

**ACCURACY ON TRAUMA CERVICAL SPINE
RADIOGRAPH INTERPRETATION AMONG
EMERGENCY MEDICINE TRAINEES**

By

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LIST OF ABBREVIATIONS

ATLS:	Advanced Trauma Life Support
CPR:	Cardiopulmonary Resuscitation
C1T1:	First Cervical spine vertebrae to upper border of first Thoracic spine vertebrae
CT:	Computed Tomography
CSI:	Cervical Spine Injuries
CS:	Cervical Spine
ED:	Emergency department
ER:	Emergency Room
EM:	Emergency Medicine
EP:	Emergency Physician
GCS :	Glassgow Coma Score
HUSM:	Hospital Universiti Sains Malaysia
ICU:	Intensive Care Unit
MMED:	Masters of Medicine
MS-CT:	Multislice-Computed Tomography
NEXUS:	National Emergency X-Radiography Utilization Study
OT:	Operation Theatre
RN:	Registration number
SOS:	Satisfaction of search

ABSTRAK

KETEPATAN INTERPRETASI FILEM RADIOGRAFI TULANG LEHER PESAKIT TRAUMA DI KALANGAN PEGAWAI PERUBATAN SARJANA PERUBATAN KECEMASAN TAHUN AKHIR DI HOSPITAL UNIVERSITI SAINS MALAYSIA

PENGENALAN: Pakar Perubatan Kecemasan yang bertugas mengendalikan kes trauma berdepan dengan cabaran yang besar dalam membuat diagnosis kecederaan tulang leher (*cervical spine*). Oleh itu, imejan radiografi merupakan langkah yang sangat penting untuk membantu membuat diagnosis. Di Jabatan Perubatan Kecemasan Hospital Universiti Sains Malaysia, Kubang Kerian, Kelantan, penggunaan radiasi sinar-X dalam pengendalian pesakit trauma dilakukan dimana filem radiografi tulang cervical dari pandangan sisi dan pandangan hadapan digunakan sebagai penilaian asas. Pemeriksaan radiografi tersebut dapat membantu doktor dalam membantu diagnosis kes trauma yang disyaki mengalami kecederaan tulang leher. Kajian ini dilakukan untuk melihat ketepatan interpretasi filem radiografi tulang leher dikalangan Pegawai Perubatan Sarjana Perubatan Kecemasan.

OBJEKTIF: Untuk menentukan ketepatan interpretasi filem radiografi tulang leher dikalangan Pegawai Perubatan Sarjana Perubatan Kecemasan tahun akhir.

KAEDAH: Kajian analisa prospektif deskriptif dilakukan daripada bulan Disember 2006 hingga Mei 2007 keatas Sarjana Perubatan Kecemasan tahun akhir di Hospital Universiti

Sains Malaysia. Penggunaan filem radiografi tulang leher bagi pesakit-pesakit trauma telah digunakan dalam kajian ini. Perbandingan interpretasi dibuat di antara pegawai yang tersebut dengan Pakar Radiologi yang merupakan rujukan piawai. Darjah persetujuan interpretasi tersebut juga dikaji. Analisa data dijalankan dengan menggunakan program SPSS versi 12.0. Darjah persetujuan interpretasi kedua pihak dijalankan dengan menggunakan Analisa Kappa .

KEPUTUSAN : Sebanyak 162 filem radiografi pesakit trauma terlibat dengan kajian ini. Pegawai Perubatan Sarjana Perubatan Kecemasan telah dapat menjalankan interpretasi mereka dengan baik dengan peratus ketepatan yang tinggi iaitu diantara 97% hingga 99%. Darjah persetujuan interpretasi mereka dengan Pakar radiologi juga sangat baik dengan nilai Kappa diantara 0.88 hingga 0.97. Kesukaran yang biasa ditemui dalam menginterpretasi filem radiografi tersebut adalah filem yang tidak mencapai piawai filem pandangan sisi. Prevalen kesilapan interpretasi juga adalah rendah dikalangan pegawai perubatan sarjana perubatan kecemasan tahun akhir iaitu diantara 0.5% hingga 2%.

