IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

ASSESSMENT OF IMMOBILIZATION DEVICES USED IN RADIOLOGY DEPARTMENT

[1]Vanshika, [2]Sameer Ahmad Ganaie, [3]Shilpa Singh

[1]M.Sc. MIT (Radiography) Research Fellow, [2]Lecturer COPMS ADESH University, Bathinda-Punjab, [3]Assistant Professor

[1] Department of Radiology,

[1] Maharishi Markandeshwar (Deemed to Be University), Mullana-Ambala, India

Abstract: To prove objective to assess the available immobilization devices which were used in Radio-diagnosis and Imaging Department. In the trauma patients, uncomfortable patients are frequently transported to hospital using full immobilization devices. At the emergency department, immobilization is often maintained until radiological work-up is completed.

In this study, we examined how these devices influence radiation exposure and noise, as a proxy for objective image quality. The Conventional Radiographs (CR), Computed Tomography (CT) and magnetic Resonance Imaging (MRI) scans were made using an immobilized on various types of immobilization devices. Manufacturers of immobilization devices should take Radiological properties of their devices into account in the development and process.

This study included 100 patients in which 61 male, 37 female and 2 pediatric patients. Then the immobilization devices have been used on these patients. These patients were divided in the four machines; like Computed Tomography (CT) and magnetic Resonance Imaging (MRI) in the building of MMIMSR and SUPER SPECIALTY HOSPITAL Mullana-Ambala (Haryana). The result of immobilization devices; In maximum age group (20-49), 45 foam pads, 5 Velcro straps, 16 head rests, 17 knee pads and 9 sand bags were used on out of 54 patients. On majority of the patients, foam pad was used.

In minimum age group (0-19), 10 foam pads, 10 Velcro straps, 3 head rests, 1 knee pads and 2 sand bags were used on out of 11 patients. On majority of the patients, foam pads and Velcro straps were used.

Conclude that, generally patients were ready to use immobilization devices but, in some cases, patient refused to use immobilization devices. As we can see in fig.8.11 and 8.12 that majority of patient used devices and some of did not. Majority of patients were ready to use these devices because they believe that these devices help to improve scanning and somewhere they are comfortable with these devices. As we mentioned earlier that few patients refused to use these devices and this is because somewhere they had fear to use these devices and generally, these patients were growing children.

Index Terms **– Magnetic Resonance Imaging, Computed Tomography, Immobilizing Devices, Nuclear Medicine Technology, Maharishi Markandeshwar Institute of medical Science and Research, Pediatric Restraints.**

1.1 INTRODUCTION

Radiology signifies a branch of medicine that deals with the radiant energy in the diagnosis and treatment of diseases by using imaging modalities. This field can be separated into two board areas Diagnostic radiology and Interventional radiology. In diagnostic radiological procedures in which use a medical image such as X-rays, Ultrasound, Computed Tomography and Magnetic Resonance Imaging scan to diagnose diseases everywhere in the body. This study explains only the immobilization device so that the artefacts can be minimized in both the imaging modalities i.e., CT and MRI unit.

1.2 Computed Tomography (CT)

The Computed Tomography or Computed Axial Tomography (CAT) scanner is a medical imaging tool that provides clear pictures of the internal structure of the body. This is process of creating cross- sectional tomographic plane or slice of any part of the body in which computers are used to create more mathematical reconstruction of slice.[1]This is

the medical imaging method employing tomography where digital geometry processing is used to create a 3-D image. The first CT scanner commercially accessible was EMI (Electrical & Musical Instrumentation) made by Godfrey Hounsfield in 1972. The Computed Tomography unit mainly consists of three system components including the gantry, the computer, and the operating console. The gantry includes x ray tube and detector. The CT procedures through a volume of data which can be manipulated, through a process known as windowing, in order to demonstrate various structure based on their ability to X-ray beam.[1]

The accurate diagnostic information about distribution of structure inside the body can be provided with the help of this imaging modality. In CT scan, X-ray machine moves all around the patient, scanning from hundreds of different angles. [1] The basic principle of CT: - ***The internal structure of an object could be recreated from numerous projections of the object.*** CT image is a 2D cross sectional image corresponding to 3D sections of the objects. (1)

Advantages of CT: -

- CT scan is painless non-invasive and accurate.
- CT examination is fast and simple.
- A major advantage of CT is its ability to image bone, soft tissue, and blood vessels all at the same time.
- CT scan provides very detailed image of many types of tissues as well as the lungs, bones, and blood vessels.
- X ray used in CT scan should have no immediate side effect.

Disadvantages of CT: -

- The risk to the patient because of the high radiation dose.
- They are very expensive.

CT artefacts: - Artefacts are any systematic difference between the CT numbers in the reconstruction of image and the true attenuation coefficients of the object. [2] The artefacts reduced the quality of CT images. The CT can arise from a number of sources in which including the patient unsuitable selection of a protocols, reconstruction processes, equipment malfunction or imperfection, and the limitation of physics. [2]

Types of artefacts: -

- Streaking: - which is generally due to an inconsistency in a single measurement.
- Shading: - which is due to a group of channels or views different gradually from the true measurement. [2]
- Rings: - which are due to errors in an individual detector's calibration.
- Coupling: - which is due to helical reconstruction.

Origin of artefacts: -

- **Physics- based artefacts**: - which result from the physical methods involved in the acquisition of CT data. [2]

✓ Beam hardening artefacts.
✓ Partial volume artefacts.
✓ Photon starvation

- **Patient based artefacts**: - which are affected by such factors as patient movement or the occurrence of metallic in or on the patients.

✓ Metallic artefact.
✓ Patient motion artefact. [2]
✓ Incomplete projection.

- **Scanner based artefacts:** - which results from an imperfection in scanner function.
- Ring artefact.
- Stair step artefact.

Patient motion artefact: - The motion artefact can be anything from a voluntary motion (caused by the patient i.e., head movement, improper breathing etc.) To involuntary motion such as peristalsis or cardiac motion. [2] The proper patient education can remain a decrease voluntary motion or by applying immobilization devices. To improved techniques such as faster pitch can reduce the voluntary motion. [2]

✓ Avoidance of motion artefacts by the operator.
✓ Built-in features for decreasing motion artefacts.

1.3 MAGNETIC RESONANCE IMAGING (MRI):-

MRI is made with radiofrequency pulse in the range 1-80 MHz the NMR, MRI, and spectroscopy, are the turns used alternatively. [3]

In 1946, flex Bloch at Stanford and Edward Purcell at Harvard independently described of NMR in a solid noble prize 1952. Damadian in early 1970's first should that malignant tissues has a different NMR spectrum from that of normal tissues. [4] He accomplished his first body image in 1976 or 3 July 1977 using magnetic field gradient to localize NMR signal and the image took almost 4 hours to procedure. The MRI increased in the mid of 1980's. [3, 4]

- Bloch and Purcell described nuclear magnetic resonance (NMR)
- Lauterbeur and Mansfield made important discoveries concerning MRI and got Nobel reward for them. [4]
- MRI is based on the principle of nuclear magnetic resonance (NMR)The basic principle of NMR is;
- The atoms by an odd number of protons or neutrons have spin.
- A moving electric charge, be it positive or negative, processes a magnetic field.
- Atoms covers of nucleus surrounded by the electrons. [3, 4] the nucleus contains of positively charged protons and neutral particles called neutrons. Body has various atoms that can be act as good MR Nuclei (^{1}H, ^{13}C, ^{19}F, ^{23}Na). [4]

There are different types of artefacts: -

Patient-related MRI Artefacts;

- Flow artefact
- Metal artefact
- Motion artefact

Signal-processing dependent artefacts

- Chemical shift artefact
- Partial volume artefact
- Wrap around artefact
- Gibbs phenomenon (ringing artefact)

Flow artefact: - The flow artefact can be apparent as either altered intravascular signal (flow improvement or flow-related signal loss), or flow- related artefact (ghost images or spatial Miss Registration). [3, 4] the flow improvement is also recognized as inflow effect, it is affected by fully magnetized protons. The fully magnetized protons produce a high signal in comparison with the rest of the neighbored [4] the high velocity flow created by the protons entering the image to eliminate by the time of 180- degree pulse is administered. The spatial miss registration manifests as the displacement of intravascular signal owing to the spatial encoding of a voxel in the phase direction preceding frequency encoding by time TE/2. The intensity of the artefact is rest on the signal intensity from the vessel, and it is less apparent with the increased TE.

Metal Artefact: - The metal artefacts occur at interfaces of tissues with the different magnetic exposures, which is caused by local magnetic field. This distortion differences the precession frequency in the tissue leading to the spatial miss mapping of the information. [4, 5] the degree of distortion rest on the types of metal. The type of interface pulse sequences and imaging parameters.The metal artefacts are produced by the external ferromagnetic such as cobalt. [4, 5]

Further methods also used are choosing the appropriate frequency encoding direction, since the metal artefacts are most pronounced in this direction, by using smaller voxel sizes and fast imaging sequences. [5] The increased band-width and avoiding gradient-echo imaging when metal is present. A technique called MARS (metal artefact reduction sequences).

