Quality assurance for the alignment of the field of radiotherapeutic treatment of cancer in of head and neck

Prayuth Rojponpradit*
Sivalee Suriyapee* Saranya Lapanich*


**Purpose**: To evaluate the accuracy of the alignment of treatment field in radiotherapy for cancer of head and neck region, in order to evaluate the precision of the field alignment which relates to the increase of survival and the reduction of side effects.

**Setting**: Division of Radiation Oncology, Department of Radiology, King Chulalongkorn Memorial Hospital.

**Research design**: Prospective observational descriptive study.

**Patients and methods**: 15 patients with cancer in the head and neck region, who were treated with linear accelerator at King Chulalongkorn Memorial Hospital from 1 February 2003 - 31 July 2003, were recruited. Weekly portal film was done; localized film was compared with first portal film which was then measured up to the consequent portal films. Inaccuracy parameters were evaluated from entrance field location, beam direction, movement, block and field edge. Excel program was implemented to identify the value of maximum, minimum, mean and standard deviation.

* Department of Radiology, Faculty of Medicine, Chulalongkorn University
Results: In total, 182 films (53 localized films and 129 portal films) and 1,510 were evaluated, and points were analyzed. The inaccuracy of entrance field location, beam direction, patient movement, block and filed edge were 0.23, 0.27, 0.26, 0.24 and 0.17 cm, respectively. The result shows the similar inaccuracy for all parameters studied and technique used. According to these data, the discrepancy in the means and standard deviations of localized and first portal film were a little bit higher than those of first portal and consequent portal films. This means the transition from simulation to treatment set up yielded larger deviations than repeated treatment set up. The maximum inaccuracy was 1.95 cm resulted from the difference between simulation and treatment at the field edge location, but it is only 0.12 % of all evaluated points.

Conclusion: The error was less than 1.00 cm and standard deviation was less than 2 cm. Therefore, international standard radiotherapy of King Chulalongkorn Memorial Hospital was approved and confirmed that role of radiation technician is important in setting the field.

Keywords: Quality assurance, Accuracy, Treatment field alignment, Radiotherapy, Head and neck cancer, King Chulalongkorn Memorial Hospital.

Reprint request: Rojponpradit P. Department of Radiology, Faculty of Medicine, Chulalongkorn University, Bangkok 10330, Thailand.

Received for publication. June 30, 2004.
ประยุทธ์ โรจน์พรประดิษฐ์, ศิริศิล ชุยกา, สาหัส ศรีจันทร์, การควบคุมคุณภาพของการตรวจสังเกตปฏิบัติการบริเวณศีรษะและลำคอ จุฬาลงกรณ์เวชสาร 2548 เมษายน; 49(4): 225 - 40

วัตถุประสงค์ : เพื่อวิเคราะห์ความคืบหน้าของข้อมูลการพยากรณ์ภัยในผู้ป่วยจะวงบริเวณศีรษะและลำคอ โดยการปรับปรุงที่มีด้านไบ์ที่จะต้องจัดตั้งต่าง ๆ จาก Localized film และ Portal film เพื่อให้การรักษาด้วยรังสีจะมีความแม่นยำเพิ่มประสิทธิภาพของการรักษาผู้ป่วย ทำให้ได้ทราบผลดีที่เพื่อใช้ในการจัดทำเอกสารมือถือและ

สถานที่ทำการศึกษา : ศูนย์รังสีการแพทย์ โรงพยาบาลจุฬาลงกรณ์ .factor.Ch.

วิธีการศึกษา : การวิจัยเชิงพรรณนาแบบไม่จำกัด

รูปแบบการวิจัย : ศึกษาในผู้ป่วยจะวงบริเวณศีรษะและลำคอจำนวนทั้งหมด 15 รายที่เข้ารับการรักษาด้วยรังสีการแพทย์ที่โรงพยาบาลจุฬาลงกรณ์ ศูนย์รังสีการแพทย์ โรงพยาบาลจุฬาลงกรณ์ .factor.Ch.