KESIMPULAN : Kajian ini telah menunjukkan kadar peratusan ketepatan interpretasi yang tinggi dikalangan Pegawai Perubatan Kecemasan Sarjana. Dalam kesibukan mengendalikan kes-kes di Jabatan Kecemasan, kemampuan interpretasi mereka adalah baik dalam mengendalikan kes yang disyaki mengalami kecederaan tulang cervikal. Dari keputusan tersebut, adalah merupakan tanggungjawab Pakar Perubatan Kecemasan untuk membuat penyelidikan radiologi seterusnya untuk menentukan tahap kecederaan tulang cervikal.

ABSTRACT

ACCURACY ON TRAUMA CERVICAL SPINE RADIOGRAPH INTERPRETATION AMONG EMERGENCY MEDICINE TRAINEES IN EMERGENCY DEPARTMENT

HOSPITAL UNIVERSITI SAINS MALAYSIA

INTRODUCTION: Emergency Physician face a great challenge in the diagnosis of cervical spine injuries, therefore radioimaging is use as an important aid for diagnostic purposes. Emergency Physician must be prepared to manage patient with potential injuries to cervical spine efficiently and effectively and act accordingly. Standard cervical film trauma series is routinely performed in Emergency Department after primary assessment has been made. Lateral and anterior-posterior view is performed in trauma case with suspected cervical spine injury. This study is performed to determine the accuracy of cervical spine radiograph interpretation among the emergency medicine trainees in Hospital Universiti Sains Malaysia.

OBJECTIVE: To determine the accuracy of two views of cervical spine trauma radiograph interpretation among Emergency Medicine trainees

METHODOLOGY: This was a prospective descriptive analytical study of a 6 months period from December 2006 until May 2007 carried out at the Emergency Department Hospital Universiti Sains Malaysia, Kubang Kerian, Kelantan. Two views cervical spine radiograph film of trauma patients with suspected cervical spine injury were used and

comparison were made between the emergency medicine trainees and radiologist as 'GOLD STANDARD'. Degree of agreement of ED trainees interpretation were also analysed. Data was analysed by using SPSS version 12.0. The degree of agreement were analysed by using Kappa statistic.

RESULTS: There were a total of 162 patients cervical spine radiograph enrolled into the study during the study period. All final year emergency medicine trainees' interpretations were accurate as radiologist. They had achieved 97% to 99% accuracy. Strength of agreement among them with the radiologist interpretation were also high with Kappa value 0.88 to 0.97. The frequent difficulties in interpreting the x-rays were inadequate view of lateral cervical spine film. The prevalence of misinterpretation were also low at 0.5% to 2%.

CONCLUSION: There are high percentages of accurate interpretations among the emergency medicine trainees in cervical trauma radiographs. In a busy ED, their ability to interpret the radiographs and subsequently proceed with CT cervical spine injuries has improved the patient care without the presence of radiologist. It is without doubt that CT is the gold standard and it is the EPs judgment to take further actions in making their decision for advance imaging modalities.

1. INTRODUCTION

Universiti Sains Malaysia is the first public university in Malaysia offers postgraduate study in Emergency Medicine i.e. Master in Medicine (Emergency Medicine). Until now six batches of graduates had been produced and send to state hospitals and University Hospitals in Malaysia.

The candidates are posted in Emergency Department and various other department specialities in HUSM and Hospital Kuala Lumpur to get experience and gain as much knowledge and skill as possible. The specialities involved are internal medicine, anaesthesiology, pediatric, general surgery, neuromedical, neurosurgery, orthopaedic, otorhinolaryngology, radiology and ophthalmology. They are also allowed to do elective posting, participate in medical cover for motorsports and involve in disaster medical management and humanitarian work.

As this program is quite new in Malaysia, a lot of work had been done and in progress to ensure the quality of emergency physicians produced, to promote emergency medicine as a recognized and respectful speciality and to increase the quality of emergency department services in Malaysia. In HUSM, Conferences and seminars had been organized by the Emergency Medicine Department such as National Conference in Emergency Medicine since the year of 2004. At national level, Malaysian Society for Traumatology and Emergency Medicine (MASTEM) has been created to provide training in the form of Malaysian Trauma Life Support (MTLS), First Responder Life Support (FRLS) and Short course in One Stop Crisis Center (OSCC).

Both MTLS and FRLS are the two most popular short courses in the Ministry of Health. At International level, 4th Asian Conference on Emergency Medicine has been successfully carried out in Kuala Lumpur 23rd-25th March 2007 organized by MASTEM in collaboration of Ministry of Health.

