The Egyptian Journal of Hospital Medicine (January 2025) Vol. 98, Page 1011- 1022

Findings and Faults of X-ray as an Only Imaging Tool in a Regional Hospital

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ABSTRACT

Background: Radiology is the other wing of medical investigation with clinical pathology. Radiology has many modalities as X-ray, ultrasound, color Doppler, computed tomography, magnetic resonance imaging and others. X-ray is one of the main radiological modalities and is considered a basic and initial diagnostic tool. It has its own role in basic scanning of chest diseases, diagnosis of bone fractures, many other pathologies and a very important role in the assessment of bone tumors. Although X-ray is a very important modality, it cannot be the only diagnostic imaging modality, especially in hospitals and secondary level healthcare centers. **Objectives:** This retrospective study aimed to assess the use of X-ray as the only diagnostic modality in Muli Regional Hospital, Meemu Atoll, Maldives in the absence of a radiology doctor and breakdown of an ultrasound machine. **Patients and Methods:** All X-ray films during the period of the study were viewed, and acquired data was recorded and analyzed. **Results:** 1808 cases had X-ray studies all over the duration of the study (10 months), 22% of them had an abnormality in their films. Chest X-ray was the most common modality, followed by UT scans. **Conclusion:** X-ray was used as the only imaging modality at Muli Regional Hospital. During the Normal studies are not a definite indicator that the case is normal. X-ray is not suitable to be the only diagnostic modality in any medical center as it has many limitations for diagnosis of many pathologies, especially emergencies.

Keywords: X-ray, Radiology emergencies, Imaging modalities, Maldives health system.

INTRODUCTION

X-ray is the oldest imaging modality, discovered at the end of the 19th century by the German scientist Wilhelm Conrad Röntgen. The X-ray tube is the source of ionizing radiation of X-ray. X-ray named by Röntgen as "X", i.e. unknown when he didn't understand the nature of this vague radiation for him that discovered by its florescence effect [(1)]. X-ray is a basic modality of diagnosis of many diseases, but later X-ray criteria were recognized as ionizing radiation. The hazards of X-ray were discovered after its misuse in the assessment of shoe size for females [(1,2,3)]. X-ray machines have shown significant advancement all over the decades, from the invention of them to the designing of small portable X-ray machines [(1,4,5,6,)].

PATIENTS AND METHODS

This retrospective observational study was conducted at Muli Regional Hospital of Meemu Atoll, Maldives, investigating X-ray studies during the duration from 1 Jan 2024 to the end of Oct 2024. Muli Regional Hospital at the time of the study hadn't any doctors in the main specialties as orthopedics, ENT, chest, and gastroenterologist. All X-ray studies were viewed, different data was recorded and analyzed.

Muli Regional Hospital has two digital X-ray machines, (DRGEM 500mA – Korea) with stand bucky and table, and a portable DR X-ray machine from Shimadzu manufacturing (400 mA). Digital X-ray views were sent in DICOM extension to internal network computers and viewed in different clinics on PCs by DICOM viewer.

Ethical considerations:

Ethical Approval has been approved by The Hospital Management. As the study design was retrospective, it did not require patients' informed written consent. The Helsinki Declaration was followed at all stages of the inquiry.

RESULTS

Table 1: Different number of cases and views in the study.

Month (2024)	Number of X-ray Cases	Number of X- ray Views	Maximal Views per Case	Females	Males	X-ray cases with Abnormal Finding
JAN	305	472	7	155	150	69
FEB	203	319	5	140	63	30
MAR	153	238	4	103	50	37
APR	124	223	3	60	64	40
MAY	160	273	4	95	65	28
JUN	195	300	5	100	95	36
JULY	206	337	5	106	100	48
AUG	189	289	4	109	80	53
SEP	150	230	3	89	61	47
OCT	123	185	3	77	46	24
TOTAL	**1808**	**2866**		**1034**	**774**	**412**

Received: 02/10/2024
Accepted: 02/12/2024

Sex distribution was 774 (42%) males and 1034 (68%) females (Fig.2). All films were viewed and revealed that only 412 (22.8%) cases showed abnormal findings in X-ray, which indicates a low incidence of X-ray indication. Fig. 3 and 4 are explaining the number of cases per each month and scan type. 56% (1808) cases were CXR, which is the maximum number of studies. Most patients with abnormal CXR were cardiomegaly (Fig. 5b), then inflammatory changes and a few cases of interstitial lung diseases and pleural effusion (Fig. 5c).

