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Original article

Dose Optimization of Electron Arc Treatment Technique in Chest Wall Beams after Mastectomy

Mastektomi Sonrası Göğüs Duvarı Işınlamalarında Elektron Ark Tedavi Tekniğinin Doz Optimizasyonu

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Abstract

In breast cancer, electron energies are preferred over photon energies because they provide minimal lung exposure when conditions allow for thin chest wall irradiation after mastectomy. In patients with irregular chest wall, it is difficult to perform a homogeneous irradiation with fixed electron beam therapy due to reasons such as thickness differences, irregular contour and lack of tissue, long scar and area joint problems. Electron arc therapy is propose as an alternative method in such patients.

The study was carried out with electron energies of 6, 9, 12, 13.5 and 16 MeV. First, in order to be able to use it in electron arc planning in the planning system, after determining the dose characteristics of all available electron energies of the electron arc technique, the accuracy of these dose distributions was verified with film and TLD dosimetry. After the suitability was determined, electron arc plans were made on the CT simulation image of 20 patients selected due to the difficulty of homogeneous irradiation with the classical method.

While the chosen reference dose of 85% covered the PTV homogeneously, it was found that the dose was decreased by an average of 50% compared to photon and classical electron therapy in the examination performed in terms of radiation dose to which the lung volume was exposed. During the planning, a homogeneous dose and bolus of different thicknesses were required depending on the energy in most patients to regulate the reduction in surface dose depending on the arc angle. Bolus prevents the lung and heart from overdosing while ensuring that the dose in the deeper parts of the target volume is more uniform. The use of tertiary block in electron-arc dose distributions prevented unwanted dose reduction in the field edges and provided a more homogeneous dose distribution at 85% reference isodose. If the structure of the patient's contour is very irregular, the dose distribution is not smooth due to the depth difference.

In this context, it has been determined that during optimization, the isocenter depth should be chosen for the homogeneity of the dose distribution and to be as equal as possible from the surface at all beam angles. In addition, in the study, it was determined that more appropriate dose distributions were obtaine when the isocenter depth is greater than the maximum reach of electrons.

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Even if multiple electron fields of different energies are used, more homogeneous dose distributions have been achieve by eliminating field combination problems with the use of electron arc therapy.

Keywords: Breast cancer, electron therapy, electron arc, dose optimization.

Özet

Meme kanserinde mastektomi sonrası ince toraks cidarı ışınlamasında, elektron ışınları minimal akciğer ışınlaması sağlaması nedeni ile foton ışınlarına göre tercih edilmektedir. Toraks cidarı düzensiz olan hastalarda kalınlık farklılıkları, düzensiz kontur, doku eksikliği, uzun skar ile birlikte alan birleşim problemleri gibi nedenlerden dolayı homojen ışınlama yapmak zordur. Elektron ark tedavisi bu tür hastalarda alternatif bir yöntem olarak önerilmektedir.

Çalışma 6, 9, 12, 13.5 ve 16 MeV elektron enerjileri ile gerçekleştirildi. Öncelikle planlama sisteminde bu enerjilerin elektron ark planlamasında kullanılabilmesi için mevcut tüm elektron enerjilerinin doz karakteristikleri belirlendi. Daha sonra bu doz dağılımlarının doğruluğu film ve TLD dozimetresi ile doğrulanmıştır. Uygunluk belirlendikten sonra klasik yöntemle homojen ışınlamanın zorluğundan dolayı seçilen 20 hastanın CT simülasyon görüntüsü üzerine elektron ark planları yapılmıştır.

Referans izodoz %85 olmak kaydı ile PTV homojen ışınlanırken akciğer volümünün maruz kaldığı radyasyon dozunun foton ve klasik elektron tedaviye göre ortalama %50 ye kadar azaldığı tespit edildi.

Planlamalar sırasında homojen bir doz ve ark açısına bağlı olarak yüzey dozundaki azalmayı düzenlemek için çoğu hastada enerjiye bağlı olarak farklı kalınlıklarda bolusa gereksinim duyuldu. Bolus, hedef hacmin daha derin kısımlarındaki dozun daha homojen olmasını sağlarken akciğer ve kalbin aşırı doz almasını önler.

Bundan başka elektron ark doz dağılımlarında tersiyer bloğun kullanımının elektron ark doz, alan kenarlarında istenmeyen doz azalmasını önledi ve% 85 referans izodozda daha homojen bir doz dağılımı sağladı bu. Hastanın kontur yapısı çok düzensiz ise derinlik farkından dolayı doz dağılımı düzgün değildir.

Bu bağlamda, optimizasyon sırasında izomerkez derinliğinin doz dağılımının homojenliği için seçilmesi ve tüm ışın açılarında yüzeyden mümkün olduğunca eşit olması gerektiği belirlenmiştir. Ayrıca çalışmada, izomerkez derinliği elektronların maksimum erişiminden daha büyük olduğunda daha uygun doz dağılımlarının elde edildiği belirlenmiştir. Ayrıca izosantır derinliğinin elektronların maksimum erişme mesafesinden daha büyük olduğu durumda daha uygun doz dağılımlarının elde edildiği gözledi. Elektron ark tedavisinde farklı enerjilerde çoklu elektron alanları kullanılsa bile alan birleşim problemleri elimine edilerek daha homojen doz dağılımları elde edilmiştir.

Anahtar Kelimeler: Meme kanseri, elektron tedavisi, elektron ark, doz optimizasyonu.

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INTRODUCTION

Breast cancer is the most common malignant tumor among women and according to Globocan 2012 data, 1.7 million cases (25% of all cancers) are newly diagnosed annually worldwide, 17.000 new breast cancer cases are see in our country every year (Yazıcı O., et al.,2018). The patology of disease, the prognostic factors belonging to the patient, the type of surgery, the pattern of spread of the tumour affect doctor's choise of treatments. The treatment can be only radiotherapy, surgery or both of them with systemic treatments.

