
THE COUCH TURNTABLE TECHNIQUE IN LATERAL HEAD AND NECK IRRADIATION : A HOMOGENEITY OF DOSE DISTRIBUTION AND DOSE DELIVERED TO ADJACENT NORMAL TISSUES

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ABSTRACT

The objective of this study was to investigate for the uniformity of dose distribution and also the dose delivered to adjacent normal tissues compared between the Straight Field and the Couch Turntable technique in Cobalt-60 lateral head and neck irradiation. Doses were measured in an anthropomorphic wax phantom with TLD-100 dosimeters. Measurements were performed three times in each technique and the analysis was done by normalizing doses at each measuring point as a percentage of dose at the reference point. From the study, the doses distribution homogeneities are satisfied in both techniques. The average doses were 95.38 ± 7.41 in the technique of Straight Field and 95.07 ± 8.15 in the technique of Couch Turntable. In the matter of doses to adjacent normal organs, it is likely that the use of Couch Turntable provided higher doses than the technique of Straight Field. Measured doses at brain tissue (under shielding blocks) in the technique of Couch Turntable was 45.74 ± 11.83 , at buccal mucosa was 65.18 ± 5.24 and at lens was 5.05 ± 14.8 respectively. Compared to the technique of straight field, the average measured dose were 30.39 ± 5.39 at brain, 56.10 ± 6.56 at buccal mucosa, and 4.88 ± 16.7 at lens. It is clearly shown that uses of the Couch Turntable to solve for the beam divergence do not affect on the dose distribution homogeneity when compared to the technique of Straight Field. But higher doses at adjacent normal tissues, especially at brain should be aware of.

INTRODUCTION

In the treatment of most head and neck tumors, irradiation of the regional lymph nodes is always necessary in order to complete irradiation of the diseases to prevent local recurrent. This is mostly accomplished by two lateral opposing fields including the primary tumor site and cervical lymph nodes. The third anterior split field that covers the lower neck and bilateral supraclavicular lymph nodes may also be used.¹⁻³ Whenever, head and neck lateral fields are used together with the third anterior split field, the potential of

overlapping doses at the junction of the fields are increased. Several methods have been used to eliminate the problem including the technique of couch turntable with the purpose of reduction of the overlapping doses from the diverging lateral fields. In this technique, the foot of the couch is rotated so that the caudal end of the two lateral fields parallel and cross the patient's neck as a straight line. Study of Tuntipumiamorn L. and Polwatsatian V.⁴ had presented that the technique of Couch Turntable in the head and neck irradiation

tion was able to improve the dose uniformity at the junction plane between the two lateral opposing fields and the third anterior split field from 112.56% to 103.69%. However, because of an uncommon beam geometry, this technique may affect on the dose distribution homogeneity and the dose delivered to surrounding organs.

In this study we intended to investigate for the effect of couch turntable in the lateral head and neck irradiation on the dose distribution and also to access for the dose delivered to the brain, lens and buccal mucosa from this technique in comparison with those delivered by the Straight Field technique with our Cobalt-60 teletherapy machine.

MATERIALS AND METHODS

Studying the homogeneity of dose distribution and the doses to specific organs in this study required a phantom that provided for both the suitable measuring positions and also an adequate number of positions. An anthropomorphic head and neck phantom was newly made from paraffin wax and the accuracy in dose measurement between the two phantoms (old and new) were verified prior taking to be used in this study. After that, our routine lateral treatment fields were defined on the phantom with the simulator. (Fig 1) Fifty-eight holes, 2.5 mm in diameter were drilled around different positions in different levels of the phantom for giving the spaces for the TLD-100 dosimeters (1x1x6 mm, rod shaped, Harshaw Company) to be put in. Thirty-nine points in 3 slices of the phantom representing for the upper, central and lower slices of the lateral treatment fields were filled with the TLD-100 dosimeters to investigate for the dose uniformity (Fig 2). Fourteen measuring points at three different levels of the lateral superior beam edge was also chosen to access for the effect of the tilting beam geometry from the couch turntable to the dose that may deliver to the brain from the lateral fields (Fig 3). For buccal mucosa and lens, there were five and two measuring points respec-

tively.

