



WORKFLOW CHANGES & RESPONSIBILITIES CONCERNING USER APPLICATION OF TOMOTHERAPY OVER LINEAR ACCELERATOR, A RADIATION THERAPIST STANDPOINT

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ABSTRACT

Radiation Therapist's (RTT) role in the driven modern Technology is rapidly evolved day by day, with the new advancement through Artificial Intelligence involvement making errors less efficient time effective workflow, but at the end of the day, there is a significant of Radiation Therapist who is responsible for mastering the high Complex Radiation dose Delivery. Linear Accelerator (LA) known as a linear particle accelerator has many applications such as they generate X-rays and high-energy electrons for Radiation therapy, Treatment purposes used directly to achieve the highest kinetic energy for light particles for particle physics. Ionizing in medicine works by damaging the DNA of cells including cancer cells. We can this is the primary radiation Unit for treating cancer patients. Most Radiation Therapists have basic user guidelines to Operate the C-arm Linear accelerator, On the Otherhand, The Tomotherapy System is among the most revolutionary radiotherapy innovations in the history of cancer treatment, completely redefining the standard for individualized and precise treatment of tumors anywhere in the body ,while creating a new paradigm for patient comfort and quality of life. Tomotherapy combines integrated CT imaging for exceptional treatment accuracy with a first-of-its-kind helical treatment delivery platform that uses patented beam-shaping technology to precisely target tumors while minimizing the impact on surrounding healthy tissue. There are various Operational Changes as compared to the traditional LA where Radiation Therapist needs to adapt themselves to these significant Changes The aim of this paper is to briefly describe the new generation of Tomotherapy Radiation Therapists point of view and the changes in the regular workflow towards the high-end treatment modality.

KEYWORDS : Therapists workflow Changes, Tomotherapy, Linear Accelerator, Role Changes, User Application Therapist

INTRODUCTION

Throughout the decade's Radiotherapy plays an integral role in the Treatment of Cancer Patients. The Treatment Delivery part is eventually divided into two forms, External Beam radiotherapy (Teletherapy) & Internal Beam Radiotherapy Brachytherapy(1). From the golden historic Cobalt era we are now expertise with advanced Proton Beam Therapy, Carbon Ion Therapy etc. These both forms of External Beam Radiotherapy fulfill the advancement of radiotherapy with greater precision and improvisation of the quality of life of cancer patients .(2)Primary challenges in Radiotherapy treatment aimed at how to ensure the beam reaches the tumor as planned and how to minimize the dose to the normal structures..

Advancement of Radiation delivery is useful when the proper utilization of these aspects is fulfilled. (3)Tomotherapy is the rotational delivery of Radiation therapy by using 64 binary leaves. A newly designed Tomotherapy treatment delivery system fulfills these needs through advanced treatment planning, integrated daily C-arm MVCT imaging, and 360-degree optimized treatment delivery(3)

The system constitutes a revolutionary step change in the work process of radiotherapy treatment planning, treatment delivery, and image verification and also reflects a very greater concussion on radiation therapists' common historic workflow.

From that historic Cobalt era to Modern Tomotherapy there is a lot of Process Changes in terms of Quality assurance, delivery system efficiency as well as the responsibility and understanding of the high-end technique on radiation therapist work level.(2)There are so many Process changes related to the ability to handle the high-end radiotherapy units also have some key factors of that particular unit which is potentiality significant (8)



Figure 1: Tomotherapy System

Sources: Internet

Linear Accelerator also has some better benefits also consequences to give the treatment delivery, Similarly, Tomotherapy high-end treatment modality also has some added benefits as well as some delivery aspects which are much more beneficial and useful for certain types of cancer diagnosis (7)

When the question arises about the efficiency of using Tomotherapy & Linear Accelerator comes to a discussion point forum where we are going to focus on several key points where RTT can relate themselves and understand the proper utilization of those units as well as the carried out the knowledge which will be benefited for them to improve their work skills on multiple treatment modalities ⁽⁴⁾

This review discusses we are mainly targeting the benefits and usefulness of Linear Accelerator with comparison to the Tomotherapy Unit and the technological advancement for cancer patients' radiation therapy services and the change in work roles & responsibilities of the radiation therapist. ⁽⁴⁾

Tomotherapy is a form of intensity-modulated rotational Radiotherapy utilizing a photon fan beam it's a radiation therapy device designed on a CT scanner-based platform.

