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Commissioning of Electron Radiotherapy Using Circular Applicator Tube for Lip Cancer Treatment

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INTRODUCTION

◆ Circular Applicator Tube

- Circular Applicator tube is being used for high energy electron beam therapy on small field to treat superficial and Intracavitary lesions.
- Elekta provides 4 different applicator tubes with diameters of 2, 3, 4, 5 cm made of stainless steel for Versa HD LINAC.

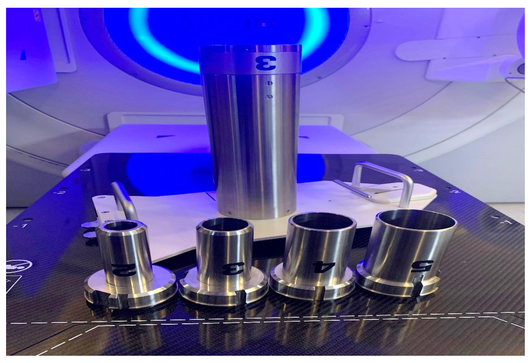

Fig 1. Circular Applicator tube in various sizes

◆ Purpose

- To report how to measure percent depth dose and output factor and how to verify dose prior to treatment for clinical application of electron radiotherapy using a circular applicator tube for patients with lip cancer in our hospital

MATERIALS & METHODS

◆ Treatment protocol

- Considering size and location of planning target volume (PTV) in the lip lesion, an circular applicator tube with a size of 4.0 cm ∅ and 6 MeV electron beam were selected to establish 10 times of treatment plan with 200 cGy of daily dose. In order to protect surrounding normal tissue during a patient treatment, a tongue displacer was used.

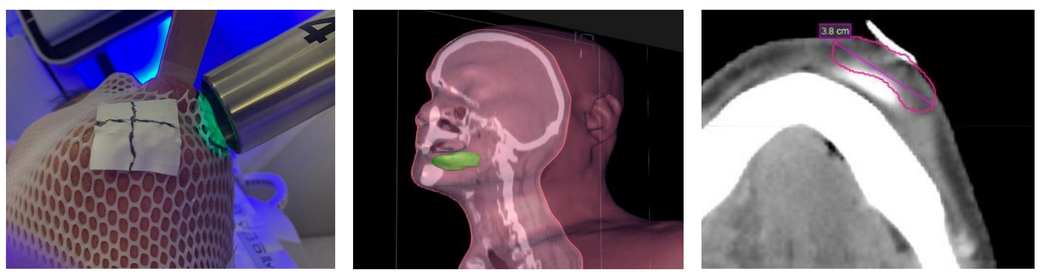

Fig 2. Illustration of patient information

◆ Measurement Condition

- For measuring PDD and output factor, semiflex ionization chamber (PTW 31010), microdiamond detector (PTW 60019) were used with MP3 water phantom (PTW, Fruiburg, Germany) on the Elekta Versa HD LINAC.

◆ *Output Factor*

- Output factor was determined via the ionization amount ratio between measurements by the circular applicator tube with 4.0 cm ∅ and applicator 10x10 cm^2 at a reference depth (Zref) of 6 MeV. For the circular applicator tube with 4.0 cm ∅, the amount of ionization was measured by giving a 1 cm air gap between the end of tube and water surface. For applicator 10x10 cm^2, the amount of ionization was measured at SSD 100 cm and the same Zref.

◆ *PDD*

- PDD measurements were performed by moving the detector at a speed of 10 mm/sec from the water surface to a depth of 10 cm along the central axis. The depths of 100%, 90%, 80%, 50% dose level were measured.

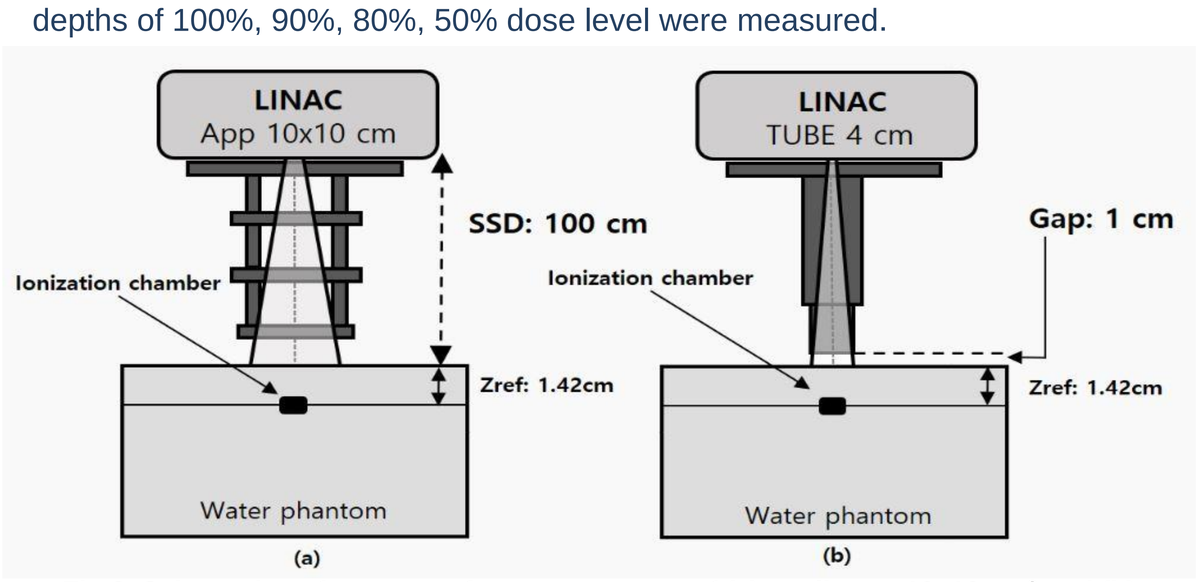

Fig 2. Schematics of geometry for measurement of (a) applicator 10x10 cm^2 and (b) circular applicator tube

