CPAP in RT: The first decade

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NEWSWEEK MAGAZINE

The 10 Best Hospitals in the World

The Clinical Gap: Populations Excluded by Active Breath-Hold

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Standard DIBH fails to achieve favorable geometry for significant patient populations with lung and breast lesions.

PULMONARY

Patients exhibiting a chronic cough.

FUNCTIONAL

Restrictive or obstructive lung function tests.

NEUROLOGICAL

Phrenic nerve paralysis.

SENSORY

Hearing loss precluding audio coaching.

COGNITIVE

Language barriers preventing complex DIBH instructions.

These vulnerable populations require a passive, reliable stabilization mechanism.

The Solution: Passive Pneumatic Splinting

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Continuous Pressure:
Applied throughout the entire respiratory cycle.

Zero Effort:
Requires absolutely no active participation or breath-holding from the patient.

High Tolerability:
4-hour general compliance rate adapts seamlessly to brief radiotherapy fractions.

CPAP transforms a high-effort patient task into a passive, machine-driven stabilization.

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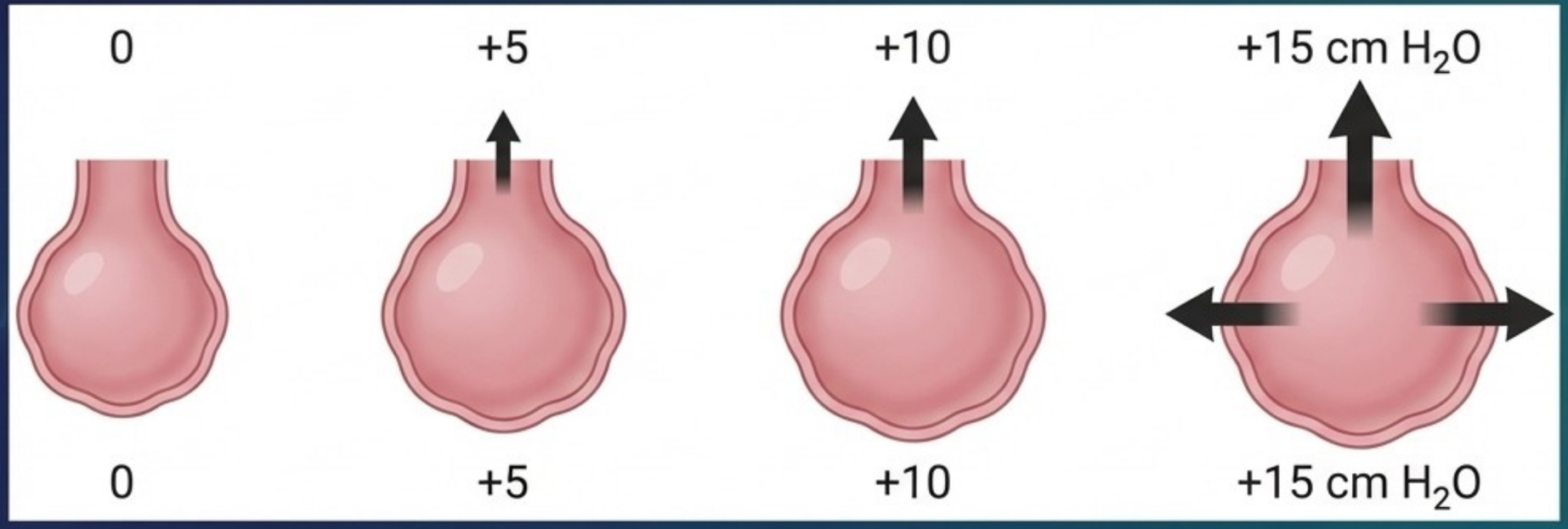
The Mechanism of Thoracic Stabilization



1. Expansion:
Expands and stabilizes collapsed alveoli at end-expiration.

2. Exchange:
Increases surface area for optimal oxygen exchange.

3. Depression:
Increased intrathoracic pressure forces and flattens the diaphragm downward.

4. Stabilization:
Ultimately reduces tidal volume, minimizing target respiratory motion.

The Hardware:
Smaller, couch-mounted Lowenstein PrismaVENT integrated for inrn delivery.

The Delivery:
Propents the ɒɐʜk of patient to imposoral motion on passure.

The Hardware:
Smaller, couch-mounted Lowenstein PrismaVENT integrated for immediate delivery.

Align RT camera system:
Align RT camera system is mounted on ceiling.

Surface Imaging Output:
Real-time monitoring ensures precise motion management.

The Clearance:
Ensure the couch, the clearance is topest in of the couch from ilinant base.