The Emergency Unit, Hospital Universiti Sains Malaysia (USM) was upgraded to a department status in 2003, in parallel with the recognition of Emergency Medicine as a specialty on its own and as a postgraduate master degree pioneered by USM. The department, at the current moment, manned by eight emergency physicians, is offering 24 hours specialist coverage everyday.

The department, as with all other emergency departments around the globe, serves as a crucial and integral link between the community and the hospital. This department is a place where the sick, the wounded, the sexually battered, the depressed, the violent, the confused, the poor, etc, would go when in needs, and where the physicians, nurses and other paramedics staffs were trained to treat them in the best possible way, 24 hours a day, 365 days per year.

At the moment, the following scopes of services are being offered in the Emergency Department, Hospital USM:

- a) Emergency Medical Dispatch and pre-hospital care to sites of incident for both medical and trauma patients with the utility of ground ambulances provided by

Hospital USM and Rescue 911 (a group of personnel trained in rescue provided from Public Services Department).

- b) Triage and initial evaluation of patients by paramedics into three categories, namely the Red Zone, Yellow Zone and Green Zone as dictated by the life-threatening and/or potentially life-threatening processes i.e. threats to the airway, breathing and circulation of the patients and the urgency of the disease processes the patients have.
- c) Evaluation, stabilization, and management of patients by medical officers and specialists once they had been triaged into the three categories as mentioned above. The urgency and the time frame between time of registration and time of treatment is, again, determined by the zone the patients in.
- d) Managing One Stop Crisis Center (OSCC), a center for the sexually abused and domestic violence victims that also serves as a temporary shelter for these groups of victims. The medical officer on duty in emergency department will serve as a co-coordinator, to inform and summon the help of the medical officers on call for relevant departments such as the obstetrics and gynecology (O&G) department, the psychiatry department and the surgical department.
- e) Observational medicine for patients, whom after being evaluated, stabilized and managed in their respective fields, but with uncertain diagnosis, or patients who require further continual care and treatment.
- f) Minor Operation Theater, for minor surgical procedures and daycare procedures. This OT is manned by an anesthesiology or emergency medicine medical officer and operative during office hours only.

Emergency Department provides first line management and care for patients who need emergency treatment. However non-emergency patients also come after office hour and during public holidays.

In HUSM, radiographic imaging is one of the several important services to facilitate diagnosis in patient care which is provided by the Department of Radiology. The Department of Radiology is equipped with the advanced facilities in Magnetic Resonance Imaging (MRI), Computed Tomography (CT or CAT), Ultrasound and Doppler, Angiography, Fluoroscopy, Mammography and General Radiography. The department has a state-of-art computer network and Picture Archiving Communication System (PACS) of General Electric Company (GE Medical Systems, USA). The department is responsible for the undergraduate and postgraduate academic activities and for research in radiology and other imaging including nuclear medicine. It also responsible for the postgraduate training from various departments such as neuroscience, emergency medicine, family medicine and dental. The radiographic services provided can be divided into three main categories:

1. Routine examinations such as chest, abdominal, skull, neck / spine and limbs radiographs.
2. Emergency services provided for Accident & Emergency (A&E) unit, Intensive Care unit (ICU), Neonatal Intensive Care unit (NICU) and the wards (for urgent cases after office hours).

3. Special radiographic examinations such as orthopantomography (OPG) and mammography

In EDHUSM, cases requiring radiology investigations will be divided into two categories, stable and unstable or potentially unstable. All stable cases will be sent to the radiology department for radioimaging study and for the unstable or potentially unstable cases will be using portable machine which is available in the Red Zone. There is an x-ray room available nearby the emergency room. A Computed Tomography (CT) scan and Magnetic Resonance Imaging (MRI) are available in Radiology Department. The portable x-ray machine is operated by the trained radiographers upon request by attending ER residents. It is also limited for cervical spine radiographs, chest radiograph, and pelvis radiograph. Radiograph of other body regions were advised to be done in the Radiology Department.

