



# **GUIDELINES FOR THE IMAGING OF THE TRAUMA PATIENT**

**NEW HAMPSHIRE  
TRAUMA MEDICAL REVIEW  
COMMITTEE**

**2010**



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## NEW HAMPSHIRE TRAUMA MEDICAL REVIEW COMMITTEE

### TABLE OF CONTENTS

CONTENTS	PAGE
Section I – Principles of Trauma Imaging	
Introduction	1
Imaging Principles and Guidelines	1
Case Study 1	3
Case Study 2	4
Section II - Technical Criteria for CT Imaging for Trauma	
CT of Head	6
CT of C-Spine	8
CT of Chest/Abdomen/Pelvis	11
CT of Abdomen/Pelvis	18
CT Cystogram	23
CT of Facial Bones	26
Section III – References	
Bibliography	29
Committee members	29

## INTRODUCTION

CT scanning has markedly improved the clinician's ability to diagnose and define the extent of injury in patients with multiple trauma. However, the indiscriminate use of multiple CT scans for all trauma patients not only adds cost to the health care system but potentially may increase cancer risks for the patient later on in life.<sup>1,2</sup> In addition, regionalization of trauma care has resulted in the need for patients to be transported from one hospital to another institution for the appropriate definitive care. CT scans that are incomplete, not properly formatted, or not sent with the patient create the need for repeated studies which add time, cost, and additional radiation exposure to an individual's care.<sup>3</sup>

Developing an algorithm to define the extent of diagnostic imaging for the multiple scenarios associated with caring for trauma patients is beyond the scope of the New Hampshire Medical Trauma Review committee. However, this manual offers technical guidelines to serve as a starting point in performing trauma CT scans and offers principles and guidelines to help decisions about how and when scans should be done. In addition several clinical cases are offered which exemplify how a selective approach to diagnostic imaging may be employed.

This information is presented to serve as a common starting point for all hospitals caring for trauma patients and to lessen the need for repeat imaging for patients requiring transfer to a second hospital for further care.

## PRINCIPLES AND GUIDELINES

### *Principle #1:*

The fear of cancer risk from CT scans should never influence the appropriate radiologic evaluation of the trauma patient. CT scanning has never been shown to cause cancer but has saved many lives with its proper and appropriate use.

### *Principle #2:*

If the need for transfer to another facility for definitive care is recognized early, all subsequent imaging should be limited to that which allows for a rapid, safe transport of the patient.

Diagnostic testing questions to ask:

- Will it change management?
- Is it dangerous for the patient?
- Can the test be done correctly?
- Will it delay transfer for definitive care?

### *Guideline #1:*

Routine CT scan performed to evaluate for blunt abdominal trauma should **always** include IV contrast\* but it is not necessary (or desired) to give enteral contrast (oral contrast administration creates a risk of aspiration and delays the duration of the scan). CT scan of the "abdomen" should **always** include the pelvis.

\*The incidence of contrast induced nephropathy is extremely low.<sup>4</sup> Waiting for serum BUN/Cr determinations should not delay CT scans with IV contrast in the seriously injured trauma patient. Special situations that may warrant caution are patients with pre existing renal insufficiency, diabetes mellitus, taking Lasix or nephrotoxic drugs.

*Guideline #2:*

The minimum radiologic evaluation for a patient being transferred for definitive care with a severe mechanism of injury should include a chest x-ray and pelvis film.

*Guideline #3:*

All trauma imaging studies should include reconstructed images in the coronal and sagittal planes except those performed on the head. Significant additional information is obtained from these views. Coronal and sagittal reconstructions of all spine CT images are especially important and this does not require additional radiation dose or scanning time.

*Guideline #4*

If clinical suspicion for renal injury is high it should be remembered that delayed images in relation to the timing of the arterial bolus must be obtained to assess for urinary extravasation. Alternatively this could be accomplished with multiple timed contrast boluses.

*Guideline #5*

If a fracture is found at one level of the spine the entire spine should be imaged as the chance of a second fracture at a different level is 10-15%.

*Guideline #6*

All modern multi-detector CT scanners have automatic control of technical factors designed to minimize patient dose while maximizing image quality. Most also have the ability to render a lower dose for pediatric and young adult populations. Although the system "noise" produced is increased, and the resolution of the images at a point will decrease, they are still generally of diagnostic quality. One should generally utilize the manufacturers' recommendations with respect to technical factors (or use factors resulting in lower doses with acceptable diagnostic quality images) unless the change is made with a specific purpose in mind and the outcome is known to not adversely affect the patient. Breast shielding should be used in all female patients having chest or abdomen CT scans, unless it interferes with utilization of dose modulation programs.

*Guideline #7*

Hierarchical preference for Patient Images accompanying a transfer is as follows:

1. A properly formatted DICOM image set including a DICOM Part 12 compliant DICOMDIR file.
2. A properly formatted DICOM image set with an embedded image viewer
3. Patient images in other formats must include an embedded image viewer with brief instruction for use

Native DICOM images with a properly formatted DICOMDIR file will allow the recipient facility to utilize image viewing tools familiar to them, reducing treatment time and enhancing patient care.

## CASE HISTORY EXAMPLES

### Case Study 1:

- 23 year old woman who was the restrained driver in a MVC rollover
- EMS report -> awake and alert, no LOC, GCS = 15
- Arrives boarded and collared at the ED 45 minutes after crash
- Vital Signs
  - BP 110/ 82 P= 95 RR = 22 GCS = 15
- PE:
  - Head = abrasion over the right frontal area
  - Chest = tenderness over the left clavicle; BS equal
  - Abdomen = soft, non distended; abrasion over the lower abdomen
  - Pelvis = stable, no pain
  - Extremities = deformity to right wrist
  - Neuro = intact
- Do you have the appropriate imaging tools to provide the proper studies?
- Do you have available resources to care for the injuries you might find?
- What studies would define injuries requiring immediate attention / stabilization?
- If no serious injuries would the patient be admitted anyway?

#### **Diagnostic Imaging:**

CXR, left clavicle, right wrist plain films, FAST  
Admit for observation

## Case Study 2:

- 32 year old male involved in high speed MCC. Initially unconscious at the scene, now combative and posturing for EMS.
- Arrives boarded and collared
- Vital Signs
  - BP 100/85 P = 115 RR = 28 O2 Sat = 95% GCS = 7
- P.E.
  - Head = 8 cm laceration over the left parietal area, bleeding. Pupils midpoint. GCS = 7
  - Chest = diminished BS on the left
  - Abdomen = soft, not distended, abrasions on LLQ
  - Pelvis = abrasion and ecchymosis over left anterior iliac spine. Movement of pelvis with compression
  - Extremities = deformity and swelling of the left thigh
- **If the decision is made to transfer... priorities change!**
  - Do not need to define every injury
  - Need to identify injuries you can help treat or stabilize to make transfer safer.

### **Diagnostic imaging and treatment** **CXR, pelvis, right femur plain films**

- Intubate
- Chest tube
- IV access
- Pelvic binder
- Traction splint
- Transfer ASAP!!