We all want to give maksimum homogeneous doses to target volume while giving minumum dose to organs at risk. The use of megavoltage radiation after 1950s, the developments at radiation physics, the use of computer tomography, Magnetic Resonance, Ultrasonography and lenfosintigraphy for screening, the use of developed computers for treatment planning added new point of wieves to the failure of locoregional radiation and problems of dosimetric issues, which lead to unwated side affects.

The optimum doses, which are suitable for target volumes are nearly determined but target volumes are at different depths of each volume of the breast, the wall of chest and regional lenfatics. The lungs, heart, medulla spinalis and osephagus are dose-limiting organs which should be considered while treatment plannning. Besides, the late side affects effecting the skin should be minumum.

The targets of radiotherapy of breast cancer:

1. The optimum homogenous dose distribution at target volume (±5) (ICRU Report 24, 1976)
2. The doses should nor decrease or increase between side-to-side fields.
3. The ganglion of mammaria interna have enough dose distribution.
4. Minimum lung volume irradition.
5. Maksimum protection of meadistinal tissues.
6. The achievement of Low Dose of contralateral breast volume.
7. The appopriate easy and repeatable ways of set-up conditions achieved (AAPM Report 13, 1984).

Due to it is minimal lung volume irradition electron treatment is developed as an alternative to tangentsial photon technique. Electron technique can used at chest wall radiation in two ways.

Fixed Beam Technique

Electrone beams can also be use at chest wall irradiation and irradiation of periferic lenfatics with appopriate choice of energy.

Electron beams;

- As an alternative or complementary to photons in mammaria interna (MI) nodes irradiation,
- As a boost to any tumor bed or gross disease in the breast or lymphatic and outhers areas,
- At tumour targets of breast and lenfatics regions or as boost radiation.
- It can be use to irradiate at scars of mastectomy which can lies through the breast tail and which penetrates beyond standard photon areas.

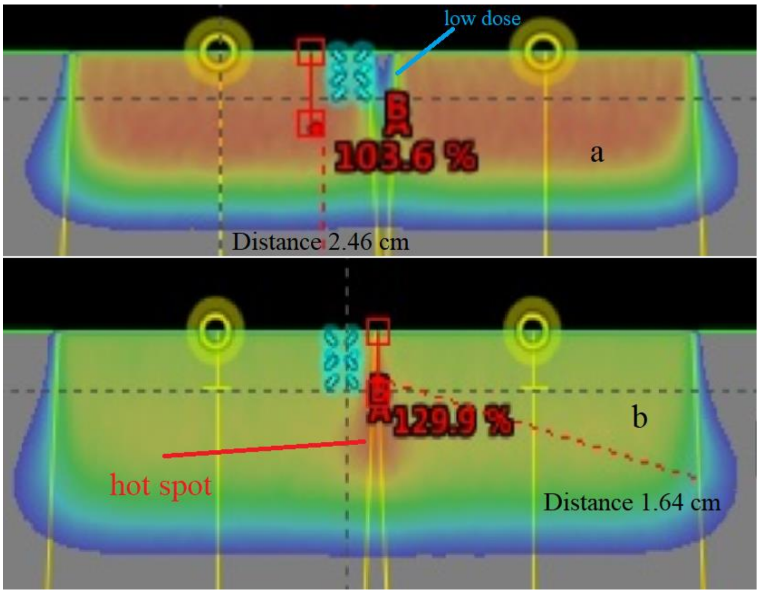


Figure 1: Calculated dose for two adjacent 12-MeV 10 × 10 cm^2 fields at 100cm SSD incident on a water phantom. a) When there is a 1 cm gap between the two areas, the dose drop is clearly see. b) The hot spot dose that occurs when the areas are side by side is 129.9%

The beams, which are use at radiotherapy have certain divergence (**Fig 1**) and create a certain divergent dose distribution in the tissues. This divergence varies depending on the energy, SDD (Source-Diaphragm-Distance) and field size.

Thise divergence leads to many problems at radiotherapy. Especially in adjacent areas, interference of rays can sometimes cause high dose regions, and leaving more gaps between areas than necessary can also cause low dose regions.

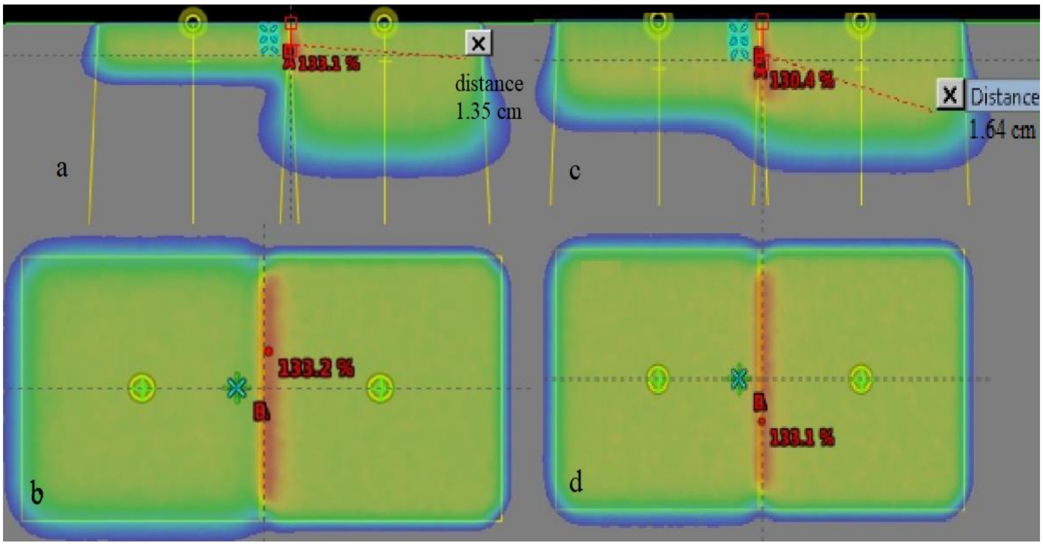


Figure 2: Dose differences at different energies at SSD = 100 cm in two 10x10 cm areas side by side a) The hot spot at 6 MeV and 15 MeV energies side by side, from left to right, occurs at 1.35 cm. b) Beam view image of the irradiation in a. c) The hot spot at 9 MeV and 12 MeV energies side by side, from left to right, occurs at 1.64 cm. d) Beam view image of the irradiation at c.

