Advancing Patient Comfort: Maskless Head & Neck Radiation Therapy with SGRT

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AdventHealth Celebration

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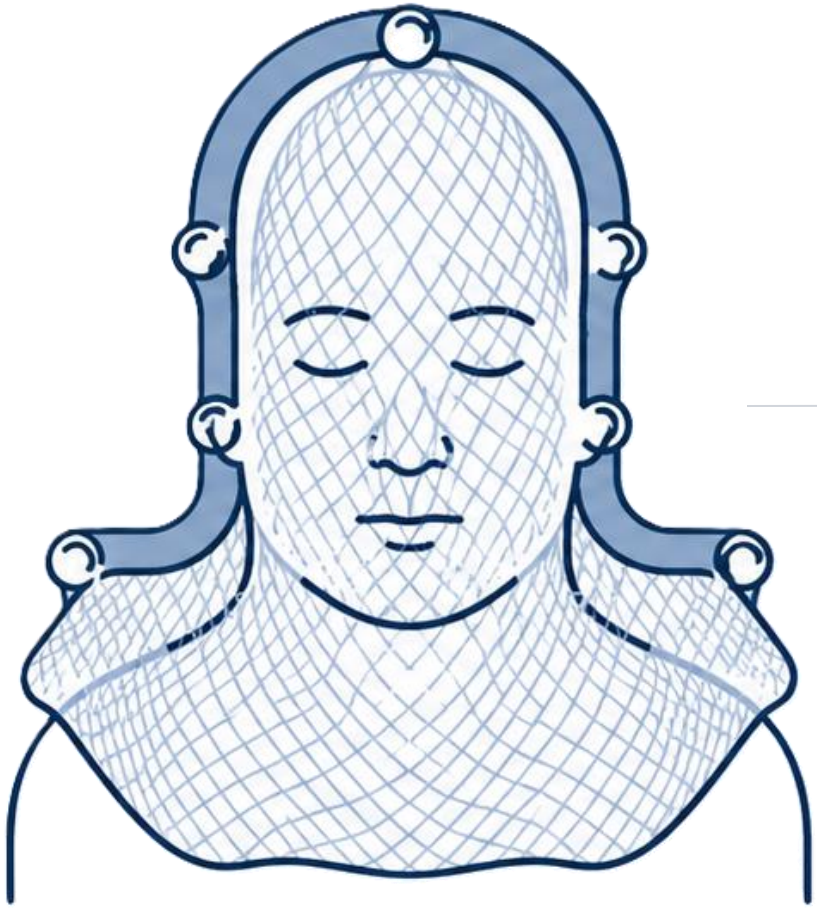
- This presentation was not influenced by financial incentives.

AdventHealth Florida

AdventHealth Central Florida:

- **15** Radiation Oncology Centers
- **25** Linear accelerators
- **2** Halcyons, **1** GammaKnife
- **3** HDRs
- **12** AlignRT systems (2 inBore)
- **3** SimRT systems
- **1** MapRT, **1** DoseRT

Mask Anxiety: A Significant Barrier to Care



43% of patients report significant anxiety before mask fitting

26% of H&N patients report mask anxiety

14–58% prevalence range across studies

IMPACT ON TREATMENT

- Treatment interruptions and session delays
- Potential treatment abandonment
- Reduced quality of life throughout course
- Increased need for anxiety medication

Nixon et al., J Med Radiat Sci 2019; Forbes et al., J Med Radiat Sci 2023

Rethink H&N Immobilization

TRADITIONAL
Closed-Face Mask

- 5-point thermoplastic
- Rigid, reproducible setup
- Anxiety & claustrophobia
- No SGRT during treatment

INTERMEDIATE
Open-Face Mask

- Improved tolerance
- Enables SGRT monitoring
- Still involves facial confinement
- Comparable accuracy to closed

PROPOSED APPROACH
Fully Maskless + SGRT

- Complete contact-free experience
- Real-time 6DoF SGRT tracking
- Dorsal shell support only
- Automatic beam-hold safety