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NotebookLM

Clinical Validation: Prospective Matched Paired Control (n=40)

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Step 1: Simulation

- Simulated sequentially with and without CPAP.

Step 2: Planning

- Treatment plans calculated with and without CPAP.

Step 3: Comparison

- Evaluated against Lung/Heart volumes, GTV, ITV, and PTV.

Step 4: Execution

- Treatment delivered with CPAP exclusively if dosimetrically beneficial.

Initial enrollment: 49
6 withdrew prior
3 mask intolerances
Final evaluated cohort = 40

Primary Endpoints:
Volume Augmentation & Motion Reduction

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Clinical Impact Dashboard

KPI

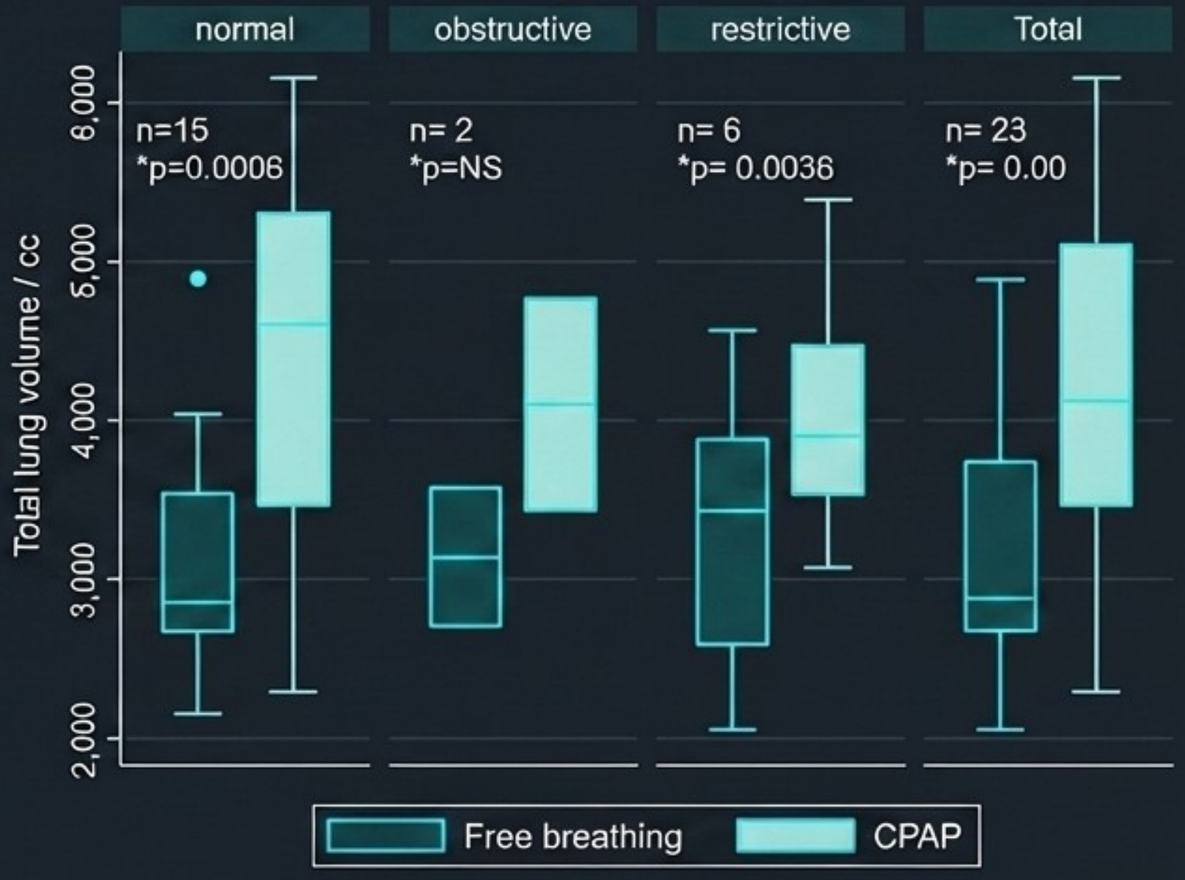
Mean lung volume **augmented** by **1283 ± 1128 cm³** (p=0.0006)

Clinically independent of age, BMI, gender, COPD, smoking status, or heart disease

KPI

Tumor motion significantly decreased, yielding a **Mean PTV Reduction of 19%** (p<0.001)

Total Lung Volume across Lung Functions (cm³)



The Dosimetric Advantage

Metric	Free Breathing	CPAP
Lungs V20, %	20.9	16.1 (p<0.01)
Lungs V5, %	46.8	39.8 (p<0.01)
Mean Lung Dose, Gy	11.0	9.2 (p<0.01)
Heart V5, %	54.5	45.6 (p<0.01)

Improved tumor coverage paired with statistically significant decreases in critical normal tissue dose.