**TRAUMA PATIENT**  
**TRANSFERS:**

**PLEASE SEND**  
**DICOM IMAGES**  
**WITH PATIENT TO**  
**RECEIVING**  
**TRAUMA CENTER**

# TRAUMA HEAD

LANDMARK: OMBL  
SCOUTS: AP AND LATERAL

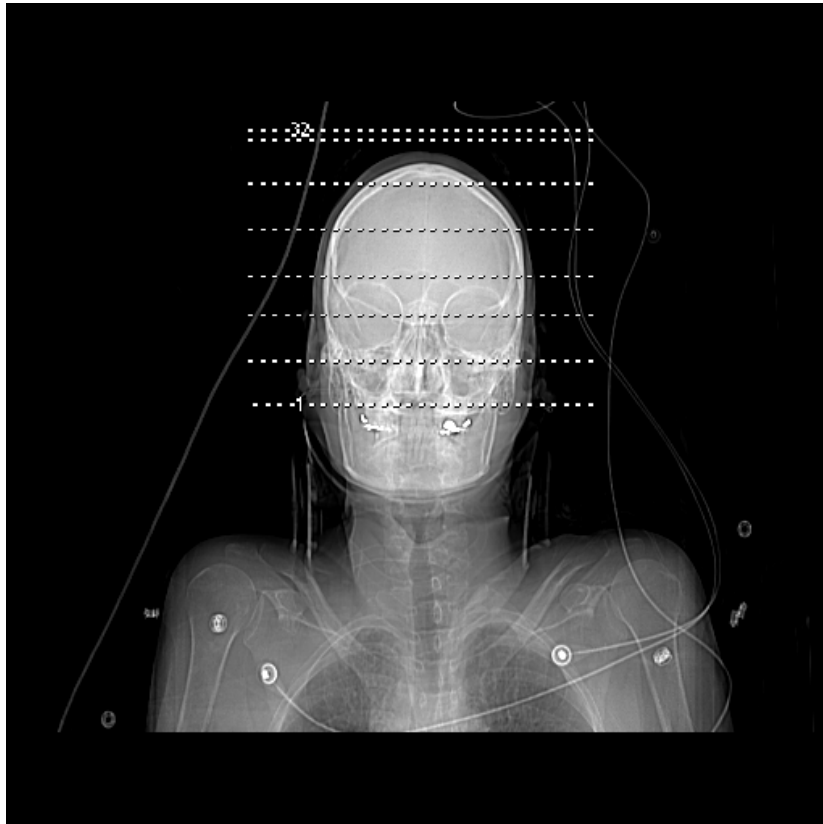
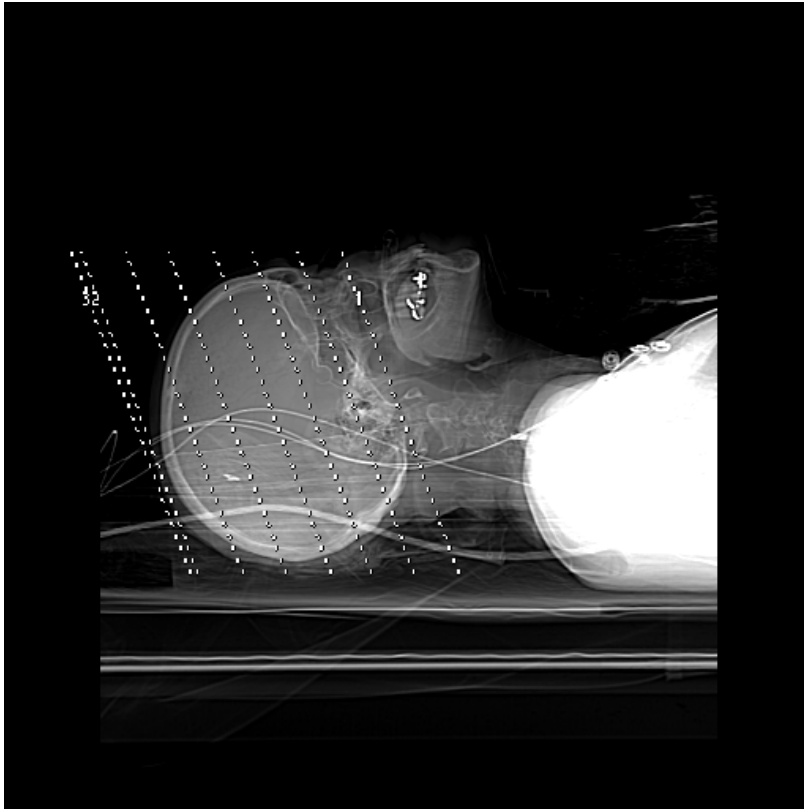
## RECON 1:

**START POINT:** JUST BELOW BASE OF SKULL  
**END POINT:** JUST ABOVE TOP OF HEAD  
**ANGLE:** ANGLE TO OML  
**DFOV:** 22  
**KV:** 140  
**MA:** 170  
**THICKNESS:** 5MM (4i)  
**INTERVAL:** 5MM  
**ALGORITHM:** STANDARD (Axials only)

## RECON 2:

**ALGORITHM:** BONE  
**THICKNESS:** 5MM (4i)  
**INTERVAL:** 5MM

AXIAL RECON 1 & 2:



## C-SPINE

LANDMARK: STERNAL NOTCH  
SCOUTS: AP AND LATERAL

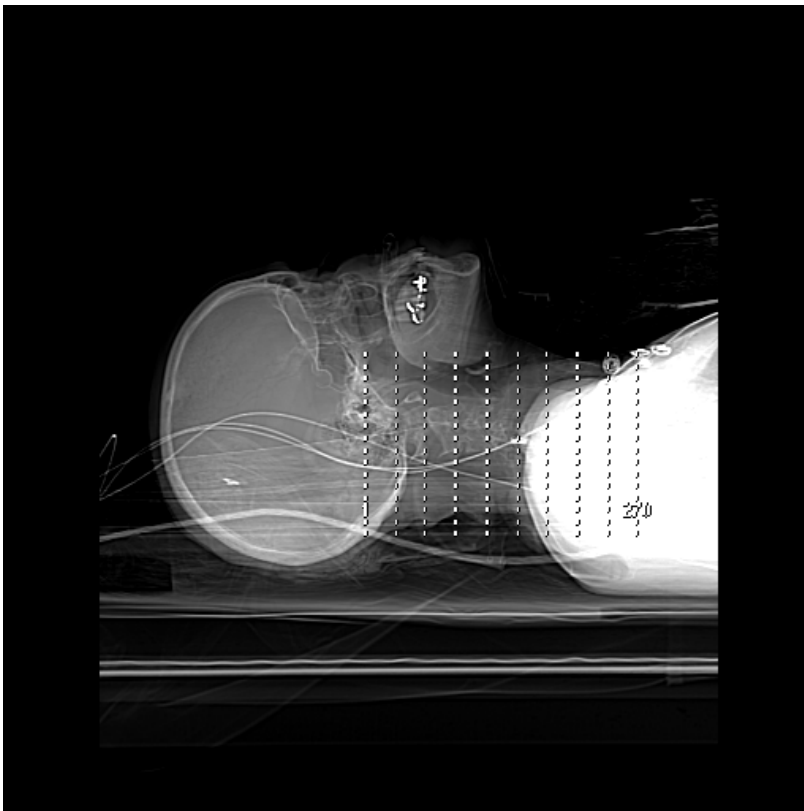
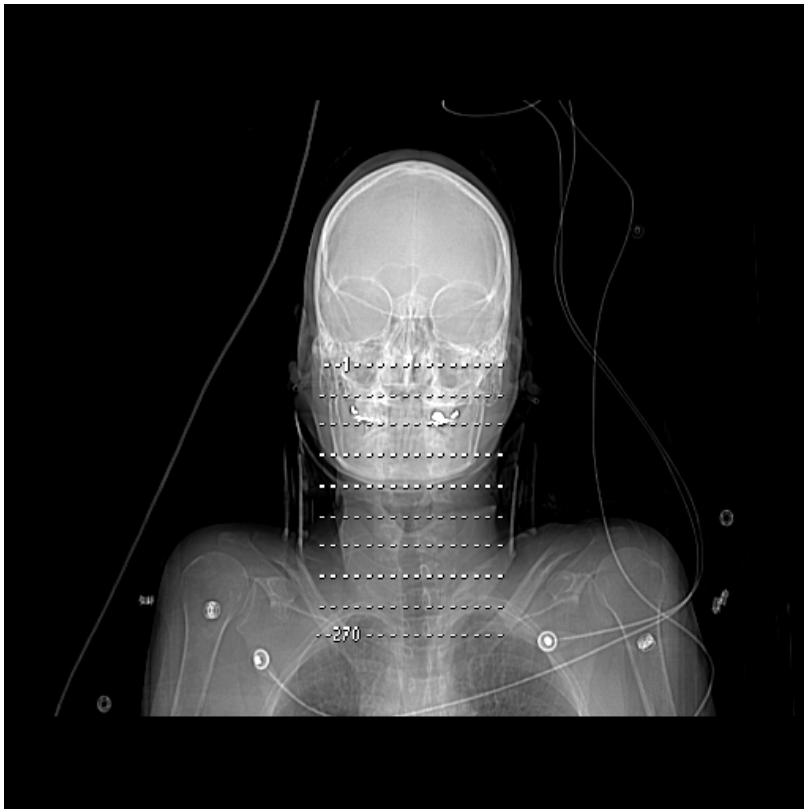
### AXIAL RECON 1:

**START POINT:** JUST ABOVE BASE OF SKULL  
**END POINT:** STERNO-CLAVICULAR JOINT  
**ANGLE:** NONE  
**SFOV:** LARGE BODY  
**DFOV:** 12  
**KV:** 140  
**MA:** 380  
**THICKNESS:** 1.25MM  
**INTERVAL:** 0.600MM  
**ALGORITHM:** BONE

**REFORMATS:** SAGITTAL, AXIAL, AND CORONAL

\

AXIAL RECON 1:



**C-SPINE REFORMATS:**

**CORONAL REFORMAT AREA:**



**SAGITTAL REFORMAT AREA:**



## TRAUMA CHEST / ABDOMEN / PELVIS

LANDMARK: STERNAL NOTCH  
SCOUTS: AP AND LATERAL  
IV CONTRAST: 110ml OMNIPAQUE (non-ionic contrast)  
IV SIZE: 20 GAUGE OR 18 GAUGE  
INJECTION RATE : 3-4ml PER SECOND

### RECON 1:

#### (GROUP 1)

START POINT: JUST ABOVE APICES  
END POINT: THROUGH THE BASE OF THE LUNG  
DFOV: DEPENDANT ON PATIENT  
KV: 120  
MA: AUTO MA TO 240  
PREP GROUP: 30 SECONDS  
THICKNESS: 2.5MM  
INTERVAL: 1.25MM  
ALGORITHM: STANDARD

#### (GROUP 2)

START POINT: BASE OF THE LUNGS  
END POINT: THROUGH THE SYMPHYSIS PUBIS  
DFOV: DEPENDANT ON THE PATIENT  
KV: 120  
MA: AUTO MA TO 440  
PREP GROUP: 60 SECONDS  
THICKNESS: 5.0MM  
INTERVAL: 5.0MM  
ALGORITHM: STANDARD