Besides at multipl areas, where different energies are needed (**Fig 2**), the most diffucult thing is to achieve the desired dose distrubiton at these breast areas.

Electron Arc Technique

Isocentric rotational electron irradiation (electron arc) technique has been develope to eliminate dose inhomogenities in thoracic wall irradiation and to reduce the irradiated lung volume. Electron-arc technique is used, Long-scar, recurrent tumor that crosses the midline or crosses the posterior thorax, distinct depth difference in target volumes (Khan FM et al., 1977, Leavitt DD. et al., 1993, Mc Neely LK et al., 1988 and Peacock LM et al., 1984).

As stated in his studies, they are use in cases where the standard photon or electron fields where most of the normal lung tissue is irradiate are insufficient.

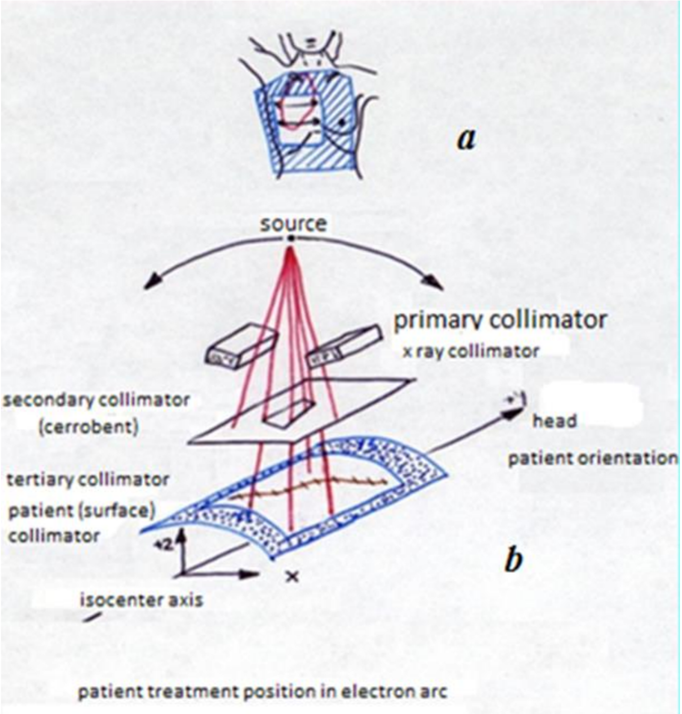


Figure 3: a) Third collimator system, which is made from cerrobend. This collimator placed next to patient's surface. b) The machine and patient in electron arc therapy.

We can irradiate mamaria interna nodes with chest wall. Different from, fixed beam technique in arc therapy secondary collimator and third collimator placed next to chest wall and surrounds the irradiating field is used. Third collimator is made from cerrobend (Bi-Bishmuth, Pb-Lead, Sn- Tin) **Fig 3** (GE-Med Syst; Physics Manuel, 1996, Hogstrom H.R. et al., 1986)

The differences at depths of in chest wall is determine by computer tomography (CT).

In order to mantain dose uniformity,

1. Bolus material is use at neccesary fields,
2. Multipl electron energy is use during treatment,
3. The arc dose rates varying per degree are used.

The thickness of irradiating chest wall differs according to patient. Depending on the anatomical differences changes in contour size along the axis of the patient it is necessary to take into consideration. Secondary collimator made from cerrobend is designe for each patient who have contour irregularity along the field (Subramania J. et al., 1996). This collimator is fitte to the block-carrier tray entrance on the device.

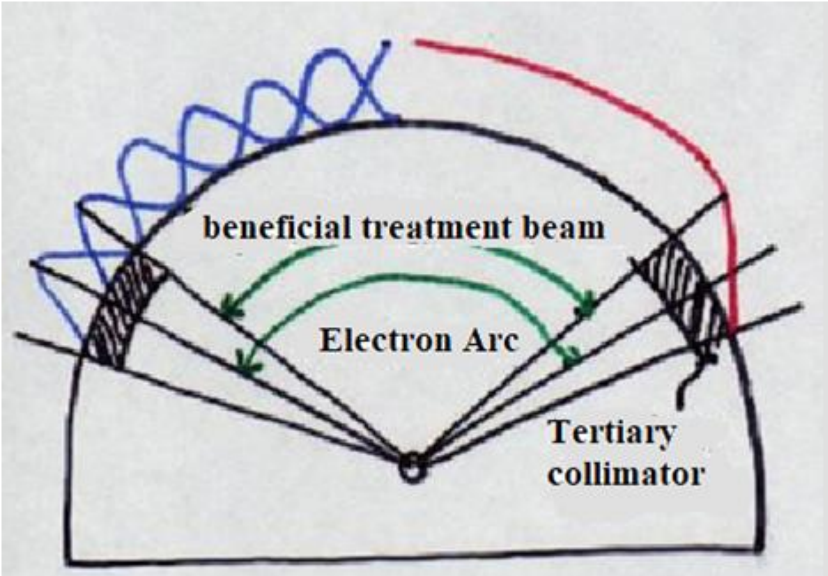


Figure 4: Schematic representation of the dose profiles for the electron arc beam optained by combining the fixed beam profiles.

On the other hand, there are some difficulties in applying this technique. The application of the patient-specific collimator is a very time consuming and demanding procedure (Leavitt DD. et al., 1993, Mc Neely LK et al., 1998 and Peacock LM et al., 1984).

In studies on this subject, it is recommende to use the electron arc technique in chest wall irradiation in cases where the standard tangential approach is difficult, large lung volume areas are within the target volume, homogeneity is not achieve in the field junction areas. Because there are large differences in target depths (Khan F.M., 1981, Mc Kenzie M.R. et al, 1993).