Chemical shift artefact: - This artefact happens at the water and fat interface in the phase encoding or section- select directions. [4, 5] these artefacts rise due to the different in resonance of protons as effect of their micro-magnetic environment. The protons of fat resonance at a slightly lower frequency than those of water. The high field strength magnets are particularly susceptible to these artefacts. [5]

Partial volume artefact: - This artefact happens when more than one tissue type is present in a voxel, so the signal is averaged. [5] For example; oblique or curved interfaces, or structures moving in and out of the slice plane. The record obvious in the slice- selection direction and worse with the thicker slices. It occurs with all tomographic imaging modalities. [5]

Wrap around artefact: - This artefact is a result of the miss mapping of anatomy that lies outside the field of view but inside size of the imaged object. [5] It can be produced by non-linear gradients or by under-sampling of the frequency hold the return signal. [5]

Gibbs phenomenon (ringing artefact): - This is affected by the under sampling of the high spatial frequencies at the sharp boundaries in the image. [5] This artefact happens near the sharp boundaries,where the high contrast transitions in the object occurs. It appears as various, regularly spaced parallel bands of alternating bright and dark signal that is contain slowly fade with the distance. [4,5] the ringing artefacts are further prominent in smaller digital matrix sizes. The procedures to correct Gibbs artefact with the filtering the K-space data prior to Fourier transform, the increasing the matrixsize for a certain field of view. [5]

Motion artefact: - The motion artefact is one of the greatest common artefacts in MR imaging, causingeither ghost images or diffuse image noise in the phase-encoding direction. [4, 5] the purpose for mostly affecting data sampling in the phase-encoding direction is the important modification in the time of acquisition in the frequency-and phase-encoding directions. Frequency-encoding sampling all the rows of the matrix (128, 256 or 512) takes place during a single echo (milliseconds). Phase-encoded sampling takes several seconds, or even minutes, owing to the collection of all the k-space lines to enable Fourier analysis. Major physiological schedules are of millisecond to second duration and thus too slow to move frequency-encoded sampling, but they have a distinct effect in the phase-encoding direction. When the immobilization methods are discussed, the effect of motion and positioning inaccuracy on the diagnostic image quality of the procedure is important to understand. [5] The main factors that affect diagnostic image quality remains motion. The motion can be either involuntary or voluntary. We cannot control the involuntary motion but voluntary motion can be controlled by the use of immobilization devices which we will be discussing further in our study. The movement of the small kids or the shaking of the hand results in the blurring of the diagnostic images and it may require the repetition of the particular radiographic examination.[5] the repetition of the radiographic examination increases the patient dose as well as it is a time-consuming procedure. Even the slightest movement of the body part can seriously compromise with quality of the standard radiographic image as it results in the penumbra.[5]

An additional important factor that might affect the diagnostic information is imprecision when the patient is positioned during the examination. [5] The patient positioning requires the exact degrees of rotation of the patient and body parts in true anatomical position. At the same time the support might be provided to the patient which significantly reduces the possibility of the motion artefact.[5]

Thus, the motion artefact degrades the image quality which can be improved by the use of the immobilization devices as it restricts the patient movement in various aspects.[5]

1.4 WHAT IS IMMOBILIZATION DEVICES?

Immobilization means '' incapable of movement''.

The immobilization devices are a tool that is used to check whether the position of the patient is stable or not; and can be maintained, without any movement. The patient is supposed to breathe normally. The positioning of patient is must for shaping these devices.

The reproducible localization of the patient with a device into which the patient is locked and helps to aid in the restriction of anatomical positions and movements.[5] the positioning with the immobilization devices must be the comfortable to the patient and minimizes the movement. It works with the positioning devices to increase the stability, immobility, and the comfort of the patient along with the reduced time. The patient feels secure and less apprehensive. These devices help to stabilize the relationship between external skin and internal structures of the human body. Without these immobilization devices, the patient is at risk of motion and its unwanted side effects.

These devices can be used by both pediatric and adult patient. The role of immobilization devices in patient positioning and immobilization are said to be the most crucial parts of radiology departmentimaging techniques. [3, 4, 5]

PROPERTIES OF AN IMMOBILIZATION DEVICES

- Strong and durable
- Lightweight, do not cause CT scan imaging artefact.
- They are reproducible and comfortable for the patient.
- Comfort of the patient and better arrangement.
- Easy in manufacturing and cleaning.

1.5 WHAT IS PATIENT IMMOBILIZATION?

A reproducible localization of the patient by through a device into which the patient is locked, to aid in the check of anatomical positioning movement [5]

1.6 WHY USE POSITIONING AND IMMOBILIZATION DEVICES?

- Easy to use
- Increase target accuracy
- Comfortable for the patient position
- Quick to set up

1.7 SIMPLE IMMOBILIZATION DEVICES

Simple techniques to decrease intrafraction positioning uncertainly due to the patient motion have been in use for years for patients and for their comfort. For patients treated in a supine position, a wedge or rolls inferior to the knees can be helpful to reduce stress on the lower back. [5] A Ring for the patient to hold can increase comfort in case of arms - down positioning. In case of lung and liver treatments, it would be better the patient to position, the arms above the head. For these cases, the arms could be kept on the shoulder by foam pads and wedges to help the patient make a relaxing position. A headrest is commonly used with supine positioning to raise the head and decrease stresson the neck. Various varieties are available of head rests like; shape, size, and materials. Most of these devices are reasonable and reusable, and they can be able to covered and / or cleaned betweenusages. [3, 4, 5]

There are different types of Immobilizing Devices are;

- Rolls
- Wedges
- Straps/Compression bands
- Grip rings
- Headrests/ Sandbags

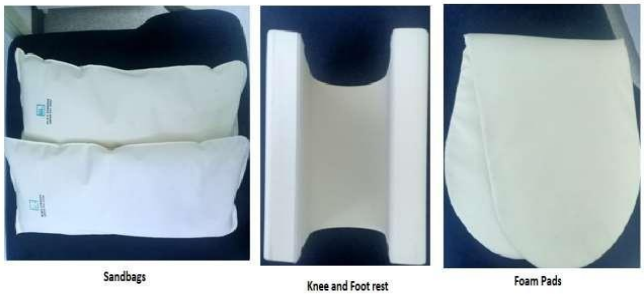

fig. 1.1 immobilization devices used in MRI (Philips multiva 1.5 tesla) in the department of radiodiagnosis in superspecialty hospital.

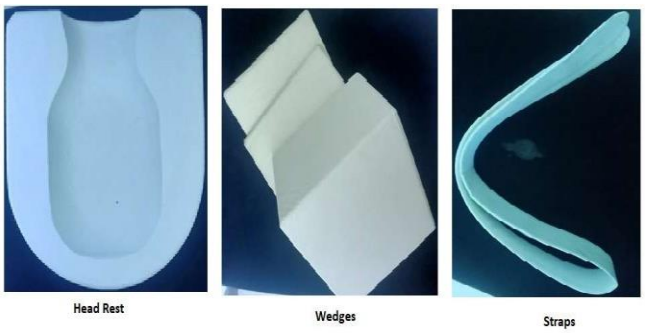

fig. 1.2 immobilization devices used in MRI (Philips multiva 1.5 tesla) in the department of radiodiagnosis in superspecialty hospital.

fig. 1.3 immobilization devices used in CT (Philips ingenuity 128 slice) in the department of radiodiagnosis in MMIMSR.

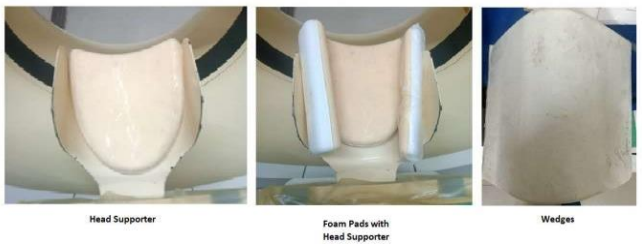

fig. 1.4 immobilization devices used in CT (Philips ingenuity 128 slice) in the department of radiodiagnosis in MMIMSR.

One of the factors that affects diagnostic image quality in motion. Selection of the immobilization depends upon the comfort of the patient. [5] The immobilization devices which are used in Radiology department mainly are **sand bags, sponges, Velcro straps, and head clamps and compression bands**. It also helps in positioning the patient in few ways. But all these things are also used in CT and MRI. [2][3] Few of the immobilization devices used in this study will be discussed below along with their physical properties and uses. [5]

Sand bags: - Sand bags are useful in-patient positioning as immobilization devices and they can be used in a variety of ways, by themselves or in combination with positioning sponges, sand bags (fig.1.5) are extremely helpful in there reducing the voluntary motion of the patients. [5] Dissimilar radiolucent positioning sponges, are radiopaque (radiation does not pass through easily). Sandbags are commonly used positioning aids is in performing examination of a lateral cervical spine or of the acromion-clavicular joints. These both examinations require same transverse plane and that the patient hold sandbags (fig.1.5) of equal weight. [5] For the lateral cervical spine, the patient position should depress the shoulder joint as much as possible to determine the lower cervical spine as well as vertebrae. [5, 6]

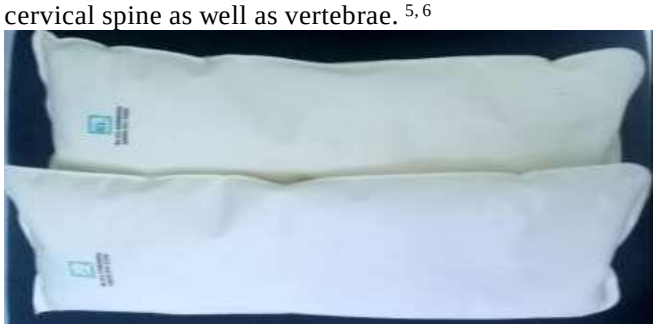

fig. 1.5 immobilization device used in MRI (Philips multiva 1.5 tesla) in the department of Radiodiagnosis in SuperSpecialist Hospital.

Velcro straps: - Velcro straps can be effective as restraining or positioning device. A good example ofthe use of straps is provided by an upright lateral chest position. The patient must be standing for achest examination. Placing the Velcro straps across the upper portion of the patient chest examination can be help patient holding still and also provided a sense of security. Velcro straps too are used in immobilizing just the area covered by the procedure. A strap that is adjustable for any size of patient. It can be adjusted to cover some part of the body such as chest, abdomen, or legs (fig.1.6). [6] These restraints also can be used for compression band. When the performing gastrointestinal procedures- for example; the patient position in the semi-erect-possibly desirable. Velcro strap applied across the patient upper abdomen and lower abdomen to support the patient firmly during the procedure. This precaution can help save the patient that he or she will not fall. [6]

fig. 1.6 immobilization device used in CT in radio diagnosis department.