The author found that no such study had been performed to assess the emergency trainees' competency in plain radiograph interpretation. There were studies comparing performance of different healthcare professionals in plain film reading performance namely emergency nurse practitioners, radiographers, emergency physician and radiology residents comparing with the radiologist. When evaluating film reading performance, there is difficulty to correlate the patient outcome to the reports one has made. This difficulty was resolved in the context of imaging technologies by applying steps according to hierarchy from the basic plain radiograph to higher imaging modalities such

as CT scan or MRI. Film reading performance studies are comparable with the “diagnostic accuracy” category. In this study, the author want to assess the accuracy of the final year emergency medicine trainees in cervical spine radiograph interpretation of trauma patient towards the arbiter i.e radiologist as the reference standard. This will allow the researcher to assess how accurate the reports whether it is concordant with

Trauma is one of the commonest causes for emergency room attendance and inability to protect the cervical spine in unconscious patient during primary assessment will cause significant morbidity and mortality in cervical spine injured patient. Mismanagement should be prevented at the first presentation.

In this study, two view of the cervical spine radiograph were selected as it is a very important diagnostic aid to facilitate diagnosis of cervical spine injury. It is important to clear the cervical spine injury in trauma patient especially in unstable patient requiring urgent surgical intervention and any delay in clearing the cervical spine will cause further morbidity or mortality to the patients. Cervical spine imaging should also be immediately requested in the patients with the following risk factors provided they have some neck pain or tenderness. Other indications are age greater than or equal to 65 years and dangerous mechanism of injury (fall from greater than one metre or five stairs; axial load to head e.g. diving; high-speed motor vehicle collision greater than 65 miles per hour; rollover motor accident; ejection from a motor vehicle; accident involving motorized recreational vehicles; bicycle collision). Identification of significant findings

on the plain cervical spine radiograph warrant further radioimaging evaluation either cervical CT scan or MRI. CT and MRI have been shown to be of value in demonstrating the prevertebral haematoma, subtle bony injury, ligament rupture, spinal cord compression due to intervertebral disc herniation and the degree of spinal cord injuries. Some outstanding exceptions include patients with spine fractures and acute head trauma. It is also very sensitive to changes in cartilage and bone structure resulting from injury, disease or aging, and can often provide information not available through other medical testing.

The emergency department resident frequently interprets plain radiographs without the presence of a radiologist. In this study, the author had selected the two view series of cervical spine radiograph films as it is commonly done in ED. Trauma of the extremities, namely the upper limbs or lower limbs, is not selected because, most of orthopaedic trauma are semi-emergency cases and such delay in performing definitive care will not cause significant outcome to the patients. At the end of this study, the author would like to highlight that the emergency medicine trainees' ability to interpret the cervical spine radiograph in trauma is as accurate as a radiologist. As a result, hopefully it will give a strong impact towards improving postgraduate Master of Medicine programmes in the future. As an emergency physician has a great responsibility in ED, they also need to provide training and to teach their junior doctors working in their department. This is because many Emergency departments are often staffed by very junior doctors.

2. LITERATURE REVIEW

Studies had showed that the presence of emergency physician has significantly improved emergency services in the emergency department. Several studies agreed that plain radiograph interpretations among emergency physician and senior surgical trainees were extremely accurate. The accuracy achieved 97.5% to 100% for cervical spine radiographs. The misinterpretations rates among them also were very low, 0.5% up to 6.5% (Brunswick et al 1996; Herman PG et al 1975; Bengert 2003). Error in interpretations among the ED residents was also unavoidable. Vincent et al (1998) in his studies found that up to 35% errors were documented by junior doctors in their radiograph interpretations. JR Bengert et al had also stated in his study, about 1.5% of the plain radiographic examinations requested by an ED will give rise to a reporting discrepancy. This can be minimized via consultation made from the experienced senior officer or from the Emergency Physicians.

In another report, the formal reporting of ED radiographs detects significant missed abnormalities (that is, ED false negatives requiring a change in management) at the rate of 3 per 1000 radiographs reported. For every five significant missed abnormalities that are detected two patients will require further unnecessary radiographs and/or visits to the ED as a result of a false positive radiology report (Bengert 2003). In a review at national preeminent hospital, radiologists' interpretations were more accurate (74% vs 55%), more sensitive (62% vs 38%) and more specific (8% vs 72%). They also reported that radiology residents' interpretations were more sensitive than those emergency medicine

faculty (66%+/- 8% vs 42%+/-9%), as accurate (71%+/-6% vs 59% +/-6%) and as specific (76%+/- 8%) (BE Kouri 2002).