In addition, we cannot possible to use fixed beam parameters in electron arc therapy planning. Because, in electron arc irradiation, dose calculation is made in the form of the sum of the contribution of the overlapping areas to the dose in arc-row angular intervals or by pencil beam analytical calculation, unlike the fixed beam technique (**Fig 4**). Because of these reasons DD % (Depth Dose Percent) of electron arc radiation, profiles of beam and output of dose for certain device should be calculated (Gerbi B.J., 2009)

At this study, the parameters of electrone arc radition wiil be calculated and loaded to the computer. The results of planning will be measure by film and TLD dosimetry and the use of arc theraphy at chest wall irradiation will be discusse.

MATERIALS and METHODS

In the study, a linear accelerator (GE-Saturn-41) with a source axis distance of 100cm was use as the electron source. Photon beam collimators were use instead of electron trimers to determine the length and nominal field widths of the electron field. This study was done by 6°, 9°, 12°, 13,5° and 16

MeV electron beams. The arc angles used at these energies are 60 °, 90°, 120° and 180°. The radial DD % curves and photon contamination of rotational electron beams were measured by film dosimetry at cylindirical perspex phantom. X-RITE 331 manual pixel densitometer, Wellhöfer 700 automatic optical densitometer and X-Omat V verification film were use for film dosimetry measurements. For electron-arc dose distributions, films were irradiate in perspex phantom and tissue equivalent Rando Phantom.

Since the central axis DD % and beam profiles are needed to calculate the patient doses in the water phantom (wellhöfer 600C, 3D water phantom) under the conditions required by the planning system (Target II) in order to make electron arc planning during the study, 6, 9, 12, 13.5 and 16 MeV electron energies beam characteristics were determined. Primary X-ray collimators determine the electron field. For this reason, the electron field was determined by using primary photon collimators at gantry 0 degrees, field size 5x30 cm in isocenter, SSD = 85 cm, SAD = 100 cm. Here SSD = Source-Skin-Distance, SAD: Source Axis Distance. This field size was chose according to standards described at literature (Hogstrom H.R. et al., 1989, Leavitt D.D. et al., 1985, Leavitt D.D. et al., 1989, Pla M., et al., 1988).

$$\sigma\theta x = 0.595 * \frac{20\,\% - 80\,\%\, penumbra}{SSD} \tag{1}$$

The **σθx (sigma teta x)** values of all energies required for electron arc planning were determined as milliradian using the Formula 1. In order to determine the required output values, a phantom with a radius of at least 2Ro and 17.5 radius from perspect (ρ=1.10 gr/cm^3) was designed by considering the device parameters (**Fig 5**) (Antolak J.A., et al., 1993). In addition, slots for TLD capsules were open on a separate plate to be use in TLD measurements (**Fig 6**).

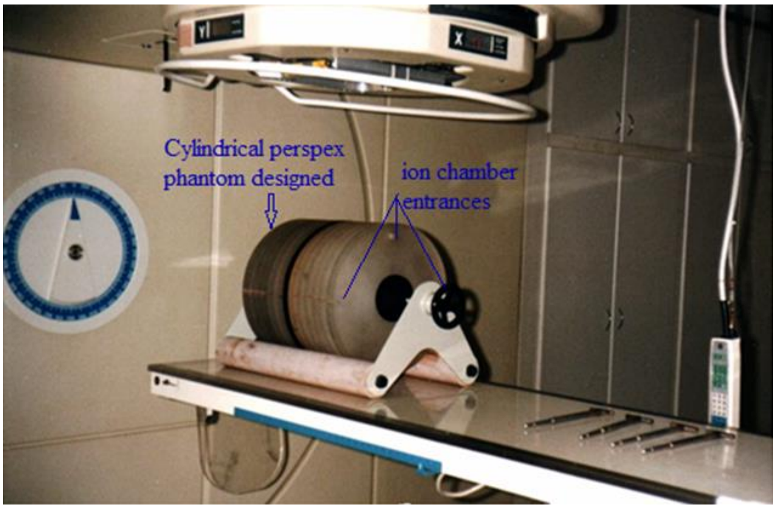


Figure 5: Out-put measurement position in designed Perspex phantom

The R_o is the max reach distance of electron beams. Using the designed cylindrical perspex phantom, at SSD = 85 cm by using the field size were adjusted with the primary photon collimator and output values were measured.

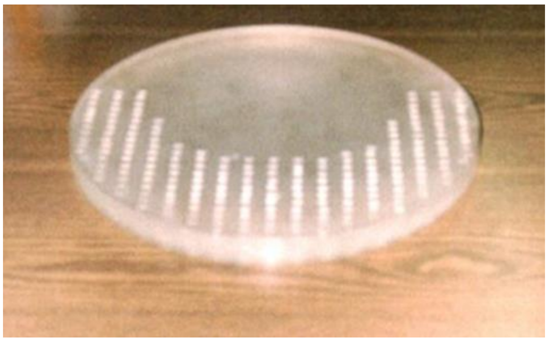


Figure 6: Opened slots for TLD measurement in designed Perspex phantom

Measurement; at arc angles of 0 °, 60 °, 90 °, 120 °, 180 ° and 3x10 cm, 3x15 cm, 3x20cm, 3x25 cm, 5x10 cm, 5x15 cm, 5x20 cm, 5x25 cm, 7x10 cm, 7x15 cm, 7x20 cm, 7x25 cm, 10x10cm, 10x15 cm, 10x20 cm ,10x25 cm field sizes were performed using UNIDOS dosimetry system and a 0.6 cc PMMA walled ion chamber at dmax depth of each energy. Dose determined in cGy per one monitor unit. After all parameters needed by planning system is determined, all values were loaded to planning system. Then, electron arc isodoses were obtaine from the treatment planning system.

