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**Whole SBRT\SRS chain validation by End to End Test: a single institution experience**

A.Ciarmatori<sup>1</sup>, E.Argazzi<sup>1</sup>, E.Belligotti<sup>1</sup>, S.Giancaterino<sup>1</sup>, M.Mariselli<sup>1</sup>, F.Palleri<sup>1</sup>, C.Biasi<sup>1</sup>, F.Maurizi<sup>1</sup>, M.Mazza<sup>1</sup>, F.Bunkheila<sup>1</sup>, M.Bono<sup>1</sup>

(1) Azienda Ospedaliera Ospedali Riuniti Marche Nord, Pesaro

**Introduction:** It is estimated that about 40% of adverse event in radiotherapy are related to implementation and commissioning process<sup>1</sup>. Given that very high dose fractions of radiation are delivered in Stereotactic Body Radiation Therapy (SBRT) and Stereotactic Radiosurgery (SRS) the consequences of these events could be very dangerous and therefore the commissioning and implementation process require special attention and diligence. End to end test are a very useful tool to validate the whole SBRT\SRS chain to ensure quality and safety in the delivery process<sup>2</sup>.

**Materials & methods:** Two anthropomorphic phantoms (one Head&Neck, and one Dynamic Thorax Phantom) have been utilized to test immobilization, Computed Tomography (CT) simulation, 4DCT Motion Management, Contouring, Image fusion, Planning, Heterogeneity Calculation, Data Transfer, Quality Assurance, Image guidance, 4DCBCT, 6 degree of freedom set up and Dose Delivery. “Single isocenter – single target” and “single isocenter - multiple target” plans have been created using flattened filter (FF) and flattening filter free (FFF) beams. QA test have been performed with an high resolution 2D array of liquid filled ionization chamber and dose measurements have been carried out with micro-ionization chamber. Finally, small error (1-2 mm and 1-2°) have been simulated to test their dosimetric impact.

**Results:** Difference between planned and calculated doses were always less than 1.5% both in “single isocenter – single target” and “single isocenter – multiple target” plan. 4DCT and 4DCBCT provided consistent result and contouring defined on 4DCT safely included 4DCBCT based target. Magnetic Resonance Imaging (MRI) an CT image fusion provided very good agreement based on Dice index and Hausdorff distance measurements. FFF beams allow significant ( $p<0.05$ ) beam time sparing without affecting dosimetric distribution. Small error in patient setup resulted in unneglectable (till 10%) dose difference.

**Conclusion:** Modern technologies allow to achieve sub-millimetre accuracy and very good dose agreement. However special attention should be used in all the steps of SBRT\SRS chain to optimize safety and quality of RT treatment.

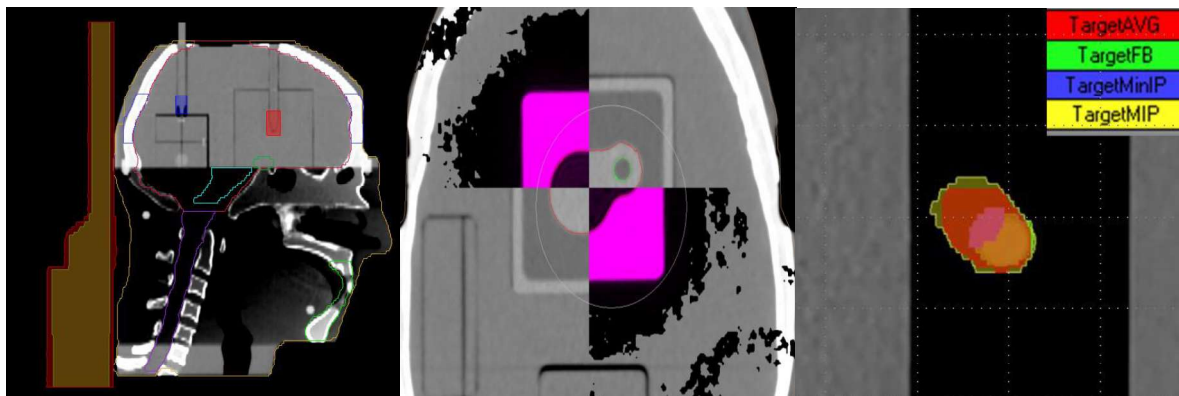


Figure 1 - Head&Neck antropomorphic phantom with 2 ionization chamber (Left), MRI - CT image fusion Test (center), Impact of 4DCT on target defintion (right)

**References:**

- [1] World Health Organization, Radiotherapy Risk Profile(2008);
- [2] Solberg TD, Quality and safety considerations in stereotactic radiosurgery and stereotactic body radiation therapy: Executive summary., Pract Radiat Oncol. 2012 Jan-Mar;2(1):2-9.

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