Key Question: *Can we eliminate rigid facial immobilization entirely without compromising geometric accuracy or safety?*

SGRT Enabling Maskless H&N Treatment

Surface Tracking
Real-time 6DoF surface tracking during both setup and delivery

Continuous Monitoring
Continuous monitoring ensures reproducible setup and safe delivery

Safety Interlock
Automatic beam-hold when motion exceeds predefined thresholds

Contact-Free Experience
Enables a fully contact-free patient experience with no rigid facial confinement

Traditional Approach

Rigid facial immobilization can cause discomfort, anxiety, and claustrophobia

SGRT Approach

Dorsal shell support with no facial immobilization

Study Objectives

Technical Validation and Clinical Impact of Maskless SGRT Workflow

TECHNICAL VALIDATION

1

Intrafraction Accuracy

Determine whether maskless H&N radiotherapy using SGRT maintains submillimeter intrafraction accuracy

2

SGRT vs IGRT Validation

Validate SGRT measurements against IGRT (CBCT) for geometric accuracy

CLINICAL IMPACT

3

Workflow Efficiency

Evaluate workflow efficiency compared to the conventional masked approach

4

Patient Comfort

Assess patient comfort and overall experience with the maskless workflow

Our study integrates precision, safety, efficiency, and patient experience to advance maskless radiotherapy for head and neck cancer

Patient Selection Criteria

Inclusion Criteria

- H&N patients suitable for conventional fractionation
- Able to maintain voluntary head stability
- Willing to participate in maskless workflow
- Physician approval for maskless approach

Considerations & Exclusions

- Involuntary head tremor or movement disorder
- Severe cognitive impairment
- Patient preference for mask (if desired)
- Physician preference for masked workflow

Final eligibility is determined collaboratively by the treating physician and patient, ensuring both clinical suitability and patient comfort.

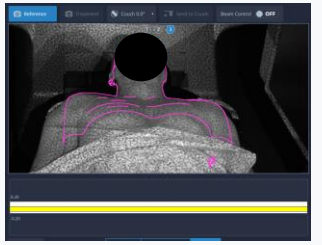
Setup & Immobilization Strategy

1. **Immobilization**
   Macromedics DSPS Prominent dorsal shell
2. **Setup**
   AlignRT postural video guidance + CBCT image guidance
3. **Monitoring**
   Continuous 6DoF SGRT tracking with auto beam-hold at ≥2 mm/2°
4. **Verification**
   Post-treatment CBCT to confirm residual displacement
5. **Evaluation**
   SGRT Real-Time Deltas + pre-/post-treatment CBCT comparison