40% of cases (717) were MSK X-rays of different joints, spine (CS, dorsal and LSS) and skull. MSK X-ray of joints or spines was mainly done in two views, the different findings were fractures and post fractures reduction follow up, congenital changes and inflammatory changes (Fig. 7 to 15) The other X-ray studies were of few numbers as explained in Table 2.

Imaging techniques weren't ideal all over the time. Fig. 16 explains some cases of bad techniques of imaging, as in KUB, which does not reach the ideal lower limit of the film (2 cm below symphysis pubis) or non-preparation of the case before the technique by evacuation of GIT gases through laxative intake and fasting. Also, lateral films of the nasopharynx technique weren't ideal, as it was imaged without complete opening of the mouth. Some of the LSS spine AP views were done without the removal of metallic objects in the clothes of the patients (such as zippers).

Table 2: Details of X-ray studies types.

Month (2024)	Number of Cases	CXR	MSK	UT (PUT and Pelvis)	Abdomen	Others (Nasal Bone-Nasopharynx)
JAN	305	185	109	6	4	1
FEB	203	118	69	4	12	0
MAR	153	81	67	2	3	0
APR	124	52	67	3	2	0
MAY	160	96	63	1	0	0
JUN	195	117	73	2	3	0
JULY	206	123	76	0	4	3
AUG	189	103	80	4	2	0
SEP	150	75	61	8	6	0
OCT	123	68	52	2	1	0
TOTAL	1808	1018	717	32	37	4

*CXR: Chest X Ray - *MSK: Musculoskeletal *UT: Urinary Tract.

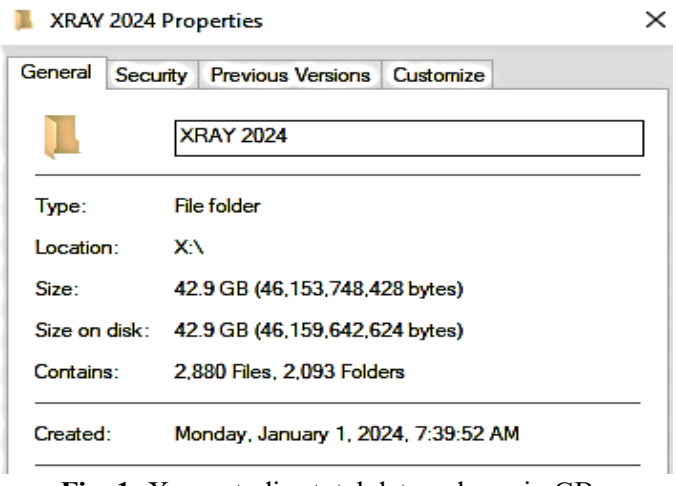

Fig. 1: X-ray studies total data volume in GB.