Head Clamps: - Head clamps are attached to radiographic imaging devices for example radiographic table, upright cassette holder is designed strictly for the use in patient positioning of various projections of the human skull. When

fig. 1.7 immobilization device used in MRI in radio diagnosis department.

these are applied safely and appropriately, head clamps serve as more important positioning aids than the immobilization devices (fig. 1.7). A patient so desiring can be easily attraction away from the head clamps. The head clamps serve as a reminder tothe patient to remain as still as possible; and these also check the reduction of the voluntary movements on the head part of the patient positioning. [5, 6]

Compression bands: - the compression bands are valuable aids for immobilization. Compression bands, but they are more effective within pediatric patients while used in combination with in the sandbags. [5]

Below discussed are the some of the basic immobilization devices used in CT and MRI units respectively. [6] there are different types of these immobilization devices available in radiology department.

Head rests: -The used to give head parts in method of the beam or within a better patient position (fig.1.8). They are comfortable for patient and patient position. They are increasing the stability and high excess of the immobilization.[6]

fig. 1.8 immobilization device used in MRI in radio diagnosis department.

GOAL OF IMMOBILIZATION DEVICES: -

- Precision/ accuracy limits the patient positioning and movement.
- Reproducibility is basically used to reduce daily dose and shifts.
- Patient comfort increase acceptances. [6]

The immobilization techniques are also used in case of the pediatric and geriatric patients. One of each type of patient provided unique opportunities to apply immobilization devices. [6, 7]

1.8 Pediatric immobilization: - This technique is used to retain child still for medical examinations. Asradiation dose may affect child 10 times more than adult. It is necessary to keep radiation dose at aslow as possible. [7] avoiding repeat imaging due to motion artifact may be result better.

Immobilization techniques: - These immobilization techniques are generally dependent on the department. [6, 7] in broad-spectrum, techniques that are used to includes;

- Distraction techniques
- Verbal techniques
- Velcro straps
- Sandbags
- Swaddling
- Feed and sleep
- Sedation

The decision to use these techniques are either done with the decision of radiographer or with the decision of departmental protocols.[6, 7] as the patients age and maturity may affect the type of techniques used, studied have shown a potential need for specific immobilization devices guidelines to assist radiographers. [7]

IMMOBILIZATION VS RESTRAINT

Immobilization denotes to keep a child still with their permission. Restraint denotes to using physical force to hold the children unmoving without their permission. [7] The restraining children canbe increasing the anxiety and the post-traumatic stress for future imaging procedure. [7] In practice still, the child is often unable to give consent and the physical force is difficult to quantify. It can besuggested by the verbal and distraction techniques are most ideal when the child imaging method. [7]

To avoid the restraint, and various reflections can be made up;

- Has a consent been obtained from the children?

(A parental consent without a children consent is still restraint)

- DO the profits of the examination and method outweigh the risks?
- Can other procedures should be used to avoid physical force?
- Can the child come back to the imaging when they are calm?

The position of the patient is: -

The patient position is determined by the rotation of motion and posture of the patient (lying,sitting, or standing)

- The children position must be important. [6, 7]
- When the patient is supine position, the vascular supply to the upper and lower lobes is equalto the gravity. It has no effect.
- When the child is sitting or standing, the gravity plays a significant role and the upper lobe vessels are less expanded than the lower lobe vessels (one-third to two-thirds size)
- One can be controlling an erect film by looking at the air fluid level in the stomach and at changes in the pulmonary vasculature. [7]

In spite of so various immobilization devices present to reduce motion artefacts, they may or may not be utilized by the healthcare professionals. [6, 7] But, it is emphasized to use immobilization devices in order to reduce motion artefacts, radiation dose to patient due to repeats and time wastage due to repeats imaging. [7]

Since carried, of reasonably higher significant of immobilization devices in Radiotherapy Department must more studies has been done in Radiotherapy immobilization devices but, it is still underrated inradiology department and very few studies have been carried out in radiology.[8]

The need for a daily reproducibility was very important in the pediatric patients since of the small margins that were used with the high-dose conformal systemsare described. For the youngest patient, the anesthesia might also be necessary to holding the patient. Then, we were considering the psychological, educational, and mechanical aids for the patient immobilization devices. In supposition, an almost entirely automated production method of 3D printed immobilization masks for the head derived from MRI data was recognized. A high level of setup accuracy was established in a volunteer cohort. Future study would have to focus on workflowoptimization and clinical evaluation. [8, 9]

The immobilization develops a problem in Computed Tomography or magnetic Resonance Imaging due to the moderately long examination times of these imaging techniques compared within simple radiography and worries about sedation of pediatric patients for diagnostic imaging studies. No sedation was used for one of the most common fluoroscopic procedures in pediatric patients; the motion artefacts throughout an imaging study could make it hard to acquire proper image quality for correct evaluation. In Which reason excessive radiation exposure to the pediatric patients. A previous study described by that motion, positioning and incorrect exposure were the most common causes of excessive radiation exposure from this perspective, reduction of motion

artefacts by immobilization devices could be one solution nearby the radiation dose decrease. This result of study to support the use of an immobilization device reflected by the important reduction in motion artefact. [10]

By using the immobilization devices for VCUG could be resulted within reduction of radiation exposure during the investigation by reducing the motion artefact and insufficient centering in which causes poor diagnostic image quality or repetitive examination in pediatric patients. [11] In this case, by using the immobilization devices could be one of determination for reduction of radiation exposure in fluoroscopic evaluation in pediatric patients.

"Effect of spinal immobilization devices on radiation exposure in conventional radiography and computed tomography" performed by "***Baukje hemmes, gerrit j. kemerink, and peter r.g. brink"*** themain motive of this study was spine board originally introduced as a means of extricating patients from a crashed vehicle or from a hard-to-reach location. [12]

Over the decades, the spinal immobilization used by a spine board or vacuum mattress with a head immobilizer had become the gold standard for pre-hospital care for trauma patients, including transport of patients on the spine boardinto the hospital. Even though physicians were instructed to remove by the patients from these devices as soon as possible, various patients suffered primary clinical and radiological evaluation at the emergency department to rapidly measure life-threatening injuries within the devices in place. [13]

In Also, whole-body needs computed tomography had recently come to be used as a primary diagnostic procedure at the emergency department. A Secondary survey was frequently included by the conventional radiography and computed tomography scans of the extremities if deemed necessary. [14]

This method was promoted in order to reduce the risk of disappeared a clinically important damage injury or unbalanced spinal fractures that could be potentially led to be serious injury and legal complications. Then, the high image quality of CT scans is a requirement or diagnostic workup, some disturbances, such as artefacts or noise, must be minimum. The artefacts could be limited by avoiding or removing objects within sharp transitions in material density, although noise reduction could be accomplished by the increasing radiation dose. But, exposure to ionizing radiation was related within the increased cancer risk. Some studies take shown that not only CT, then, to a lesser degree, too diagnostic conventional radiography might reason for a non-negligible increased risk of cancer.[15]

Research done by "k ***donato" in order evaluate the "a comparative evaluation of two head and neck immobilization devices using electronic portal imaging".*** A Study was performed to compare the positioning reproducibility and the cost efficiency for two head and neck immobilization devices. Thepatient treated with 3D conformal radiography for head and neck cancers and tumors were casuallynominated (10 for each of the two different immobilization systems) and electronic portal images developed in their course of treatment were saved and used in this study. [16]

"Patient-specific and generic immobilization devices for prostate radiotherapy" by **"*Adam d. Melancon, and Kudchadker*".** The determination of this study was to compare interactional bony setup variants in pelvic anatomy through two immobilization devices, the patient-specific vac-lok and the generic dual leg positioned system. Conclude that image guidance could be needed to accurate transmitted system. To introduced through simulation CT, generally with the generic immobilization system. During regular patient, setup, pelvic immobilization devices, was critical step in handling treatment uncertainly in prostate Radiotherapy. [17]

At many cancer centers, the daily localization had become prevalent. The previous studies had used port films or electronic portal imaging devices till this date it is unknown that how much range actually uncertainly is affected by these bony variationsand are the use of particular immobilization device able to reduce this affect. During regular patientsetup for Radiotherapy, had remained well documented that prostate position could be changed. Although, it was unclassified that the role of immobilization device could be decreased with daily image guided setup. But it was crucial to note a simple shift (the common type of correction in image guidance) could not precise complicated anatomical changes resulting from improper immobilization. Vac-Lok, the first immobilization device is a patient-oriented device that conforms tightly to the patient's body. (Civco medical Solutions, Kalona, IA and Dual Leg Positioner, the second immobilization device was a non-patient-specific positioning system that decreases storage needs. On the basis of our conclusions, conclude that the Vac-Lok pelvic immobilization device outperformsthe Dual Leg Positioned mostly when considering systematic translation along with the lateral axis. Treatment beam and target translational misalignment remains correctable within proper image guidance and the suitable couch changes for modification. Moreover, for the case of lateral proton beam treatment, lateral translation of the patient did not alter the water-equivalent depth from thepatient's skin surface to the distal end of the target. Hence, translational uncertainty would have minimal effects on our current proton treatment protocols. The group immobilized at the leg level established smaller variations than the group immobilized at the pelvic level. In light of these findings,given the association between femoral rotation and prostate translation that creation in our study, immobilization at the leg level could be consumed by the reduced femoral rotation and therefore, reduced prostate translation. But, in a study of compared pelvic immobilization using by a rubber leg cushion, a thermoplastic Hip fix (Civco medical Solutions), and an alpha cradle device and found that the hip immobilization device was superior to the other two types. Since the results from these two studies and our investigation reach at no consensus, we were able to drawn no conclusions whether immobilization devices hip decreases femur rotation. Few authors had properly addressed rotation in pelvic immobilization devices studies. This study measured by pelvic translation and rotation in 50 prostate patients immobilized with a thermoplastic body cast. [18]