ผลการศึกษา : จำนวน Film ทั้งหมด 182 films แบ่งเป็น Localized film 53 films และ Portal film 129 films จำนวนจุดที่ถูกทั้งหมด 1,510 จุด พบว่า จำนวนความคลาดเคลื่อนของแบบของ Localized film กับ Portal film คือน้อยที่สุด ประมาณ 0.23,

0.27, 0.26, 0.24 และ 0.17 เช่นเดียวกัน ตามลำดับ ปัจจัยผู้ป่วย ของความแตกต่างระหว่าง Localized film กับ Portal film คือน้อยมากกว่า Mean และ SD ของความแตกต่างระหว่าง Portal film ของการรักษาจะส่งผลต่อกับ Portal film ในครั้งต่อ ๆ ไป ซึ่งแสดงว่าเมื่อมีการเปลี่ยนผู้ป่วยจากเครื่อง Simulation มาถึงเครื่องอย่างค่อนข้างบ้างของความคลาดเคลื่อนก็ยังคงกับการรักษาจะส่งผลต่อกับPortal film ในครั้งต่อ ๆ ไป ค่าความคลาดเคลื่อนที่พิจารณาสูงสุดคือความแตกต่างระหว่าง Localized film กับ Portal film คือ 1.95 เท่ากับกัน 0.12 % ของจำนวนจุดที่ถูกทั้งหมด
บทสรุป: ค่าความคลาดเคลื่อนเฉลี่ยมีค่าอยู่ในเกณฑ์มาตรฐานที่ยอมรับได้คือมีค่าความคลาดเคลื่อนน้อยกว่า 1.00 เซนติเมตร และมีค่า Standard deviation (SD) น้อยกว่า 2 ซึ่งสรุปได้ว่ามาตรฐานการขายรังสีของสาขารังสีทักษะ ของผู้ประกอบการรังสีและสาขา อัตราการรับผิดการรักษา หมายถึงลูกค้าการรักษาในเกณฑ์มาตรฐานลำดับที่ยอมรับได้

คำสำคัญ: การควบคุมคุณภาพ, การขายรังสี, ประสบการณ์ด้านคุณภาพและลูกค้า
According to the statistics of the Division of Radiation Oncology, Department of Radiology, King Chulalongkorn Memorial Hospital, the number of patients with cancer has been increasing every year, mostly with the malignancy of the head and neck region.1)

The preferred model of treatment for most cases of cancer is multimodality approach consisting of radiation, surgery, chemotherapy, etc. In daily radiation therapy, there are substantial inaccuracies of the field alignment for radiation that occur due to a number of factors.2)

Many researches were conducted, on the assurance of the field alignment for radiotherapy such as:

- Herring et al.3) documented that the change of radiation dose for patient at +/- 10% could result in the decrease of tumor control and the increase of normal tissue necrosis.

- Sue E et al.4) identified that the accuracy of reference points between localized and portal film of pelvic irradiation were below acceptable standard points.

- C.L. Creutzberg et al.5) identified portal film and summarized that the inaccuracy of reference points in radiotherapy of breast cancer are below the acceptable standard points.

Therefore the accuracy of radiation dose and alignment of radiation field in radiotherapy are necessary for the improvement of the efficiency of treatment.3-6)

**Inclusion criteria**

To be qualified for recruitment into the study, the subject needs to fit in with the following criteria, namely:

1. Age equal or more than 18 years
2. Histopathology proved for head and neck cancer
3. Karnofsky performance status (KPS) equal or more than 70%.
4. Submitted written informed consent
5. Psychologically healthy
6. No previous history of irradiation
7. Prescribed for Linear accelerator

**Exclusion criteria**

The criteria for exclusion of the candidate for the study are as follows:

1. Second primary carcinoma found
2. Pregnancy
3. Radiation therapy planned with non-conventional dose prescription
4. Incomplete schedule of radiation treatment

**Research materials**

1. Simulator: Varian Ximatron CX
2. Linear accelerator: Varian Clinac 1800
3. Cassette: Kodak Lanex for Localized film
4. Cassette: Kodak EC-L Cassette/ Screen for verification 14 x 17 inch for Portal film
5. Diagnostic film for Localized film
6. Kodak EC film for oncology 14 x 17 inch for portal film

**Procedure in the Simulation Room**

Markers were attached bilaterally on the fixation mask. Simulation was done. Localized film was taken bilaterally.