STEPS 1–3 Setup & Monitoring

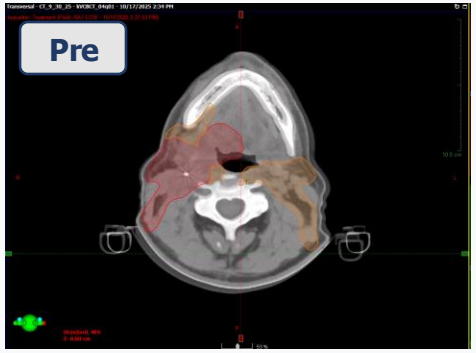
Simulation

Dorsal shell setup



AlignRT live surface

STEPS 4–5 Verification & Evaluation



Pre- vs post-treatment CBCT — residual displacement comparison

AlignRT ROI Configuration for Maskless H&N

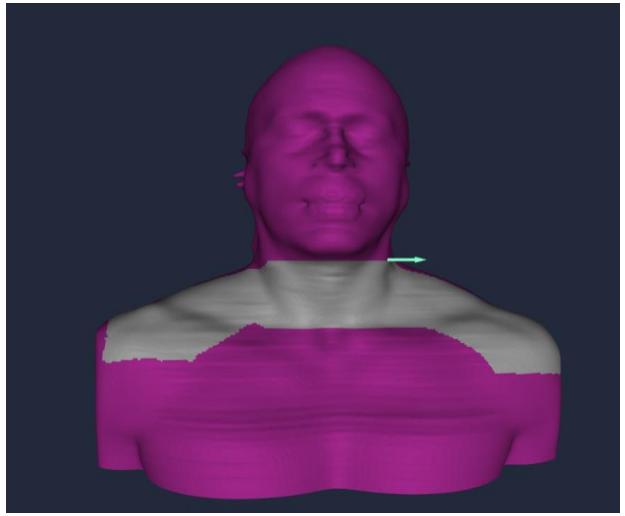
Two-stage setup ROI accounts for independent rotation axes of head and shoulders before switching to the treatment ROI.

SETUP ROI 1

Face + Shoulders

Initial coarse alignment — both rotation axes tracked together.

SETUP ROI 2



Shoulders Only

Refine shoulder/torso alignment independent of head rotation.

TREATMENT ROI

Face Only

Head-only tracking during beam delivery; shoulders excluded.

INCLUDE
Forehead, bridge of nose, cheeks, upper chest

EXCLUDE
Jaw/mandible, lips, neck folds (mobile structures)

Verify ROI quality with deformation view (non-rigid motion) and color map (surface agreement) before proceeding to treatment.

Evaluation Method

Three Steps how we evaluated maskless H&N radiotherapy for safety, geometric precision, and patient acceptance.

Step 1
Motion Assessment

Real-time intrafraction tracking

INSTRUMENT
AlignRT 6DoF SGRT

SAMPLE RATE
15–25 fps continuous

THRESHOLD
≥2 mm / ≥2° (any axis)

ACTION
Automatic beam-hold

REPORTED
Mean intrafraction RTDs; % fractions with violation

Step 2
Geometric Verification

Volumetric image guidance

INSTRUMENT
CBCT (pre + post)

REGISTRATION
Rigid, post-CBCT to pre-CBCT

METRIC
Per-axis mean residual shift

REPORTED
Translation (mm) and rotation (°) per axis

COVERAGE
Every fraction, all patients

Step 3
Patient Experience

Qualitative comfort assessment

INSTRUMENT
Internal qualitative questionnaire

TIMING
End of treatment course

DOMAINS
Comfort, anxiety, mask preference

COMPARATOR
Self-reported prior mask experience

REPORTED
Patient preference (%); narrative comfort themes

Reporting basis: per-fraction continuous SGRT logs, per-fraction CBCT registration, end-of-course patient questionnaire. N = 10 patients, 330 fractions.

Results: Maskless SGRT Performance

ACCURACY

1.0 mm
Mean intrafraction translation

0.9°
Mean intrafraction rotation

0.5 mm
Post-CBCT residual translation

SCALE & COMPLIANCE

10
Patients enrolled

330
Fractions delivered

10%
Fractions w/ ≥1 threshold violation

4%
Fractions requiring repositioning

Submillimeter accuracy maintained across 330 fractions with maskless SGRT

Intrafraction data from continuous SGRT monitoring; residual displacement from pre- vs post-treatment CBCT.

Head-to-Head: Maskless vs Masked Workflow

THE MASKLESS ADVANTAGE

Comparison against institutional historical data on prior masked H&N patients.

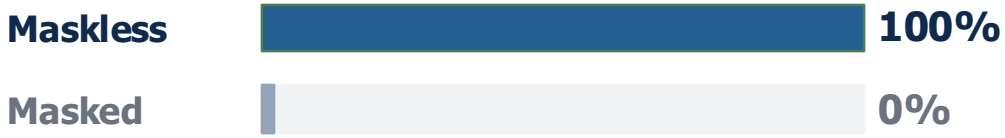
INTRAFRACTION MOTION

60% lower

Substantially less head motion despite eliminating rigid immobilization.

PATIENT PREFERENCE

Universal



Every patient who experienced both preferred the maskless workflow.