The Good immobilization devices should be accomplished by a true reproducibility of patient's anatomy however, the reducing additional workload introduced by other interventional, image-guided setup procedures these devices must be reasonably easy for therapists to use so that setup time was minimized and patientcomfort maximized. [19]

Research done by ***"Paul keall"*** in order evaluate the ***"patient immobilization and image guidance"***.The goal of radical radiotherapy was to deliver a high radiation dose to a target but minimize the radiation dose to neighboring healthy tissues. In order to fulfil this goal, it was needed to consider what creates the target and how to confirm that the target was in the correct location for the treatment. The present chapter commences with a discussion of target volumes as they were developed in the highly influential reports 50 and 62 of the International Commission on Radiologicalmeasurements and units (ICRU) (ICRU 1993, 1999). An important definition

was the concept of margins to confirm that the structural volume that must be needed to irradiate was really receive the precise dose of radiation on all treatment day. [20]

It needs to be the aim to the minimized margins as much as possible. fraction motion was currently an area of intensive research and various aspects would be presented, whereas immobilization devices aim to provide the reproducible positioning of the patients by through negligible patient movement and comfort of the patient must be measured; their requirements to be a balance between the two goals. In many immobilization devices this can be accomplished by improve the patient setup and immobilization. But, knowledge too of the target location on every day of treatment would be reduced the uncertainty of radiation dose delivery and henceforth, the margin essential for the delivery. This interaction motion organization be able to complete by using the image-guided radiation therapy (IGRT), an important feature of uncertainty in delivery was the possible motion of the target throughout by the delivery. [21]

If the immobilization technique was show that increase the setup reproducibility, then it was applied for routine use on the cohort group of patients for whom it had been shown to be suitable but, still they were not permanently practical for all patients having day-to-day fractionized treatment. [22]

They were Patients aligned to external markers either placed on the head cast positioning of the patient. They were external marker positions were commonly defined at CT simulation time, whereby external fiducially markers were placed with the reference to isocenter. Unfortunately, there was internal organ mobility, so external markers could be the best only guide the initial treatment setup. Although some structures such as the pelvic lymph nodes might follow by the bony anatomy quite nicely, other organs such as the prostate undergo important motion done by with the respect to the bony anatomy. [23]

There had been some studies into the use of Tran's abdominal images for tracking prostate motion (e.g., Jani et al. 2005, Lattanzi et al. 2000). At the very least, ultrasound had pioneered our knowledge base about prostate movements. Numerous trainings were required to use these devices effectively. These devices produced no hazard from additional dose from ionizing radiation for collection of images in which was an advantage. [24]

Magnetic Resonance Imaging (MRI) was really the most exciting new modality that was being examined as an in-linac room or MRI. This had three cobalt60 beam sources, each mounted in its own treatment head, with conventional MLC. The multiple sources of cobalt-60 heads make sure radiation dose rates upcoming those presently provided by linacs. It was recommended the simplicity of a cobalt-60 source drive would be reduced the impact of the magnetic field from the MRI on the beam steering. There were also linac-mounted designs using lower strength magnetic fields. Images from these devices had been reported in the literature (Raaymakers et al. 2004). The electrons generated from X-rays were speciously changed in the tracks they follow, and could large effects on the radiation dose delivery if large magnetic fields were employed (Bielajew 1993). But these low magnetic field strengths smaller effects on the linac beam dose deliveries had been characterized (Raaijmakers et al. 2005). [24, 25]

We are able to accomplish this, the image guidance may be necessary for the proper, regular translation, is presented for the simulation of computed tomography (CT /MRI, and, in particular, with the complete immobilization of the system. A High degree of femoral rotation, and would be able to present to the prostate gland, as well as translation, and in order to be in line with the lateral proton beams with a prostate-enabled device. This study was observing the similarity of head and neck immobilization device with magnetic Resonance Imaging. The immobilization devices used to patient in the same way as when a getting a computed tomography scan for radiology planning and radiation treatment. [26]

This benefit of by the immobilization in MR was recover by the accuracy in CT/MRI images registration allowing greater confidence in the explanation of the images. Mainly the practical restrains in using an immobilization device in MRI makes their use mismatched with head and neck imaging coils. The Patient immobilization devices and magnetic resonance imaging coil preparation. An Imaging patient whereas immobilized in the patient position in which they would be received by the radiation exposure treatment drastically decreases motion artefact, enabling the acquisition of high- quality chemical exchange saturation transfer (CEST) and other MR images. When using an immobilization mask, a magnetic Resonance Imaging (MRI) receiving the head coil cannot be used in the patient and patients might be practice to the discomfort during the examinations. We were advanced by a new approach to produce individual immobilization devices for the head based on MRI data and 3D printing technologies. This study was determined by the patient position accuracy with healthy volunteers. [27]

The 3D MRI data of the head were acquired for 8 volunteers. In-house developed software processed the image data to generate a surface mesh model of the immobilization mask. After the adding an interface for the couch, the fixation setup was materialized using a 3D printer with acrylonitrile butadiene styrene (ABS). Repeated MRI datasets (n=10) were acquired for all volunteers wearing their masks thus simulating a situation for the multiple fractions. [28]

Using by the automatic image-to-image registration, displacements of the head were considered relative to the first dataset (6 degrees of freedom). [29, 30]

"*A retrospective review of the effect of a simple foot immobilization device for the treatment of prostate cancer*" by "***Thalicia james, laura d' alimonte***" the aim of this study was suggested radical radiation therapy was to eliminate tumour cells by through deliver in the maximum radiation dose to the target volume. This was required to correct daily patient position to minimize the chances of a geographical miss of the target and minimized radiation dose to the surrounding normal tissue. The various studies had been shown to be find out the best immobilization devices to improve the patient positioning for men with prostate cancer. [30]

this study was performed by a simple foot strap device was implemented for use in a group of prostate cancer patients, and they were subsequently analyzed. Patients in the free setup cohort were simulated and treated with their feet falling in a naturally comfortable position of the patient. The patients in the foot strap immobilization cohort were simulated and treated with their feet fastened, so that heels were organized, and the strap was placed around the feet and fastened mid-foot, just above the heels, tight enough so that heels stayed together. Simple statistics were used to analyses the data and to determine by the association between foot immobilization and incidence of isocenter shifts. The fisher exact test was used for analysis to calculate the probability of the frequency of shifts occurring free of the use of an immobilization device. The introduction of some immobilization devices must be comfortable for the patient, simple to implement in the simulation procedure, easy to use, and not affect in the delivery of treatment. [31]

There have been various published studies evaluating the effectiveness of different immobilization devices. At this institution, the foot straps were introduced to patient comfort setup and improve the reproducibility. Even though ease of setup was not formally captured in this study, an informal

survey of treatment radiation therapists revealed that foot strap immobilization reducedto the overall setup time of treatment. However, a formal analysis would be required to verify these findings. Now adding, our formal analysis revealed a remarkable advantage of the foot strap in its ability to decrease the frequency of isocenter shifts. This was consisting through by the several published works associate the theory that the calculation of an immobilization device, anyway which types of used, decreases the incidence and frequency of isocenter shifts. Despite these limitations, the foot strap was a simple and inexpensive technique of improving the daily setup reliability and decreasingthe need for isocenter shifts. [32] The use of foot strap immobilization device was enhanced to prostatepatient setup, and they had been adopted as normal training at this institution. [33, 34]

"*A review of 3d printed patient specific immobilization device in radiotherapy* "performed by "***Amirhossein asfia, james i. novak and tomas kron"*** evolved new techniques in order to evaluate the Radiotherapy is one of the common most treatment to stop spreading cancerous cells. [34] Almosthalf of cancer patient accept radiotherapy during period of their treatment. Although, radiotherapy have good results but at the same time radiotherapy could have negative side effects, device used tokill cancerous cells also injurious to healthy tissues. As a result, the immobilization devices were oftenused to minimize the patient movements throughout the radiation treatments, thus make sure the radiation dose was contained mainly on the tumour site. This method also limited radiation exposureof healthy cells to radiation, whereas similarly agree to reproducibility of arrangement on a day-to- day. The immobilization devices could approximately be categorized into two groups: invasive and non-invasive. [35]

The non-invasive fixation had become the chosen procedure of the treatment, justifying the issues of invasive fixation. Then, head and neck region is considered, creating a custom fitting mask which is created by thermoplastic sheet and moulded directly terminated with the patient. Its thickness range is 1.6-3.1mm. These thermoplastic masks could be immobilized a patient. As a result, it had gained the attention of researchers as a new technique forcreating non-invasive immobilization devices by using 3D patient models, such as those taken in Computed Tomography or Magnetic Resonance Imaging combined with innovative Computer-AidedDesign. All through radiotherapy, high dose of radiation was distributed to specific localized areas of the patient. As a result, the target accuracy was vital in order to minimize the negative effects to immediate by the healthy tissues. [36]

The immobilization devices were critical to his treatment procedure, minimize of the patient position and movement. However, there was a common consent that 3D printed immobilizers were capable of replacing traditional immobilizers, primarily thermoformed face masks, the low number of human and the low volume of studies. It was found that an absence of technical information, combined with disparate studies with the small amount of patient samples, required by the more research in order to confirm claims associate the benefits of 3D printing to the improvement by comfort of the patient or increase the treatment accuracy. [37, 38]

2. MATERIAL AND METHODS

STUDY DESIGN

Retrospective cross –sectional design will be used.

SOURCE OF DATA

The set of data as Performa will be used and it is obtained from the radiology department *at MAHARISHI MARKANDESHWAR INSTITUTE OF MEDICAL SCIENCES AND RESEARCH MULLANA.*

STUDY POPULATION

This study will be conducted on 100 cases including patients, radiation professionals and radiologists in the tabulated manner on the analysis basis. Data was collected in CT and MRI machine then; patients were collected in my research article. In which outpatient department (OPD) patient were scanned. And the positioning of the patient with immobilization devices which saves the time of patient and the image quality is better and there is no movement of the patient which makes the scan easier.

