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PORTAL VERIFICATION FOR BREAST CANCER RADIOTHERAPY

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***Abstract* – At the University Clinic in Skopje, breast cancer irradiation is being planned and performed by using a mono-isocentrical method, which means that a unique isocenter (IC) for all irradiation fields is used. The goal of this paper is to present the patient's position in all coordinates before the first treatment session, relative to the position determined during the CT simulation. Deviation of up to 5 mm is allowed. The analysis was made by using a portal verification. Sixty female patients at random selection are reviewed. The matching results show that for each patient deviation exists at least on one axis. The largest deviations are in the longitudinal direction (head-feet) up to 4 mm, mean 1.8 mm. In 60 out of 85 analysed fields, the deviation is towards the head. In lateral direction, median deviation is 1.1 mm and in 65% of the analysed portals those deviations are in medial direction – contralateral breast which can increases the dose in the lung and in the contralateral breast. This deviation for supraclavicular field can increase the dose in the spinal cord. Although these doses are well below the limit, this fact should be taken into account in setting the treatment fields. The final conclusion from the research is that despite of the fact we are dealing with small deviations, in conditions when accuracy in positioning is done with portal, the portal verification needs to be done in the coming weeks of the treatment, not only before the first treatment. This provides information for an intrafractional set-up deviation.**

***Keywords* – isocenter, CT-simulation, portal verification**

1. INTRODUCTION

This is the most common type of radiation therapy for women with breast cancer. The radiation is focused from a machine outside the body on the area affected by the cancer. The extent of radiation depends on whether mastectomy or breast –conserving surgery was done and whether or not lymph nodes are involved. The treatment consists of two angled (tangential) beams designed to minimize the dose to the underlying normal lung tissues. A similar approach is used in women treated to the chest wall following mastectomy. In women found to have a lymph node involvement, the radiation is also delivered to the regionally lymph nodes (axilliary and supraclavicular region). In these cases, additional beams are mathed to the tangential (breast) fields.

At the University Clinic in Skopje, breast cancer irradiation is being planned and performed by using a mono-isocentrical method, which means that a unique isocenter (IC) for all irradiation fields is used. The treatment is planned to be performed through two tangential fields if only the breast should be irradiated or with three fields if supra and infra-clavicular nodes should be included into the region of interest (two tangential for thorax wall irradiation and supra field for supra and infra-clavicular nodes irradiation). In longitudinal direction (head-feet), the IC is located in the middle of the tangential fields in the first case, and between tangential and supra fields in the second (Fig.1).

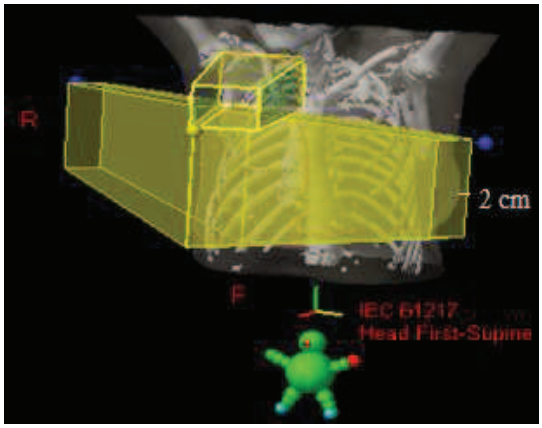

Fig. 1 – Supra and Tangential field arranging

When designing tangential fields, the outer limit from the skin is 2 cm measured from projecting furthest point (Fig.1). This is to provide a projection of the breast (or chest wall) being in the radiation field during treatment because of the normal breathing.

2. MATERIALS AND METHODS

The analysis was made for 60 female patients at random selection. During the irradiation the patient lies on a breast board. The pre-treatment positioning and the definition of the treatment isocentar (IC) are performed on a CT simulator, where the region of interest is scanned. The IC location is marked with two tattoos, one at the intersection of transversal and sagital laser and the other in the point of transversal with coronary laser intersection (Fig. 2).

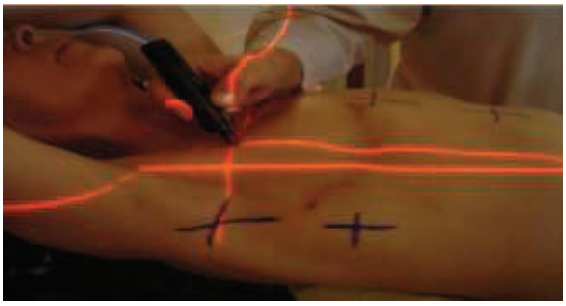

Fig. 2 – Supra field matching

The treatment plan is often made without changing the isocenter, defined during the CT simulation. Daily patient positioning should provide lasers to pass through tattoos and SSD for each irradiation field to match the default in the plan. In that case, no deviation is expected. But in reality, an ideal match is impossible. Before the first treatment fraction, portal verification, which checks deviation of position on all 3 axes, is mandatory (Fig. 3 and 4).

