Case Report

DETECTION & DIFFERENTIATION OF SOFT TISSUE INJURIES IN ADVANCE MAGNETIC RESONANCE IMAGING (MRI)

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ABSTRACT

BACKGROUND: Radiology is the application of the science of diagnostic imaging to questions of clinical and medicolegal practice. Forensic medicine refers to the application of medical knowledge in the collection of medical evidence to be used by law enforcing agencies & in courts of law for furthering of justice. Such evidence may be collected from either living or deceased subjects. Modern techniques & Imaging modalities such as computed tomography (CT) and Magnetic Resonance Imaging (MRI) are being used for assessment of soft tissue trauma, morphology of organ or joint as well as wounds and their complications. The ongoing development of imaging and the recent integration of cross-sectional imaging methods into the medicolegal workflow have resulted in an increasing number of forensic institutes acquiring dedicated CT and MRI scanners.

METHODOLOGY: Out of the total three Medico legal cases studied in Radiology Department of Sir Ganga Ram Hospital Lahore; two were ultimately proven to have hidden findings. All the three cases presented with non-specific injury during fight on head and appeared in front of medical board for examination regarding depth of scar underlying head injury. Final diagnosis was achieved by MRI specific sequences.

RESULTS: Initial examiner found no fracture on digital X-rays of skull AP & Lat. Views in all three cases. On MRI, one case was normal. In the 2nd case, significant soft tissue injuries were identified in the eye ball i.e. subluxation of lens in right eye and in 3rd case, sub-galleal bone deep hematoma was identified on left temporal area (corresponding to the injury).

CONCLUSION: Magnetic Resonance Imaging is shown to have best modality to identify hidden findings & is one of the increasingly used modality in the collection of forensic evidence. The expertise of radiology and forensic medicine should be integrated to settle the quarries of detection and differentiation of soft tissues trauma in many cases of clinical as well as forensic interest.

KEY WORDS: Forensic Radiology, Computed Tomography, Magnetic Resonance Imaging. Soft tissue injuries

INTRODUCTION:

Although there are various radiologic procedures that can be most appropriate depending on specific clinical conditions, a good rule of thumb is that Magnetic resonance imaging (MRI) can evaluate both soft tissues and bones. It is the most reliable diagnostic procedure for an objective, noninvasive assessment of the soft tissue status as well as accurate assessment of the joint morphology[1]. This modern high-resolution imaging has also been used as a well described aid in the setting

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of forensic medicine for post-mortem investigations. In developed countries Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are now being evaluated as complementary means for cause of death determination[2]. A group of researchers documented the postmortem imaging as a good forensic visualization tool for examination of traumatic injuries and other pathologic findings in a broad range of scenarios[3]. Cardiac pathologies, such as myocardial infarction, may be ruled out easily using postmortem cardiac MRI (minimally including short axis sequences and at least one four-chamber view) and may establish the cause of death which was presumed natural before autopsy[4]. The emerging trends and rapid technical developments of medical imaging have made the field of radiology essential to be used in clinical / forensic practice[5]. Postmortem or forensic imaging always includes unenhanced postmortem CT as a baseline examination without removal of any medical devices and may be supplemented by postmortem CTA, postmortem MRI, or both for complete visualization of vascular or tissue pathologies[6-9]. The scope of forensic radiology ranges widely and includes determination of identity, evaluation of injury and death, applications in both criminal and civil litigation, detection of abuse, investigation of gunshot wounds, medical education and research[10]. Newer modalities and techniques afford opportunity for the expansion of forensic radiology if problems of accessibility and cost can be resolved along with improvement in interdisciplinary cooperation and understanding. Imaging modalities such as computed tomography (CT) and Magnetic Resonance Imaging (MRI) are increasingly being used where available. MRI has advantages i.e. free of radiation hazard, superior soft tissue and contrast resolution and multi-planar modality. So not only wounds but also complications associated with wounds such as infections are assessed[11]. MRI is better than CT scanning in depicting axonal injury, small areas of contusion & subtle neurological damage in cases of injury to cranium and vertebral column.

METHODOLOGY:

Sir Ganga Ram Teaching Hospital Lahore; Radiology Departmental protocol is structured upon two applications of imaging radiography for forensic purposes:

1. **Investigation of non-fatal injuries.** The production of evidence to support the investigation of injury to an individual.
   - o According to the findings by Casualty Medical Officers (CMOs) in medico-legal cases and radiology specific procedures to safeguard adults like accidental trauma cases.
2. **Location of other forensic evidence.** The provision of imaging evidence to demonstrate the presence of hidden foreign bodies.
   - o Suspected firearm metallic densities.