Where Linear accelerator also serves the same purpose Tomotherapy literally "Slice therapy" IMRT is delivered as a narrow slit rotational beam by using high-speed binary MLCs. It is utilized in a helical pattern by delivering multiple rotating arcs at the same time the treatment couch moves or gets pitched towards the gantry bore. In the case of linear accelerators have featured Step & Shoot, dynamic or rotational VMAT delivery.

Tomotherapy has the added feature of treating a target with a maximum volume length of 135 cm without splitting the isocenters which is not possible to execute with a Linear accelerator for its beam opening or Treatment field restrictions

An integrated MVCT [3.5mv] imaging system acquires a high-resolution image visualizing both the bone and soft tissues at very low doses. During the registration procedures, the MVCT scans were compared with the planning KVCT image to reduce the variance between the actual in-room CT position of the patient and the position of the same patient acquired on the diagnostic CT, used during the plan preparation.

Whereas linear accelerators can perform Volumetric or 2D Imaging in very less time compared to the Tomotherapy system, Tomotherapy system does not feature with the 2D system.

Automatic registration of the MVCT scans to the planning KVCT plans by the Image registration software using the Bone and Soft tissue technique, fine resolution, and translational-only options resulted in automatic shift values.

The Image verification process will be followed and matched by the radiation therapist with a manual position shift correction. The Tomotherapy System does not feature with the 6D Couch but we can apply the role correction applied by the rotating gantry. Whereas Linear accelerators usually have Translational corrections but few LA units can be upgraded with hexapod or 6D couches.

The sum of the manual and automatic corrections are applied clinically. This novel treatment execution is apparently a different approach to clinical practice is required which is common in Tomotherapy as well as LA units

Treatment Delivery Process Changes & Additions:

The use of the Tomotherapy and Linear accelerator though serves the main purpose of delivering an external beam of highly energetic X-rays, But both machines' utilization and expertisation in terms of handling and case specification are quite different.

The Treatment Technical Changes the Radiotherapy process, a major difference and a wide margin of responsibility is carried out for the Radiation Therapists.

In our daily Radixact Tomo workflow we are adding an additional 2-3 minutes for the daily CT is precisely used to plot the radiation beam and allows the therapists to modify the treatment because if the patient's anatomy changes due to the weight loss and the tumor shrinkage.

The commitment to accuracy at the point of treatment preparation and delivery is a very censorious component of modern radiotherapy and it requires knowledge and understanding of the basic science as well as the interaction between the technology used in the radiotherapy field and the area of the body that is irradiated,

The significance of radiation therapists and his /her level is unremitting and expanding. During oversight of the Radixact X9 high-end radiotherapy machine, a responsible radiation therapist must undergo the following guidelines

BACKGROUND

Learning Constraints for Radiation Therapists (RTTs)

Patient Preparation & Counselling Prospectus:- Radiotherapy patients undergo three basic steps of Treatment preparation like patient counseling, Preparation of customized Mould or Vacuum cushions, and CT Simulation Before Starting any Radiotherapy procedure RTT must council & provide a detailed explanation about the Treatment Delivery procedure and possible side effects related to the Radiation Delivery Procedure.

- **Pretreatment Cross Verification of Dose Prescription:-** Before administrating the Radiotherapy Treatment RTT must cross-check Check to Identify the area for treatment and the practical problems associated with the machine and accessory and treatment prescription.
- **Checklist to Follow RT Prescriptions against local Protocols:-** RTT will thoroughly Describe the treatment protocols used routinely in the department & identify the organs at risk and the dose values. Evaluate (with the radiation oncologist) departmental protocols with respect to evidence-based good practice.
- **Patient Positioning at the Treatment Couch:-** Patient Positing on Treatment Couch as per the guideline or as such the Planning Scan RTTs Should be well trained Be familiar with the techniques and equipment used & The protocols used in the department also Evaluate the patient condition and Analyze the information and integrate to define the optimal patient position
- **Acquisition of the Pretreatment initial verification images:-** As a standard procedure RTT needs to perform pretreatment volumetric or 2D images to ensure the positional, Distinguish between systematic and random errors, Compare and contrast bony anatomy and soft tissue matching evaluate the Daily KVCT/MVCT images
- **Ensuring the Radiation Safety & Protection aspects:-** Needs to Describe the radiation hazards and how they are managed Explain the 1 legislation relating to radiation protection and carry out Routinely inspection of the area to ensure that radiation protection measures are in place and functional, in case any mishandling inform to RSO.
- **Monitor, Manage and Record the Patient's side effects throughout Treatment:-** Identify the side effects associated with the individual treatment, Select the correct settings for imaging & acquire an appropriate image