2.1 ROLE OF EMERGENCY PHYSICIAN IN CERVICAL SPINE INJURIES

EP face a great challenge in the diagnosis of CSI, therefore radioimaging is used as an important aid for diagnostic purposes. EP must be prepared to manage this patient with potential injuries to the neck and cervical spine efficiently and effectively and act accordingly. To accomplish this task, the EP must adhere to the basic principles of trauma management and protect the cervical spine to prevent additional neurologic injury. The EP must know the complex anatomy of the cervical spine and understand the mechanism and types of neck and cervical spine injuries. The EP must be able to recognize and manage associated soft tissue, vascular, and neurologic injuries. Last, the EP must have an understanding of immobilization techniques, the utility and limitations of available imaging modalities, and the management of specific patient populations at risk for neck and cervical spine injuries (William J, 1999).

Standard cervical film trauma series is routinely performed in ED after primary assessment has been made. Advance imaging such as CT scan is the gold standard whereas MRI which is radiation free sound like good screening tool for bone, ligament and disc injury. Furthermore, MRI is unsuitable for unstable polytrauma patient because of difficulties in monitoring ventilated patients (Paula J R, 2005; Brunswick 1996). ED residents routinely interpret radiograph studies during the evaluation of trauma patients, which directs further evaluation and invasive procedures. The films must be evaluated by

a competent practitioner who maintains sufficient activity to maintain their skills in radiographic interpretation (Paula J R, 2005). In current practice, all radiographs usually does not need radiologist involvement. This is because post evaluation by a radiologist may take hours or days, therefore they frequently act on their impressions before official readings available which most of the time not routinely done (Robert WV et al 2002). Radiographic examinations are only one aspect of patient care which assists clinicians in the diagnosis of acute trauma or illness through the confirmation of the suspected clinical diagnosis (Hardy & Bennet, 2003). This come the role of EPs when their consultation are needed by their ED residents or by the junior doctors.

EDHUSM is a teaching center for postgraduate and undergraduate students. Our ED is run by dedicated ER residents as well as postgraduate trainees in Emergency Medicine. Most emergency medicine trainees gained their knowledge on interpreting diagnostic imaging during their clinical training in medical schools and their practice in the hospitals after graduated. Their performance in assessment of trauma patient, management and appropriate disposition requires clinical examinations and also depends on their skillful and on-the-spot interpretation of x-ray films (Robert et al, 2002; Brunswick, 1996 and Paul LM et al, 1985).

Even though misinterpretation of radiographic studies still could occur and it is a common source of medical error. Of particular concern is the significant number of misinterpretations of plain radiographs in emergency departments. Therefore, such study is useful to facilitate learning and also helpful to understand medical thinking (Henry

Guly, 2001). The author own experienced while doing his district posting where absence of expertise for consultation and lack of experiences, cause significant delay and outcome to the patient care.

The ability to rapidly identify patients with no cervical spine injuries is important as it is well known that prolonged placement of rigid cervical collar can lead to pressure ulcers. In addition, continued cervical immobilization may impair overall mobilization of the critically ill patient (Craig H Rabb, 2007).

In Emergency Department, Hospital Universiti Sains Malaysia, we use the color coding triage system in managing trauma and non trauma cases. The ED is divided into few cubicles separating green, yellow and red zones. The triage officer will determine the cases based on the complaints and triaged them accordingly.

Most trauma patients presented to ED HUSM; either walk-in cases, ambulance-call cases or referred from various sources (district hospitals, health clinics or general practitioners) are triaged accordingly by the triage officer. Any trauma cases triaged Red will be immediately reviewed by the medical officers on duty then prompt treatment directing to the presenting complaints are carried out without delay.

Primary and secondary surveys are carried out followed by identifying of the underlying problems. Any unstable trauma cases will be stabilized in this zone. These include administration of drugs, intravenous cannulation and fluids, cardiopulmonary

resuscitation and intubations and ventilation if required. Any patient with clinically diagnosed to have fracture deformity of the extremities or dislocated joints will be immediately subjected for portable radioimaging to confirm the diagnosis. Emergency medicine residents will make an attempt to reduce it under conscious sedation. If it failed after single attempt further consultations to the respective department for disposition of patients are made after emergency cares have been delivered to the patients. Flow of management of trauma patient is shown in **APPENDIX A**.

For stable trauma cases, patient who is suspected to have fracture will be subjected for plain radiograph based on the mechanism of injury and presentation to ED. A series of radiograph will be done if they have multiple traumas to the extremities. The radiograph film then will be reviewed by the attending medical officer.