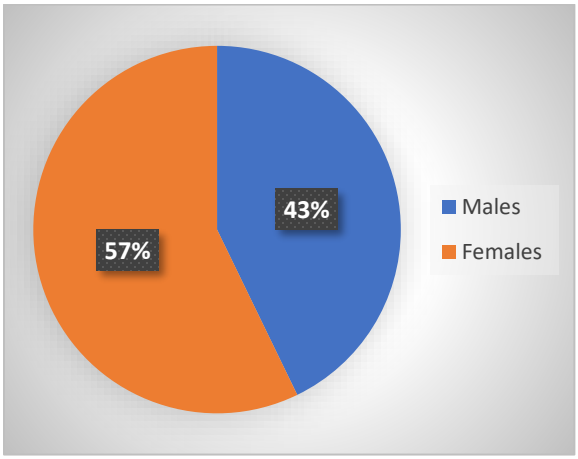

Fig.2: Sex distribution of the study

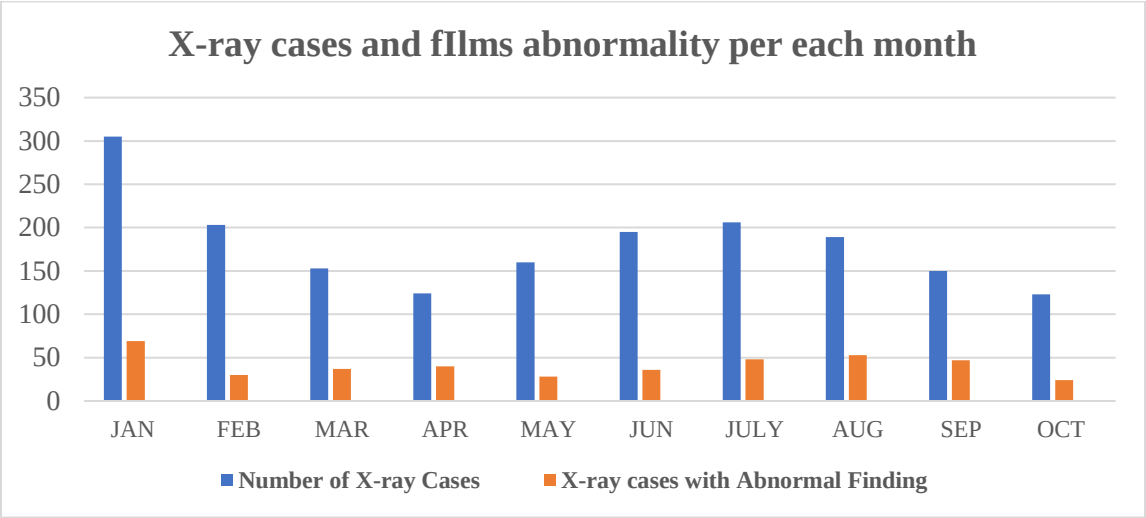

Fig. 3: Number of X-ray cases and cases showing abnormality per each month.

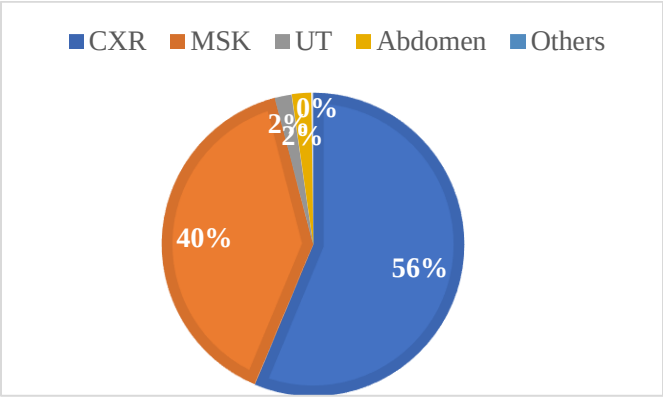

Fig. 4: Number and percentage of each X-ray study type

CASE PRESENTATION

In this sector we are discussing the different findings in X-ray films, showing different abnormalities either in table 3 or different cases presentation.

Table 3: Explaining the different diagnoses viewed in our study

X-ray	Diagnosis
CXR	- Cardiomegaly - Lung mass - Chest inflammatory changes - Interstitial lung disease - Pleural effusion
MSK Joints - Spine	- Fractures - Post fracture fixation follow up - Joint dislocation - Osteoarthritis - Bone tumors (Osteo-chondroma) - Spondylodegenerative changes
Urinary Tract (KUB - Pelvis)	- Urinary stones
Abdomen	- Intestinal obstruction - FB ingestion
Nasopharynx	- Enlarged adenoids
Nasal Bone	- Nasal bone fracture