After having placed the TLD-100 into different positions in the phantom, it was irradiated at 80 cm SSD with Cobalt-60 teletherapy machine. Measurements of doses were performed by the Straight Field technique and Couch Turntable technique.

In the Straight Field technique, the angle of a collimator and a treatment couch was at zero, while in the technique of Couch Turntable, the collimator angle was in the same position but the couch was turned to an angle of 5° in the direction to make the lower border of the divergence beam of radiation to be in the same straight line as the lower lateral neck field across the phantom's neck.⁵

Measurements were performed in each technique three times. To analyze the data, doses at each point will be normalized as a percentage to the dose at the reference point. The reference point here was set at the midline of head and neck phantom at the level of field center and dose delivered to this point was 100 cGy from each port.



Fig. 1. Anthropomorphic head and neck paraffin wax phantom

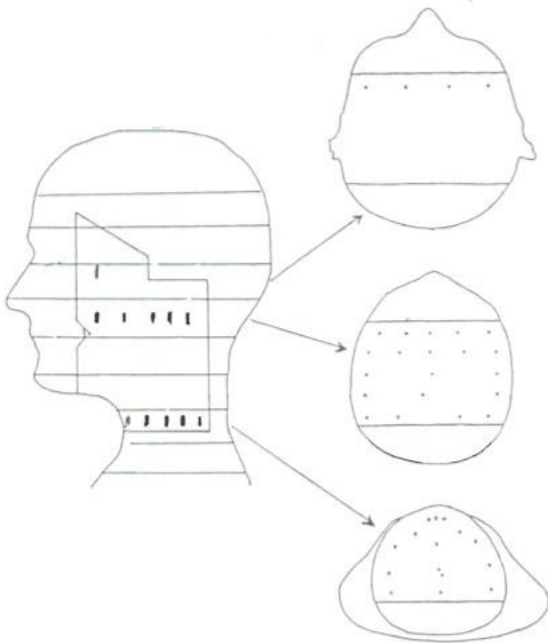


Fig. 2. Diagram shows the TLD positions in the three different levels of lateral head and neck treatment field to investigate for the dose homogeneity. The total number of measuring points was thirty-nine.

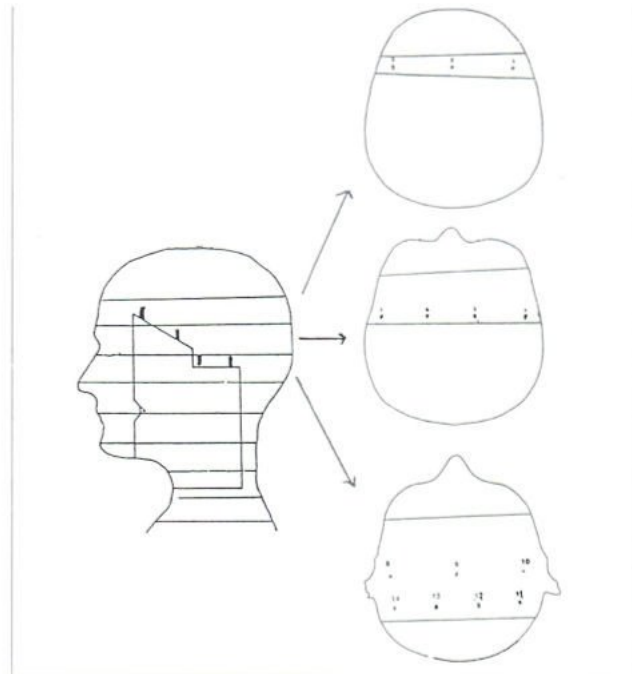


Fig. 3. Diagram shows fourteen measuring positions in three different levels of the lateral superior beam edge to access for the dose delivered to brain tissue (under shielding blocks)

RESULTS

The anthropomorphic wax phantom used in this study do not represent for the tissue inhomogeneity as in the Alderson rando phantom. Therefore, verification in the accuracy of dose measured in our paraffin wax phantom was necessary. We found that the accuracy of doses measured in our wax phantom was acceptable. The doses measurements in both phantoms were shown to be different within $\pm 5\%$.

The results for the investigation of dose

distribution homogeneity, no difference of the results in both techniques of Straight Field and Couch Turntable was detectable. Measured doses at point by point in both techniques were much closely the same.