Visual Evidence: Anatomy in Practice

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Dramatic diaphragmatic depression and visibly increased lung volume.

Free Breathing

Continuous Positive Airway Pressure (CPAP)

Tighter, more concentrated PTV under CPAP vs. elongated motion blur of free breathing.

The Clinical Decision Matrix

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Modality	Geometric Stability	Patient Effort Required
Standard Free Breathing	Unpredictable geometry	Zero patient effort
Standard DIBH	Stable/ May vary	High patient effort/compliance required
CPAP Free Breathing	Passive pneumatic splinting	Minimal effort
CPAP + DIBH	Stable/minor variation	High effort triggered only if CPAP FB fails

CLINICAL RULE: Patients simulating on CPAP free breathing who exhibit > 1 cm of motion are automatically re-simulated with a combination of CPAP and active breath-hold (DIBH).

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The 10 Best Hospitals in the World

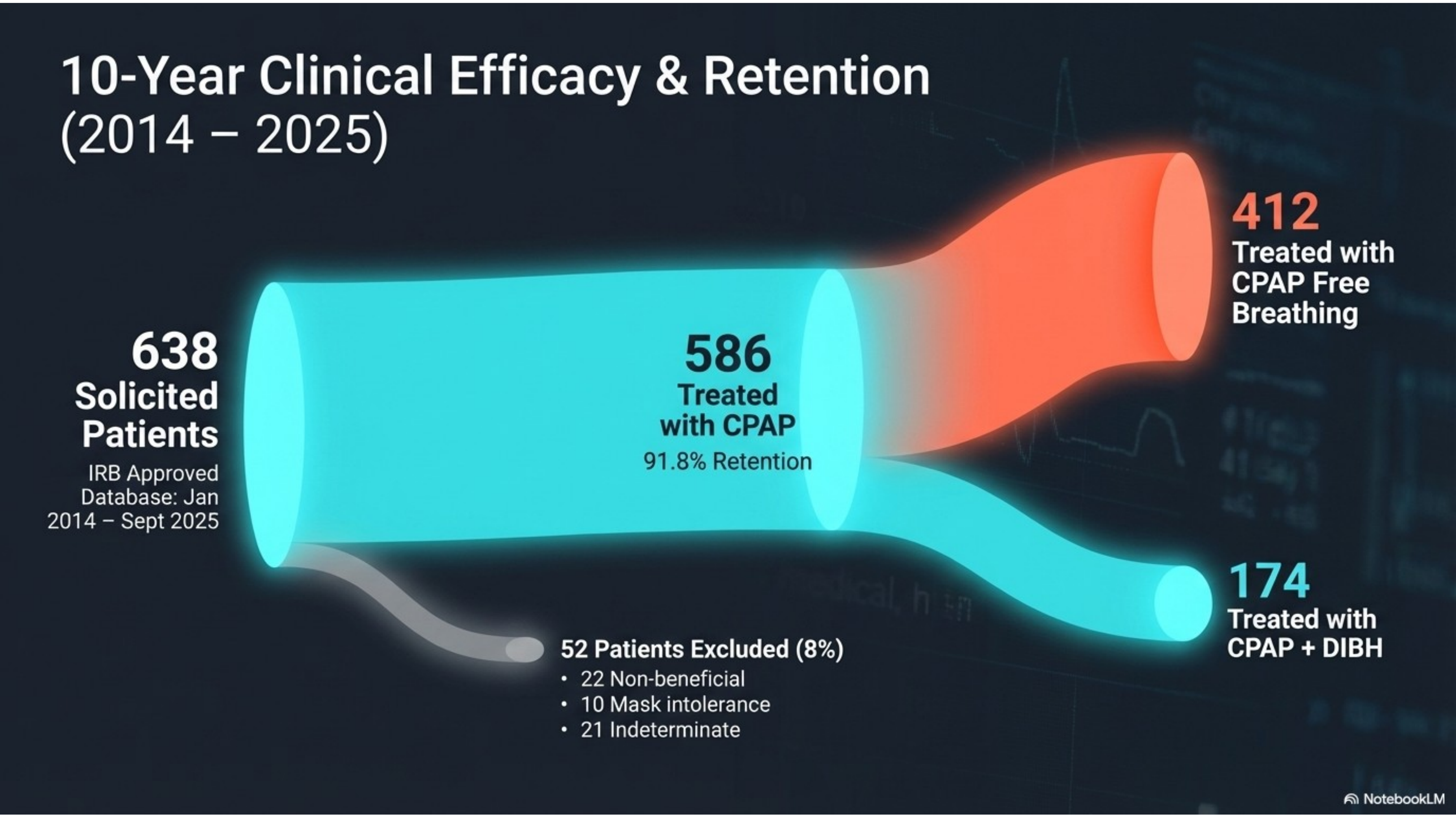
5 Linac Academic Department

>200 Patients Treated Daily

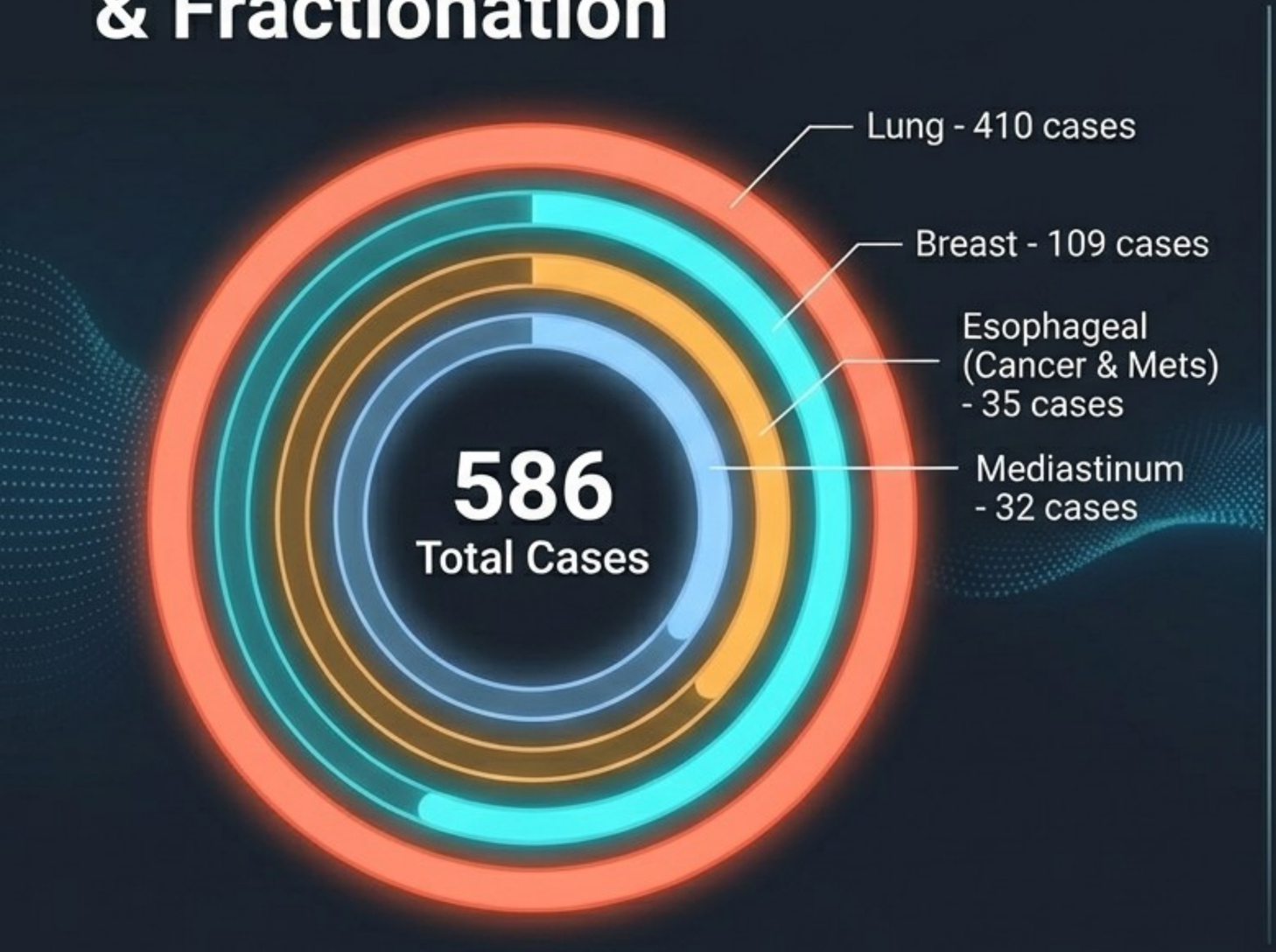
10 Year IRB Approved Database

Innovating at the limits of high-volume care.