Out of the total three medico legal cases, two were ultimately proven to have hidden findings selected for this study. All the three cases presented with non-specific injury during fight on head and were selected through medical board examination regarding depth of scar underlying head injury. Final diagnosis was achieved from MRI specific sequences.

RESULTS & DISCUSSION:

The results showed that all the three cases presented with blunt injury on head during fight three months back and initial medico legal certificate (MLC) issued by CMO described no significant finding. Plain Film Digital Radiography of skull AP & Lateral views of all three cases was normal. All cases underwent MRI head and TIWI; T2WI & FLAIR sequences of imaging with 5 mm inter slice thickness.

One case was normal.

Second case showed dislocation of lens in right eye & heterogeneity of signals along soft tissue of upper eye and inside eye due to blood mixed with aqueous humor making it like a uni-locular cyst, underlying the described injury in medico legal certificate. Though overall globe shape of right eye was well maintained and remains comparable with left eye.

Third case showed a sub-galleal bone deep hematoma collection on left temporal region

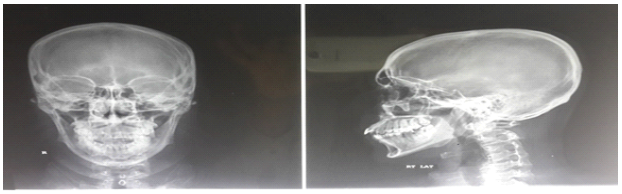
measuring 45 mm x 11 mm lying beneath the described injury in medico legal certificate.

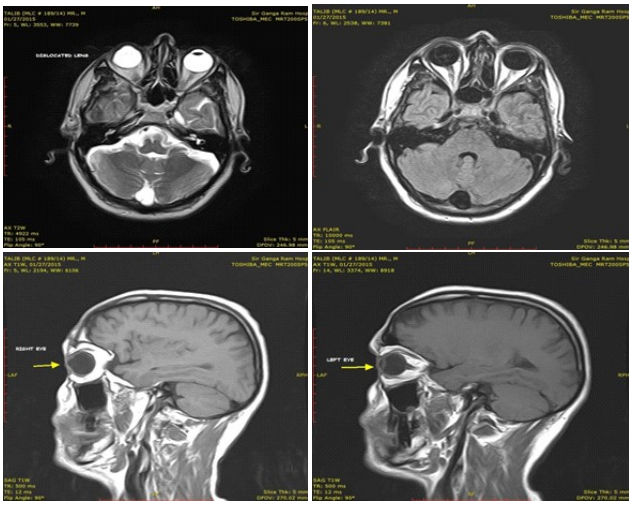
In all cases; bone signals including diploe space, inner & outer tables of skull were normal. Magnetic Resonance Imaging is shown to have best modality to show hidden findings & is one of the increasingly used modality in the collection of forensic evidence.

Injury especially the head injury in a medico-legal case (MLC) may be evident upon Physical examination or Digital Plain Film Radiography which is one of the most commonly used conventional methods in the collection of Forensic evidence. Plain Radiography (digital and analogue) using AP and Lateral views are the foundation of forensic radiography. However, MR imaging is the increasingly used advance imaging modality which has a special application in hidden cases and for better soft tissue resolution. The imaging techniques utilizing MRI represent a viable option in the diagnosis of soft tissue injuries documented in few studies [12,13]. The role of MRI in detecting muscle contour irregularity from a lacerated muscle has been advocated in several case reports which demonstrate muscle changes missed on the initial CT such as muscle disinsertion, that were later detected on MRI [14,15].