WHERE MASKLESS REQUIRES MORE VIGILANCE

THRESHOLD VIOLATIONS

+5%

Maskless **10%** vs Masked **5%**

Same ≥2 mm/2° thresholds, more honest enforcement without rigid restraint.

TREATMENT INTERRUPTIONS

+2%

Maskless **4%** vs Masked **2%**

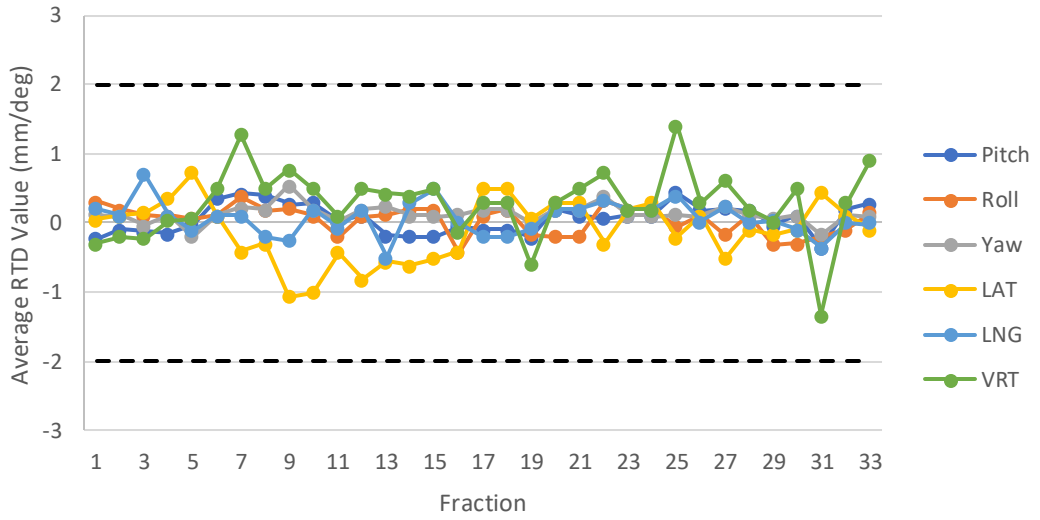
Expected from active beam-hold protection; no fraction was abandoned.

SGRT Intrafraction Stability

Population-level safety and case-level safety-system performance under continuous 6DoF tracking.

AGGREGATE BEHAVIOR

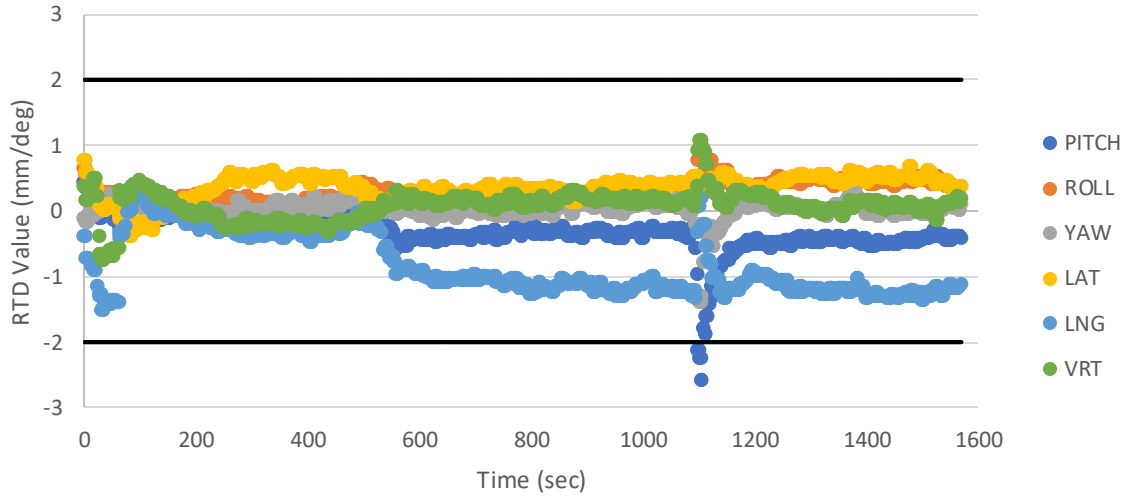
Mean RTDs stay well within threshold across all 330 fractions