The average measured doses in the Straight Field technique was 95.83 ± 7.41 and 95.07 ± 8.15 in the technique of Couch Turntable. Data of measured doses in three different slices were presented in Table I.

Table I. The measured doses in three different levels of the lateral head and neck treatment field compared between the technique of Straight Field and Couch Turntable.

Site	Number of Measuring Points	% Averaged Dose	
		Straight Field	Couch Turntable
Upper slice	4	84.99±1.88	84.46±2.45
Central slice	20	95.36±5.19	96.21±4.75
Lower slice	15	92.39±8.67	95.78±6.50
Mean± SD	39	95.38±7.41	95.07±8.15

Table II-IV presented data for dose measured at the adjacent organs. We found that the doses delivered to brain and buccal mucosa was higher in the technique of Couch Turntable than in the technique of Straight Field. While the doses scattered to lens from both techniques were quite equal.

It was noted that, the data of the measured doses at different points recorded in Table II were higher in the Couch turntable technique than the Straight Field technique, especially at the 6 measuring points (# 2, 5, 6, 9, 12,13) are remarkably high. All these 6 points previously mentioned were located near the sagittal midplane of the phantom.

Table II. Doses measured at brain compared between the technique of Straight Field and Couch Turntable

Measuring Points	% Averaged Dose	
	Straight Field	Couch Turntable
1	22.25±40.75	32.03±8.64
2*	37.31±26.36	66.89±5.49
3	29.65±11.80	39.09±17.45
4	36.08±59.62	36.53±30.01
5*	39.40±30.47	64.81±8.75
6*	32.83±22.27	65.18±3.75
7	27.26±13.11	35.43±8.91
8	34.56±8.07	37.54±19.51
9*	35.07±42.45	54.49±31.45
10	25.59±42.65	39.05±29.26
11	24.71±31.86	35.86±8.42
12*	27.85±46.05	47.10±12.32
13*	25.67±61.21	47.92±21.26
14	27.28±74.81	38.37±27.04
Mean±SD	30.39±17.7	45.74±26.8

* Measuring points that presented remarkably higher dose.

Table III. Doses measured at lens compared between the technique of Straight Field and Couch Turntable

Site	% Averaged Dose	
	Straight Field	Couch Turntable
Left lens	4.30±7.54	4.52±2.10
Right lens	5.45±5.27	5.58±0.99
Mean±SD	4.88±16.7	5.05±14.80

Table IV. Doses measured at buccal mucosa compared between the technique of Straight field and Couch turntable

Measuring Point	% Averaged Dose	
	Straight Field	Couch Turntable
1	61.02±10.52	60.92±10.13
2	65.00±10.52	71.42±10.52
3	53.61±16.86	65.92±13.22
4	54.99±18.31	68.68±15.55
5	45.88±22.85	58.95±19.16
Mean±SD	56.10±6.56	65.18±5.24

DISCUSSION

The use of couch turntable in the lateral head and neck irradiation was proved to be an effective method to solve for a problem of lateral beam divergence. It is interesting that this technique is simple, easy to be used, no need of extra accessory and applicable to all kinds of teletherapy machines,

Anyhow, the tilting beam geometry raised a question of whether the dosage distribution in the treatment volume is still be uniform or not. And also the doses to the normal surrounding structures obtained by this technique are still

acceptable or not.

For the results obtained in this paper, we found that by turning the treatment couch 5° to make the inferior border of the lateral treatment field to match with the superior border of the anterior supraclavicular field do not affect on the dose homogeneity of the area to be treated.

The overlapping field between the right and the left superior beam edge at the midline of the head may be the hot spot of the Couch Turntable technique. Thereby, the 6 measuring

points located near the midplane of the phantom had shown significantly higher doses in the technique of Couch Turntable than in the technique of Straight Field. The highest dose point in this region from the measurements, was about 2/3 of the dose at the reference point.

CONCLUSION

In the institute that Cobalt-60 machine are being used for lateral head and neck irradiation, the Couch Turntable technique may be considered to be used as an alternative to other techniques in solving the problem of beam divergence. It provided a dose homogeneity both at the junction plane between the upper and lower cervical fields and also the treatment volume to be irradiated. But the surrounding normal tissues, especially the brain, should be well aware of if this technique are being applied.

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