

COMPARING INTENSITY MODULATED PROTON THERAPY (IMPT) VS HELICAL TOMOTHERAPY (HT) FOR NASOPHARYNX CANCER PATIENTS

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Purpose:

To compare intensity modulated proton therapy (IMPT) and Helical Tomotherapy (HT) in the treatment of head and neck (H&N) nasopharynx cancer (NPC) using a simultaneous integrated boost (SIB) approach.

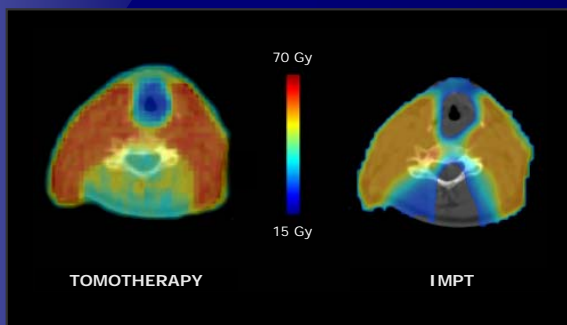
Methods and materials:

Data of 3 patients previously treated at S.Raffaele Institute with HT were used for the study. The main organs at risk considered were parotids, spinal cord, brainstem, mandible, larynx, thyroid, mucosae, chiasm and esophagus. In a first step, a default set of clinical constraints was applied to the OARs for both HT and IMPT optimisation; in a second step the sparing of OARs was maximized using IMPT while ensuring the same PTV coverage as in the first step.

A 3-beams (60°, 180° and 300°) IMPT technique was optimised in the Hyperion treatment planning system, simulating a 'spot scanning' technique (5 mm spot separation, 3 mm sigma at patient entrance). HT was planned in the tomotherapy treatment planning system (Tomotherapy Inc.) with a 2.5 cm field width, pitch 0.25-0.3 and modulation factor between 3 and 4.5. Both techniques were optimised to deliver simultaneously 66 Gy in 30 fractions on PTV1 (T+N+) and 54 Gy on PTV2 (N). The prescribed dose was delivered at the 98% of the volume for PTV2 and as median dose for PTV1 with the prescription that 95% of the volume receives at least 95% of the dose.

Results:

Considering the second step results, a comparable PTVs coverage and homogeneity of the target dose distribution for IMPT and HT was found: for example V95% of PTV1 are the same within 1%. Concerning the OARs sparing: the median dose in the parotids decreased from 23.6 Gy (HT) to 14.5 Gy (IMPT). Mucosae V30 and V20 decreased from 37.5% and 61.1% in HT to 21.7% and 36.5% in IMPT. Larynx V30 and V20 decreased from 38.2% and 50.9% in HT to 33.0% and 42.7% in IMPT. Dmax of brain stem was reduced from 51.9 Gy (HT) to 37.6 Gy (IMPT). V30 and V20 values in total body volume decreased with IMPT of 17% and 23% respectively. V45 values for thyroid were better in HT (38.1%) compared to IMPT (53.7%); the average value of V50 for larynx and esophagus are the same for HT and IMPT within a SD of 5%.



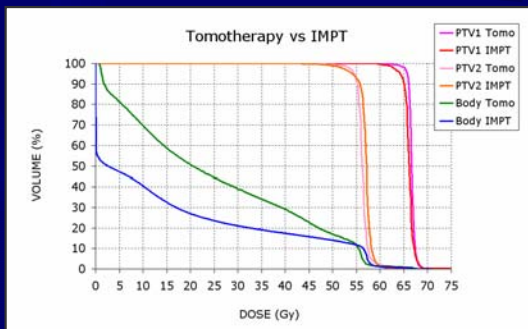
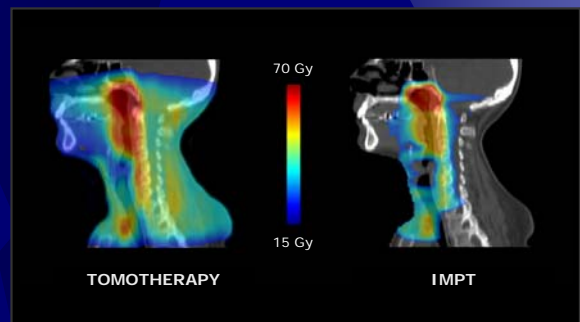
✓ COMPARABLE PTVs COVERAGE AND DOSE HOMOGENEITY

✓ OARs DOSE REDUCTION

- PAROTIDS: MEDIAN DOSE FROM 23.6GY TO 14.5GY
- SPINAL CORD: MAXIMUM DOSE FROM 38.2GY TO 29.9GY
- LARYNX: V20 AND V30 DECREASED FROM 51% TO 43% AND FROM 38% TO 33% RESPECTIVELY
- ESOPHAGUS: MEDIAN DOSE FROM 30.2GY TO 21.6 GY

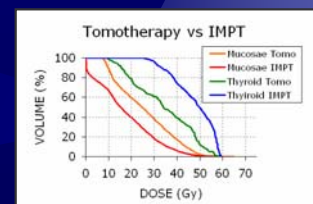
✓ BODY SPARING AT MEDIUM-TO-LOW DOSES

- INTEGRAL DOSE REDUCED OF 41%
- V10, V20 AND V30: DECREASED OF 27.4%, 22.9% AND 17.1% RESPECTIVELY
- SMALL DIFFERENCE FOR V50: REDUCTION OF 2.6% FROM 16.1% TO 13.5%



✓ ONLY THYROID WAS BETTER SPARED IN HT COMPARED WITH IMPT

- THYROID V45 INCREASED OF 15%
- MUCOSAE V30 DECREASED OF 16%



DVH OF MUCOSAE REFERRED ONLY TO MUCOSAE OUTSIDE THE PTVs

EXAMPLE WITH AN EQUIVALENT TARGET COVERAGE SHOWING BODY SPARING IN IMPT COMPARED TO HELICAL TOMOTHERAPY

Conclusions:

Excellent target coverage, homogeneity within PTVs and sparing of the OARs were reached with both modalities. Given an equivalent target coverage, IMPT allows better OARs sparing, especially at medium-to-low doses. The clinical significance of this advantage remains to be demonstrated in controlled clinical studies.