

Use of BrainLab- ExacTrac IGRT with Dot Decimal electron compensator(BolusECT) for accurate patient positioning

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Introduction:

Dot Decimal electron compensators(BolusECT) are used to achieve conformal dose distributions and greater sparing to critical structures. The compensators are beneficial for cases with varying patient contours with steep gradients. Such cases are treated with single electron fields. Daily setup can be difficult and time consuming for such patients because of small clearance between the electron cone and the bolus. Hence additional verification is needed for fast setup so as to avoid discomfort for the patient. In this study we have explored the use of BrainLab ExacTrac IGRT system for accurate setup.

Method and materials:

I. Verification with Wax Phantom

A specially designed wax head phantom provided by Dot decimal was used for the initial verification. A wax bolus was designed for this Phantom using Varian Eclipse Planning System and Dot-decimal compensator software. Based on the software input the wax compensator was milled to fit the wax head phantom. The intended treatment area in this head phantom was the nose. Five holes were drilled into this wax compensator and tungsten BBs were inserted at different depths. The different depths provide for proper viewing of the BBs at the orthogonal angles of the imaging system of BrainLab (45° and 315°). Tungsten BBs are used instead of gold seeds for cost effectiveness and their ready detection on ExacTrac system. The Holes are then sealed again with wax to prevent the BBs from falling off. Fig 1. Shows the wax head phantom with BolusECT compensator and tungsten BBs

Method:

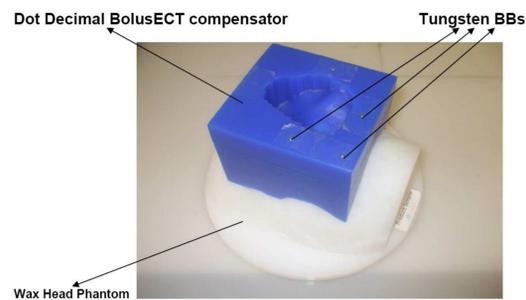
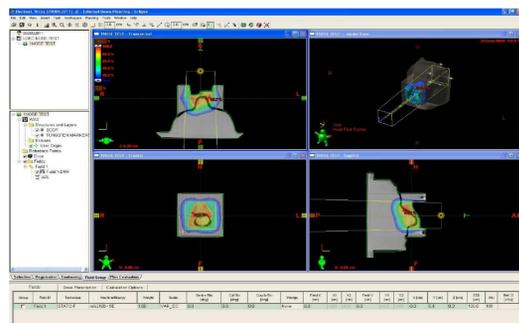


Fig 1. Wax Head Phantom and BolusECT compensator with Tungsten BBs

II. Post Plan and Setup. Verification

A post Plan was generated by scanning the wax head phantom with the BolusECT placed on top of it with the tungsten BBs inserted in the compensator. After comparison of the pre and post plan the plan was approved in Eclipse planning system and CT image set was exported to BrainLab ExacTrac System.



The wax head phantom was then placed on the treatment couch and tested for two situations

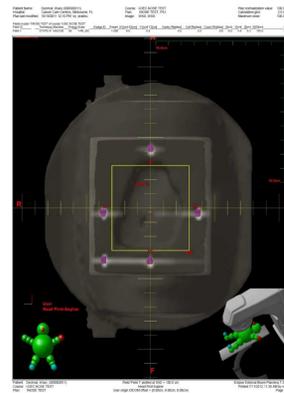
a. SSD offset by few millimeters:

The wax head Phantom was setup on the table using lasers and marks on the phantom. The SSD was purposely offset by 5-6 millimeters to determine if the BrainLab ExacTrac system correctly compensated for the shift in SSD.

b. Head Phantom position offset:

In this test The head phantom was setup with the correct SSD but intentionally offset with respect to its position. This test evaluates if the ExacTrac system compensates for translation and rotation shifts.

Orthogonal Images are taken on the Brainlab ExacTrac IGRT system at 45 and 135 degrees respectively. These orthogonal images are compared with the DRR generated from the CT scan. The system calculates shifts based on the tungsten BBs and the couch is shifted based on these corrections.



DRR with Fiducials Marked



ExacTrac Shifts Printout

Patient Plans:

- Based on the tests on the wax head phantom, this method was implemented in two patients treated with electrons on the nose. As in the case of wax phantom, a pre plan was first generated on the patient CT scan and then a wax compensator was designed for the patients using the Dot decimal compensator software. After the compensator was designed for the correct energy and depth of the treatment plan, the wax compensator was milled by Dot decimal for each of the patient.