Figure 7: Rando phantom set-up position. 1. The areas to be irradiated were marked on the Rando Phantom. 2. Kodak x-omat V verification films were cut according to the rando phantom section and edge were covered with black tape for light impermeability. 3. Planning was made using CT sections obtained from rando phantom. 4. Then, using the planning data obtained, the films were irradiate while inside the rando phantom.

Comparison of these isodoses with central axis and off-axis point dose's was made by TLD and film dosimeter method. We used took computerized tomography (Cytec 3000C CT) of rando phantom which looked like woman at different areas at treatment position in order to determine the accurance of planning system's dose distribution used for the patient.

These determined areas are the meadial border of classical tangential area, which passes median line, the area obtained by adding the MI field to this tangential field, MI (Mammaria İnterna) area and lateral border are tangential areas crossing the mid axillary line.

The sections obtained from CT transferred to planning system to get electron-arc dose distributions **Fig 7.** Kodak X-OMAT V verification films were cute according to rando phantom section ane the edges were close with black bands in order not to pass light.

The films were irradiated according to physical conditions (SSD, isocenter point, area, energy and arc angle) determined by treatment planning at central plan and dose distributions were obtained by optical dansitometer. The results were compare with dose distributions obtained from treatment planning computer.According to comparasion with Treatment Planning System (TPS) and film dansitometry the isodoses are similiar to each other at depth and shape with 1mm error margin.

In the comparison of TLD (Thermoluminescent Dosimeter), Treatment planning system (TPS) and film densitometer results; the point dose difference of ısodoses obtained from TLD and tps at central axis was 1%, the difference with the doses obtained from the film dosimeter is around 5%. The difference increases up to 10% with TLD at points outside the central axis. It was thought that this difference might be due to the coordinate difference in the opening of TLD holes in the phantom in a convex structure and the difference in isodoses in the lateral region due to the algorithm.

Subsequently, CT images of 20 former patients with thin chest wall, extensive incision scars and irregular contours were select. The sections loaded to treatment planning system were configure as 3D forms and the treatment planning of arc teraphy mode of these patients. As a tangential treatment area during planning, the upper border was under the 2.front costa, the low border was under the other breast with 2 cm security margine, at medial border median axis and at lateral border was median axillar line.

We made sure all large incision scars were in the target volume by enlarging the treatment area according to scar or by adding new treatment areas. If the mammaria interna areas were plane to irradiate by another area, target volume was chose beyond 1cm lateral to median axis. If the mammaria interna node was planned to irradiate within the tangential area and if the isodose was not enough, the edge of the area was offset to normal breast 2-3 cm.The isodose of 85% isodose axis consisiting of target volüme was chosen as reference (Perez C.A.et al., 1994).

In order to optimise the plans;

1. The use of bolus was taken into account to increase surface dose
2. Electron arc combinations at different energies were take into consideration in order to get homogeneous dose distributions at target volumes with irregular tissues.
3. The patients at whom mammaria interna should be irradiated was irradiated with high-energy electrons according to depth and low energy electrons irradiated chest wall. The irradiation of irregular chest Wall with bolus material was ivestigated for compensation of tissue. During the planning, how the dose distribution changes according to the depth of the isocentric was investigate.

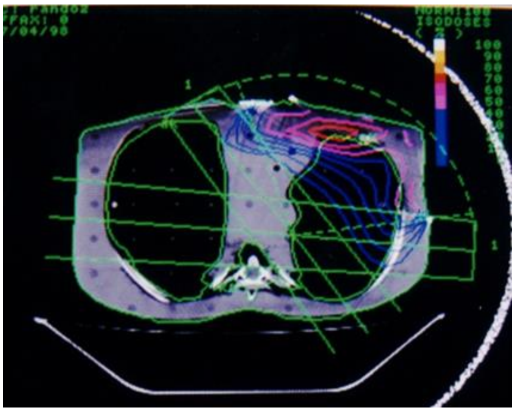


Figure 8: The distribution of isodose obtained from the treatment planning computer at 9 MeV electrons in the rando phantom, at 129° arc angle.

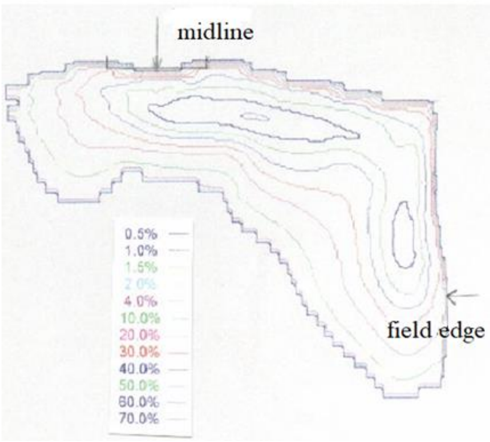


Figure 9 : Isodose distribution obtained from film densitometer at 129° arc angle at 9 MeV electrons in rando phantom

The treatment plans of these patients were made with classical treatment methods, and the dose distributions and critical organ doses (lung, heart) were compared with arc therapy. Electron arc therapy was evaluate for the irradiation of the chest wall.

RESULTS and DISCUSSION

At tissue equivalent phantom;

a) Dose distributions obtained from the Target 2 planning system are show in **Fig 8.**

b) Dose distributions obtained by the film dosimeter method are show in **Fig 9.**

In the reviews made in terms of optimization

In electron arc irradiation, it was observe that the reference (85 %) isodose did not cover the specified target volume as desired and the dose at the edge of the field was lower than desired (**Fig 10a**). For this reason, the area was re-plane by expanding 1.5 cm on both sides and increasing the arc angle.The 1.5 cm border left at the edge of the field allowed the desired dose value to pass from the real field edge (**Fig 10b**).