Study duration: - 6 months

INCLUSION CRITERIA: -

- Patients of any age group and either sex.
- During procedure the patients are given immobilization devices.
- Scanning on OPD patients has done.

EXCLUSION CRITERIA: -

- Uncooperative patients.

Computed tomography (CT SCAN): -

- Philips Ingenuity 128 slice CT scanner.
- Philips Access 16 slice CT scanner.

Magnetic resonance imaging (MRI SCAN) :-

Philips Achieva 1.5 Tesla MRI scanner.

- Philips Multiva 1.5 Tesla MRI scanner.

COMPUTED TOMOGRAPHY: -

Computed Tomography defines a computerized X-ray imaging process in which, on patient a thin beam is marked and quickly rotate around the body. Computer to produce the cross-sectional images or slices of the body. The usage of ionizing radiations occasionally restricts its use owed to its adverse effects. Though, CT scan can be used in the patients within metallic implants or pacemakers anywhere MRI is a contraindication. These also have the use of immobilization devices. [2, 40]

fig. 4.1: Philips ingenuity 128 slice ct scanner in MMIMSR

❖ **SPECIFICATIONS OF PHILIPS INGENUITY 128 SLICE CT SCANNER: -**

- Number of slices: 128 slice system
- Brand : Philips
- Model name / number : ingenuity core 128

Factory of origin: - Philips Healthcare (SUZHOU) Co., Ltd, China Melalui Philips medical System(CLEVELAND) INC, United States.

- maximum load capacity : 450 lbs. (204 kg)
- Gantry tilt : -3 degree to +30 degree with 0.5-degree increments
- Gantry aperture : 700mm
- Coverage : 40mm
- maximum scan able range : 1750mm(2200mm)
- Bore size : 700mm
- idose reconstruction speed : 18 IPS
- Standard reconstruction speed : 25 IPS
- Anode effective heat capacity : 30 MHU
- Focus Isocentre distance : 570mm
- Focus detector distance : 1040mm
- Rotation times : 0.4,0.5,0.75,1,1.5 seconds for full 360

degree of scans, 0.28,0.33 secondsfor partial angle 240 degree of scan

- Intercom system : two-way connection in between the gantry and console area
- Patient table maximum scan able range : 1750-2100mm
- Pitch : 0.5-1.5
- Z position accuracy : +/- 0.25mm
- Longitudinal speed : 0.5mm/s- 185mm/s
- Lowest table height : 579mm
- Effective power with idose : 105KW
- Generator effective power with idose : 105KW
- Power rating : 80 KW
- kVp setting : 80,100,120,140
- mA range (step size) : 20-665 (1 mA steps)
- anode heat capacity : 8.0 MHU
- maximum anode cooling rate : 1,608 KHU/min
- anode diameter : 200mm
- anode rotation speed : 105 Hz (6,300 RPM)
- target angle : 7 degrees
- maximum helical exposure time : 100 S
- Nano panel detector coverage: 40mm
- material : solid state GOS with 43,008 elements
- Dynamic range : 1,000,000:1
- Slip ring : optical – 5.3 Gbps transfer rate
- Data sampling rate : up to 4,640 views, revolution, element
- Slice thickness (helical mode) : 0.67-5mm
- Slice thickness (axial mode) : 0.675-12.5mm
- Scan angles : 240,360,420 degrees
- Scan field angles: 250mm, 500mm

❖ **Philips Access 16 slice CT scanner**

Specifications of Philips Access 16 slice CT scanner: -

- Number of slices : 16 slice system
- Brand : Philips
- Scan length (mm) : 120
- Application : diagnostic center
- Power: 28KW
- Gantry aperture : 65cm

Fig. 4.2 Philips access 16 slice CT scanner in Super Specialty Hospital.

Magnetic Resonance Imaging (MRI): - It is a medical imaging procedure used in radiology to form images of the anatomy and the physiological procedures of the body. [3,41] MRI scanners use strong magnetic fields, magnetic field gradients, and radio waves to produce images of the organs in the body. MRI does not contain X-rays or the use of ionizing radiation, in which differentiates it from CT and PET scans. MRI is a medical use of Nuclear magnetic Resonance (NMR) which can similarly use for imaging in other NMR applications, for example NMR spectroscopy.

❖ **Philips Achieva 1.5 Tesla MRI SCANNER: -**

fig.4.3 Philips Achieva 1.5 tesla MRI scanner in MMIMSR.

SPECIFICATIONS OF PHILIPS ACHIEVA 1.5 TESLA MRI SCANNER: -

- Brand :- Philips
- model name/ number :- Achieva 1.5T
- magnetic strength :- 1.5 Tesla (T)
- machine condition :- new
- Bore size :- 60cm
- maximum amplitude :- 33mT/m
- maximum slew rate :-122T/m/s

The Philips Achieva 1.5 tesla machine is a fast and easy to use machine. It is an available in 8, 16, and 32 channels. The Philips Achieva contains smart exam functions that agree for uniform image quality through the patients, technicians/ operators, patient position, and pathology. The Philips Achieva 1.5tesla is a fast scanner. [5, 42] they can be done by the scan in 20 minutes like brain and spinal scan. The patient table height can be lowered to 20-inches, and the patient support allows patients weighing up to 550 pounds. It also consumes variable lightings, a fresh air supply and a handheld call button. These also have the use of immobilization devices and MR coils also used in the MRI scanner.

❖ **Philips Multiva 1.5 Tesla MRI scanner**

fig. 4.4 Philips multiva 1.5 tesla MRI scanner in super specialty hospital.

SPECIFICATIONS OF PHILIPS MULTIVA 1.5 TESLA MRI SCANNER: -

- magnet weight :- 2900kg
- Bore design :- 60cm
- maximum FOV:- 53cm
- Ultra compact, zero boil off magnet: - yes
- maximum amplitude :- 33mT/m
- Effective :- 57mT/m , 208mT/m/ms mt/m
- maximum slew rate :- 120mT/m/ms
- Number of channels :- 16
- Channel bandwidth :- 3mHz per channel
- Sampling :- direct digital sampling (DDS)
- Preamplifiers :- all RF coils include built in dedicated low noise preamplifiers for optimal signal-to-noise
- maximum scan matrix :- 1024 (2048 optional)
- maximum number of slices :- 1024
- Output power :- 18 KW
- Amplitude resolution :- 16 bits
- Tuning :- per patient rapid automatic power & frequency optimization

❖ The Philips Multiva 1.5 Tesla a high-performance specification that facilitates clinicians to take lesstime to view images. A high quality of images, reliable imaging that benefits for the more patients.

❖ **Components of MRI SYSTEM: -**

- magnet:-
- Permanent magnet
- Electromagnet
- Superconducting magnet
- Shim coils
- Gradient coils
- RF transmitter/ receiver coils:-
- 8 channel sense head coils
- 16 channel sense neurovascular coil
- Torso coil
- Spine coil
- medium coil
- Small coil
- Knee coil
- Breast coil
- Surface coil
- Computer

The various factors affecting a diagnostic image quality of motion are: - The Collection of the immobilization devices depends on the patient comfort. The immobilization devices which are used in radiology department mainly are sand bags, sponges, Velcro straps, foam pads, head rests, head clamps, wedges, and compression bands. It also helps in positioning the patient in few ways. Then, all these things are also used in Computed Tomography and magnetic Resonance Imaging. The Insufficient of the immobilization devices used in this study will be debated under alongside by their physical properties and usages. [43, 44]

Sand bags: - sand bags are useful for positioning, immobilization devices can be used in a variety of ways shown in (fig.4.5) By themselves or in combination with patient positioning like, sponges, sand bags are extremely accommodating in the decreasing voluntary motion.

Velcro strap: - Velcro strap restraints are intended to be involved easily to the radiography table. [9, 44]these types of limitations contain two brackets that mount to each side of the table with a Velcro strap shown in (fig.4.6) that is adjustable for any size of patient. It could be adjusted to cover by theany part of the body, such as the chest, abdomen, or legs.

Foam pads: - we have a variety of foam pads shown in (fig.4.7) and foam positioning aids appropriate for your medical facility. We offer a collection of sizes to suit your needs during the techniques and examinations. Our foampads shown in (fig.4.5) are durable, easy to clean with an alcohol solution and display no artefacts on medical imaging technology. [45]

Compression bands: - the compression bands are valuable aids for immobilization show that (fig.4.6). Compression bands, then, they are more effective in pediatric patients whereas used in combination with in the sandbags.

Head rest: - The used to give head parts in technique of the beam or in a better patient position. Theyare comfortable for patient show that (fig.4.7) and patient position. They are increasing the stabilityand high excess of the immobilization. There are different types of immobilization devices available in Radiology Department like a wedges,sponges, and head rests. [47] They are helpful to patient positioning and patient comfort.

DIFFERENT-DIFFERENT TYPES OF IMMOBILIZATION DEVICES ARE USED IN CT AND MRI SCANNER: -

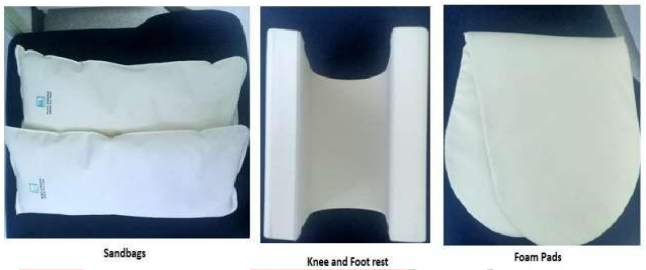

FIG. 4.5 IMMOBILIZATION DEVICES USED IN MRI (PHILIPS MULTIVA 1.5 TESLA) IN THE DEPARTMENT OF RADIODIAGNOSIS IN SUPERSPECIALTY HOSPITAL.