- A post plan was generated by scanning the patient with the wax compensator and tungsten BBs inserted at various depths in the compensator.

- The post plan was verified, approved and the CT scan was sent

- to the ExacTrac IGRT system with patient contours and Fiducial contour.

- Orthogonal x-rays were taken with the ExacTrac system and compared with the DRRs generated from the patient CT scan

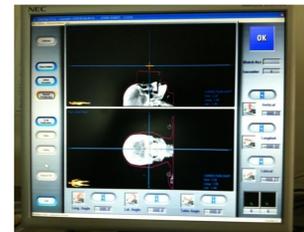
- All the necessary shifts were applied, the SSD was verified.

- Finally the electron cone is inserted and the patient was treated

- Diode Dosimetry was performed with the Bolus ECT on the phantom and correct SSD and setup prior to commencement of patient treatment.



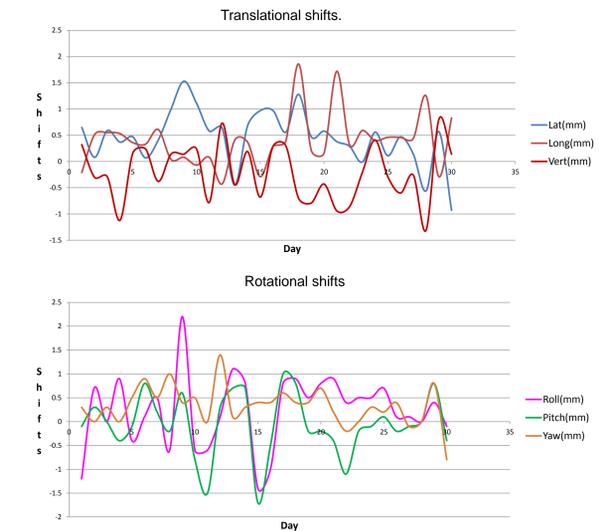
ExacTrac fiducial selection, DRR comparison and shifts



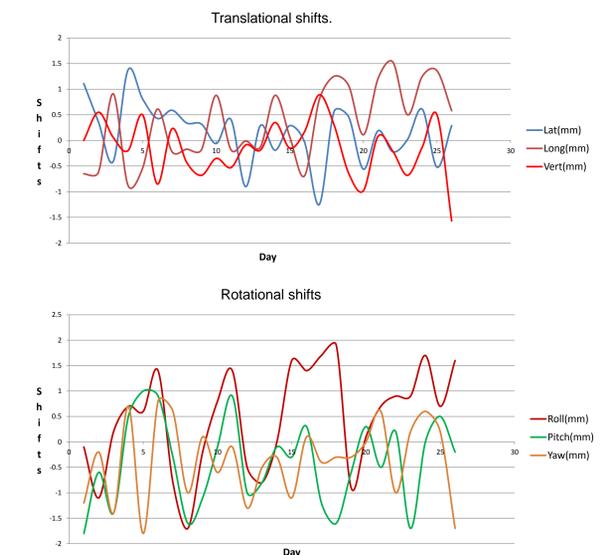
Patient Setup:



Results – Patient 1:



Results – Patient 2:



Results:

1. Phantom tests

For both the Phantom tests, the ExacTrac system correctly aligned with the fiducials. The SSD was within ± 0.5 mm from the planned SSD. The Translational as well as rotational shifts were within ± 1 mm.

2. Patient setup results

In patient 1, the average shifts over the period of entire treatment duration of 30 days was -0.14, 0.31 and 0.23 for translational shifts (Lateral, Longitudinal, vertical). For rotational shifts of roll, pitch and yaw the average corrections over 30 days were -0.65, -0.25, -0.25

In patient 2, the average shifts over the period of 26 days was 0.7, -0.035 and -0.785 for translational shifts(Lat, Long, Vert). For rotational shifts, the average shifts over 26 days were 0.75, -1.0, -1.45

Since the institution does not have the robotic Exact Couch system, Rotational shifts were not applied to the setup correction.

In both the patients the Setup SSD was within ± 0.3 mm of Planned SSD

Conclusions:

1. Use of BrainLab ExacTrac IGRT system with Dot decimal electron compensator (BolusECT) is excellent for accurate daily positioning.
2. This method helps in faster setup of patient thus avoiding discomfort for the patients.
3. Use of Tungsten BBs for tracking is cost effective as compared to the gold seeds.
4. Phantom Verification should be performed before implementing this system for patient use.