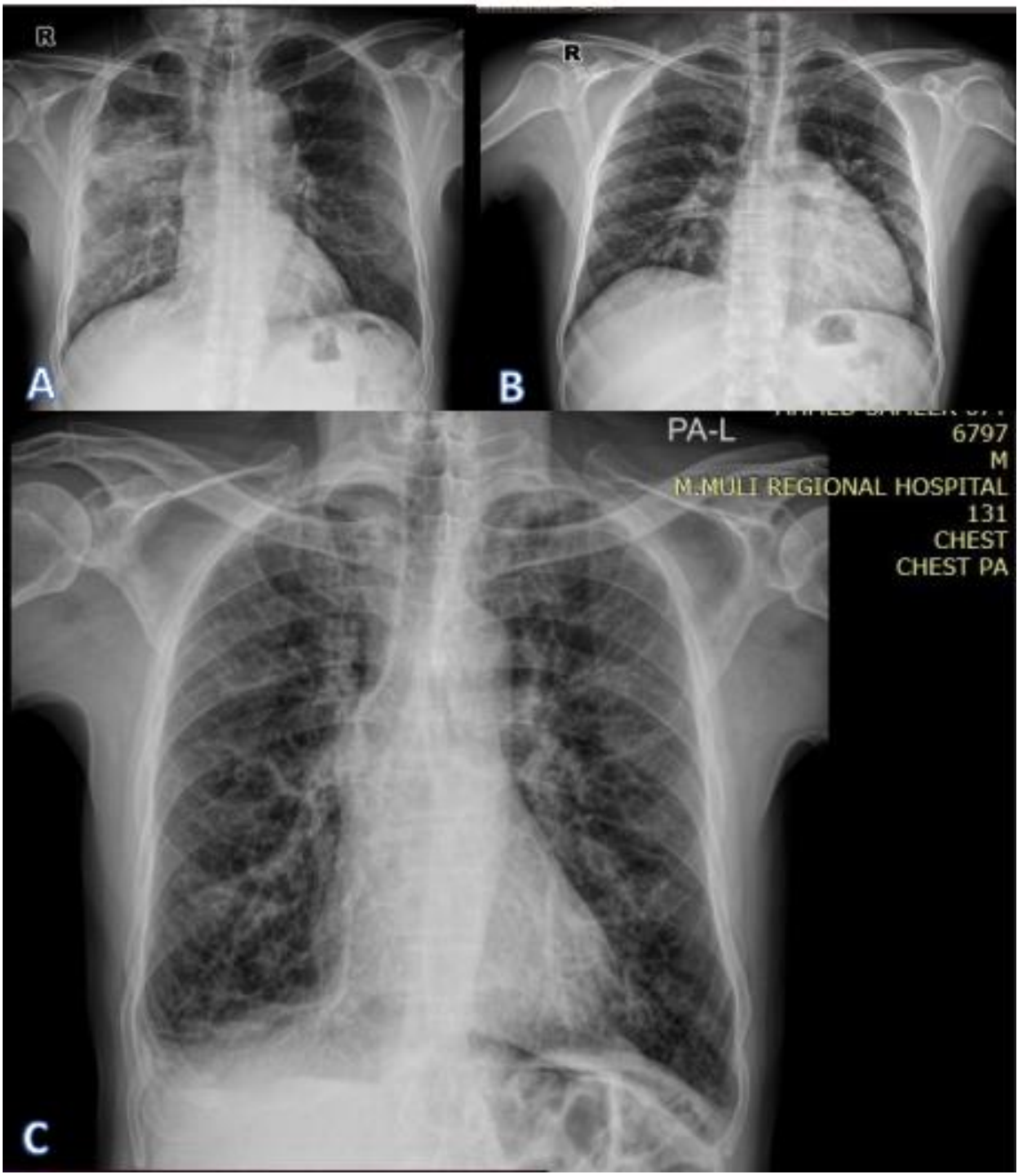

Fig. 5: A- CXR – PA view shows Rt middle lung zone mass and distal reticulation; CT further assessment is mandatory. **B- CXR- PA** view of adult patient suffering significant cardiomegaly, echocardiography is essential for further assessment. No data available if the patient did it in another hospital or not. **C-** CXR of middle-aged adult male suffering dyspnea, it shows bilateral reticulation in both lung fields (likely to be an interstitial lung disease which is better assessed by CT scan) with obliterated Rt costophrenic recess denoting small amount of pleural effusion which is better assessed by ultrasound.

Fig.6: Middle aged female patient presented with back deformity; X-ray shows scoliotic deformity of dorsal spine.