The distribution of isodose obtained as result of the use of bolus to increase the surface dose is show in **Fig 11**. Here, an increase in surface doses canbe seen as result of bolus use. The isodose distribution obtained when using electron combinations with different energies in target volumes showing tissue irregularity is show in **Fig 12.** The optimum dose distribution obtained by using different energy and bolus for MI (13.5 MeV) and chest wall (9 MeV) in the patient with MI irradiation indication is shown in **Fig 13.**

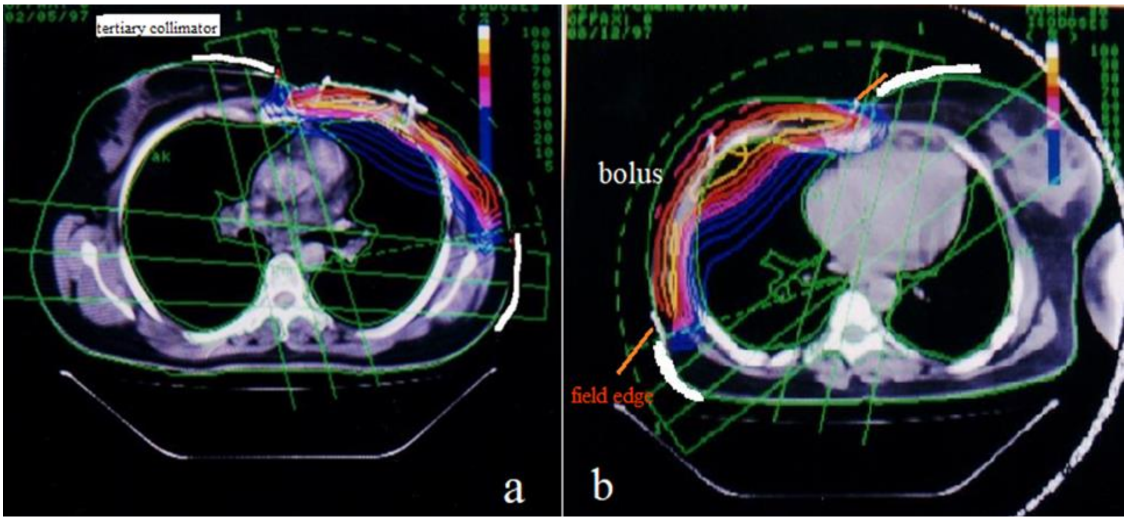


Figure 10: If the electron arc starts from the specified area, undesirable dose reduction occurs at the edge of the field. a) When planning the left breast at 1.5 cm safety margin from the edge of the field. b) When planning right udder with a 1.5 cm safety margin from the field edge, the desired dose value at the field edge is obtaine. The black area bolus on the contour shows the area boundaries on the skin in the white lines.

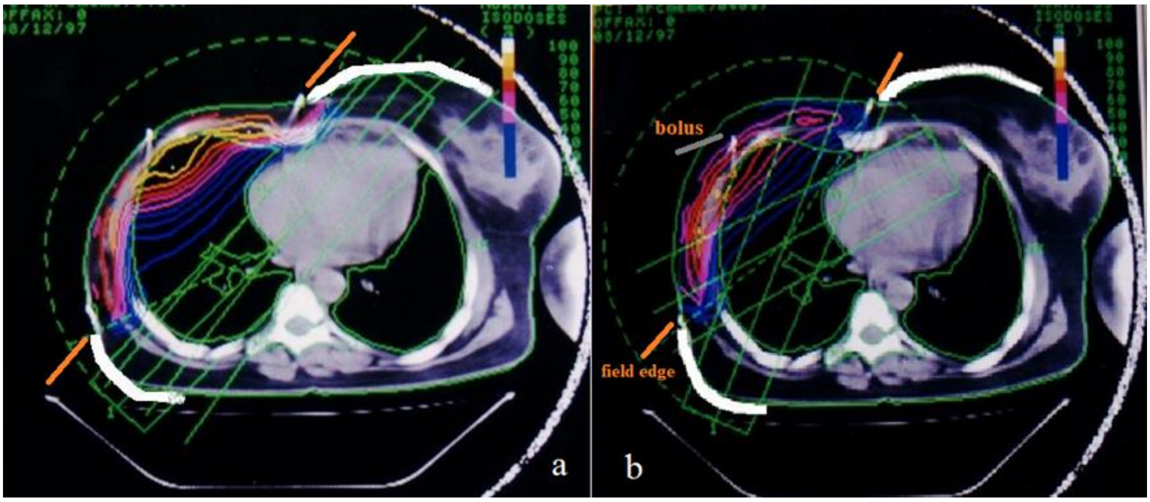


Figure 11: a) Arc isodose distribution of 13.5° 6 MeV electrons without a bolus. The field width is 5 cm in isocentric b) Arc isodose distribution of 145 ° 6 MeV electrons with bolus. The bolus was assigne according to the patient contour, equidistant from the surface isocentre. The black area between the isodose and the skin in the picture shows the bolus.

The change in the isodose distributions according to the isocenter depth selected during the planning is see in **Fig 14.**

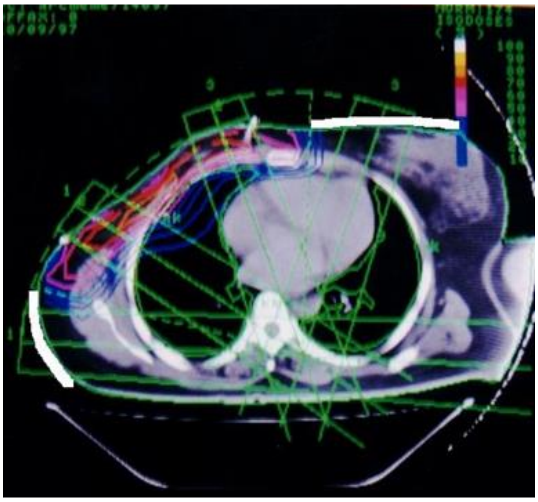


Figure 12: Provided from left to right, electron energies of 12 MeV in beam 1, 6 MeV in 2 and 9 MeV in 3 were used. Irradiation was started 3 cm outside the area to prevent low dose at the edge of the field.