### RECON 2: (LUNG)

START POINT: JUST ABOVE APICES  
END POINT: THROUGH THE BASE OF THE LUNG  
DFOV: SAME AS RECON 1  
ALGORITHM: LUNG  
THICKNESS: 5.0MM  
INTERVAL: 5.0MM

### RECON 3: (T/L SPINE)

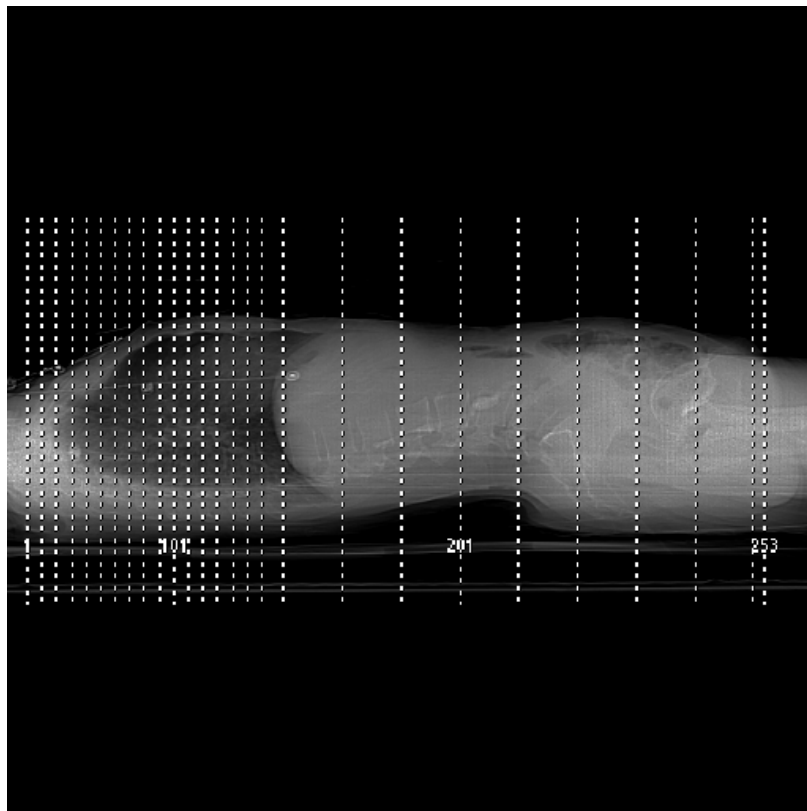
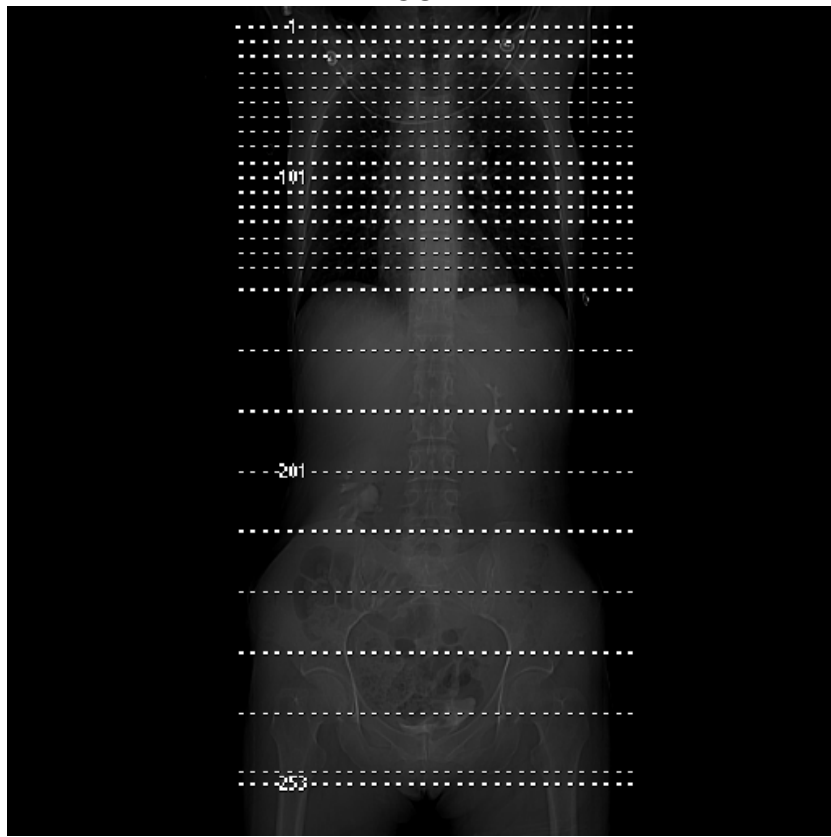
START POINT: JUST ABOVE APICES  
END POINT: S2  
DFOV: 16-18 (PT DEPENDANT)  
ALGORITHM: BONE  
THICKNESS: 2.5MM  
INTERVAL: 1.25MM

**RETRO RECONS:** RETRO RECON THE WHOLE SCAN (CHEST, ABDOMEN AND PELVIS) INTO THINS (1.25 THICK BY 0.625 SPACING) SO THAT REFORMATS MAY BE DONE

### REFORMATS:

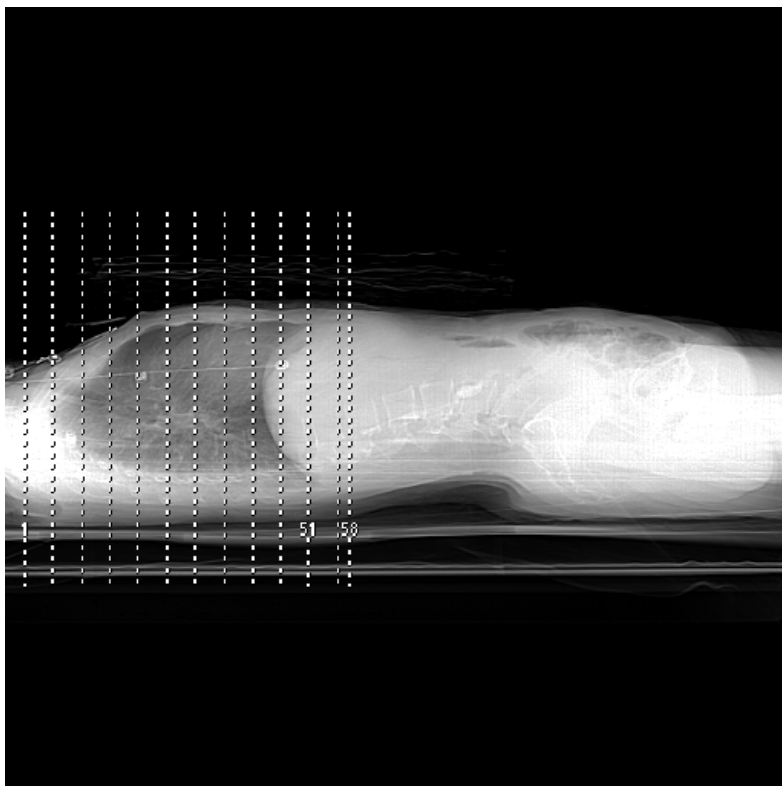
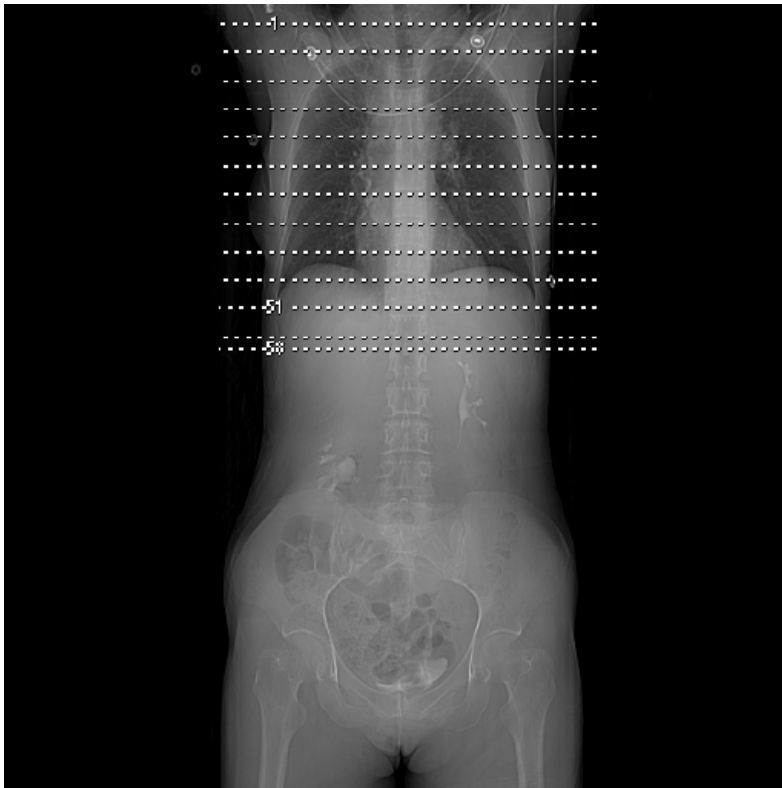
- AXIAL, CORONAL AND SAGITTAL OF THE CHEST, ABDOMEN AND PELVIS
- AXIAL, CORONAL AND SAGITTAL OF THE T-SPINE
- AXIAL, CORONAL AND SAGITTAL OF THE L-SPINE