**Procedure in the Linear Accelerator Room**

Portal film of the radiation field was done on the first day of radiotherapy, both right and left lateral field, anterior-posterior field and anterior-posterior face field (Figure 1-13). After that, portal film was taken weekly.

![Figure 1. Points of evaluation of lateral field of simulation film and portal film.](image1)

1=Marker 1, 2=Marker 2, 3=Marker 3, 4=Anatomical point 1 (Lowest point of sella), 5=Anatomical point 2 (Tip of transverse process of C1), 6=Block 1 (The most lateral point of cranial block), 7=Field edge 1 (Field edge of treatment field; left), 8=Field edge 2 (Field edge of treatment field; inferior), 9=Field edge 3 (Field edge of treatment field; right), 10=Block 2 (The most lateral point of oral mucosa block), 11=Anatomical point 3 (Tip of middle mandible)

![Figure 2. Points of evaluation of AP field of simulation film and portal film.](image2)

1=Anatomical point 1 (The most inferior point of left clavicle head), 2=Anatomical point 2 (The most inferior point of right clavicle head), 3=Field edge 1 (Field edge of treatment field; superior), 4=Field edge 2 (Field edge of treatment field; left), 5= Field edge 3 (Field edge of treatment field; inferior), 6=Field edge 4 (Field edge of treatment field; right), 7=Block 1 (Right lateral of middle of block edge), 8=Block 2 (Left lateral of middle of block edge)
Figure 3. Points of evaluation of AP face field of simulation film and portal film.
1=Marker 1, 2=Marker 2, 3=Anatomical point 1(The most lateral point nasal cavity wall; left), 4=Anatomical point 2 (The most lateral point nasal cavity wall; right), 5=Field edge 1 (Field edge of treatment field; superior), 6=Field edge 2 (Field edge of treatment field; left), 7=Field edge 3 (Field edge of treatment field; inferior), 8=Field edge 4 (Field edge of treatment field; right).

Figure 4. Differences of entrance field location on X and Y axis, comparing between the first Localized and Portal film.

Figure 5. Differences of beam direction on X and Y axis, comparing between the first localized and portal film.
**Figure 6.** Differences of movement on X and Y axis, comparing between the first localized and portal film.

**Figure 7.** Differences of Block on X and Y axis, comparing between the first localized and portal film.

**Figure 8.** Differences of field edge on X and Y axis, comparing between the first localized and portal film.
Figure 9. Differences of X and Y axis, comparing between the first and consequent portal films.

Figure 10. Differences of beam direction on X and Y axis, comparing between the first and consequent portal films.

Figure 11. Differences of movement on X and Y axis, comparing with first and consequence portal film.
Figure 12. Difference of block on X and Y axis, comparing between first
an consequence portal film.

Figure 13. Differences of field edge on X and Y axis, comparing between first
and consequence portal film.

Data collection and analysis

Differences of reference points on both the X and Y axis were identified by comparing localized to
first portal film, and first portal film was measured up
to the consequent portal films based on the same
alignment as anatomical landmarks, field edges,
blocks and markers.

1. X and Y axis were set up with the origin at
the center of treatment field.

2. Measured distance between reference
points and the origin on both the X and Y axis of
localized and first portal film. The results were divided
by magnification each films.

