ABSTRACT

Purpose: To analyze the dosimetric impact of x-ray source turn-on time and inter-dwell times on treatment planning for the Axxent Electronic Brachytherapy System in APBI.

Methods and Materials: At the first dwell position, the treatment timer starts after the source has ramped up to full operating voltage and beam current have reached their operating points (50 kV, 300 µA), 32 seconds after the sequence starts.

RESULTS

The composite depth-dose curve is indicated by the blue diamonds in Figure 3. This curve agreed within 1.5% from 0.4 to 5.0 cm to source operation for 5.8 seconds at 37.5 kVp (red curve).

Figure 3. Dose During Source Turn-On Sequence (Assessed in Water). Calculated turn-on dose (blue line) and measured dose (red line) are shown for 2.5 seconds at 50 kV (black curves) and 2.5 seconds at 37.5 kVp (dashed curves). These curves agree within 1% at a distance of 3.0 cm from the source axis and 1% at a distance of 1 cm from the source axis.

Figure 4. X-ray Source Turn-On Sequence. Source high voltage, filament current and beam current turn-on sequences (37.5 kVp and nominal 17 seconds after turn-on).

Three characteristics of the Axxent System need to be considered when preparing treatment plans for Accelerated Partial Breast Irradiation (APBI):

1. **Turn-On Dose:** The first dwell position, the control of dwell time factors and the treatment timer. The total effective dwell time includes a turn-on time at the first dwell position.

2. **Transit Dose:** The movement of the X-ray Source within the balloon applicator and the controller. The total transit time includes the turn-on time and pullback movement of the X-ray Source within the balloon.

3. **Radiation Source:** The use of a radiation source designed to be less labor intensive, shorten treatment time and minimize handling and disposal of isotope sources.

The Axxent System can be configured to deliver a plan for APBI. The system is being used in the U.S. for Accelerated Partial Breast Irradiation (APBI) in patients.

**INTRODUCTION**

The Axxent System consists of the X-ray source, the balloon applicator and the controller. The translations and pullback movement of the X-ray Source within the balloon is designed to provide a predictable dose of radiation in the tissue surrounding the balloon. The Axxent System is characterized using the TG-43 protocol and electronic Brachytherapy System standards such as ICRU Report 62.

**MATERIALS AND METHODS**

At the first dwell position, the treatment timer starts after the source has ramped up to full operating voltage and beam current have reached their operating points (50 kV, 300 µA), 32 seconds after the sequence starts.

**RESULTS**

The calculated doses from a standard treatment plan were compared to those from a treatment plan that included provision for dose delivery during source transit between reference points.

**DISCUSSION**

The Axxent System is one of the few electronic high dose rate brachytherapy systems designed to be less labor intensive, shorten treatment time and minimize handling and disposal of isotope sources.

**CONCLUSIONS**

- **Transit Dose:** The calculated doses from a standard treatment plan were compared to those from a treatment plan that included provision for dose delivery during source transit between reference points.

- **Turn-on Dose:** The turn-on dose may be approximated in treatment planning by adding 2 seconds to the first dwell time.

- **Transit Dose:** The Axxent System is characterized using the TG-43 protocol and electronic Brachytherapy System standards such as ICRU Report 62.

**ACKNOWLEDGMENTS**

- The Axxent System was developed for medical use by Varian Medical Systems, Inc., Palo Alto, CA. The procedure was also supported by Varian Medical Systems, Inc.

**REFERENCES**


- References:


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