Workflow Changes of Tomotherapy Unit over Linear Accelerator, Radiation Therapist View Point Daily Morning Warmup and QA:

The Tomotherapy system features performing the Daily warmup, TQA, Air scan, and evaluation of the TQA results with Medical Physicists. Whereas in the linear Accelerator Performing of the MPC (Machine Performance Check) as both of the machines is having a different level of QA aspects which is obligatory for any External Beam Radiotherapy Machine.

Patient Setup & Initial Position Alignment on 3D Treatment Couch:

In the Tomotherapy Unit, the Patient is usually positioned on the cobra couch top at a virtual isocenter plane with 3 movable lesser Coordinates, From their actual treatment isocenter will be 70cm longitudinal movement, as Radiation Therapist cant position the patient on actual isocenter due to lesser and bore diameter limitation. In the case of Linear Accelerator, the patient is positioned on the actual Linac isocenter where all the Couch and Gantry isocenter intersect each other with a traditional 3-fixed laser coordinate system. Hence there is some positional & geometrical flexibility with the linear Accelerator providing a wide range of freedom for the Radiation Therapist.

Process of Plan Implementation on the First-day Radiotherapy:

Tomotherapy Plans are made in such ways we are usually not

required to apply the planning isocenter shift as the planning system itself fixes the red lesser on the reference fiducial marker itself as the reference CT isocenter will convert as a Treatment isocenter facilitates therapists more hassle-free workflow and also minimizes the gross systematic error at the initial PI procedure. Whereas the linear Accelerator radiation Therapist has to exercise with shifting the Treatment Isocenter from the Initial reference CT Isocenter. There is a chance of Gross Error if there is no mind accountability of the Radiation Therapist executing the process.

The practice of Daily Pre-Treatment Image Verification:

Performing the Daily MVCT based IGRT on the Tomotherapy allows the therapist to select the area of the scan apart from the ROI and the PTV area. Whereas in Linear Accelerator KVCT Planning data images & DRR images have limited freedom available on slice selection or the ROI image selection.

Significant Limitations of couch Lateral movement as compared to Linear Accelerator:

Radixact Tomotherapy Couch Has a maximum Lateral movement of 25 mm which is very less and needs to account in mind while performing Mould room procedures also couch has limitations in treating Non- Coplanar plans. Linear accelerator Having wide freedom of approx. 100 mm where we can easily treat the patient if the isocenter is off-axis and have the liberty of treating Non-Coplanar Plans.

Practice Parameter from a Therapist Point of View:

From a therapist's point of view there are many more considerations. Where RTT can relate themselves in terms of the use of Advanced Radiotherapy Equipment with proper key knowledge and interpersonal skills present.

DISCUSSION:

Radiation Delivery using Tomotherapy is truly a Challenging complex geometry, and the system will work best when all its components are optimized for the best performance delivery. Hence at the end of the day the highly optimized radiation doses are been delivered by the radiation therapist and while dealing with such kind of modern high-end treatment option, caring and the presence of mind will make it much easier to get a charming award on this battle against Cancer. Here we have compared both the Tomotherapy and linear Accelerator user feasibility and uses on specific clinical conditions with better outcomes. We are not promoting any of the vendors here on the basis of certain features. The theme of this Clinical paper was to give awareness and provide an overall idea of a workflow Guide for Radiation Therapists who are getting in place to work with the Tomotherapy high-end machine and struggling to streamline their prospectus on treating patients.

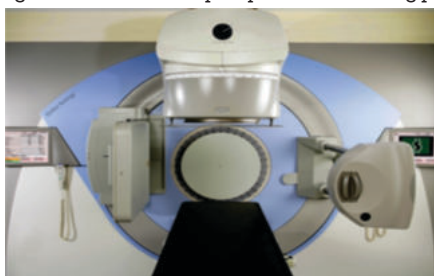


Fig-2 Linear Accelerator

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