3. Differences of reference points on the X
and Y axis were identified by comparing localized
and first portal films.

4. Measured distance between reference
points and the origin on both the X and Y axis of first
and consequent portal films. The results were divided
by magnification each films.
5. Differences of reference points on the X and Y axis were identified by compared first and consequent portal films.

6. Identified the maximum, the minimum, mean and SD by Excel program.

Differences in each reference points would be used in each parameter as follows:

1. Entrance field location consists of markers on the entrance of radiation beam
2. Beam direction consists of markers on the exit of radiation beam
3. Movement consists of anatomical points
4. Block consists of block alignment
5. Field edge consists of treatment field edge

**Results**

Totally, 182 films (53 localized films and 129 portal films) and 1,510 points were analyzed. Differences of reference points on localized films and first portal films have shown differences of radiation plan and the first radiotherapy on the first day. Differences of reference points on first and consequent portal film have shown differences of radiotherapy between the first and consequent weeks. Details are as follows:

Statistical evaluation was commenced with the use of Microsoft Excel program for the calculation of the maximum, the minimum, mean and standard deviation of parameters in each group. They are shown in table 1 as follows:

**Table 1.** The inaccuracy in term of Maximum, Minimum, Mean and Standard deviation of each parameter of this study.

<table>
<thead>
<tr>
<th>Statistical evaluation</th>
<th>Entrance field location</th>
<th>Beam</th>
<th>Movement</th>
<th>Block</th>
<th>Field edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum (cm)</td>
<td>1.52</td>
<td>1.59</td>
<td>1.83</td>
<td>1.88</td>
<td>1.95</td>
</tr>
<tr>
<td>Minimum (cm)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Mean (cm)</td>
<td>0.23</td>
<td>0.27</td>
<td>0.26</td>
<td>0.24</td>
<td>0.17</td>
</tr>
<tr>
<td>SD (cm)</td>
<td>0.23</td>
<td>0.29</td>
<td>0.29</td>
<td>0.26</td>
<td>0.22</td>
</tr>
</tbody>
</table>

**Table 2.** Maximum, Minimum, Mean and Standard deviation of each parameter were considered on the difference of Localized and first Portal film, as well as first and consequence Portal film.

<table>
<thead>
<tr>
<th>Statistical evaluation</th>
<th>Entrance field location</th>
<th>Beam direction</th>
<th>Movement</th>
<th>Block</th>
<th>Field edge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>P</td>
<td>L</td>
<td>P</td>
<td>L</td>
</tr>
<tr>
<td>Maximum(cm)</td>
<td>1.52</td>
<td>1.17</td>
<td>1.59</td>
<td>1.38</td>
<td>1.83</td>
</tr>
<tr>
<td>Minimum(cm)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Mean(cm)</td>
<td>0.26</td>
<td>0.19</td>
<td>0.34</td>
<td>0.21</td>
<td>0.30</td>
</tr>
<tr>
<td>SD(cm)</td>
<td>0.27</td>
<td>0.19</td>
<td>0.34</td>
<td>0.23</td>
<td>0.37</td>
</tr>
</tbody>
</table>

L = Differences of Localized and first Portal films.
P = Differences of first and consequence Portal films.
According to table 1, the maximums, minimums, means and standard deviations of each parameter in the study are as follows:

1. Entrance field location: maximum = 1.52 cm, minimum = 0.00 cm, mean = 0.23 cm, SD = 0.23 cm
2. Beam direction: maximum = 1.59 cm, minimum = 0.00 cm, mean = 0.27 cm, SD = 0.29 cm
3. Movement: maximum = 1.83 cm, minimum = 0.00 cm, mean = 0.26 cm, SD = 0.29 cm
4. Block: maximum = 1.88 cm, minimum = 0.00 cm, mean = 0.24 cm, SD = 0.26 cm
5. Field edge: maximum = 1.95 cm, minimum = 0.00 cm, mean = 0.17 cm, SD = 0.22 cm

According to table 3 and 4, differences between localized and first portal film are shown in terms of maximum, minimum, mean and standard deviation with a little higher range than first and consequent portal film.