10-Year Clinical Efficacy & Retention (2014 – 2025)

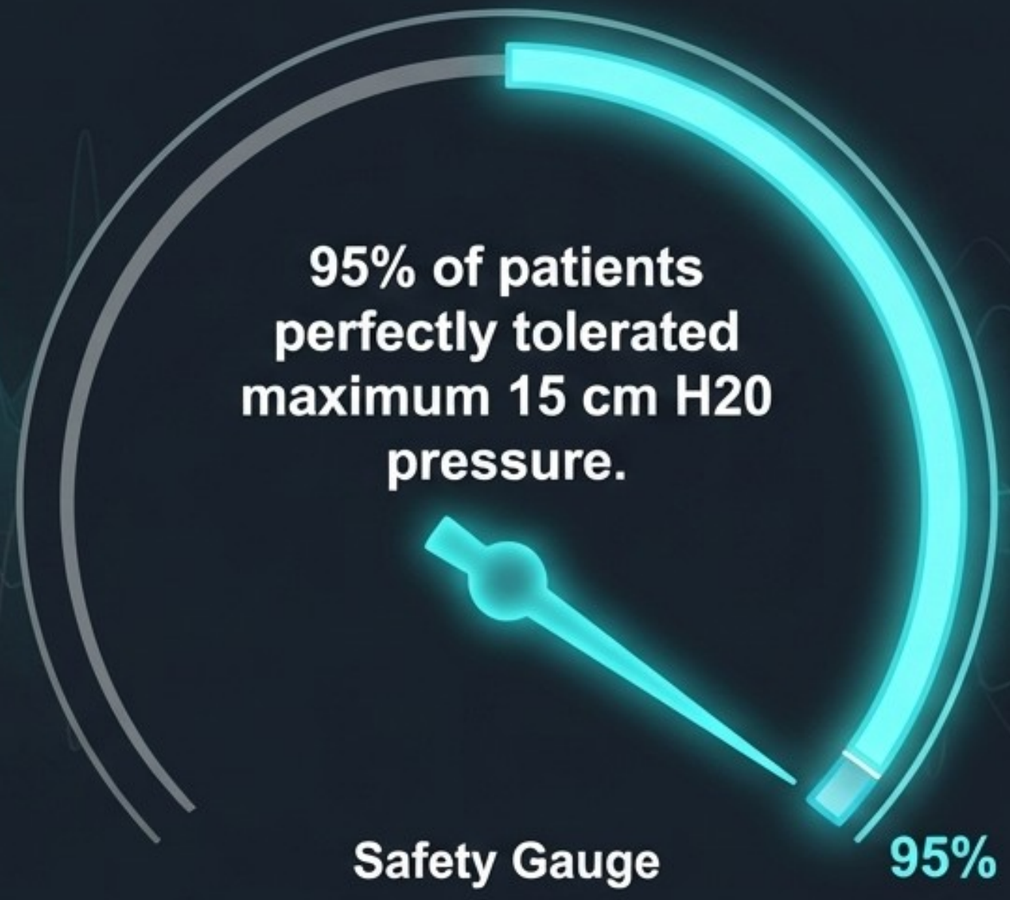


Treatment Profiles: Anatomy & Fractionation



Two ablation cases represent single fraction delivery for malignant cardiac arrhythmia.

Patient Safety and Tolerance Limits



Remaining 5% successfully treated with lower calibrated pressures.

Adverse Event Tracking (10 Years / 586 Patients)

A single Serious Adverse Event (SAE) recorded.

1 case of vasovagal syncope occurred while the patient was walking with CPAP to the linac.

Extraordinary safety profile across a highly vulnerable patient demographic.

The Synthesis: Efficacy Without Operational Compromise

CLINICAL EFFICACY

>90% Patient Compliance across diverse indications.

Zero degradation in target coverage.

OPERATIONAL THROUGHPUT

Scaled across a 5-linac academic department.

Sustaining a volume of >200 patients per day.

TIME NEUTRALITY

The initial 10-minute automated ramp-up is entirely offset by geometric certainty and reduced intra-fraction interruptions. Treatment duration with CPAP free breathing is statistically associated with similar treatment times to fractions utilizing no motion management.

Redefining the Standard for Motion Management

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A decade of continuous, high-volume utilization proves CPAP is not a niche intervention—it is a robust, scalable standard of care.

It uniquely maintains exceedingly high satisfaction for both high-high-risk patient populations and radiotherapy operational staff.

CPAP can be integrated as a safe, simple, and universally effective baseline strategy for motion management in modern radiotherapy.