plans and (d-f) ART plans. (adopted from [1])

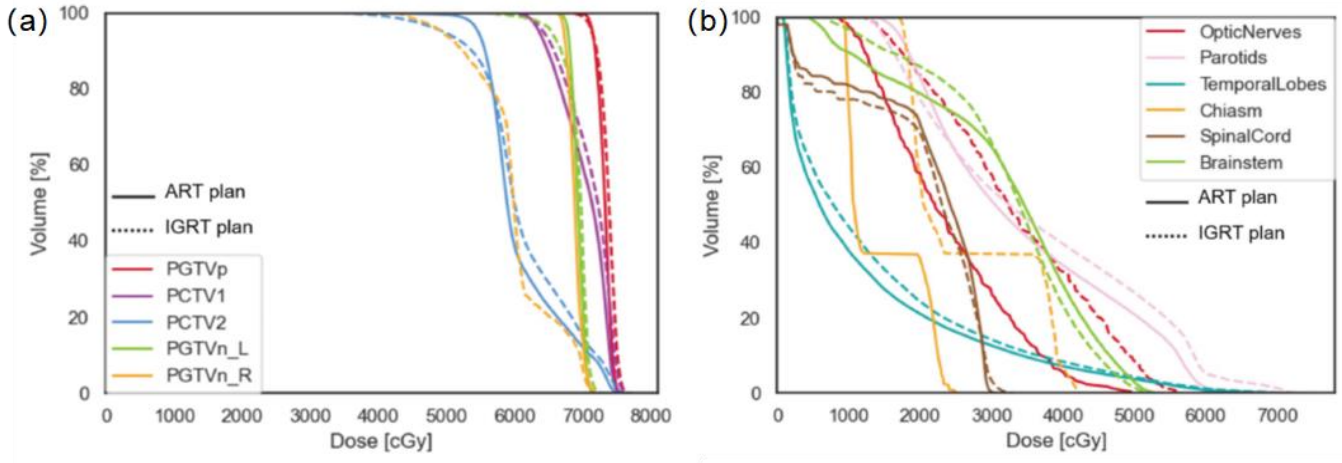


Figure 4. Dose and Volume Histogram (DVH) of targets(a) and OARs(b) of scheduled plans (dotted line) and ART plans (solid line). (adopted from [1])

The cumulative DVH plot of targets and OARs are shown in Figure 4, respectively. The solid line represents the ART plan, and the dotted line represents the scheduled plan.

ART plan is better than the scheduled plan - the dose to critical organs is reduced in ART. For example, in chiasm, there is 43% lower dose in ART plan.

Representative data from a Cervical cancer case:

Dose volume histogram comparison are shown for a cervical cancer patient. Adaptive planning consistently improved target coverage (PTV D95 met prescription) while reducing dose to rectum, bladder, and small bowel in Figure 5. Real-time EPID monitoring confirmed >99% gamma passing rate, validating delivery accuracy. Even with tumor movement and bladder fullness, adaptive plans-maintained precision — something static plans failed to do.

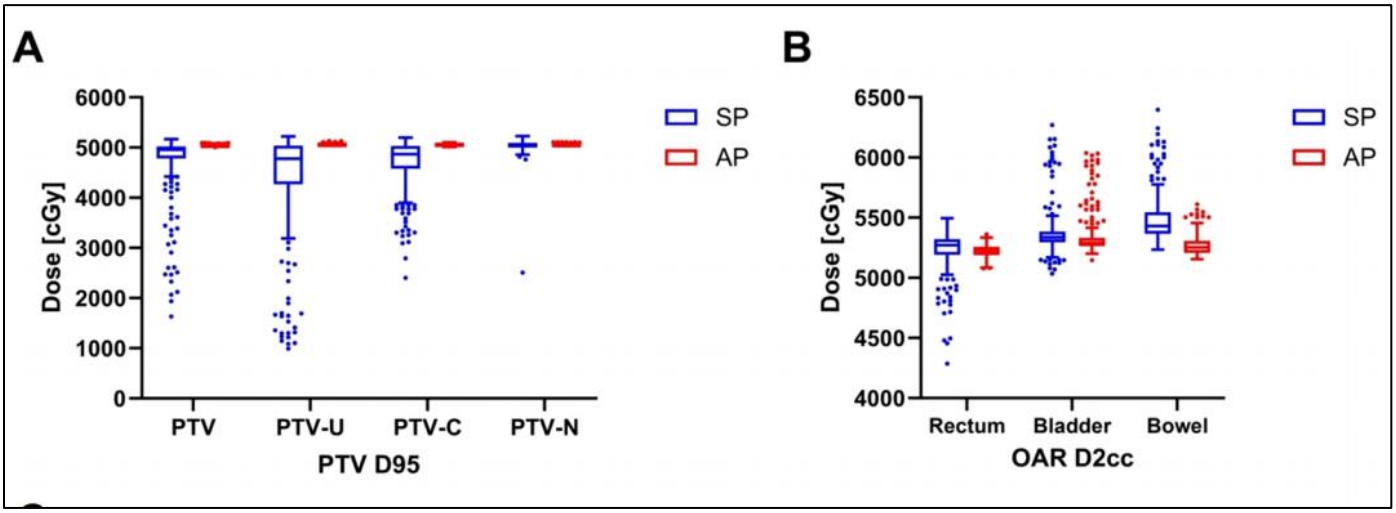


Figure 5. The differences in dosimetric parameters of targets and OARs between ART plans(red) and scheduled plans(blue) : (A) Targets (B) OARs. (adopted from [2])