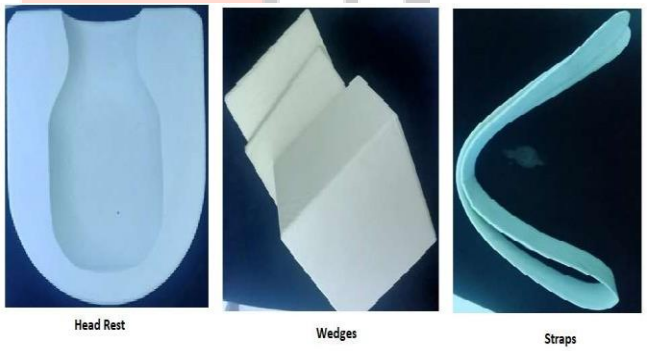

Fig. 4.6 Immobilization devices used in MRI (Philips Multiva 1.5 Tesla) in the Department of Radiodiagnosis in SuperSpecialty Hospital.

INSTRUMENTS FOR DATA COLLECTION

- Performa
- Sandbags
- Sponges
- Head rests
- Wedges
- Foam pads
- Head supporter
- Velcro-straps
- Head clamps
- Knee and foot rest
- Compression bands
- Positioning aids

3. DATA ANALYSIS

Total 100 patients were taken in my research article, in which both male and female patients were available. Then, the immobilization devices have been used on these patients.

❖ **MMIMSR: -**

- In CT scan of MMIMSR, there were total 20 patients. In which 13 male and 7 female patients.
- There were no paediatric patients.

In MRI of MMIMSR, there were total 30 patients. In which 20 male, 8 female and 2 paediatric patients. In case of paediatric patients, there were both female patients.

❖ **SUPER SPECIALTY HOSPITAL: -**

- In CT scan of SUPER SPECIALTY HOSPITAL, there were total 20 patients, out of which 12 were female and 8 female patients. There were no paediatric patients.
- In MRI scan of SUPER SPECIALTY HOSPITAL, there were total 30 patients, out of which 16 were female and 14 female patients. There were no paediatric patients.

Table no 5.1: - CT/MRI scan patients' distribution of study population.

CT SCAN(MMIMSR)	MRI SCAN(MMIMSR)	CT SCAN (SUPER SPECIALTY HOSPITAL)	MRI SCAN (SUPER SPECIALTY HOSPITAL)
Total patient: - 20	Total patient: - 30	Total patient: - 20	Total patient: - 30
male patient: - 13	male patient: - 20	male patient: - 12	male patient: - 16
Female patient: - 7	Female patient: - 8	Female patient: - 8	Female patient: - 14
Pediatric patient:- nil	Pediatric patient:- 2	Pediatric patient:- nil	Pediatric patient:- nil

The following observations were made in the present study Table 5.2 and figure 5.1 show that the age of the study group which consisted of 100 patients was between 0-90 years. The maximum number of patients 54 were in the age group of 20-49 years, followed by 35 in the age group of 50-90 years. There were 11 patients and between the age of 0-19years.

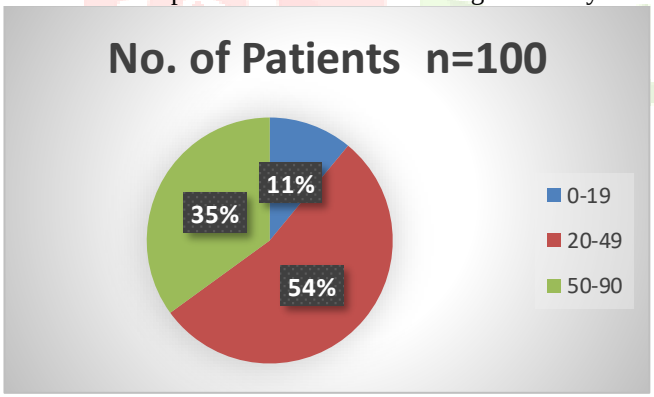

table no 5.2: - age wise distribution of study population (n=100).

Table no 5.3 and figure no 5.2 show that the sex wise distribution of the study group which consisted of 100 patients was between male, female and pediatric patients. The maximum number of patients 61 were in the male patients of followed by 37 in the female patients. There were 2 pediatric patients in this study population.

Table no: - 5.3 Sex wise distribution of study population (n=100)

S. No	sex	Number of patients (n=100)
1	Male	61
2	Female	37
3	Pediatric	2
4	Total	100

A variety of immobilization devices were used in the MMIMSR CT scan. Out of which foam pads, Velcro straps and head rests have been used on the patients. Of all these devices, different types of immobilization devices have been used.

Philips Ingenuity 128 slice CT scanner in MMIMSR: -

Table no 5.4 and figure no 5.3 show the foam pads distribution of study population. In which consisted of 20 patients was between male, female and pediatric patients. Therefore, in which total number of patients are 20 and total number of foam pads are used 13.

table no 5.4: - immobilization devices distribution of study population (n=20)

S. No	Number of patients	Immobilization devices	Number of used immobilization devices
1	20	Foam pads	13
2	20	Velcro straps	4
3	20	Head rests	13

In which consisted of 20 patients was between male, female and pediatric patients. Therefore, in which total number of patients are 20 and total number of Velcro straps are used 4.

Philips Achieva 1.5 tesla MRI scanner in MMIMSR: -

Table no 5.5 and figure no 5.6 show that the foam pads/sponges' distribution of study population. In which consisted of 30 patients was between male, female and pediatric patients. Therefore, in which total number of patients are 30 and total foam pads are used 24.

table no 5.5 immobilization devices distribution of study population (n=30)

S. No	Number of patients	Immobilization devices	Number of used immobilization devices
1	30	Foam pads/ sponges	24
2	30	Velcro straps	6
3	30	Sand bags	4
4	30	Knee pads	16

Philips Access 16 slice CT scanner in Super Specialty Hospital: -

Table no 5.6 and figure no 5.10 show that the foam pads distribution of study population. In which consisted of 20 patients was between male, female and pediatric patients.

Therefore, in which totalnumber of patients are 20 and total foam pads are used 18.

Table no 5.6 immobilization devices distribution of study population (n=20)

S. No	Number of patients	Immobilization devices	Number of used immobilization devices
1	20	Foam pads	18
2	20	Velcro straps	3
3	20	Head rests	18

Philips Multiva 1.5 Tesla MRI scanner in Super Specialty Hospital: -

Table no 5.7 and figure no 5.13 show that the foam pads /sponges' distribution of study population. In which consisted of 30 patients was between male, female and pediatric patients. Therefore, in which total number of patients are 30 and total foam pads are used 26.

The Velcro straps distribution of study population. Inwhich consisted of 30 patients was between male, female and pediatric patients. Therefore, in which total number of patients are 30 and total foam pads are used 2.

The sand bags distribution of study population. In which consisted of 30 patients was between male, female and pediatric patients. Therefore, in which totalnumber of patients are 30 and total foam pads are used 5.

We use immobilization devices on patients because this helps to maintain the position of the patientand there is no movement of the patient. Patient is supposed to breathe normally due to which it is easy to scan. Some cases patient finds difficult to get familiar to immobilization devices or might theydo not in stable condition. Therefore, cooperation with these patients is quite difficult.

Table no 5.7 immobilization devices distribution of study population (n=30)

S. No	Number of patients	Immobilization devices	Number of used immobilization devices
1	30	Foam pads/ sponges	26
2	30	Velcro straps	2
3	30	Sand bags	5
4	30	Knee pads	10

4. RESULTS

In my research article, taken 100 patients. There were three category of patientsthat is pediatric,adultsandold aged. Then, the immobilization devices have been used on these patients.

❖ **MMIMSR: -**

- In CT scan of MMIMSR, there were total 20 patients. In which 13 male and 7 female patients. There were no paediatric patients.
- In MRI of MMIMSR, there were total 30 patients. In which 20 male, 8 female and 2 paediatricpatients. In case of paediatric patients both were female.

❖ **SUPER SPECIALTY HOSPITAL: -**

- In CT scan of SUPER SPECIALTY HOSPITAL, there were total 20 patients, out of which 12 weremale and 8 female patients. There were no paediatric patients.
- In MRI scan of SUPER SPECIALTY HOSPITAL, there were total 30 patients, out of which 16 weremale and 14 female patients. There were no paediatric patients.
- The characterization was done on the basis of their age shown in table no 6.8 and shown in figure6.17;

table no 6.8: - age wise distribution of study population (n=100)

S. No	Age (years)	Number of patients (n=100)
1	0-19	11
2	20-49	54
3	50-90	35

❖ **MMIMSR: -**

- CT scan of MMIMSR, under age group 0-19, 3 patients were taken which were 2 maleand 1 female. On these patients foam pads, head rests and Velcro straps were used.
- CT scan of MMIMSR, under age group 20-49, 7 patients were taken which were 3 maleand 4 female. On these male patients foam pads and Velcro straps were used and on female patients foam pads was used.
- CT scan of MMIMSR, under age group 50-90, 10 patients were taken which were 8 male and 2 female. On these male patients foam pads, Velcro straps and head rests were used and on female patients foam pads and head rests were used.
- MRI scan of MMIMSR, under age group 0-19, 4 patients were taken which are 2 maleand 2 female. Out of these 2 females, 1 female was paediatric. On these male patients foam pads, sponges and Velcro straps were used and on female patients foam pads, sponges and Velcro straps were used.
- MRI scan of MMIMSR, under age group 20-49, 16 patients weretaken which were 11male and 5 female. On these male patients foam pads, sponges and knee pads were used and on female patient's sand bags, sponges, foam pads and knee pads were used.
- MRI scan of MMIMSR, under age group 50-90, 8 patients were taken which were 6 male and 2 female. On these male patients foam pads and knee pads were used.