RECON 1:

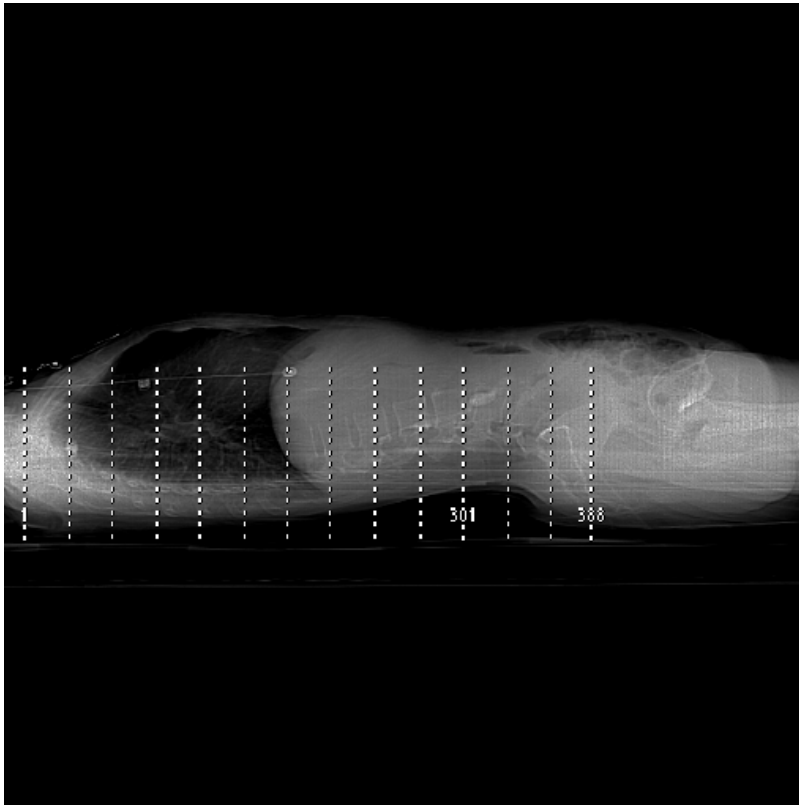
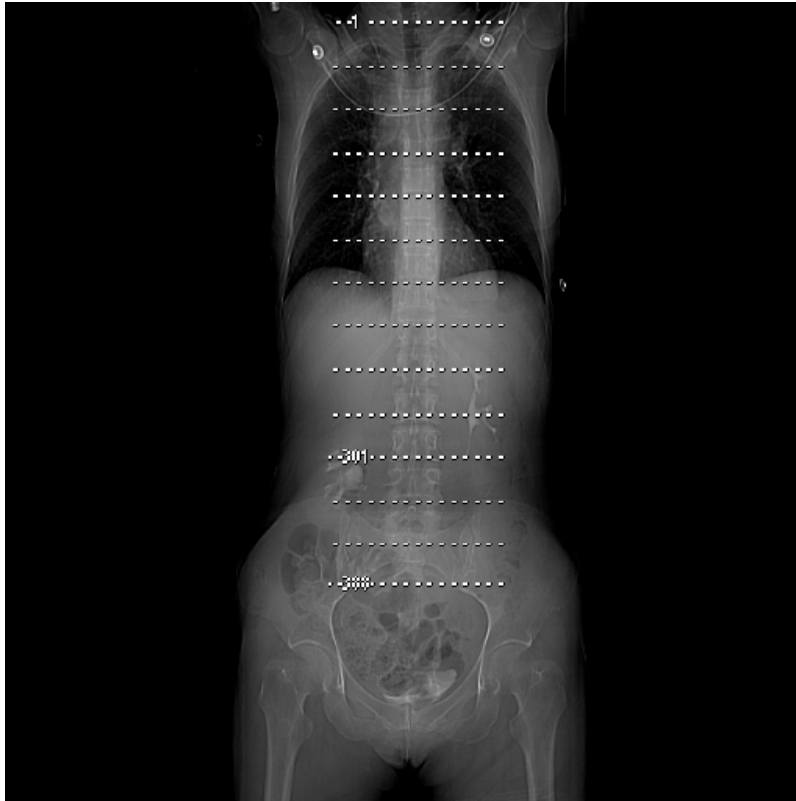




RECON 2:

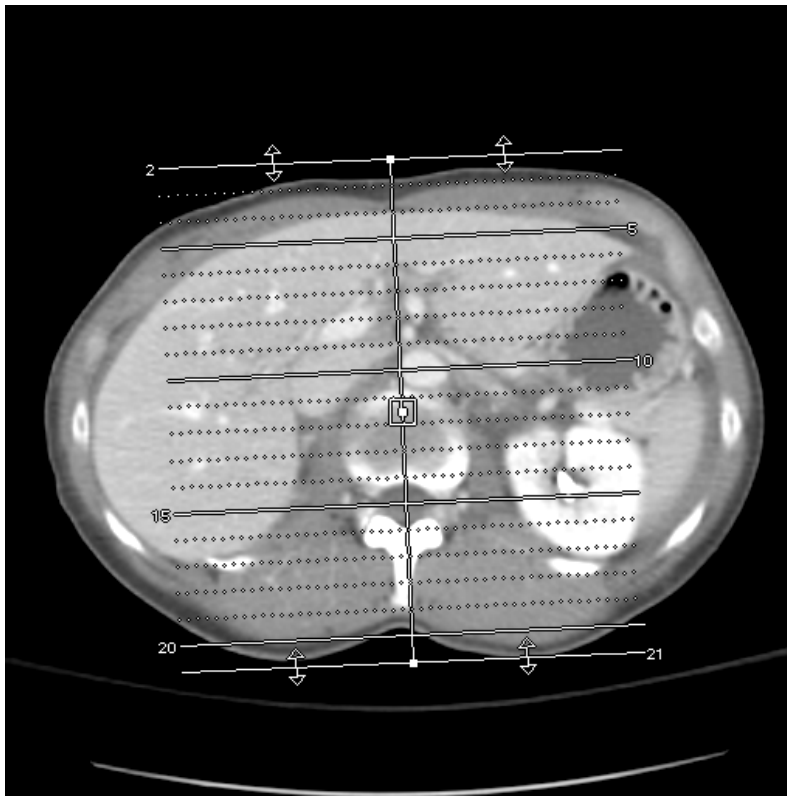


**RECON 3:**



**CHEST / ABDOMEN / PELVIS REFORMATS:**

**CORONAL REFORMAT AREA:**



**SAGITTAL REFORMAT AREA:**

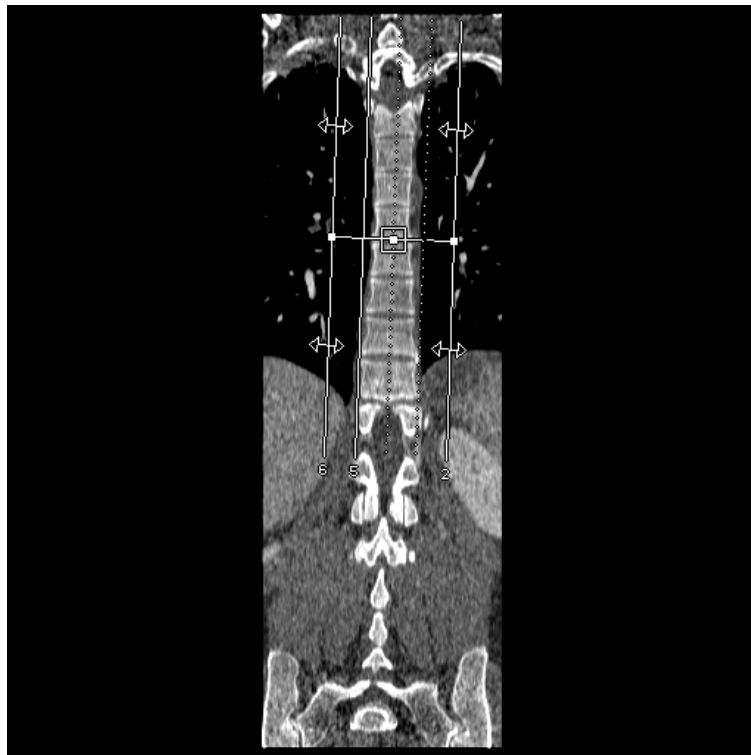


**T-SPINE REFORMATS:**

**CORONAL REFORMAT AREA:**



**SAGITTAL REFORMAT AREA:**

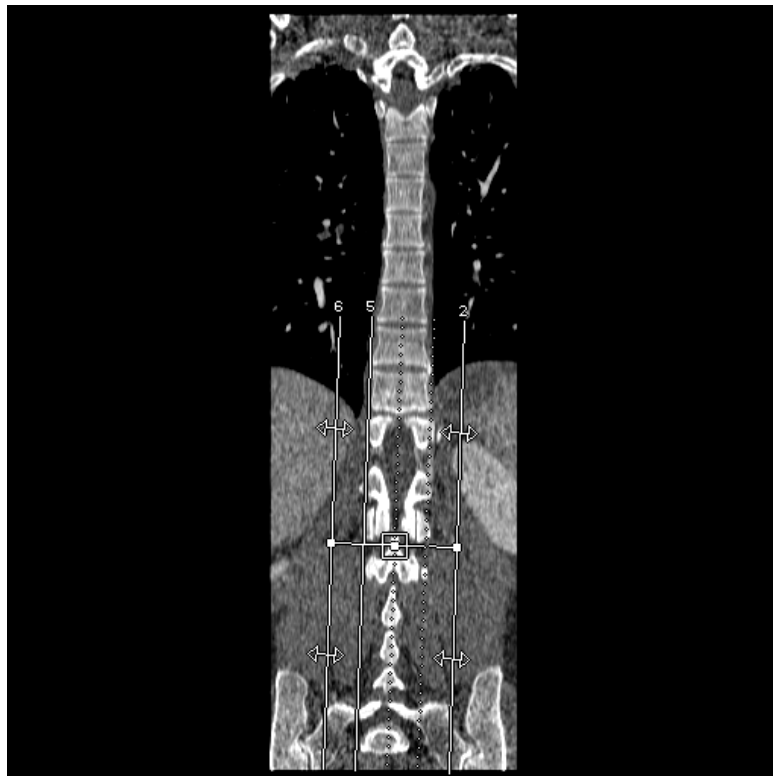


**L-SPINE REFORMATS:**

**CORONAL REFORMAT AREA:**



**SAGITTAL REFORMAT AREA:**



## **TRAUMA ABDOMEN/PELVIS**

LANDMARK: XYPHOID  
SCOUTS: AP AND LATERAL  
IV CONTRAST: 110CC OMNIPAQUE  
IV SIZE: 20 GAUGE OR 18 GAUGE  
INJECTION RATE: 3-4CC PER SECOND

### **RECON 1:**

**START POINT:** BASE OF THE LUNGS  
**END POINT:** THROUGH THE SYMPHYSIS PUBIS  
**DFOV:** DEPENDANT ON THE PATIENT  
**KV:** 120  
**MA:** AUTO MA TO 440  
**PREP GROUP:** 70 SECONDS  
**THICKNESS:** 5.0MM  
**INTERVAL:** 5.0MM  
**ALGORITHM:** STANDARD

### **RECON 2:**

**THICKNESS:** 1.25MM  
**INTERVAL:** 0.625MM  
**ALGORITHM:** STANDARD

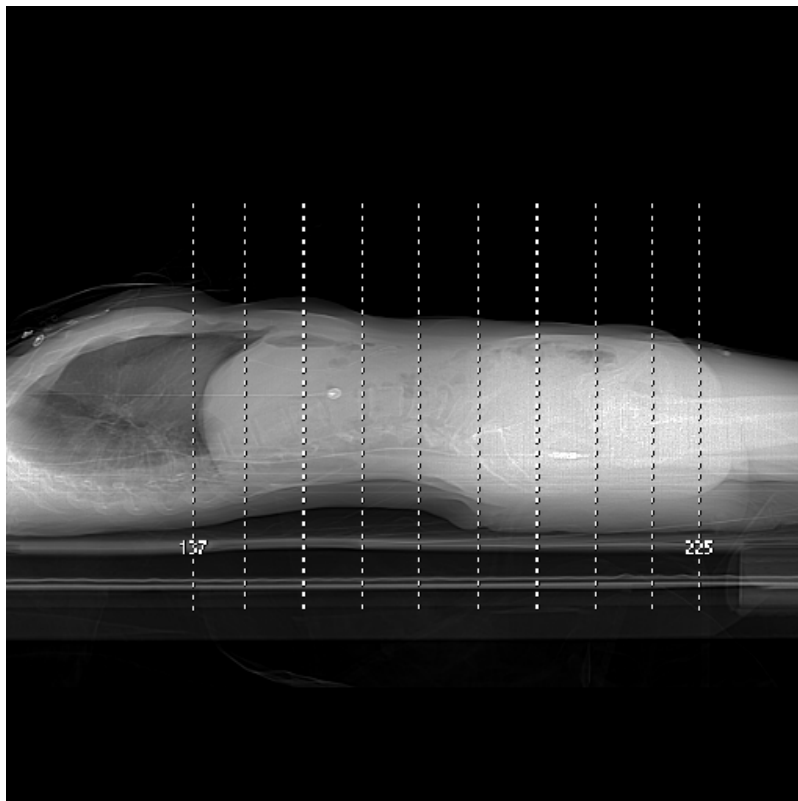
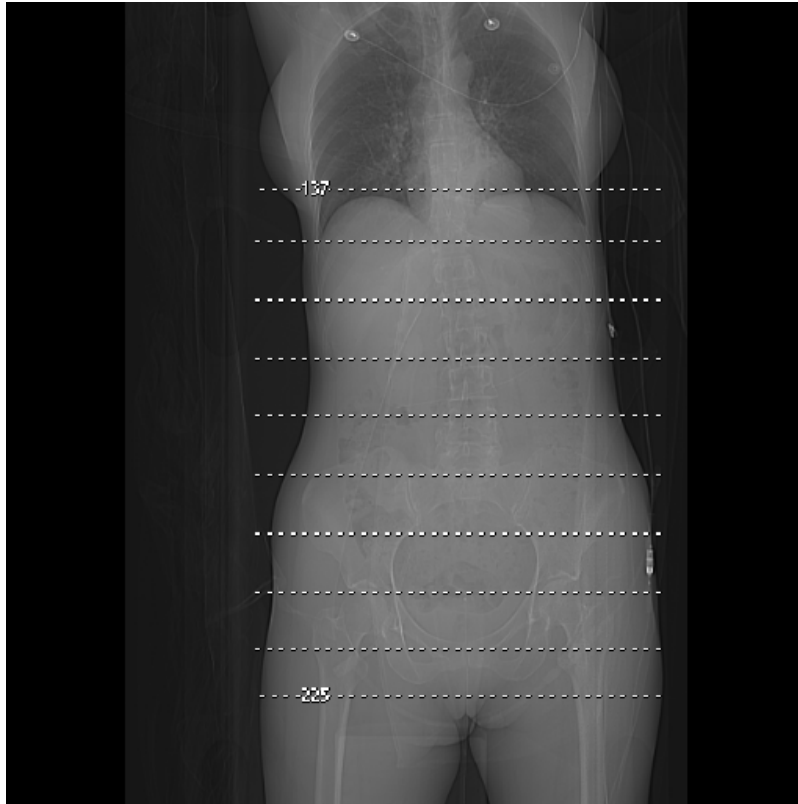
### **RECON 3:**

L-SPINE (IF REQUESTED)  
**START POINT:** T12  
**END POINT:** S2  
**DFOV:** 16-18 (PT DEPENDANT)  
**ALGORITHM:** BONE  
**THICKNESS:** 2.5MM  
**INTERVAL:** 1.25MM