In this study, we will be focusing on the cervical spine plain radiograph of adult trauma cases presented to ED HUSM from the critical zone or red zone. We received and managed more than 200 trauma patients per month in our ED. In year of 2005, chest radiograph is the commonest radiograph done in ED followed by skull and cervical. The least is for the radiograph of the arm (Figure 1.1).

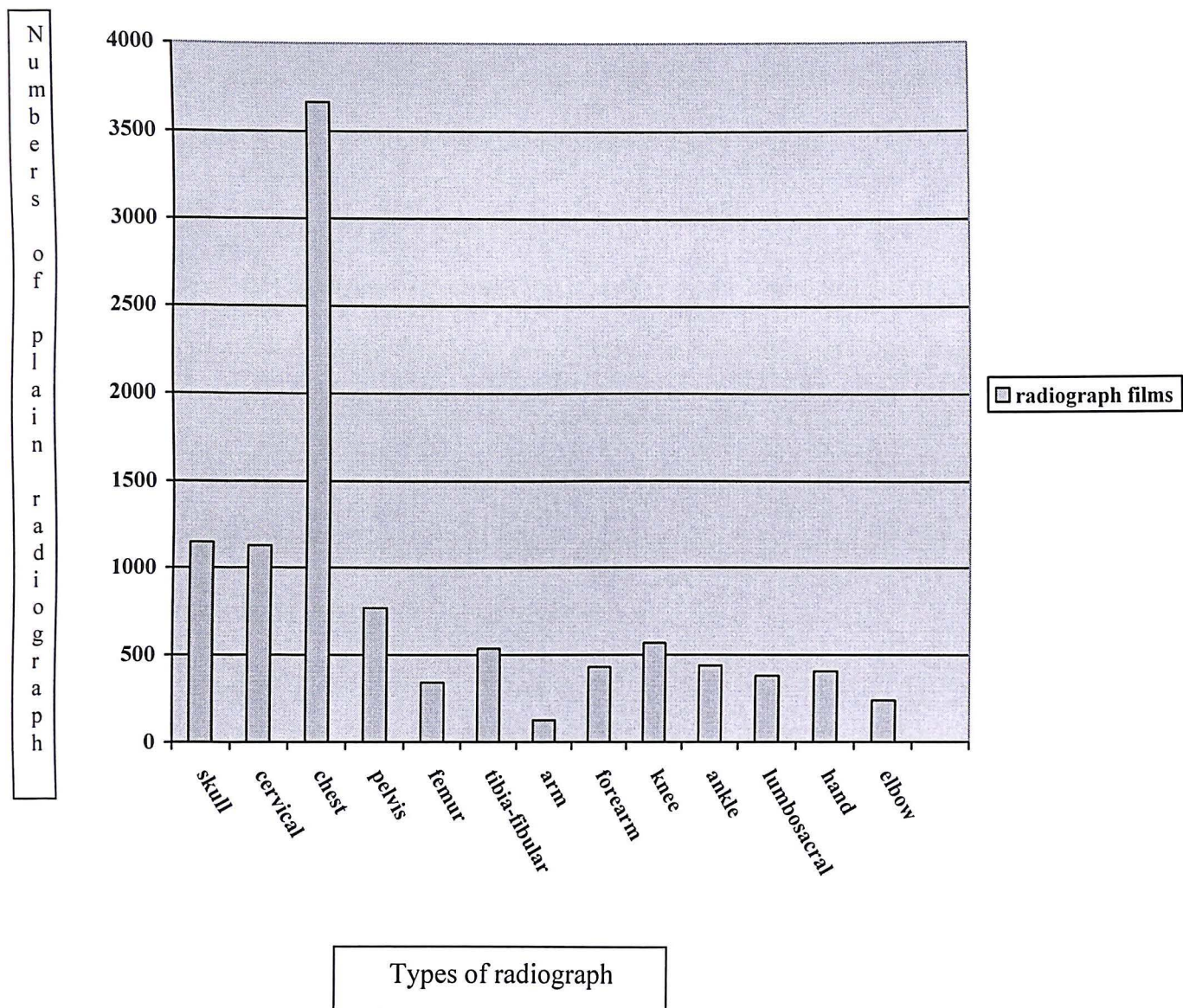


Figure 1.1: Description of plain radiograph performed according to body part in EDHUSM in 2005

Source: Department Of Radiology, HUSM 2005