❖ **SUPER SPECIALTY HOSPITAL: -**

- CT scan of SUPER SPECIALTY HOSPITAL, under age group 0-19, 1 patient was taken which was 1 female. On these female patients foam pads, Velcro straps and head restswere used.
- CT scan of SUPER SPECIALTY HOSPITAL, under age group 20-49, 10 patients were takenwhich were 6 male and 4 female. On these male patients foam pads, head rests and Velcro straps were used and on female patients Velcro straps, head rests and foam pads were used.
- CT scan of SUPER SPECIALTY HOSPITAL, under age group 50-90, 9 patients were takenwhich were 6 male and 3 female. On these male patient's head rests, foam pads and Velcro straps were used and on female patients foam pads and head rests were used.
- MRI scan of SUPER SPECIALITY HOSPITAL, under age group 0-19, 3 patients were takenwhich were 2 male and 1 female. On these male patients foam pads, sponges and Velcro straps were used and on female patients foam pads and Velcro straps were used.
- MRI scan of SUPER SPECIALITY HOSPITAL, under

age group 20-49, 21 patients were taken which were 11 male and 10 female. On these male patients foam pads and sponges were used and on female patient's knee pads and foam pads were used.

- MRI scan of SUPER SPECIALITY HOSPITAL, under age group 50-90, 8 patients were taken which were 4 male and 4 female. On these male patients foam pads and knee pads were used and on female patient's knee pads and foam pads were used.

In maximum age group (20-49), 45 Foam pads, 5 Velcro straps, 16 head rests, 17 knee pads and 9 sand bags were used on out of 54 patients.

table no.6.9 immobilization devices distribution of study population (n=54)

S.No.	Immobilization device	Number of patients	Immobilization devices are used
1	Foam pads	54	45
2	Velcro straps	54	5
3	Head rests	54	16
4	Knee pads	54	17
5	Sand bags	54	9

On majority of the patients, foam pads were used.

In minimum age group (0-19), 10 foam pads, 10 Velcro straps, 3 head rests, 1 knee pads and 2 sandbags were used on out of 11 patients.

table no 6.10 immobilization devices distribution of study population (n=11)

S.No.	Immobilization device	Number of patients	Immobilization devices are used
1	Foam pads	11	10
2	Velcro straps	11	10
3	Head rests	11	3
4	Knee pads	11	1
5	Sand bags	11	2

On majority of the patients, foam pads and Velcro straps were used.

5. DISCUSSION

This research article consists of immobilization devices. Total 100 patients were there in this researcharticle, consists 61 males and 39 females in which 2 were pediatric patients. There were every kind of category of patient like; pediatric, adult, and elder age. In all examination immobilization deviceshave been used, radiation professionals and radiologists in the tabulated manner on the analysis basis. Data was collected in CT and MRI machine then; patients were collected in my research article. In which outpatient department (OPD) patient were scanned. And the positioning of the patient with immobilization devices which saves the time of patient and the image quality is better and there is no movement of the patient which makes the scan easier. On age group of (0-19), (20-49) and (50- 90) 11%, 54% and 35% immobilization devices were used respectively. As study had been done, conclusion drawn is that there were different devices have been used in Radiology and different in Radiotherapy. This study is given by Hyun-Hae Cho who revealed a decreased shot number in VCUG, which is the most common fluoroscopy technique performed in pediatric patients. Seventy-seven patients were immobilized in this study as opposed to the study done by Hyun-Hae Cho whereas 100 patients were immobilized. It is higher than this study because immobilization is crucial in Radiotherapy where a small error can cause damage to normal tissue and spare cancerous tissue. Decreased mean fluoroscopic period was also noted and resulted in a reduction of radiation dose exposure throughout the examination. Decreased incidence of motion artifacts and inadequate shot timing and centering can improve overall image quality in pediatric VCUG studies by through immobilization devices in radiological department. [47] The radiation exposure is one of the most important matters in radiological imaging studies involving pediatric patients. Although fluoroscopic studies have played a major role in diagnosis. There has been relatively little effort devoted to reducingthe radiation exposure in the investigation. It is tough to estimation and calculation in the radiation dose exposure by through the procedure due to variable procedural protocols amongst the patients,operators, and centers. Hence, there was important variation in fluoroscopic duration or number of scout image shots amongst the different centers. Furthermore, there is even a noted deviation among operators in the same centers. It was used for reducing radiation dose for pediatric fluoroscopic studies including recommendation of pulsed fluoroscopy, grid removal, and last image hold. But these methods can be complicated to adapt and required additional education and training. Therefore, we focused on a simple way to reduce radiation dose exposure by using an immobilization device. [48] The immobilization is easy to adapt and it is a usually used way for uncooperative pediatric patients, and then, essential for exact imaging evaluation. The immobilization devices become an issue in Computed Tomography and magnetic Resonance Imaging due to the relatively long examination times of these radiological imaging process compared with simple radiography, and concerns regarding sedation of pediatric patients for imaging studies. In the research article done by *Baukje Hemmes, Gerrit and Peter R.g. brink"*, seventy seven patient were consist of where only 30% of patients were immobilized by various devices like; spine board, vac-lok cushions, thermoplastic mask and vaginal insertion where this research article consist of hundred patients and where 100% of patients were immobilized by various types of devices like; foam pads, Velcro straps, knee pads, head rests and sand bags in which 81% of foam pads, 16% of Velcro straps, 27% of knee pads, 31% of head rests and 11% of sandbags were used. It is higher thanthe study done by *Baukje Hemmes, Gerrit and Peter R.g. brink"*, it is because immobilization is crucialin both radiology and radiotherapy slight motion can cause motion artefact in imaging while can miss the target in radiotherapy. [49] A retrospective study given by *Thalicia James, Laura d' alimonte* completed with forty patients were immobilized in this study whereas 100% patients were immobilized by various devices like; foam pads, Velcro straps, knee pads, head rests and sand bags in which 81% of foam pads, 16% of Velcro straps, 27% of knee pads, 31% of head rests and 11% of sand bags were used. It is higher than the study done by *Thalicia James, Laura d' alimonte*, it is because immobilization is crucial in both radiology and radiotherapy slight motion can cause motion artefactin imaging while can miss the target in radiotherapy. The goal of radical radiation therapy is to eliminate tumor cells by delivering maximum radiation dose to the target volume. This is required to correct the daily positioning of the patient to minimize the chances of a geographical miss of the target and minimizing the radiation dose to the surrounding normal tissue. [50] The various type of studies has been conducted to find out the best immobilization device to improve reproducibility and setup of patient positioning for men with prostate cancer. A study was given by *Tatsuya ohno, and makoto Sakai* complete with the aim of development of a vaginal immobilization device, 30% patients were immobilized whereas 100% patients were immobilized by various immobilization devices; in which 81% of foam pads, 16% of Velcro straps, 27% of knee pads,

31% of head rests and 11% of sand bags were used. It is higher than the study done by *Tatsuya ohno, and makoto Sakai,* it is because immobilization is crucial in both radiology and radiotherapy slight motion can cause motion artefact in imaging while can miss the target in radiotherapy. As, the Computed Tomographyimage with and without device insert were repeatedly acquired without breaks. After that a related effect would be saw in proton therapy because the proton beams also exhibit sharp radiation dose.

When the cervical tumor and rectum are in vicinity, in calculation with normal margin, the rectum receive a higher radiation dose. In instant cases, the high radiation dose to the rectum may largely be reduced by altering the plan to evade the rectal side. [51] It is essential to consider whether and how much of the plan to alter such as the radiation dose would be minimal. In this study has assured limitations. The interactional position changes of the device are uncertain that would happen with the changes in bowel position. The bowel dose has a threat of the increasing the treatment-planning dose, the verification is also needed in this study. In other cases, this study was completed with the immobilization techniques in the radiology department. The patient is also comfortable with these devices. Well, immobilization devices should be used on each and every patient but, it is must for those patients which are uncomfortable with scanning because these devices help patient to gain their comfort and position. [53] So, there is no occurrence of any problem while scanning of the patient.This study was *given by Amirhossein asfia, and Tomas kron* a review of 3D printed patient specific immobilization devices in radiotherapy' was conducted 38 databases, with results limited 61% of relevant studies, 22% focused and 11% used phantoms whereas 100% patients were immobilized by various immobilization devices; in which 81% of foam pads, 16% of Velcro straps, 27% of knee pads, 31% of head rests and 11% of sand bags were used. It is higher than the study done by *Amirhossein asfia, and Tomas kroon,* it is because immobilization is crucial in both radiology and radiotherapy slight motion can cause motion artefact in imaging while can miss the target in radiotherapy. During this procedure high radiation doses are delivered to specific localized areas of the patient; as a result, the target accuracy is vital in order to minimizing the negative effects to nearby healthy tissues. The immobilization devices are critical to this treatment process, minimize the patient movement, and confirm repeatability of the treatment over as much as forty sessions. In another cases, the immobilization devices must be important for the patient during the procedure. [54] In the radiology department devices must be available and technician should use this technique. In some cases, patients find difficult to get familiar to immobilization devices or might they do not in stable conditionand cooperation with these patients is quite difficult. In this case technician should remain calm and she/he should cooperate with patients and by telling the advantages of immobilization devices he/she can use these devices and perform scanning successfully. [55] In the present study we have shown that immobilization (radiology) devices are better than immobilization (radiotherapy) devices.

6. CONCLUSION

In maximum age group (20-49), 45 foam pads, 5 Velcro straps, 16 head rests, 17 knee pads and 9 sandbags were used on out of 54 patients.

table no.8.11 immobilization devices distribution of study population (n=54)

S.No.	Immobilization device	Number of patients	Immobilization devices are used
1	Foam pads	54	45
2	Velcro straps	54	5
3	Head rests	54	16
4	Knee pads	54	17
5	Sand bags	54	9

Foam pads: - On 83% of patients foam pads were used because foam pads help to retain the position of patient and bring stabilization in image quality and decrease motion artefact. Apart from this there are few patients who feel uncomfortable to use foam pads. Generally, growing children do not use foam pads because somewhere they find difficult to use these devices and above age 18 patient do not use foam pads because they feel comfortable without foam pads and scanning done easily. Velcro straps: - Only on 9% of patients Velcro straps were used because Velcro straps helps to maintain the positioning of patient. Sometimes, at the time of injury it is good to you Velcro straps because it helps to reduce pain of patient and helps to get better image quality. [56] majority of patients did not use Velcro straps because patient feel uncomfortable and they do not find easy to get familiar with these devices. Head rests: - On 30% of patients head rests were used because head rests help to maintain the position of head. Majority of patients did not use head rests because patient feel uncomfortable. Knee pads: - On 31% of patients knee pads were used because knee pads help to retain the position of patient. Maximum number of patients do not like using knee pads. Sand bags:

- Only on 17% of patients sand bags were used because sand bags work as weight put on any joint of body to reduce fluctuation in that joint so that image quality be better. As sand bags are used only for joints and many patients do not scan their joints.