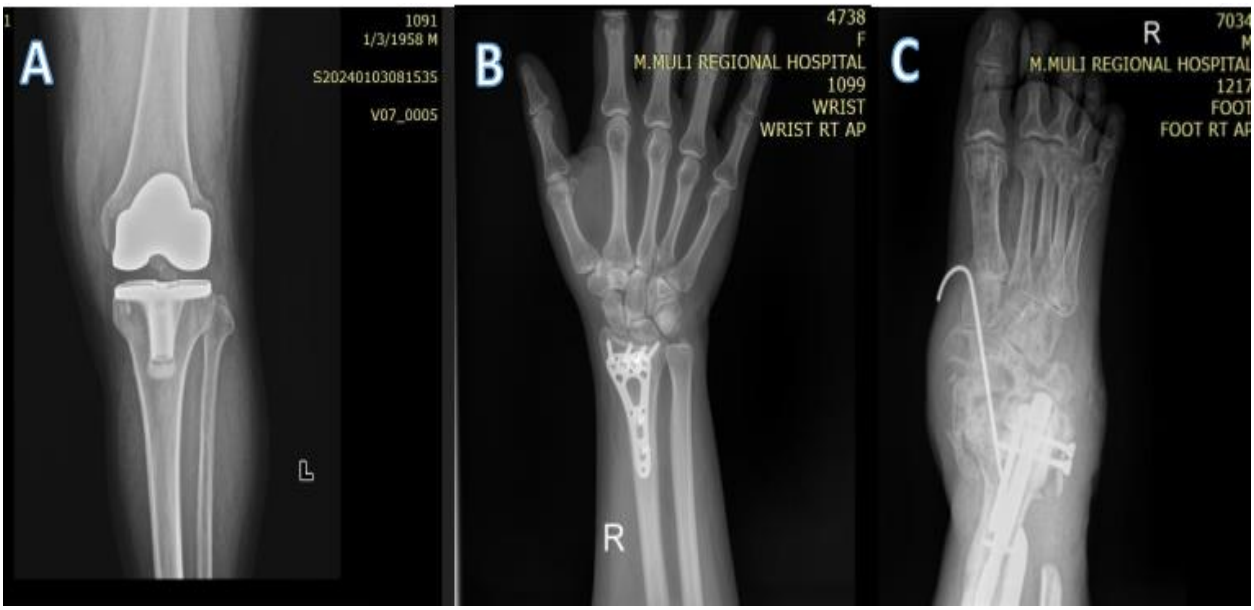

Fig. 7: Postoperative fractures fixation: A - X ray Lt Knee, AP and lateral views of a case of total knee replacement follow up. **B-** X ray Rt distal forearm shows distal radius fracture postoperative plate and screws fixation in adult female patient. and **C-** Middle aged male patient**,** Rt foot postoperative fixation of comminuted fracture by wires and screws

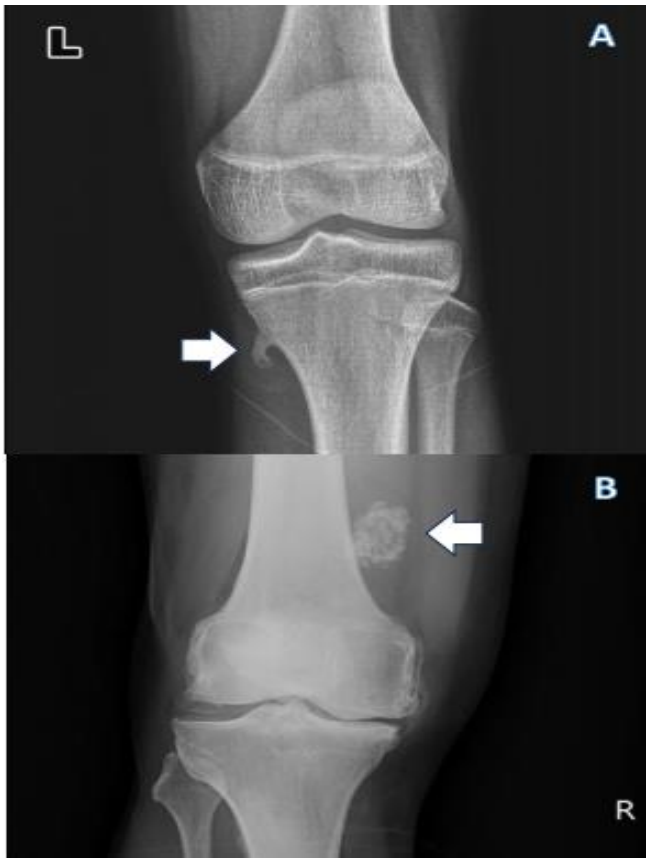

Fig. 8: A and B; 2 adult patient cases X-ray knee, AP views show cartilaginous cap exostosis (osteo-chondroma) A- at Lt knee medial aspect of proximal tibia, B- at Rt knee medial aspect of distal femur. Notice the criteria of it "direction against joint". MRI follow up is mandatory if the size increased.

Fig. 9: A- Little finger of Lt hand, with middle interphalangeal joint dislocation. B- a case of male patient, 21 y, presented with Lt foot trauma, X-ray foot AP view shows little toe middle phalanx fracture.

Fig. 10: Joints dislocation: A- Male patient 27 y with Lt arm trauma, X-ray shows Lt elbow joint complete dislocation. Further MRI assessment is mandatory before any surgical process. **B-** Male patient presented with Lt shoulder trauma and shows anterior shoulder dislocation.

Fig. 11: Forearm fractures: A- A case of boy 7 y presented with forearm fracture **B-** a case of boy 14 y with both radius and ulna mid shaft fracture and **C**- post external fixation follow up.

Fig. 12: X-ray of LSS spine, of adult patients, lateral views show spondylodegenerative changes. MRI is mandatory for further assessment.

Fig. 13: Male patient, 34 y presented with severe trauma of Lt elbow. X-ray show comminuted fracture of distal humerus. CT further assessment is highly recommended. MRI also may be needed for assessment of ligamentous injury.

Fig. 14: A case of female patient, 49 y, complaining bilateral foot pain, both feet lateral view shows lower calcaneus small spur.

Fig. 15: A and B: Two cases male and female adult patient show knee osteoarthritic changes, which show reduced joint space more in medial compartment with marginal osteophytes.