Case: 1. Radiological findings in head injury

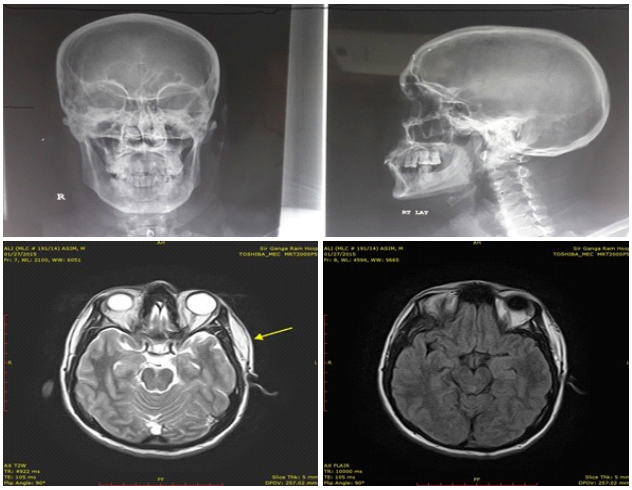
History & Physical Examination	3 months back History of Lacerated wound measuring 4 cm x 1 cm on right side of forehead, bone deep, bleeding positive.
Findings on Plain Film	No bone fracture.
Findings on MRI for depth of injury.	High TIWI, High T2WI, High signals on FLAIR, along right upper eyelid & inside the eyeball with dislocated lens.

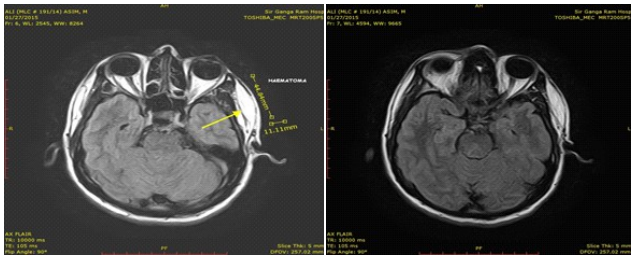




Case: 2. Radiological findings in Blunt rauma on left parietal region

History & Physical Exam	H/O 3 months back Lacerated wound 3 cm x 1 cm on left parietal region, bone deep, bleeding positive.
Findings on Plain Film	No bone fracture.
Findings on MRI for depth of injury.	Sub-galleal hematoma collection 45 X 11 mm in left side of temporo-parietal region. High TIWI, High T2WI & Increased signal on FLAIR.





Case: 3. Radiological findings in blunt trauma on right side of forehead

History & Physical Exam	H/O 3 months back Lacerated wound 2 cm x 1 cm on right forehead and 1.5 x 1 cm upper front of right ear, skin deep, bone deep, bleeding positive.
Findings on Plain Film	No bone fracture.
Findings on MRI for depth of injury.	No abnormal signal change in the area of injury.

RADIOLOGICAL FEATURES:

Plain Film Digital Radiography:

On conventional plain radiography findings of nature of soft tissue density injury often not depicted. However; gross bony injury like fracture or dislocation is often obvious.

CT Scan:

Multi-slice CT study with narrow inter-slice thickness and facility of workstation can help in reformatting of acquired images in any plane with surface rendering thus helping the injury to define more precisely. Even density measurement is performed thus differentiating metallic, bone, soft tissue and blood or air density.

MRI Imaging:

Findings of soft tissue injury and depth location are easily defined due to better resolution, like scar depth, active granulation tissue, chronic or radiation induced fibrosis, edema, collection; abscess or hematoma age can be determined on TIWI, T2WI and FLAIR sequences. Sometime MRI specific contrast is used to differentiate the lesion.

CONCLUSION:

Modern Radiography including CT & MRI is particularly useful for Identifying and confirmation of pre-existing soft tissue trauma, Assisting in determination / for cause of debility, deformity & death as well as locating hidden foreign bodies such as wooden pieces & fragments of explosives.

Magnetic Resonance Imaging is shown to have best modality to identify hidden findings & is one of the increasingly used modalities in the collection of forensic evidence. The expertise of radiology and forensic medicine should be integrated to settle the quarries in many cases of clinical as well as forensic interest.The challenge is to unite the two disciplines by direct communications and basic understanding as well as a foundational knowledge of imaging by forensic pathologists.

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Sohayl bin Hunayf Ansari was a favourite companion of Imam Ali. At the time of Imam Ali's return from Siffin, he died at Kufa of the wounds sustained in the battle. His death left Imam Ali very sad and he said: "Even if a mountain loves me it will be crushed into bits". (it means people are tested with my love, and to prove it they have to pass through loss and calamities).

When a community is composed of honest, sober and virtuous people, your forming a bad opinion about anyone of its members, when nothing wicked has been seen of him, is a great injustice to him. On the contrary in a corrupt society to form good opinion of anyone of them and to trust him is to harm yourself.

Hazrat Ali (Karmulha Wajhay)