The solid line represents the ART plan, and the dotted line represents the scheduled plan. So, it shows that ART plan is better than Scheduled plan because of improved distribution to both targets and organs at risk (OARs). First, the dose is reduced in ART plans for critical OARs. For example, in the small intestine, there is a 2.17 Gy lower D2cc (dose to the most irradiated 2 cm^3) for the ART plan, and in the rectum, the D2cc is 0.10 Gy lower, demonstrating superior organ sparing.

So What?

Patients win: fewer side effects, better tumor targeting, preserved organ function (like ovaries or hearing). Clinics win: no workflow disruption, no extra machines, no long waits.

The future? Daily adaptation becomes standard — not for select cases, but for all patients who need precision.

UIH's platform sets a new benchmark: adaptive radiotherapy that's fast, smart, and ready for prime time.

The impact? Higher cure rates, better quality of life, and a scalable model for global implementation — even in resource-limited settings.

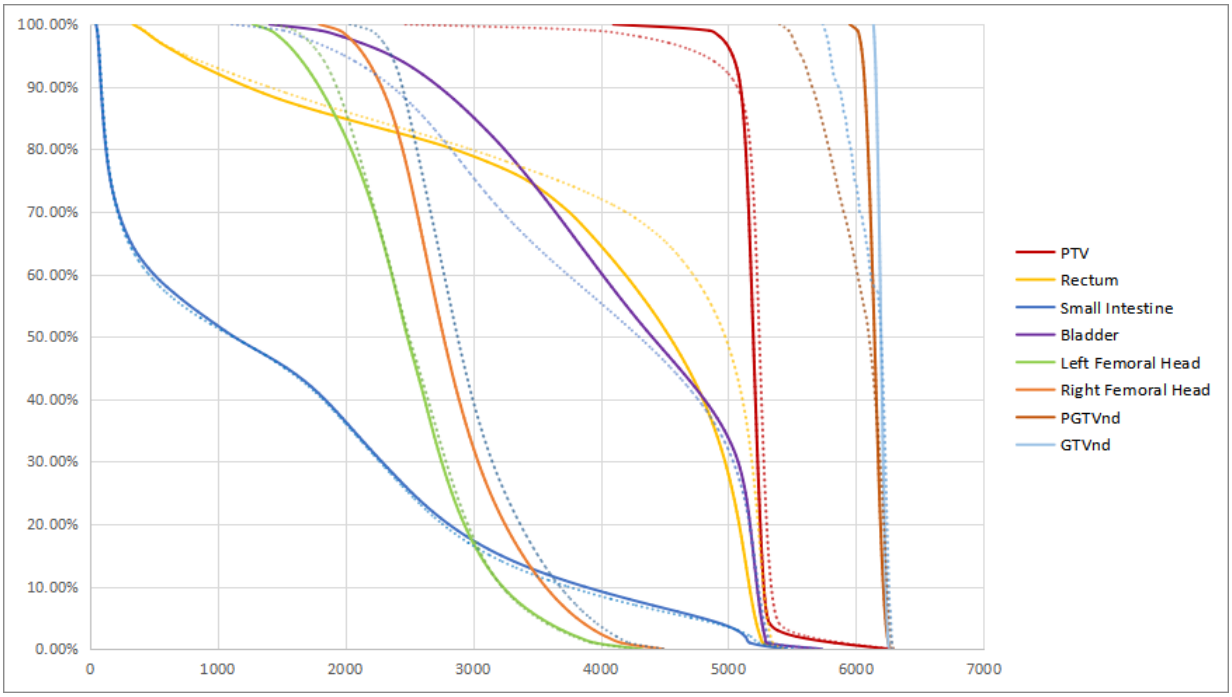


Figure 6. The DVH of the scheduled plans(dotted line) and ART plans(solid line) for a representative patient (adopted from [2]) **.**

Author Statement

Until now, adaptive radiotherapy was too slow, too complex, or too inaccurate for routine use. Our integrated CT-Linac with AI automation makes daily adaptation not just possible — but practical for busy departments treating complex head and neck or pelvic cancers.

References:

[1] Yang, Y-X, Li L et al. (2024). Initial Experience of CT-Based Online Adaptive Radiotherapy for Nasopharyngeal Carcinoma With a Novel Integrated Platform: A Case Report. Cureus.

[2] Sun, Gong et al (2025). Evaluating the Implementation of fan-beam CT-guided online adaptive re-planning in definitive cervical cancer radiotherapy. Frontiers in Oncology.

Author's Biography

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