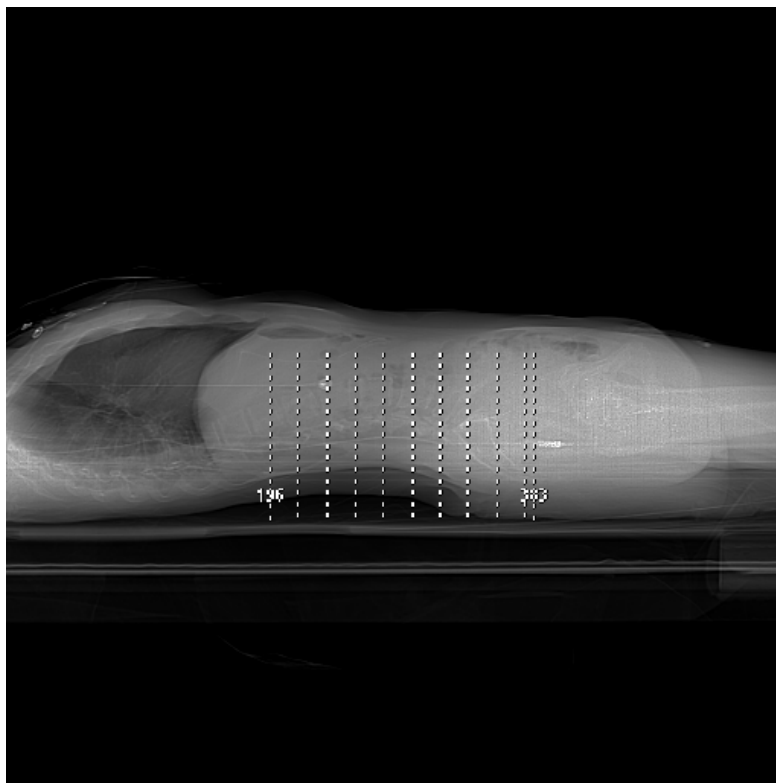
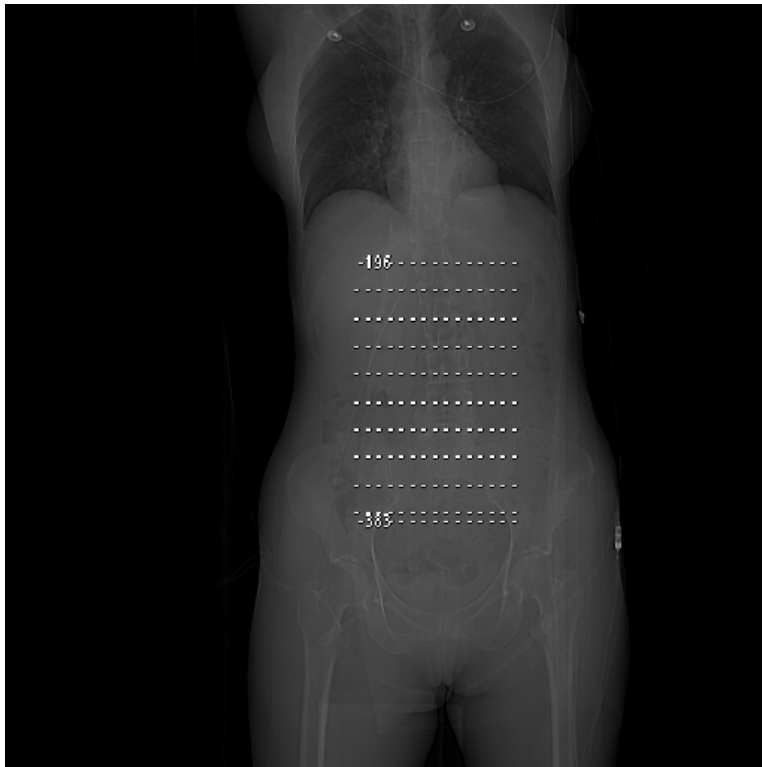
### **REFORMATS:**

- AXIAL, CORONAL AND SAGITTAL OF THE ABDOMEN AND PELVIS
- AXIAL, CORONAL AND SAGITTAL OF THE L-SPINE

RECON 1 (AND 2):



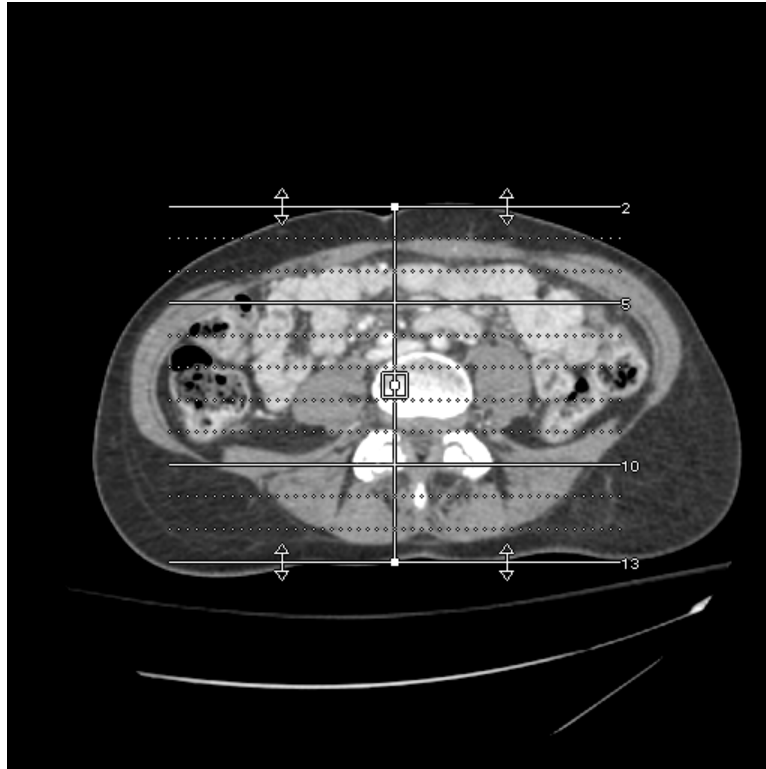
**RECON 3:**



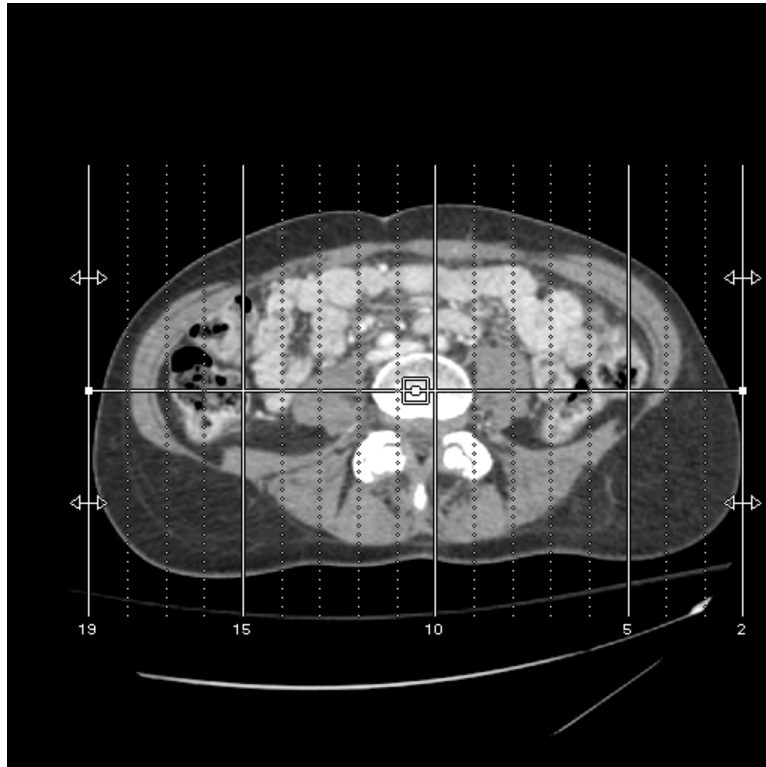


**ABDOMEN / PELVIS REFORMATS:**

**CORONAL REFORMAT AREA:**

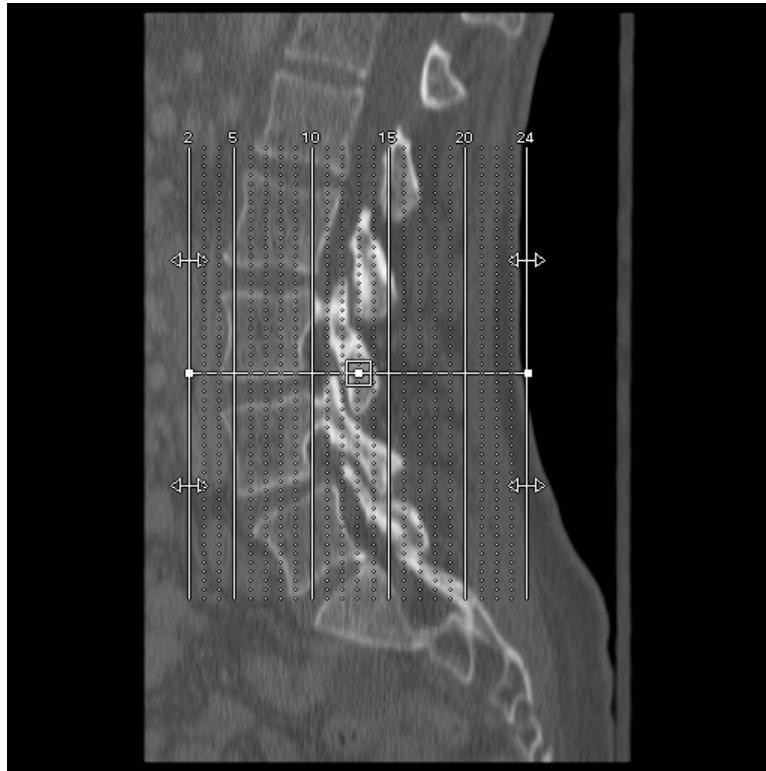


**SAGITTAL REFORMAT AREA:**



**L-SPINE REFORMATS:**

**CORONAL REFORMAT AREA:**



**SAGITTAL REFORMAT AREA:**



## CYSTOGRAM

LANDMARK: ILIAC CREST  
SCOUTS: AP AND LATERAL

### RECON 1:

**START POINT:** ABOVE THE CREST  
**END POINT:** BELOW THE SYMPHYSIS PUBIS  
**ANGLE:** NONE  
**DFOV:** DEPENDANT ON PATIENT  
**KV:** 120  
**MA:** AUTO MA TO 440  
**THICKNESS:** 5.0MM  
**INTERVAL:** 5.0MM  
**ALGORITHM:** STANDARD