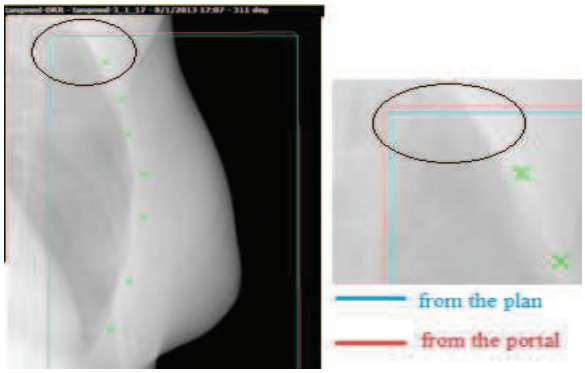

Fig. 3 – Tangential field matching

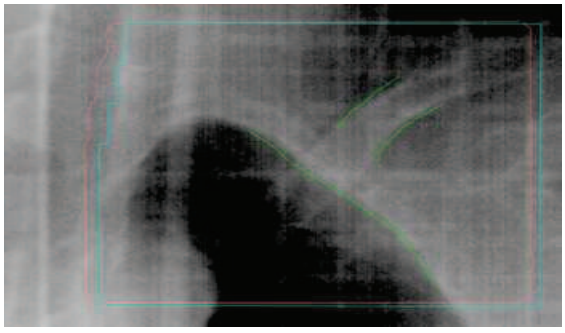

Fig. 4 – Supra field matching results

If necessary, the verification procedure can be repeated before the next session or later. Deviation of up to 5 mm is allowed. For deviations greater than 5 mm treatment can not start.

3. RESULTS

Matching results are presented in three axes. Vertical direction represents the Z axis. The deviations in that direction are anterior posterior deviations for the patient. Longitudinal direction represents Y axis or for the patient head-feet direction. Lateral – X axis for the patient is left – right. An individual matching result is shown on Fig. 5 below.

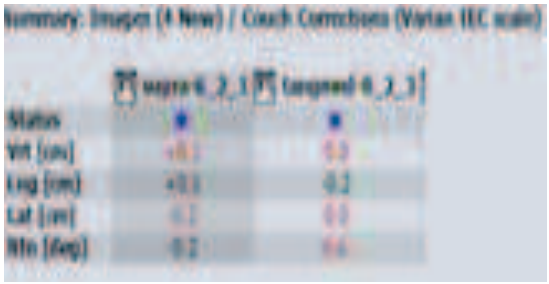

Fig. 5 – An individual matching result

Analysis shows that for each patient deviation exists at least on one axis. 15 patients – 25%, had deviation in all three axis and 40 patients – 67% had deviations in 2 axes. Analysis results show deviations as on Table 1 and Fig. 6 below.

As it is shown in Table 1, the deviations are minimal in vertical direction (anterior – posterior direction), where the mean deviation is 1 mm.

The largest deviations are in the longitudinal direction (head-feet direction), mean 1.8 mm. It is intriguing that only seven had no deviations in that direction. Eighteen deviations are at the feet direction, and the remaining 60 analysed fields (out of 85) had deviation towards the head (Fig. 2 and 3). This is probably result of the steepness of the breast board patients are lying on, as well as the fact that the hand is more relaxed than during a CT scanning done usually two weeks before the treatment. Deviations are not larger than 4 mm, which is acceptable.

Table 1. Deviation in three directions

deviation (mm)	max	min	mean
vert	3	-3	1
lgn	4	-4	1,86
lat	4	-4	1,12

In lateral direction, the median deviation is 1.1 mm and in 65% of the analysed portals those deviations are in medial direction – contralateral breast. However, the biggest deviation is 4 mm, and in worst case scenario for tangential field with 20 cm length, the projection (screening area) of the irradiation field that will be shifted in medial direction is only 8 cm^{2}. In this case, increasing the dose in the lung and in the

contralateral breast would still be acceptable. This deviation for supraclavicular field can increase the dose in the spinal cord. Although this dose is well below the limit, this fact should be taken into account in setting the treatment fields. The supraclavicular treatment field should be designed in such a way that the medial limit is at least 4 mm out of the spinal cord, ensuring that the spinal cord is definitely outside the irradiation field.