**Table 3.** Average of Maximum, Minimum, Mean and Standard deviation on each Treatment field have been shown in X and Y axis, comparing between differences of Localized and first Portal film.

<table>
<thead>
<tr>
<th>Treatment field</th>
<th>Maximum (cm) X</th>
<th>Minimum (cm) X</th>
<th>Mean (cm) X</th>
<th>SD (cm) X</th>
<th>Maximum (cm) Y</th>
<th>Minimum (cm) Y</th>
<th>Mean (cm) Y</th>
<th>SD (cm) Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right lateral</td>
<td>1.17</td>
<td>0.00</td>
<td>0.19</td>
<td>0.78</td>
<td>1.33</td>
<td>0.00</td>
<td>0.29</td>
<td>0.24</td>
</tr>
<tr>
<td>Left lateral</td>
<td>1.81</td>
<td>0.00</td>
<td>0.81</td>
<td>0.23</td>
<td>1.59</td>
<td>0.00</td>
<td>0.30</td>
<td>0.29</td>
</tr>
<tr>
<td>Right lateral reduced</td>
<td>1.44</td>
<td>0.00</td>
<td>0.26</td>
<td>0.25</td>
<td>1.88</td>
<td>0.00</td>
<td>0.55</td>
<td>0.56</td>
</tr>
<tr>
<td>Left lateral reduced</td>
<td>1.28</td>
<td>0.00</td>
<td>0.24</td>
<td>0.25</td>
<td>1.95</td>
<td>0.00</td>
<td>0.43</td>
<td>0.43</td>
</tr>
<tr>
<td>Anteroposterior</td>
<td>1.04</td>
<td>0.00</td>
<td>0.25</td>
<td>0.24</td>
<td>1.64</td>
<td>0.00</td>
<td>0.18</td>
<td>0.31</td>
</tr>
<tr>
<td>Anteroposterior face</td>
<td>0.11</td>
<td>0.00</td>
<td>0.03</td>
<td>0.03</td>
<td>0.54</td>
<td>0.00</td>
<td>0.11</td>
<td>0.01</td>
</tr>
<tr>
<td>All treatment fields</td>
<td>1.81</td>
<td>0.00</td>
<td>0.30</td>
<td>0.30</td>
<td>1.95</td>
<td>0.00</td>
<td>0.31</td>
<td>0.32</td>
</tr>
</tbody>
</table>

**Table 4.** Average of Maximum, Minimum, Mean and Standard deviation on each Treatment field have been shown in X and Y axis, comparing with differences of first and consequence Portal films.

<table>
<thead>
<tr>
<th>Treatment field</th>
<th>Maximum (cm) X</th>
<th>Minimum (cm) X</th>
<th>Mean (cm) X</th>
<th>SD (cm) X</th>
<th>Maximum (cm) Y</th>
<th>Minimum (cm) Y</th>
<th>Mean (cm) Y</th>
<th>SD (cm) Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right lateral</td>
<td>1.17</td>
<td>0.00</td>
<td>0.18</td>
<td>0.18</td>
<td>1.07</td>
<td>0.00</td>
<td>0.22</td>
<td>0.19</td>
</tr>
<tr>
<td>Left lateral</td>
<td>1.34</td>
<td>0.00</td>
<td>0.19</td>
<td>0.19</td>
<td>1.10</td>
<td>0.00</td>
<td>0.26</td>
<td>0.24</td>
</tr>
<tr>
<td>Right lateral reduced</td>
<td>0.50</td>
<td>0.00</td>
<td>0.17</td>
<td>0.14</td>
<td>1.38</td>
<td>0.00</td>
<td>0.36</td>
<td>0.34</td>
</tr>
<tr>
<td>Left lateral reduced</td>
<td>0.53</td>
<td>0.00</td>
<td>0.15</td>
<td>0.10</td>
<td>0.72</td>
<td>0.00</td>
<td>0.23</td>
<td>0.14</td>
</tr>
<tr>
<td>Anteroposterior</td>
<td>0.92</td>
<td>0.00</td>
<td>0.26</td>
<td>0.17</td>
<td>0.76</td>
<td>0.00</td>
<td>0.15</td>
<td>0.16</td>
</tr>
<tr>
<td>Anteroposterior face</td>
<td>0.34</td>
<td>0.00</td>
<td>0.05</td>
<td>0.06</td>
<td>0.24</td>
<td>0.00</td>
<td>0.05</td>
<td>0.06</td>
</tr>
<tr>
<td>All treatment fields</td>
<td>1.34</td>
<td>0.00</td>
<td>0.17</td>
<td>0.14</td>
<td>1.38</td>
<td>0.00</td>
<td>0.21</td>
<td>0.19</td>
</tr>
</tbody>
</table>
Discussion