### RECON 2:

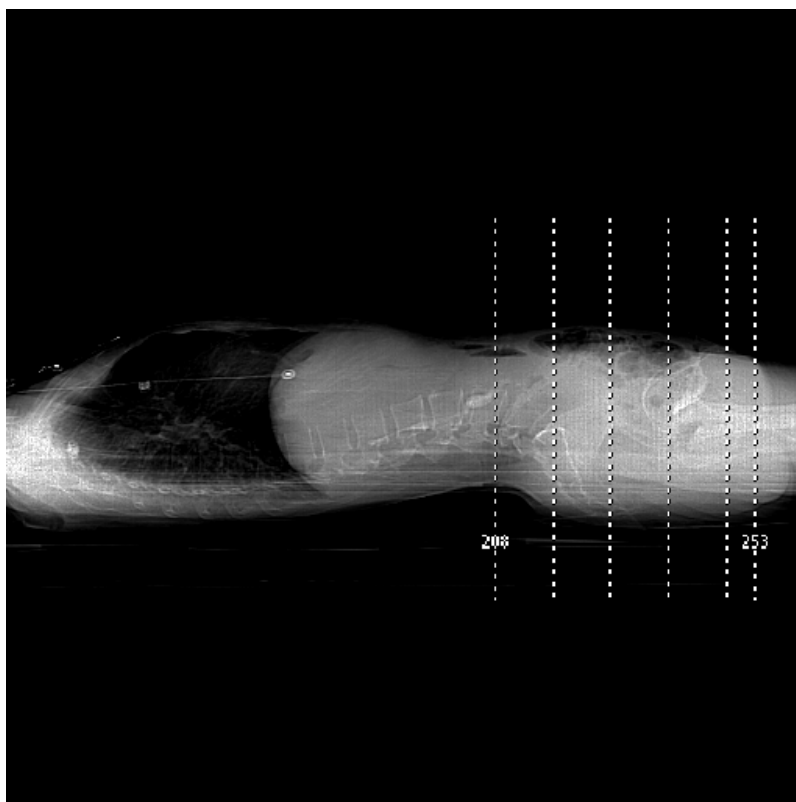
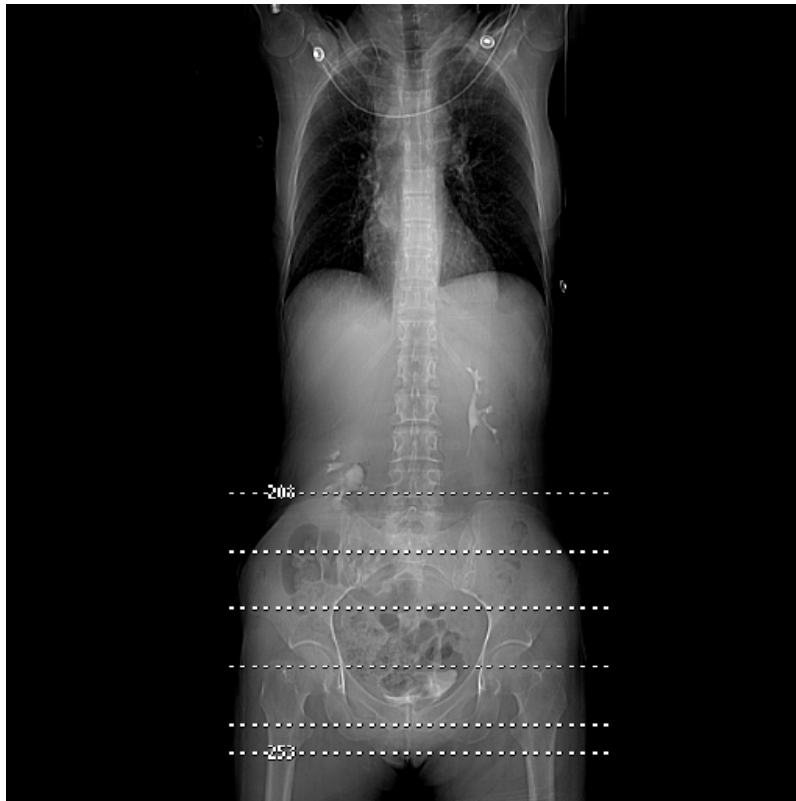
**ALGORITHM:** STANDARD  
**THICKNESS:** 1.25MM  
**INTERVAL:** 0.625MM

1. SCAN THE PELVIS (IF SCANNING A CHEST/ABDOMEN/PELVIS TRAUMA SCAN, SKIP TO #2)
2. GRAVITY FILL THE BLADDER WITH NO MORE THAN 300CC DILUTE CONTRAST) AND SCAN THE PELVIS AGAIN.

### CYSTOGRAM CONTRAST:

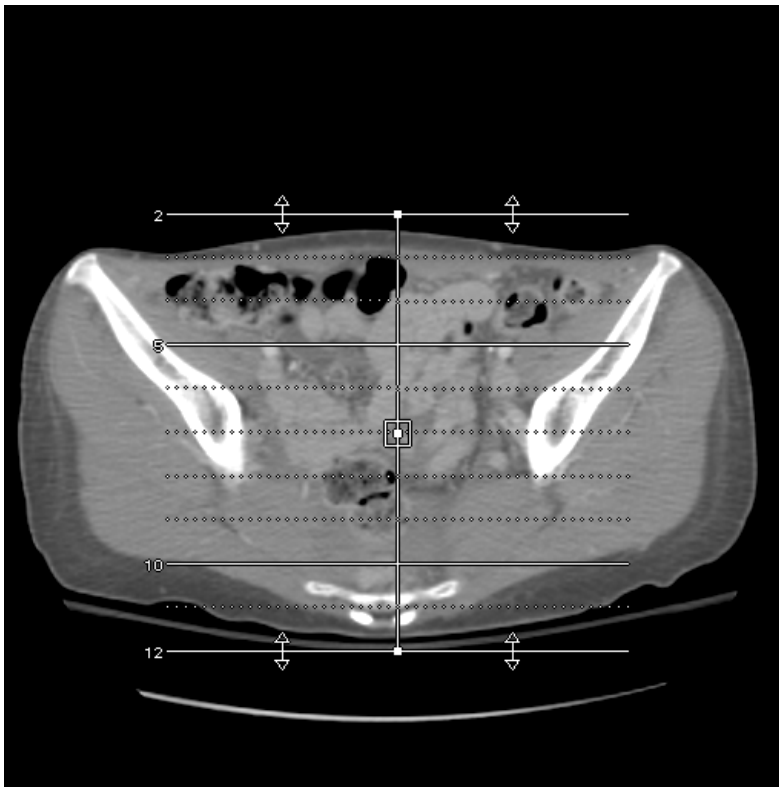
- **CYSTOGRAFFIN 14% SOLUTION:** MIX 30CC CYSTOGRAFFIN PER 250CC SALINE BOTTLE (280CC TOTAL)
- **OMNIPAQUE 350:** MIX 15CC OMNIPAQUE PER 250CC SALINE BOTTLE (265CC TOTAL)

RECON 1 :