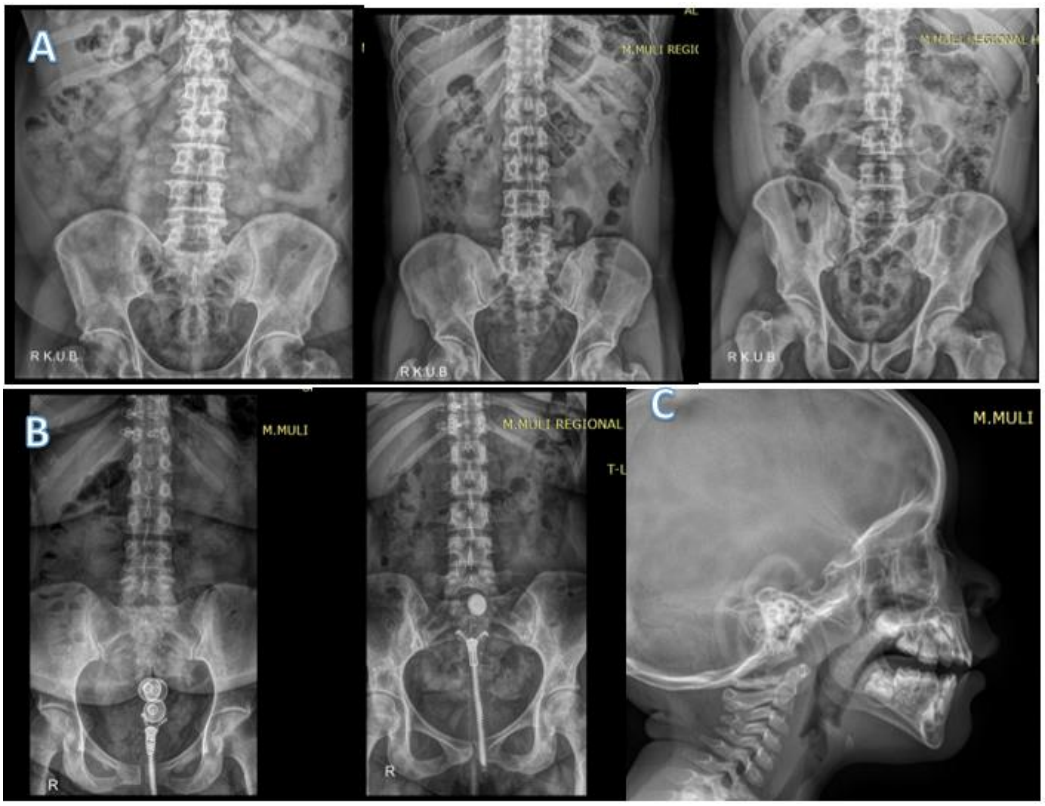

Fig. 16: (Bad techniques) Different X-ray scans denoting bad technique imaging: A- KUB with bad pre scan GIT preparation and show excessive gases which can mask minute pathologies B. 2 cases of LSS AP view show bad imaging technique due to non-removal of metallic objects in the patient's cloths **C.** X-ray of nasopharynx shows enlarged soft tissue shadow of nasopharyngeal tonsil, but the film should be imaged with complete open mouth.