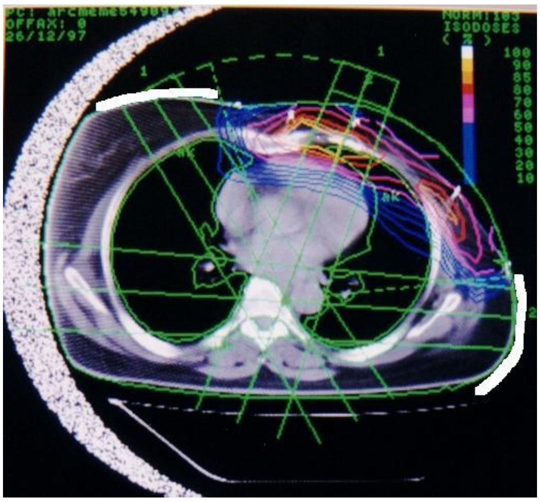


Figure 13: The MI area was irradiate with 13.5 MeV and the chest wall with 9 MeV. Bolus was use in accordance with the patient's anatomy to increase the skin dose.

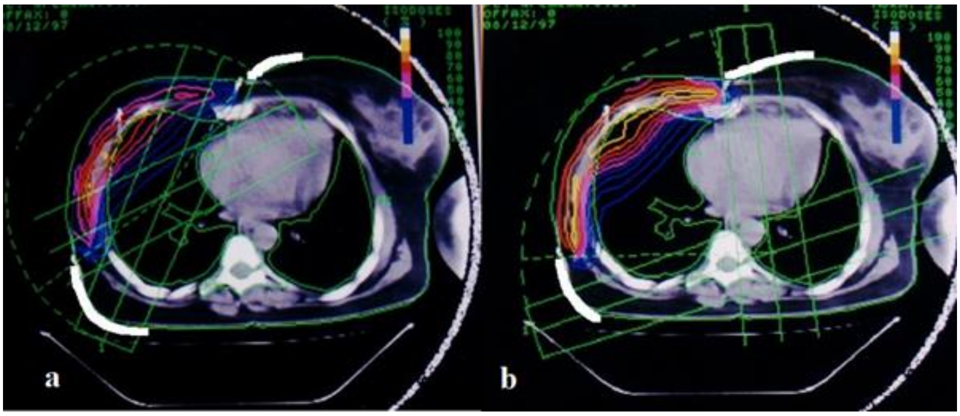
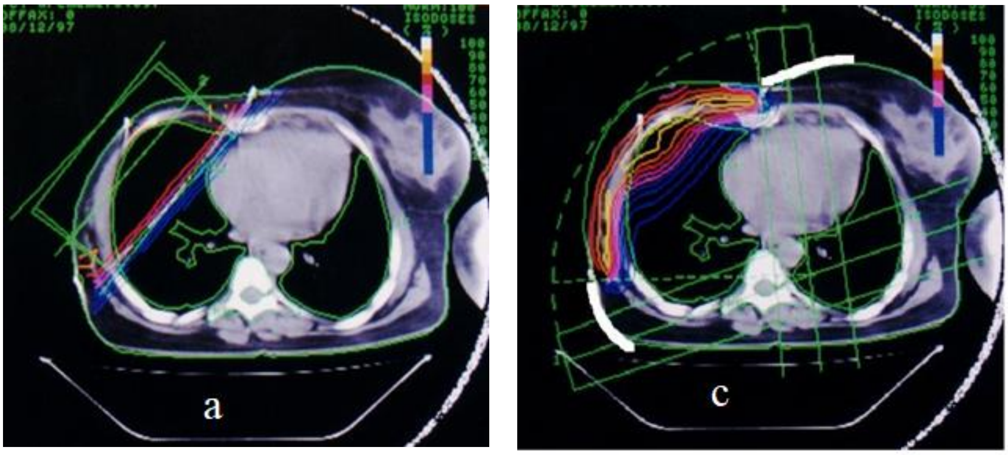


Figure 14: Change in isodose distribution according to the isocenter placement in a planned patient plan with 9 MeV electrons and bolus as reference. a) When the isocanter is close to the surface, the desired homogeneous electron dose distribution cannot be achieve. b) If the isocante is deeper, a better dose distribution is obtaine.



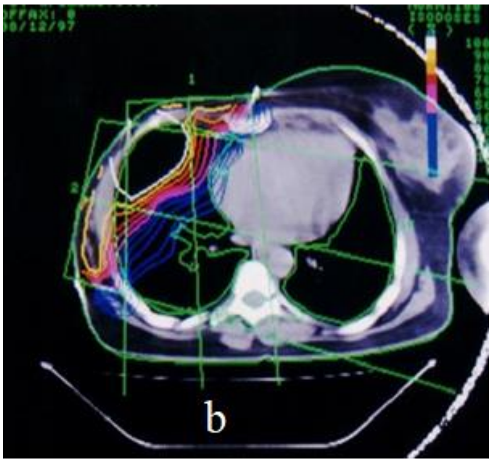


Figure 15: Isodose distribution obtained by irradiating the chest wall with a) tangential photon beam, b) electron beams, c) electron arc

Comparison of the treatment plans made with classical treatment method and arc treatment method in terms of lung and heart can be see in **Fig 15** and **Fig 16.**

The width of the irradiated lung volume draws attention when the chest wall is irradiate with tangential photon fields in the irradiation of the right chest wall with different irradiation techniques. In case of irradiation with multiple electron fields, the homogeneity in the thoracic wall deteriorates due to the field combination. In this case, the irradiated lung volume decreases for high doses and increases for low doses. In electron arc irradiation, while a homogeneous dose distribution is obtaine, the irradiated lung volume decreases compared to other techniques (**Fig 15**).

Similar results were obtaine in the heart when the left breast was irradiate with the same irradiation techniques. However, due to the bolus used to increase the skin dose, the need to increase energy caused the heart to be irradiate more (**Fig 16**).