0 of 330 fractions had mean RTD exceed ±2 mm/° threshold

SINGLE-FRACTION DETAIL

When threshold is crossed, beam-hold engages and patient self-corrects in 15–30 s



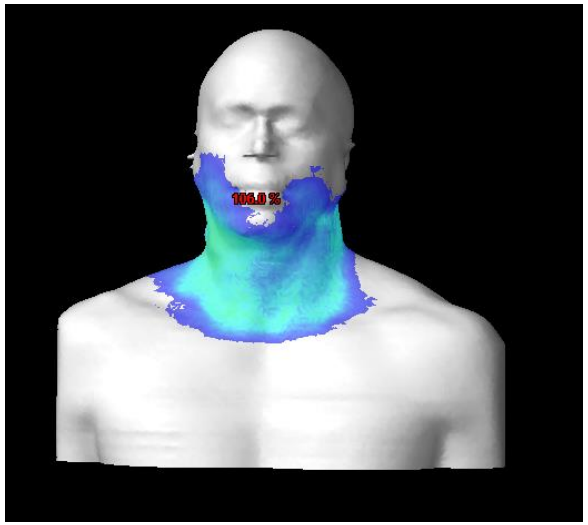
15–30 s typical return to within tolerance after beam-hold

Left: per-fraction averages across all patients and 6DoF channels. Right: representative example from the 10% of fractions with ≥1 threshold violation.

Treatment Verification with Cherenkov Imaging

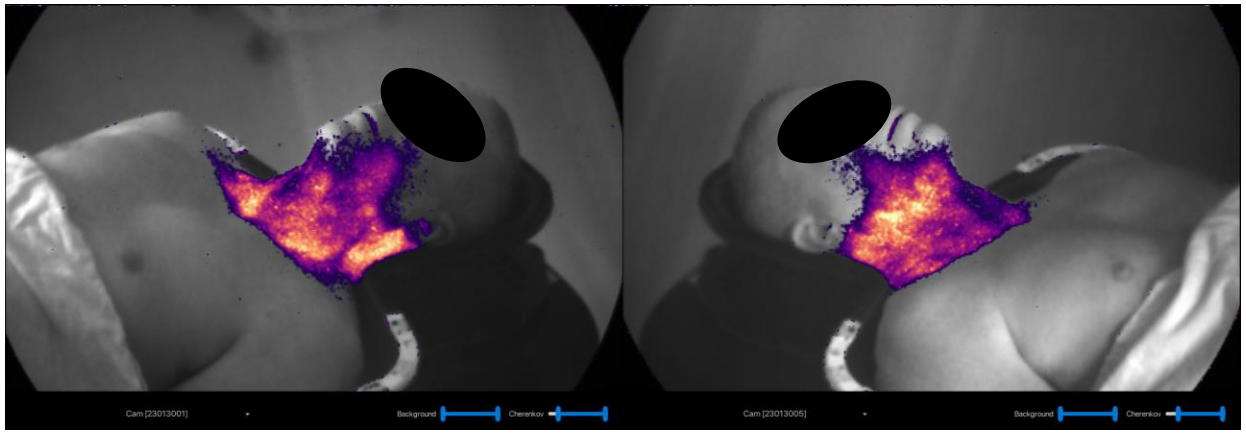
Qualitative comparison between planned dose distribution and delivered Cherenkov emission. Single fraction, single patient.

PLANNED Dose distribution



Computed dose at patient surface from treatment plan

DELIVERED Cherenkov Signal



Cherenkov light emitted during beam delivery, captured from two angles

Single fraction from one patient in the cohort. Cherenkov imaging provides qualitative spatial verification, not quantitative dosimetry.