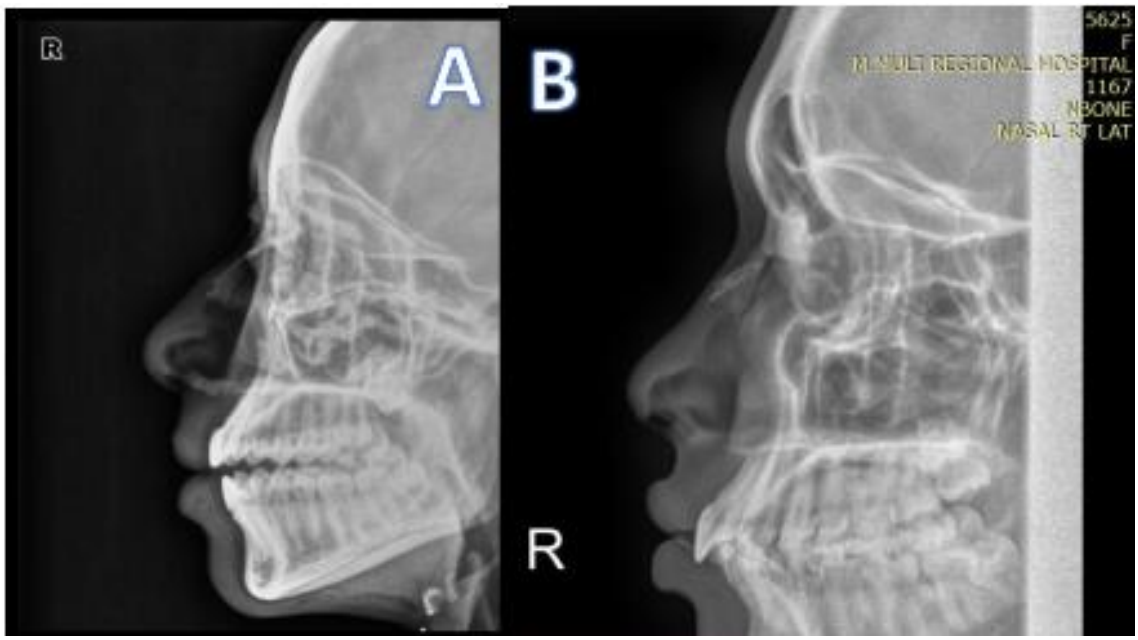

Fig. 17: A- A case of Female patient, 15 y presented with nasal trauma, X ray lateral view of nasal bone is showing nasal bone fracture. **B-** Other female patient, 16 Y with the same presentation and finding

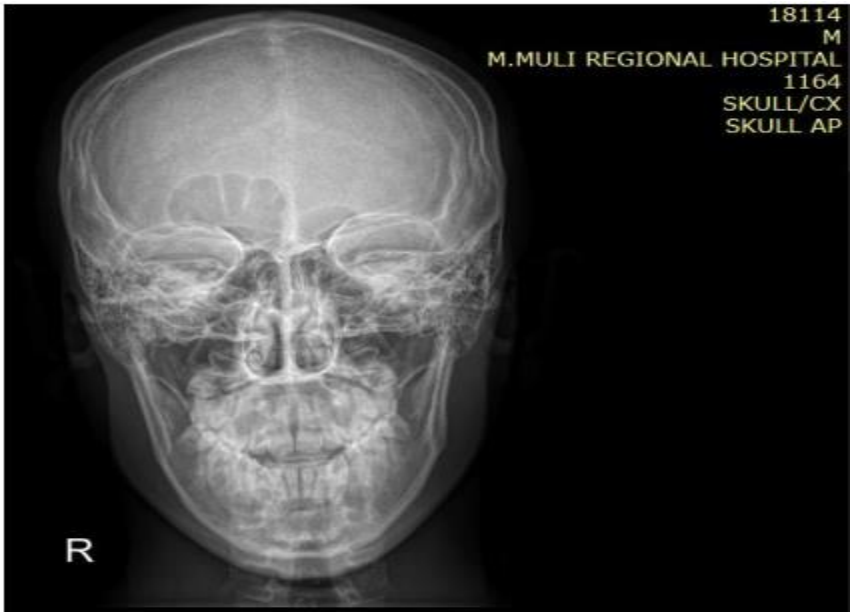

Fig. 18: Normal X-ray skull of patient presented with head trauma; skull X-ray was the least conclusive study as it has a limited role in assessment of head trauma (only discovering skull fractures). Patient was transmitted to another hospital and had CT scan, which approved that he has an extradural hematoma.