ICRU (International Commission on Radiation Units and Measurements)\(^7\) number 24 applied in the standard of uncertainty in dose to a patient at 5 % and inaccuracy value in radiation field edge at less than 1.00 cm. Uncertainty in dose to a patient = 5 %, consist of the followings:

1. Cumulative uncertainty in dose delivered to a tissue = 2.5 %
2. Uncertainty in the treatment planning computation of dose to a patient = 4.2 %

Uncertainty in dose to a patient is shown in figure 14.

Inaccuracy value of radiation therapy must be less than 1.00 cm (Details are shown in figure 15). It consists of machine inaccuracy of less than 0.50 cm; patient set up and patient motion is less than 0.80 cm.

In daily radiation therapy, there are substantial inaccuracies of the alignment of treatment field due to the machine. Therefore the machine should be maintained at the tolerance level.\(^8\) Markers on entrance radiation beam for entrance field location which

---

**Figure 14.** Dosimetric uncertainties in the process of radiation therapy. The uncertainties represent approximately 95 % of confidence level.

---

**Figure 15.** Spatial uncertainties (at the 95 % confidence level) in the radiation therapy process.
means the accuracy of entrance beam direction and mask positioning. Markers on exit beam direction for beam direction. Anatomical points for patient movement. Blocks for setting up and Field edge for field alignment of the treatment.

In conclusion:

1. References points were marked at the same position for both localized and portal film. After considering the inaccuracy on both the X and Y axis, the result are shown in the average inaccuracy of entrance field location, beam direction, movement, block, and field edge at 0.23, 0.27, 0.26, 0.24 and 0.17 cm, respectively.

2. Differences of localized and first portal film, and up to the consequent portal film: Reference point have shown entrance field location, beam direction, movement, block and field edge with different mean and SD as follows:

   - Differences of localized and first portal film were identified with mean at 0.21-0.34 cm, SD at 0.27-0.37 cm. Differences of first and consequent portal film were identified with mean at 0.15-0.23 cm, SD at 0.17-0.23 cm.

   - Differences of means and SD on localized and first portal film were identified with the higher rate than first and consequent portal film which means the transition from simulation to treatment set up yielded larger deviations than repeated treatment set up.

3. The highest degree of mean was 0.34 cm which is lower than 1.00 cm. Of ICRU 24’s standard inaccuracy value, it means the accuracy in reference points between localized and first portal film were under acceptable standard points as Sue(11) and Creutzberg’s study.(3)

4. SD is nearly or higher than mean of each parameter, compared between localized and first portal films. For the comparison between first and consequent portal films, SD was used to identify extreme value and abnormal data distribution. The majority of differences and inaccuracies were found at 0.00 - 0.40 cm, with the minority at 1.95 cm.