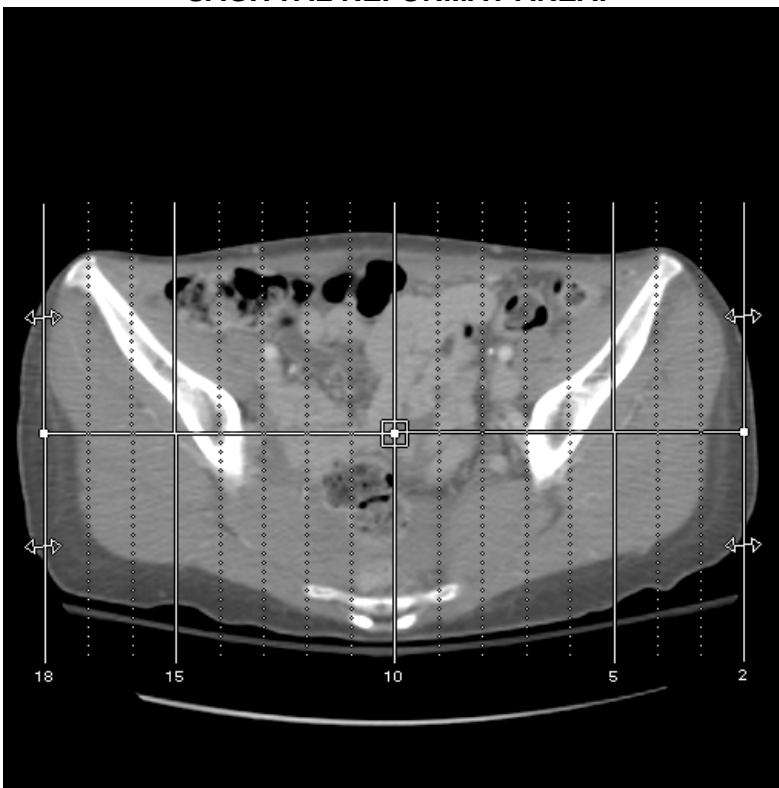


**CYSTOGRAM REFORMATS :**

**CORONAL REFORMAT AREA:**



**SAGITTAL REFORMAT AREA:**



## **FACIAL BONES**

LANDMARK: OMBL  
SCOUTS: AP AND LATERAL

### **RECON 1:**

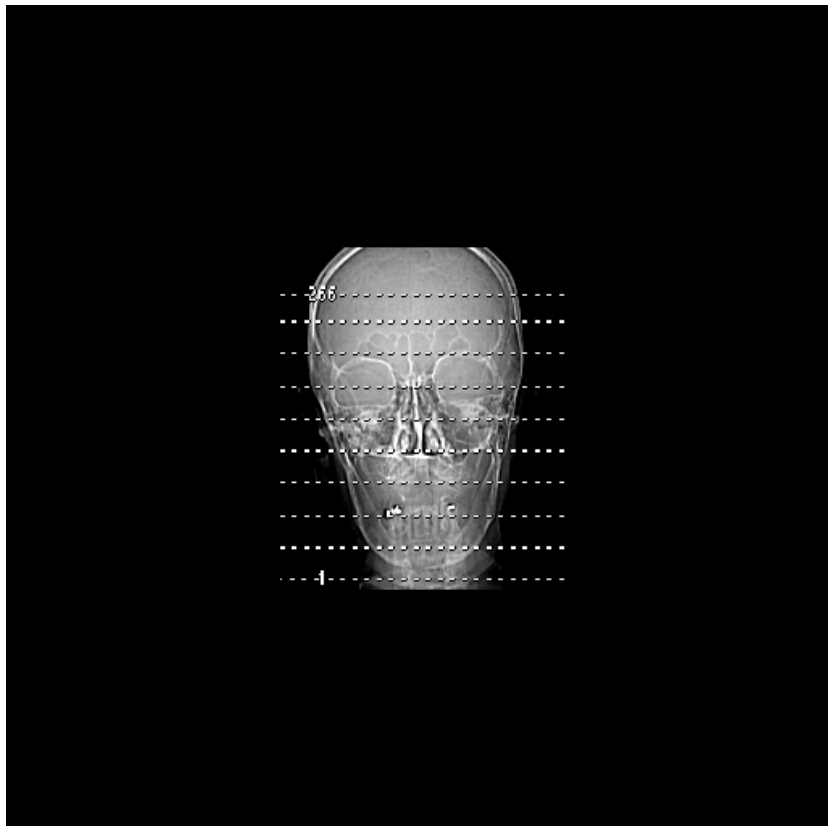
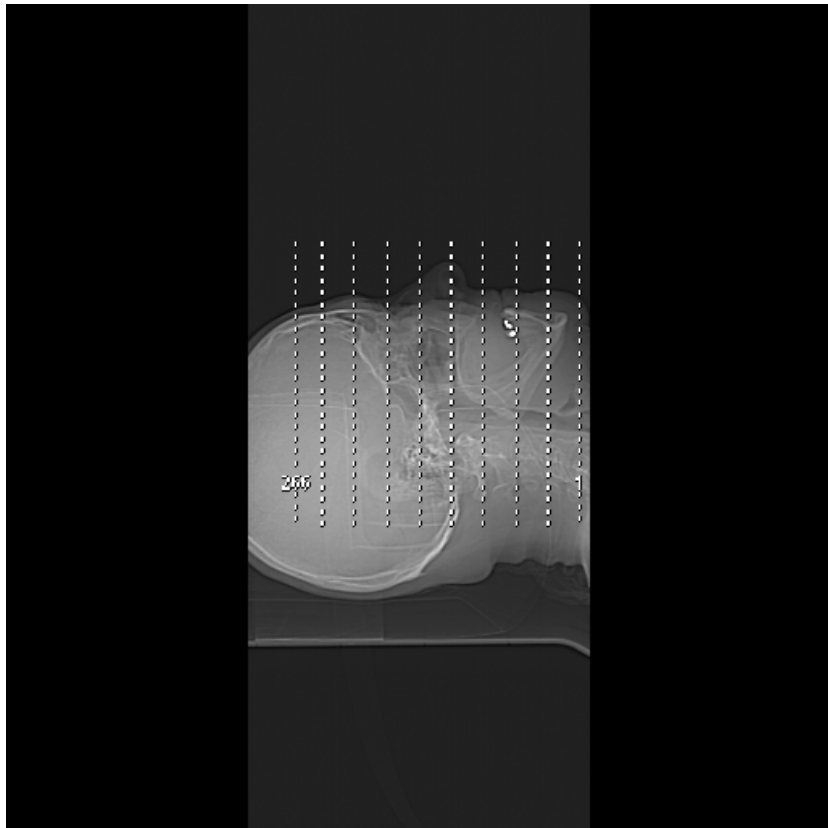
**START POINT:** JUST BELOW MANDIBLE  
**END POINT:** JUST ABOVE FRONTAL SINUSES  
**ANGLE:** ANGLE TO FACE  
**DFOV:** 18  
**KV:** 140  
**MA:** 135  
**THICKNESS:** 1.25MM  
**INTERVAL:** 0.600MM  
**ALGORITHM:** BONE

### **RECON 2:**

**ALGORITHM:** STANDARD  
**THICKNESS:** 0.625MM  
**INTERVAL:** 0.625MM

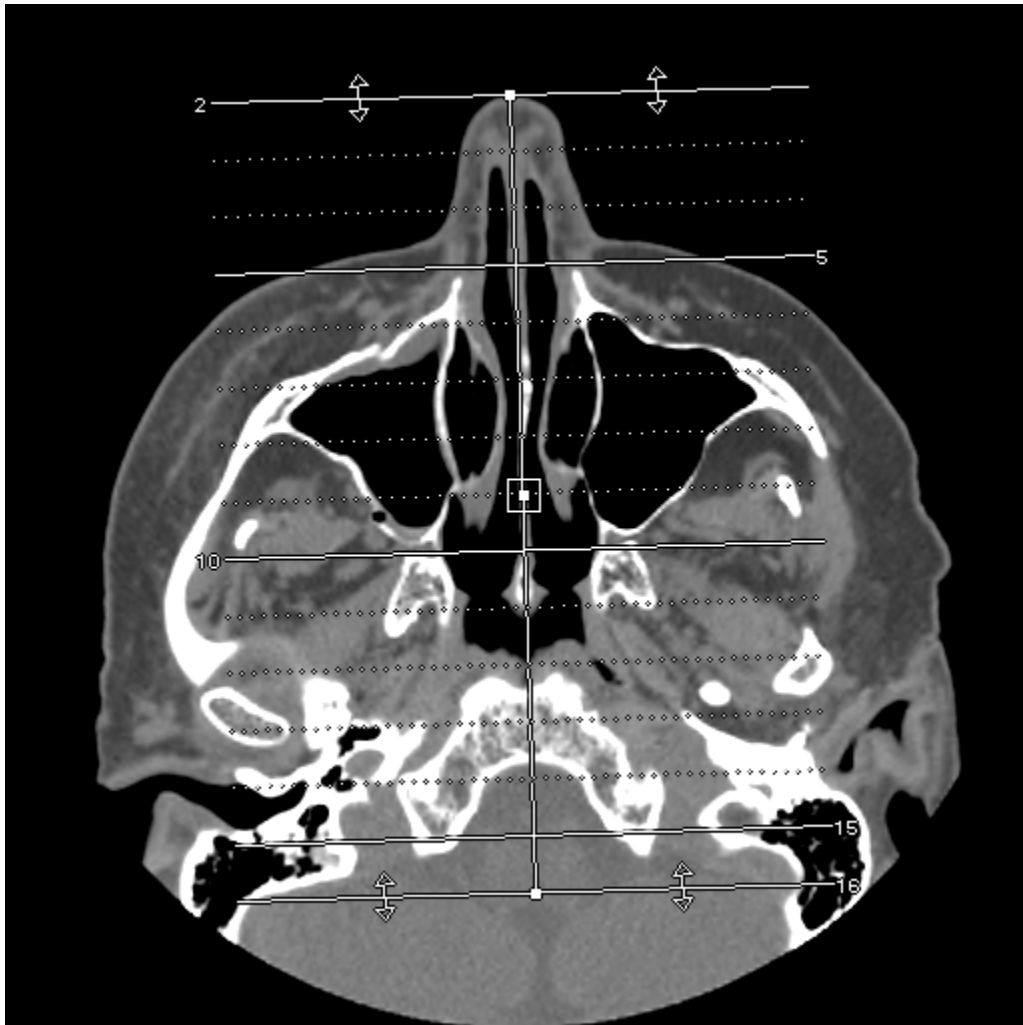
**REFORMATS:** AXIAL, SAGGITAL AND CORONAL

RECON 1:



**FACE REFORMATS:**

**CORONAL REFORMAT AREA:**





## **BIBLIOGRAPHY**

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3. Gupta, R, Greer, S, Martin, E: Inefficiencies in a Rural Trauma System: The Burden of Repeat Imaging in Interfacility Transfers, Journal of Trauma-Injury Infection & Critical Care, 69(2):253-255, August 2010
4. McGillicuddy, EA, Schuster, KM, Kaplan, LJ, Maung, AA, Lui, FY, Maerz, LL, Johnson, DC, Davis, KA: Contrast-Induced Nephrology in Elderly Trauma Patients. Journal of Trauma, 68(2):294-297, February 2010

## **TRAUMA IMAGING SUB-COMMITTEE MEMBERS - 2010**

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