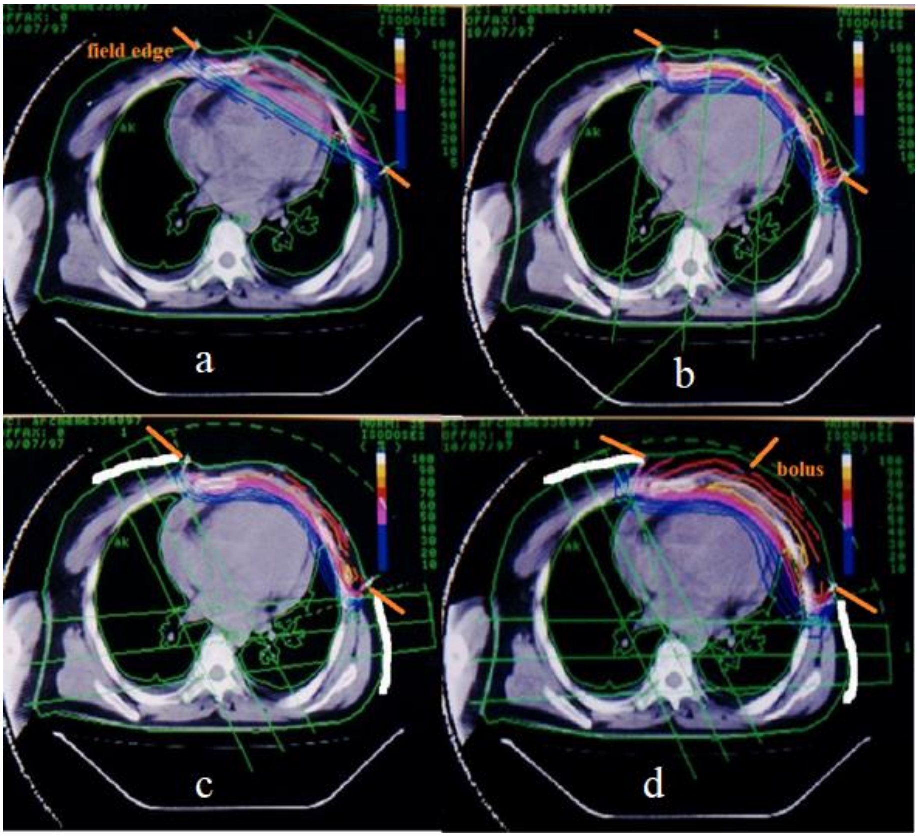


Figure 16: Position of the heart in the irradiation of the left chest wall a) with tangential photon beams, b) with electron beams, c) with electron arc, d) isodose distributions obtained by bolus electron arc.

In patients with irregular chest wall after mastectomy, due to thickness differences, irregular contour, lack of tissue, and long scars, field-joining problems occur (Aslay I et al., 1997, Boyer A.L et al., 1982, Mc Neely LK et al., 1988). Electron arc therapy is propose as an alternative method in such patients. For this purpose, in a study in which the applicability of electron arc therapy in patients with irregular contour and scar problems was investigate:

We needed bolus to mantain homogeneos dose at these patients in order to have tissue compensation along the arc area and to arrenge the decrease of surface dose due to arc angle (El-Khatib E et al., 1992, Hogstrom H.R. et al., 1989, Leavitt D.D. et al., 1985). Bolus was use to make dose uniform at the depth of target volume as well as to decrease the dose at heart and lung under the target volume the edges of the bolus should be given shape according to patients contour and should be placed at appropriate position. Because, as a result of the air inside and outside the bolus, dose decreases and increases occur due to the scattered electrons between the bolus surfaces. The use of tertiary block in electron arc dose distributions obtained by using TPS prevents unwanted dose reductions in the field edges. This is similar to literature (Blackburn B.E., 1981, Khan F.M. et al., 1977, Khan F.M., 1981).

Arc radiation is better at lung dose compared to deep tangential radition.the electrone arc radition of the thorax Wall after mastectomy decrease lung voulme compared to deep tangential photon irradition.at the study which Mc Neely and his collegues have done it was shown that lung volüme is decrease nearly 50% by electrone arc therapy compared to tangential irradition.

For ideal arc treatment, patient contour should be circle but real patient contours are irregular. If the contour is too irregular because of differences of depth, dose distribution cannot be homogeneous. We should coose the depth of isodoses as equal to surface, as posssible for all angle of beams. According to our findings when the isocenter depth is far from electrones maximum point of electron, more apporiate dose distrubitions are achieve. This is similar to the literature (Boyer A.L. et al., 1982, Pla M. et al., 1988, Pla M. et al., 1989, Ruegsegger D.R. et al., 1979, Subramania J. et al., 1996).

As a result, it is diffucult to treat the patients after mastectomy or recurrence of chest wall with classic photon or constant electrone beams. The long scar, the recurrent tumour lying beyond the median line, different thickness at target volume make it diffucult to irradiate with constant photon beams. As well with these treatments large volumes of lung are irradiate too. These problems can be decrease by consant electrone beams but result irregular dose distrubitions at target volume serious differences at doses at combination points of irregular chest wall areas.

Conclusion

Electron arc treatment give homogeneous dose distributions at large areas obetween chest wall and mammaria interna nodes and at the areas of chest wall without area combination. At our study, area combination problems were eliminate by using electrone arc therapy so we obtained more homogeneous dose distributions. Besides arc-therapy is superior at doses of organs at risk. Secondry collimator should used to decrease the affect of great diffrences of chest contours at target volumes. Approriate margine should be left at edges of areas and thertiary collimator should be used to prevent the drop of dose at area margins and avoid the scattering of electrones at edges. Since electrone arc therapy need complicated computers, patient planning is complex, preparation of secondry and third collimator is special and takes time, the use of electrone arc therapy is difficult (Orr J.,1981, Peacock L. et al., 1984, Thomadsen B.,1981). As a result, I suggest that electron arc therapy is suitable at conditions where classic methods cannot be use at chest wall irradiation.

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