In minimum age group (0-19), 10 foam pads, 10 Velcro straps, 3 head rests, 1 knee pads and 2 sand bags were used on out of 11 patients.

table no 8.12 immobilization devices distribution of study population (n=11)

S.No.	Immobilization device	Number of patients	Immobilization devices are used
1	Foam pads	11	10
2	Velcro straps	11	10
3	Head rests	11	3
4	Knee pads	11	1
5	Sand bags	11	2

Foam pads: - On 90% patients foam pads were used because foam pads help to retain the position of the patient and helps him to be still while scanning. Apart from this there are few patients who feel uncomfortable to use foam pads. Velcro straps: - On 90% patients Velcro straps were used because Velcro straps helps to maintain the position of the patient and image quality be better. Majority of patients did not use Velcro straps because patients feel uncomfortable and they do not find to get familiar with these devices. Head rests: - Only on 27% patients head rests were used because head rests help to ensure the position of the patient, without any movement. Majority of patients did not use head rests because patients feel uncomfortable with these devices. Knee pads:

- On 9% patients knee pads were used because knee pads help to retain the position of patient. Maximum number of patients feel uncomfortable and patients do not like using knee pads. Sand bags: - On 18% patients sand bags were used because sand bags help to maintain the patient position and bring stabilization in image quality. [59] As sand bags are used only for joints and majority of patients did not use sand bags because patient feel uncomfortable and they do not find easy to get familiar with these devices.

Conclude that, generally patient is ready to use immobilization devices but in some cases patient refuse to use

immobilization devices. As we can see in fig.8.11 and 8.12 that majority of patient useddevices and some of did not. Majority of patients are ready to use these devices because they believe that these devices help to improve scanning and somewhere they are comfortable with these devices. As we mentioned earlier that few patients refuse to use these devices and this is because somewhere they have fear to use these devices and generally, these patients are growing children.

Conflict of interest: - The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

7. BIBLIOGRAPHY

References

[1] Immobilization and simulation: l Archana S. Gautam.

[2] Barrett JF, Keat N. Artefacts in CT: recognition and avoidance. Radiographic. 2004; 24 (6): 1679-91. doi:10.1148/rg.246045065 - PubMed citation.

[3] Anne B. Planning and Positioning in MRI. Churchill Livingstone. (2011) ISBN: 0729539857.

[4] McRobbie DW, Moore EA, Graves's MJ. MRI from picture to proton. Cambridge Univ Pr. (2007) ISBN: 052168384X.

[5] Westbrook C, Roth CK, Talbot J. MRI in Practice. Wiley-Blackwell. (2011) ISBN: 1444337432.

[6] Noonan S, Spur K, Nielsen S. Immobilisation in Australian paediatric medical imaging: A pilot study. (2017) Radiography (London, England: 1995). 23 (2): e34- e40. Doi: 10.1016/j.radi.2016.12.005 - PubMed.

[7] Graham P, Hardy m. The immobilisation and restraint of paediatric patients during plain film radiographic examinations. (2004) Radiography. 10 (1): 23-31. Doi: 10.1016/j.radi.2016.12.005.

[8] Hemmes B, Jeukens CRLPN, et al. Effect of spine board and headlocks on the image quality of Head CT scans.

[9] Lim R, Khawaja RD, Nimkin K, Sagar P, Shailam R, Gee MS, et al. Relationship betweenradiologist training level and fluoroscopy time for voiding Cystourethrography.

[10] Cooke MW use of the spinal board with the accident and emergency department. J AccidEmerg med 18:28-30.

[11] Ahlswede Em, Hernanz-Schulman m. Fluoroscopic procedures in children.

[12] Ward VL. Patient dose reduction during voiding Cystourethrography.

[13] The American college of Radiology tsfPR. Practice guideline for the performance of VoidingCystourethrography in children 2009.

[14] http://www.civco.com

[15] Hall EJ, Brenner DJ (2008) cancer risks from diagnostic radiology. Br J Radiol 1 81:362-378

[16] Immobilization device for use on patients undergoing radiological procedures of the head orneck J K Jeurink

[17] Immobilization Devices & Stabilizers; By DAN WASHMUTH, KIM L. LIGHT.

[18] Effect of using immobilization device in radiological studies: (H. H. Chosomie)

[19] Farrington JD, Extriction of victims- surgical principles. J trauma.

[20] Hemmes B, Jeukens CRLPN, et al. Effect of spine board and headlocks on the image quality of Head CT scans.

[21] Meek S Fractures of the thoracolumbar spine in major trauma patients. BmJ: Br med J.

[22] Miller JA, mele C, Abu-Judeh H, significance of back board artefacts on portable traumaseries chest radiographs. Emerg Radiol.

[23] K wan I, Bunn F& Roberts IG spinal immobilization for trauma patients.

[24] Mills Am, Raja AS, Marin JR optimizing diagnostic imaging in the emergency department,Acad Emerg med.

[25] Hauswald m, A reconceptualization of acute spinal care Emerg med J 30:720-723

[26] Mettler FA, Huda W, Mahesh m, effective doses in radiology and diagnostic department.

[27] C patients. Fiorina, m. Reni, A. Bonini and R. Calandrino, "set-up Error in supine-Positioned patients immobilized with two different modalities during conformal Radiotherapy of
Prostate Cancer''.

[28] A. Kneebone, V. Gebski, N. Hongendoorn and S. Turner, " A Randomized Trail Evaluating Rigid immobilization for Pelvic irradiation,"

[29] C. Mitine, m. T. Hoornaert and m. Beauduin, '' Radiotherapy of Pelvic malignancies: Impactof two types of rigid immobilization devices on localization errors".

[30] S. Malone, J. Szanto, G. Perry and J. Crook, "A prospective comparison of three systems of patient immobilization for prostate Radiotherapy".

[31] G. C. Bentel, L.B. marks, and M.S. Anscher," The Effectiveness of immobilization duringProstate Irradiation."

[32] K.m. Langen and D.T. Jones, "Organ motion and its management".

[33] M. Urie, m. Goitein and m. Wagner," Compensating for Heterogeneities in Proton Radiation Therapy".

[34] L. E. Court and L. Dong, '' Automatic Registration of the Prostate for Computed Tomography- Guided Radiotherapy".

[35] Kraft G: Tumour therapy with heavy charged particles.

[36] Perez CA, Grigsby PW, Lockett mA, and Williamson J: Radiation therapy morbidity in carcinoma of the uterine cervix: Dosimetric and clinical correlation.

[37] Webb S: The physical basis of IMRT and inverse planning. Br J Radiol 76

[38] Mundt AJ, Lujan AE, Yamada SD and Fleming G. Intensity-modulated whole pelvic Radiotherapy in women with gynaecologic malignancies.

[39] Renner TR, Chu WT: Wobbler facility for biomedical experiments.

[40] Suit H, Delaney T, Hall E, Flanz J, Hallman J, Trofimov A: Proton vs carbon ion beams in the definitive radiation treatment of cancer patients.

[41] Ahlswede Em, Hernanz-Schulman m. Fluoroscopic procedures in children.

[42] Newman B, John S, Hernanz-Schulman m. Pause and Pulse: Radiation dose in paediatricfluoroscopy.

[43] Ward VL. Patient dose reduction during voiding Cystourethrography.

[44] Ghodadra A, Bartoletti S. Reducing Radiation Dose in Paediatric patients in the Radiology Department.

[45] Ailsa Allison Km. immobilization and restraining of paediatric patients in the Radiology Department: A perspective and review of legislation relevant to UK radiographic professions.

[46] Le Heron JC. Estimation of effective dose to the patient during medical X-ray examinations from measurements of the dose-area product.

[47] Riccabona m. cystography in infants and children: a critical appraisal of the many forms with special regard to Voiding Cystourethrography.

[48] Agrawalla S, Pearce R, Goodman TR. How to perform the perfect Voiding Cystourethrogram

[49] Dashti mA- An m, Al-Ostath S. current immobilization implementation of paediatric patients in five major public hospitals in Kuwait: a prospective study into policies and guidelines for radiology departments. Indian J innovations

Dev. 2012.
[50] C.L Ventola: medical applications for 3D printing: current and projected uses.
[51] R. Unterhinninghofen, F. Giesel, and m. Wade: 3D printing of individual immobilization devices based on imaging analysis of positioning accuracy.
[52] Q.V.V. Pham, A. Foias and P. Wong: Radiotherapy immobilization mask molding through theuse of 3D-printed head models.
[53] m. Fisher, m. Hulse and D. Emmens: Evaluation of 3D printed immobilization shells for headand neck ImRT.
[54] K. Sato, K. Kishi and K. Ito: positional accuracy valuation of a three-dimensional printeddevice for head and neck immobilization.
[55] Bragg C, Dodwell D, Green D, Hart J. A systematic review of methods to immobilize breasttissue during adjuvant breast irradiation, Radiography.
[56] Hadida C, Lamire J (1997) missed upper cervical spine fracture: clinical and Radiological considerations. J Can Chiropr Assoc 41: 77-85
[57] https://doi.org/10.1016/0141-0229(87)90145-1.
[58] https://doi.org/10.21873/anticanres.13300.
[59] https://doi.org/10.1016/j.phro.2020.03.003.