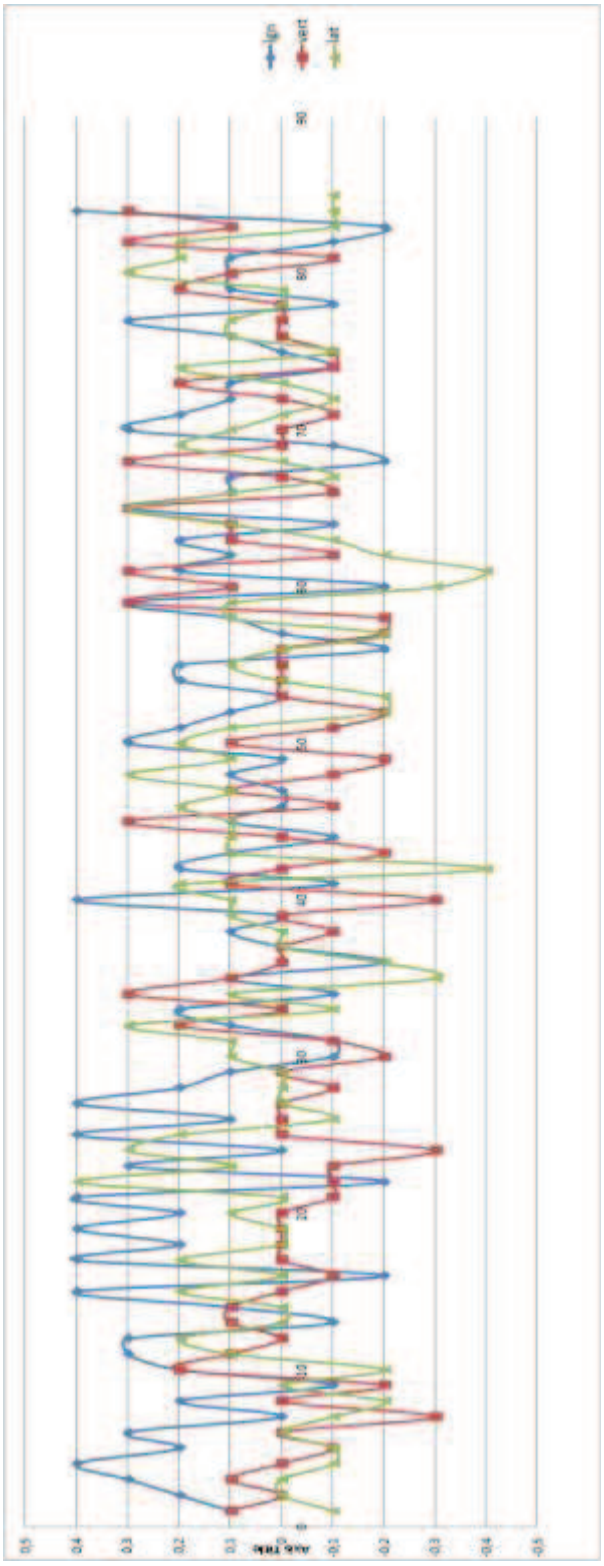

Fig. 6 – Position deviation

Additionaly, matching results show that the longitudinally deviations in any patient are not identical to supra and tangential field. It can be as a result of the uncertainties of the portal imager itself. Furthermore, the portal verification is time consuming, and the patient can change her position a little bit between the two portals. It should be also taken into account that to face a radiotherapy is a special psychological moment for the patient, and certainly has an impact on relaxation and position accuracy, especially during the first treatment. But to be able to make a proper conclusion for that, it is necessary to conduct further analyses. It can be a topic for advanced research.

4. CONCLUSION

According to the matching results, there is a good agreement in the position of the breast cancer patient before the first treatment compared to that in the CT simulation. The presented deviations in patients are negligible in clinical practice. They can be attributed to random errors due to the patient's movement and breathing. Furthermore, more stringent limit (4 mm) can be recommended. To decide to apply this recommendation, more portal verification for each patient should be made. The final conclusion from the research is that despite of the fact we are dealing with small deviations, in conditions when accuracy in positioning is done with portal, the portal verification needs to be done in the coming weeks of the treatment, not only before the first treatment. This provides information for an intrafractional set-up deviation.

5. REFERENCES

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