Patient Treatment Example

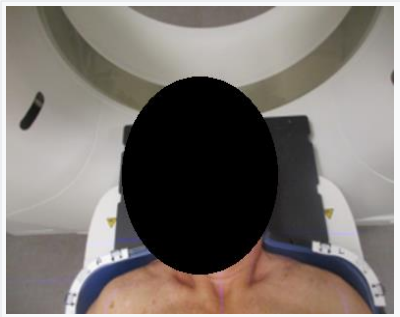
PATIENT 3

DIAGNOSIS
Malignant neoplasm of tonsillar pillar

PRESCRIPTION
70 Gy / 33 fx

1 **SIM**

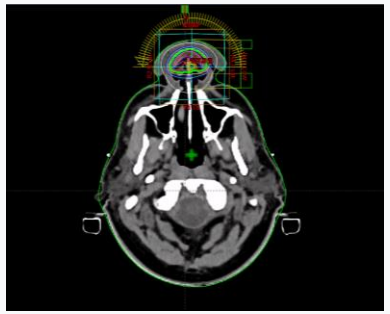
CT Simulation



Dorsal shell, no facial mask. MapRT clearance check.

2 **PLAN**

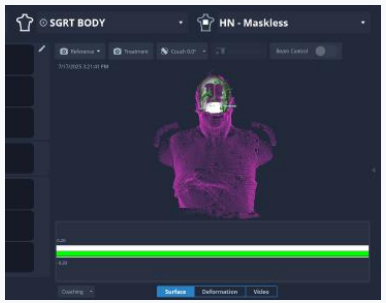
VMAT Plan



Standard VMAT planning. AlignRT ROI on face/upper chest.

3 **TX DAY**

Treatment Setup



SGRT-guided setup, postural video, CBCT verification.

4 **VERIFY**

Live Monitoring

Continuous 6DoF tracking; <1 mm post-CBCT residual.

5 **OUTCOME**

Course Complete

33/33

33/33 fractions delivered. Patient relaxed, comfortable.

33/33 fractions completed • 0 repositioning events • <1 mm post-CBCT residual • Comfortable, no anxiety

Representative case from the 10-patient cohort. All identifying features removed.

Patient Experience

The maskless workflow was initiated in response to what patients told us before treatment began.

3 of **10** patients

stated at consult that they would not proceed with mask-based treatment.

The trigger that initiated our move to a maskless workflow

*Maskless treatment was not just preferred it was the difference between **completing** or **declining** treatment.*

REDUCED CONFINEMENT

Patients consistently reported feeling less claustrophobic during setup and delivery without the rigid facial mask.

IMPROVED COMFORT

100% of treated patients preferred the maskless workflow at end-of-course questionnaire.

DECREASED ANXIETY

Therapists observed shorter time-to-comfort on the table and reduced pre-treatment anxiety throughout the course.

Pre-treatment statements made directly to physician and therapist at consult. Aggregate observations from treatment course.

Conclusions & Next Steps

KEY FINDINGS

Clinically feasible
across 10 patients, 330 fractions

Submillimeter accuracy
1.0 mm intrafraction motion; <1 mm post-CBCT residual

Active safety delivery
automatic beam-hold; only 4% of fractions required repositioning

Universal patient preference
100% of patients preferred maskless workflow

WHAT THIS MEANS

FOR PATIENTS

A maskless option exists. Ask your radiation oncology team about SGRT-based H&N treatment if mask anxiety is a concern.

FOR THERAPISTS

Workflow integrates with existing AlignRT setups. Two-stage ROI switching and beam-hold response replace rigid immobilization protocols.

FOR PHYSICS

Commissioning requires ROI templating per anatomy, threshold validation, and SGRT log review pathways. Enhanced QA framework.

FUTURE WORK

- Multi-site feasibility with diverse populations
- Standardized QA & ROI selection guidelines
- Long-term setup reproducibility & dosimetric impact
- Comprehensive patient-reported outcomes

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