   The inaccuracy in treatment field between localized and portal film is related to the following factors:(11-13)

   1. Machine inaccuracy: the inaccuracy from simulation room to treatment room

   2. The inaccuracy from daily radiotherapy, such as:

      2.1 Patient’s movement

      2.2 Patient’s positioning and treatment field set by radiation technician, considered from entrance field location, beam direction, block and field edge.

   The inaccuracy of the filed of treatment between localized film and first portal film can be identified with the higher rate than between first and consequent portal films. The transition may result in machine inaccuracy. Hence, it is necessary to improve the accuracy by quality assurance.

   After considering each parameter, we found that an inaccuracy degree could be decreased by the radiation technician, the accuracy of treatment field alignment and block. Also the result in this study shows that radiotherapy with different block sizes will result in different of outcomes on portal film.

**Conclusion**

From this study, the mean of each parameter and in total are under the acceptable standard point
with an inaccuracy degree at equal or less than 1.00 cm and SD degree less than 2 cm. Radiation technique can be improved, if the cause of the inaccuracy is identified according to the following parameters:

1. Error rate from machine can be avoided by implementing quality assurance.
2. The inaccuracy of patient positioning:
   2.1 Patient movement can be decreased by immobilizing device.
   2.2 Technical factors can be improved: an inaccuracy degree can be decreased by the radiation technician.

Therefore the recommendation for improvement should be presented to radiation therapists in their daily practice in order to improve the technique of radiation. Daily radiotherapy on the filed of treatment is related to the inaccuracy of alignment of the field of treatment due to the technique of radiation therapy, set up, immobilization device, patient motion and machine. Radiotherapy in King Chulalongkorn Memorial Hospital is below the acceptable standard, this may be because the radiation technicians were informed, pertaining the implementation of this study.

The results of this study will be used to evaluate the quality of radiation of Three Dimensional Conformal Radiation Therapy (3DCRT) and Intensity Modulated Radiation Therapy (IMRT), consist of real time film taken with portal imaging machine which resulted in the accuracy of radiotherapy on treatment field border.

The advantages from this study

1. Technique of treatment can be improved.
2. It achieved maximal precision in radiotherapy.

3. It maintained radiotherapy treatment of KCMH at acceptable standard.
4. It collected data and recommendation from patient and family for the next treatment.
5. It encouraged radiation technician to improve themselves in their daily positioning of treatment filed in order to achieve maximal precision in radiotherapy.

Suggestion for further work

Portal film should be taken routinely to identify the inaccuracy, precision and maximal achievement in radiotherapy. Collection of information can be advantage for the next treatment. The findings of this study should be presented to radiation technicians to empower them to do their best in daily practices.

Acknowledgements

Firstly, we would like to acknowledge with appreciation the following members of our medical team. Assoc. Prof. Prasert Lertsanguansincha MD, Assoc. Prof. Nopadol Asavametha MD, Assoc. Prof. Chonlakiet Khorpasert MD, Assoc. Prof. Kanjana Shotelersuk MD, Chawalit Lertbutsayanukul MD. for their kind assistance and cooperation.

Secondly, we would like to thank our radiation technicians, Mr. Wisut Wannawichit, Mr.Chutinan Nashin, Mr.Jamnong Khumkao, Ms. Amonwan Nasingkan, Ms. Aranya Ekwongsa, and Mr. Tinnakorn Boonrab for their wonderful works. Lastly, we would like to thank our physicists, Ms. Chulee Jaroonsantowong and Mr. Taweept Saenghangtham, and research assistance Ms. Sumada Lapanich and Dr. Wuttipong Tirakotai in their effort of making the research to its final conclusion.
References

1. Tumor registry, King Chulalongkorn Memorial Hospital. Statistical unit, Department of Radiology, Faculty of Medicine, Chulalongkorn University and King Chulalongkorn Memorial Hospital, Thai Red Cross society, 1999.


7. World Health Organization and Institute of Radiation Hygiene, Germany. Quality assurance in radiotherapy. A guide prepared following a workshop held at Schloss Reisenganberg, Germany, 3-7 December 1984


