

# Diagnostic imaging methods in the examination of the skeleton and joints

## Skiagraphy

Skiagraphy is a basic examination method of bones and joints. Most bones and joints are imaged in two projections. This does not apply, for example, to the clavicle. The second projection sometimes cannot be made in immobile or uncooperative patients. In addition to the bone itself, we also evaluate the position in the joints, soft tissues, the position of the osteosynthetic material (if any) and the possible presence of foreign bodies (metal splint, cinder,...).

### Projection

Most bones and joints are shown in two projections. It is used:

- **orthograde projection** : the central beam passes perpendicular to the film. Usually, two projections perpendicular to each other are made, or front-back or back-front and side,
- **oblique projection** , eg occipital bone(Towne projection), the central ray is not perpendicular to the film and the geometric proportions are distorted,
- **tangential projection** : eg zygomatic arch,
- **tunnel projection** : eg intercondylar eminence of the knee.

Special projections are named after medical personalities: eg Waters projection (semi-axial Ibi image), Towne projection (occipital bone image), Stevers projection (calcaneal bone), and many others.



Axillary dislocation of the shoulder joint: X-ray image in two projections

## Dynamic images

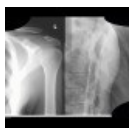
Dynamic images show the relative position of the bones in different phases of movement. They are most often indicated for the spine to evaluate the dynamics (development of the spine) or the movement of the vertebral bodies during mutual displacement (olisthesis).

pondylolisthesis, spondylolysis, spina bifida: (static) X-ray image, two projections ([http://atlas.mudr.org%26sol/img-Spondylolisthesis-spondylolysis-spina-bifida-712.jpg?\\_x\\_tr\\_sl=auto&\\_x\\_tr\\_tl=en&\\_x\\_tr\\_hl=en](http://atlas.mudr.org%26sol/img-Spondylolisthesis-spondylolysis-spina-bifida-712.jpg?_x_tr_sl=auto&_x_tr_tl=en&_x_tr_hl=en))

Spondylolisthesis, spondylolysis, spina bifida: (static) X-ray image, two projections (<https://translate.google.com/website?sl=auto&tl=en&hl=en&u=http://atlas.mudr.org/img-Spondylolisthesis-spondylolysis-spina-bifida-713>)

## Stress images

Stress images can show pathology that is not apparent on "rest" images. This is most often a picture of the acromioclavicular joint (luxation in the AC joint), less often so-called held pictures of the ankle or wrist to assess a lesion of the ligamentous apparatus. Carrying out an image of the knee joint while standing (with weight) will show the actual narrowing of the joint space in arthrosis.



Widening (subluxation) of the AC joint after trauma: X-ray image (<https://translate.google.com/website?sl=auto&tl=en&hl=en&u=http://atlas.mudr.org/Case-images-Acromioclavicular-joint-separation-1082>)

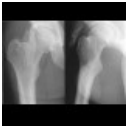
## Soft tissues

In addition to the skeleton (bones), it is possible to evaluate soft tissues from skiagraphic images. Of particular importance are:

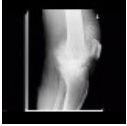
- filling of the suprapatellar recess with fluid,
- dislocation of fat bodies of the elbow joint when filled with fluid,
- periarticular edema of soft tissues in arthritis,
- soft tissue defect, eg with an ulcer,
- expansion of prevertebral soft tissues during hematoma (indirect sign of fracture),
- obscuration of the paranasal sinuses due to fluid or hematoma.



X-ray image of the knee joint: hemarthrosis - filling of the suprapatellar recess



X-ray of the right hip joint: myositis ossificans



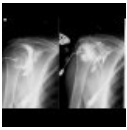
X-ray of the knee joint: chondromatosis, gonatrosis

## Fluoroscopy

X-ray examination with an emphasis on time resolution is used in operating theaters when adjusting the position of bone fragments or osteosynthetic material.

## Arthrography

Arthrography is the imaging of a joint after it has been filled with contrast material. Nowadays, it recedes into the background thanks to MRI.



Fistography of the right shoulder: contrast material fills the joint capsule

## Ultrasound

An ultrasound examination is used to examine:

- joints: to rule out effusion, synovitis,
- ligaments and tendons: degenerative, inflammatory and traumatic changes,
- muscles: traumatic changes – rupture, hematoma.



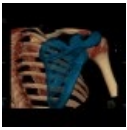
Soft tissue US: osteomyelitis and sequestration

## CT - computed tomography

CT is used in complicated traumas mainly to clarify the spatial arrangement of bone fragments, which sometimes cannot be seen from a simple X-ray image. CT is also indicated for unclear findings from the skiagraphic examination, when using an X-ray image it is not possible to exclude traumatic changes of the skeleton. CT arthrography has receded into the background thanks to MRI.



CT of the elbow joint: fractura capitulum humeri



CT of the right shoulder: fracture of the scapula



CT pelvis: iliac crest sarcoma

## MRI - magnetic resonance

MRI has excellent resolution for soft tissues. As the method of choice, it is used to visualize traumatic or degenerative soft tissue changes in the joint area. MRI best shows bone metastases and occult fractures that may not be visible on X-ray methods.

## Skeletal scintigraphy

Radionuclide examination based on the detection of bone remodeling, in which phosphate complexes labeled with  $^{99m}\text{Tc}$  are used, most often  $^{99m}\text{Tc}$  MDP and  $^{99m}\text{Tc}$  HDP. The method is very sensitive, not very specific, it shows localities that are suitable for further investigation. Indications include the search and staging of bone metastases, injuries - fractures, fatigue fractures, bone contusions, bone inflammations and others.

## Intervention performances

### Vertebroplasty

Vertebroplasty means the filling of compressed vertebral bodies with cement.

### Kyphoplasty

Kyphoplasty means the filling of a cavity in a compressed vertebral body, which is created by introducing a balloon and inflating it in the vertebral body.

### RFA of bone metastases

Radiofrequency ablation can also be used in the treatment of bone metastases.

### Biopsies

The collection of biological material from the bone for the purpose of histological processing can be carried out either non-targetedly in the case of diffuse damage to the skeleton (eg hematological diseases), or targeted under the control of imaging methods - CT or X-ray.

## Radiological archaeology

Imaging methods find special application in archeology -skiagraphy of bones, CT of body remains.



X-ray of archaeological finds - bones

## Links

### External links

- Images at atlas.mudr.org
- Classification and tables in radiodiagnostics at mudr.org (<http://www.mudr.org/web/>)