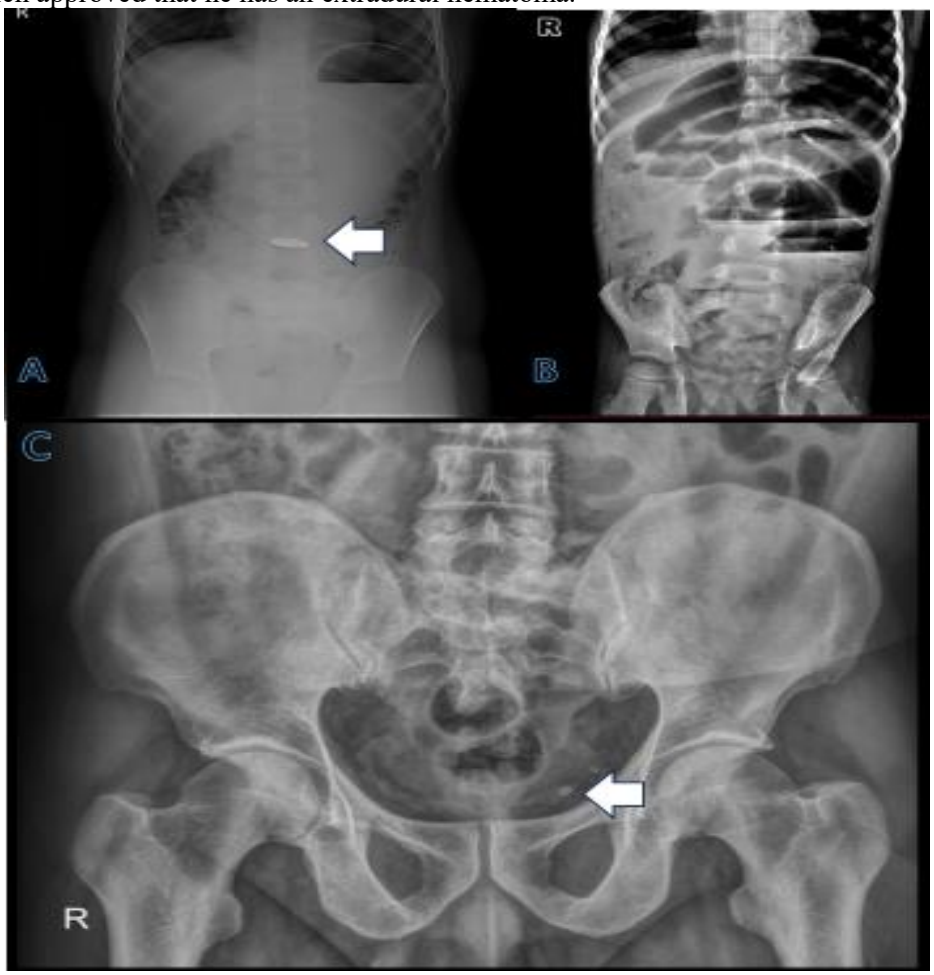

Fig. 19: A- Female patient (7 months) ingested foreign body; X-ray abdomen AP view shows metallic FB at the lower abdomen. **B-** Female child 4 y, presented with absolute constipation, X-ray Abdomen erect position shows multiple air fluid levels (Intestinal Obstruction) **C-** X ray pelvis-AP view of a patient presented with Lt loin pain; it shows Lt distal ureteric 2 variable size calicular shadows. Diagnosis confirmed by CT scan was done in another hospital.

DISCUSSION

X-ray is the oldest imaging modality, discovered by William Röntgen in the 1890s. Although it is the oldest modality and many modalities are discovered after it, it still has an important role in basic and initial assessment of certain organs and diseases as CXR, bone trauma and joints inflammatory changes [1,5,6,7,8].

Muli Regional Hospital at the time of the study hadn't any doctors in the main specialties as orthopedics, ENT, chest, and gastroenterologist. This may be a main cause of the misuse of requested scans. The maximum number of cases per month was in Jan 2024. The number of cases in different hospitals in the Maldives is generally related to climate changes as long durations of bad climate makes transport through the ocean in-between islands difficult or even completely stopped.

Bone tumors assessment is one of the most important roles of X-ray. Even with MRI scan, X-ray film is still mandatory and the key of diagnosis. Normal films do not indicate a normal case. Mild chest complaints do not show abnormalities in CXR which may need advanced CT assessment. Also, advanced chest diseases like interstitial lung disease need mandatory multi-slice CT assessment [7-11,13]. X-ray of different joints can explain bony abnormalities of significant inflammatory changes [11,12]. The ideal technique of imaging is mandatory for good diagnosis, nonrepeating of the technique, which makes more load on X-ray machine tubes, and decreases non-important patient exposure to X-ray. The ideal parameters of X-ray film should be according to suitable KV and mAs for the imaged organ and the film should involve imaged area totally within the view or the film. X-ray also have significant limitations in the diagnosis of many emergency diseases such as head and abdominal trauma, ligamentous injury, and soft tissue abnormalities generally [3,11,12,14,15]. Although CXR is the most common X-ray used in medical daily work, but X-ray is considered only an initial key of diagnosis with mandatory need to other advanced modalities as CT for proper assessment [16-21].

CONCLUSION

X-ray was the only imaging modality in Muli Regional Hospital, Meemu Atolls, Maldives for about 1 year; the duration of the study. Small percentage of X-ray films done were showing abnormality, which denots misuse of the modality. Chest X-ray is the most common X-ray technique followed by MSK X-ray imaging. As X-ray has a main role in basic scan of the chest disease and bone trauma, it has also a big limitation in diagnosis or prediction of head and abdominal trauma. X-ray alone as a radiological modality is not enough to be alone in assessment of all emergencies. Providing hospitals especially central or regional with CT machine is mandatory even with absence of radiologist depending on teleradiology solution for diagnosis and reporting.

Funding: None.

Conflicts of Interests: None.

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