HP PRO Solution

Background & aim

The aim is verification of the setup of proton H&N treatments using the Orfit HP PRO immobilization system. Because of uniformity in workflow, this system -consisting of a 5-point Nanor mask, HP PRO carbon fiber base plate, and T-shaped vacuum bag- is also used for photon treatments on a Varian TrueBeam linac.

Procedure

Setup analysis is performed using extra CBCT imaging before and after the treatment beams, to identify residual error and intrafraction movement.

4D offline matches of 17 patients are applied to determine the margins in lateral (x), longitudinal (y) and vertical (z) direction.

$$M_{x,y,z} = 2.5 \times \sqrt{[(\Sigma_{x,y,x})^2_{\text{before RT}} + (\Sigma_{x,y,x})^2_{\Delta}]} + 0.7 \times \sqrt{[(\sigma_{\text{RMS } x,y,z})^2_{\text{voor Rx}} + (\sigma_{\text{RMS } x,y,z})^2_{\Delta}]}$$

with : "Δ" = "CBCT after RT - CBCT before RT", Systematic error : $\Sigma_{x,y,z} = \text{sd}\,(\text{gem}_i)_{x,y,z}$, Random error : $\sigma_{\text{RMS } x,y,z} = \sqrt{(\text{gem}\,[(\text{sd}_i)^2])}_{x,y,z}$

Translational intrafraction movement

	x[mm]	y[mm]	z[mm]
μ	0.45	0.20	0.02
∑	0.75	0.78	0.53
σ	1.07	1.13	0.84
σRMS	1.11	1.21	0.90
marges	**2.66**	**2.78**	**1.96**

Results

We have found that a margin of 3 mm CTV-PTV is suitable to treat the H&N patient with this immobilization system.

HP PRO Solution

Background & aim

The aim is verification of the setup of proton neuro treatments using the Orfit HP PRO immobilization system. Because of uniformity in workflow, this system -consisting of a 3-point Nanor mask, HP PRO carbon fiber base plate, and T-shaped vacuum bag- is also used for photon treatments on a Varian TrueBeamSTx linac with 6DoF couch.
We have tested the mask without and with biteblock, for 12 and 11 patients respectively.

Translational intrafraction movement

Without biteblock

	x[mm]	y[mm]	z[mm]
μ	0.09	0.04	0.08
Σ	0.21	0.34	0.20
σ	0.35	0.37	0.42
σRMS	0.43	0.44	0.50
marges	0.83	1.15	0.85

With biteblock

	x[mm]	y[mm]	z[mm]
μ	0.12	0.19	0.17
Σ	0.20	0.30	0.22
σ	0.22	0.35	0.38
σRMS	0.31	0.39	0.43
marges	0.71	1.02	0.85

Procedure

Setup analysis is performed using extra CBCT imaging before and after the treatment beams, to identify residual error and intrafraction movement.
6D offline matches of 23 patients in total are applied to determine the margins in lateral (x), longitudinal (y) and vertical (z) direction.

$$M_{x,y,z} = 2.5 \times \sqrt{[(\Sigma_{x,y,x})^2_{\text{before RT}} + (\Sigma_{x,y,x})^2_{\Delta}]} + 0.7 \times \sqrt{[(\sigma_{\text{RMS } x,y,z})^2_{\text{voor Rx}} + (\sigma_{\text{RMS } x,y,z})^2_{\Delta}]}$$

with : "Δ" = "CBCT after RT - CBCT before RT", Systematic error : $\Sigma_{x,y,z} = \text{sd}(\text{gem}_i)_{x,y,z}$, Random error : $\sigma_{\text{RMS } x,y,z} = \sqrt{(\text{gem}[(\text{sd}_i)^2])}_{x,y,z}$

Results

Neglecting the uncertainty in target contouring, we have found that a PTV margin of 1 mm is achievable to treat the neuro patient with this immobilization system, extended with a biteblock.