◆Delivery and Evaluation

- Monitor unit (MU) corresponding to the prescription dose was calculated by using output factor and PDD.
- The EBT3 film was placed at the prescription depth of the solid water phantom (RW3, PTW). Pretreatment dose verification was performed using the calculated MU value.

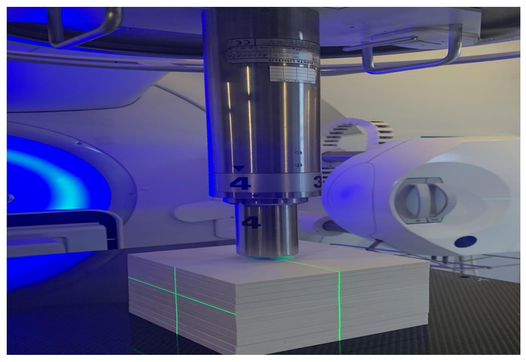

Fig 3. Pretreatment dose verification using EBT3 film

RESULTS & Conclusion

◆Results

- For dose distribution of the circular applicator tube, R100, R90, R80, R50 and output were shown, in comparison with the applicator with 10x10 cm^2.
- It was found that R100, R90, R80, and R50 in the circular applicator tube with 4 cm ∅ for 6 MeV showed differences of 11.5%, 6.3%, 4.4%, and 2.9% compared to the applicator with 10x10 cm^2.
- The output factor was determined to be 0.958 and the difference between the detector measurements was -0.94%.
- For verifying the prescription dose estimated from the calculated MU, it was shown that difference between the measured central axis dose and the prescription dose of EBT3 film was 1.2%.

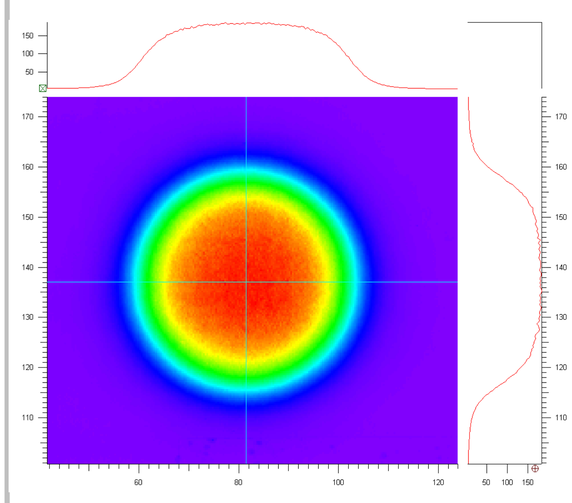

Fig 4. Film and Dose evaluation

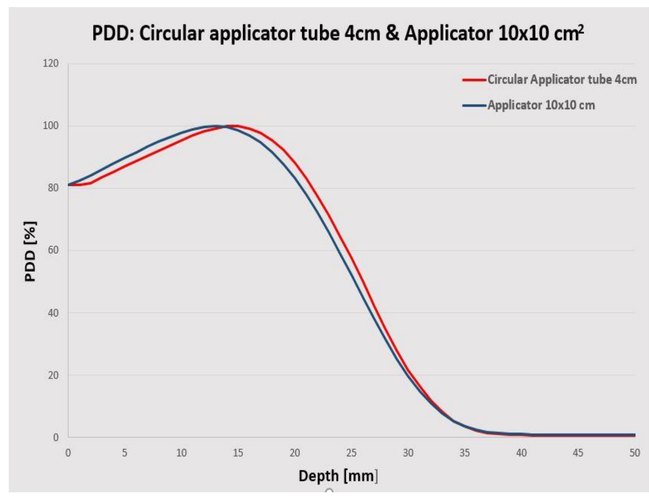

Fig 5. Comparison of PDDs between circular applicator tube 4cm and applicator 10x10cm^2

Table 1. Differences between R100, R90, R80, and R50 measured with circular applicator tube 4cm and applicator 10x10cm^2

	Applicator 10x10cm^2 [mm]	Circular Applicator tube 4cm [mm]	Difference [%]
R100	13.0	14.5	11.5%
R90	18.4	19.6	6.3%
R80	20.6	21.6	4.4%
R50	25.3	26.0	2.9%

◆Conclusion

- It was observed that high energy electron beam has a characteristic that the dose is intensively given only to a certain depth within the tissue and is then rapidly decreased. It was confirmed that the dose distribution in the tissue is very diverse through various types of fields and collimators.
- It seems that the variability of PDD and output factor in the circular applicator tube was mainly due to the effect of electron scatter generated in the inner wall of the tube. Measuring the dose distribution of the electron beam during treatment with a circular applicator tube enables accurate treatment in clinical situations.

Acknowledgment

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