RediFoam Immobilization System Technique for Stereotactic Body Radiosurgery

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Stereotactic radiosurgery had been developed in the early sixties in Sweden, and recently adapted at Karolinska Institute to treat the inoperable neoplasms of the chest, abdomen and pelvis. The new method uses a specially designed stereotactic body frame, which is a device equipped with fiducial markers. The patient is positioned inside the body frame with the area of interest within the boundaries of the fiducial markers. These allow for the localization of the tumor to be treated and the exact positioning of an isocenter, which is essential for the successful administration of multiple treatments. The method for patient repositioning as suggested by the Karolinska Hospital, Stockholm is the use of a vacuum bag, which although efficient in patient immobilization, has certain inherent risks. At Staten Island University Hospital we proposed to use a custom fitted rigid body mold. The material used is RediFoam Immobilization System, a two part MDI-based rigid urethane system. When the ingredients are properly mixed the chemical reaction results in a custom impression of the patient’s contours. Its rigid structure will not be altered by normal use thereby insuring patient immobilization and replication. The system allows to use a smaller number of SBF and provides substantial cost effectiveness.

INTRODUCTION

A new method for the treatment of neoplasm in the chest, abdomen, and pelvis has been developed at the Karolinska Hospital, Stockholm, Sweden (1, 2, 3, 4) which is based on the external beam stereotactic radiotherapy the same way as it is used for the treatment of intracranial lesions. (5) This stereotactic radiotherapy of extracranial targets was named stereotactic body radiosurgery. A special stereotactic body-frame (SBF) has been developed for this purpose for stereotactic body radiosurgery and is commercially manufactured (by Precision Therapy Inc.). The body-frame is both computed tomography and magnetic resonance imaging (MRI) compatible (Figs. 1, 2). Fiducial markers are located in the sides of the body frame (Fig. 3). These fiducial markers allow a computerized planning system to set an isocenter using an \( x \), \( y \) and \( z \) coordinate system. The \( x \) and \( y \) coordinates correspond to a stereotactic arc (Fig. 2, 3), which fits to the body frame and can be locked in place. The stereotactic arc is marked in millimeter increments. The stereotactic arc is fitted with a chest marking device (Fig 2, #2). As well as the sides of the body frame (Fig. 2, #7) corresponding to the \( z \) axis. This device has an indicator which aligns with the millimeter marking along the stereotactic arc, two pointers attached to the chest marker and can be lowered to the patients skin where tattoo marks are made. A leg marker (Fig. 2, #6) attaches to the stereotactic body frame and has a laser attachment which casts a beam across both legs of the patient. The leg marker has also a pointer that corresponds to the \( z \) axis of the stereotactic body frame. Tattoo marks are also placed on the patients where the laser beam crosses, usually at the anterior portion of the tibia. These markings are used to reposition the patient for treatment. Patient immobilization and replication is essential in assuring that when an...
isocenter is set in the $x$, $y$ and $z$ coordinates, and the patient is precisely repositioned in the SBF, a successful treatment is achieved.

The aim of this paper is to describe our new method of patient's positioning and to check the accuracy of multiple positioning.

DESCRIPTION OF PATIENT’S POSITIONING

Material Character

The material used to form the immobilization device is RediFoam full size supplied by Med-Tec, Orange City, Iowa. RediFoam is a two part MDI-based rigid urethane system. The system is characterized by an exothermic reaction time of 15 minutes until its consistency is firm. This relatively long reaction time enables patient manipulation into the desired position before the product becomes set. A low exothermic temperature minimizes patient discomfort. Strong plastic bags with a width equal to the inner dimensions, and a length long enough to allow for a lip, when created by the RediFoam, aides in the proper placement of the mold back into the body frame. These bags have been custom-made and are supplied to us by Med-Tec. Strong tape is also needed to seal the end of the bags once the RediFoam has been poured. Silver Duct tape works well in this capacity.

Method of Patient's Positioning

Prepositioning the patient before the chemical is mixed is done to minimize the need for undue patient manipulation while the chemical is setting. The stereotactic body frame is placed on the end of the simulator table, or other flat surface. The patient is then positioned at the foot of the table and helped into a seated position in the body frame. Then the personnel help him into a supine position. At that moment, the stereotactic body frame is moved toward the head of the table by two team members positioned on either side of the table. The patient is positioned in the frame making sure the area of interest is within the feducial markers. The patients' arms are placed...