MRI and CT scan of the coccyx

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INTRODUCTION

Magnetic resonance imaging (MRI) of the coccyx can provide significant information for the management of patients with chronic coccydynia. The same goes for computed tomography (CT), which is, however, less requested.

INDICATIONS FOR MRI OF THE COCCYX

MRI of the coccyx must be systematically requested when there is suspicion of a tumour of the coccyx, the sacrum or peri-coccygeal soft tissues and in the case of coccydynia in children, adolescents and young adults (under 2 years). In young patients, this non-irradiating examination avoids the use of dynamic X-rays by showing anomalies that are very frequent at this age, such as spicules or post-traumatic bone oedema. The absence of dynamic X-rays is insignificant for these patients since the abnormalities they can reveal (hypermobility or dislocation) hardly exist in the young.

MRI of the coccyx is often required in cases of post-traumatic coccydynia, in search of a bone oedema or contusion. This is especially true if coccydynia appears during childbirth. Fractures with pseudoarthrosis are not uncommon in this case and the image can be difficult to differentiate from a normal joint on plain X-rays. This is also the case when the dynamic X-rays are normal after violent trauma. Finally, should there be a poor outcome after surgery, MRI sometimes demonstrates interesting results.

MRI of the coccyx may be requested when there is a spicule, in order to search for bursitis, or when there is an intradiscal coccygeal calcification to seek inflammation of the disc or adjacent vertebral plates and thus confirm the cause of the calcification.

In some cases, MRI of the coccyx is requested after a failed injection or because the patient is unusually worried, but it has a lower diagnostic yield.

MRI TECHNIQUE FOR THE COCCYX

We perform MRI on a 1.5-Tesla machine with surface emitter and receiver coils. The patient lies on his/her back and is introduced into the bore head-first. Straps are used to reduce body movement. Three different sequences are acquired in all cases: (1) a sagittal T1-weighted spin-echo sequence, (2) a sagittal short inversion recovery sequence (STIR) and (3) an axial STIR (fig. 1). A study with high resolution is needed with a small field of view and with contiguous 2.5- and 3-mm slices. T1-weighted images have more precise resolution and are useful for anatomical details like spicules, while T2-weighted acquisitions are more helpful to determine pathology. T2 STIR acquisitions were more contributive than T2-weighted spin-echo sequences in determining inflammatory changes [Fig 1].

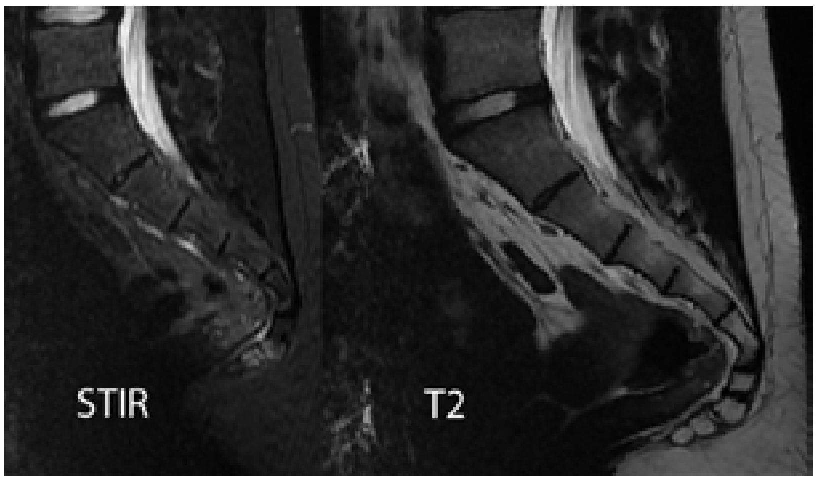

Figure 1. Value of STIR sequences. Comparison of sagittal STIR sequence (left) and T2 spin-echo with fat saturation (right): hypersignal of the C1–C2 vertebral plates with hypersignal of the disc on STIR sequences, not visible on spin-echo sequences. This shows the value of the STIR sequences for imaging the coccyx, as they are more sensitive to inflammatory changes.

Gadolinium intravascular injection with T1 weighting and fat suppression helps to differentiate a vascular image from bursitis, and inflammatory changes from liquid effusion; in a postoperative context, it can assist in determining scarring changes.

RESULTS

The MRI may show abnormalities of the sacrococcygeal or intercoccygeal discs, soft tissue abnormalities around the end of the coccyx or bone abnormalities.

1 Abnormalities of coccygeal discs and vertebral plates

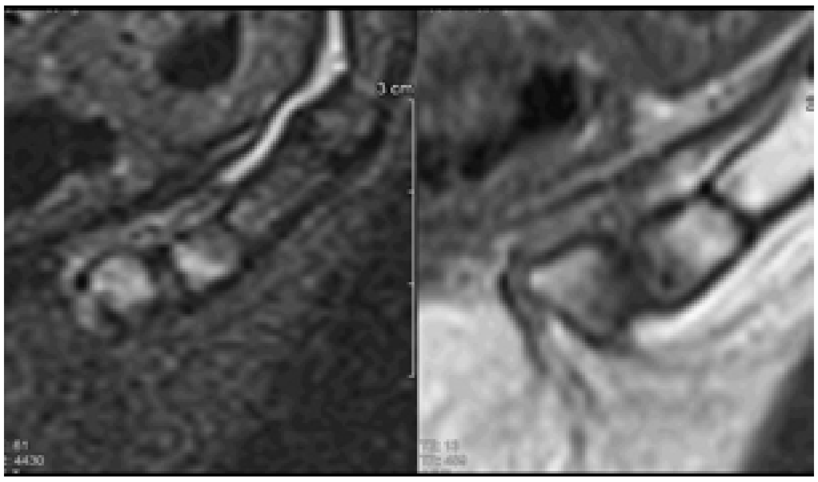

Figure 2. Sagittal T1 (right) and T2 STIR (left) sequence. Chronic pain in an adult. T2 hypersignal and T1 hyposignal of the last two caudal vertebrae reflecting inflammatory lesions comparable with a Modic type 1. Note hypointense geodes of the subchondral bone in T1.
T2 hypersignal of the disc and the apex of the same nature.

In a previous piece of work [1], we described abnormalities of the sacrococcygeal or intercoccygeal discs with a hyperintense signal of the vertebral endplates on T2 and an isointense signal on T1-weighted images. In the majority of the cases (38 out of 70), the image was inhomogeneous, moderately intense, poorly delimited and sometimes associated with a slightly increased intradiscal signal on T2 [Fig 2]. We interpreted this as oedema due to joint (disc) inflammation, by analogy with the situation described by Modic et al. [2] for the lumbar spine. In a smaller proportion of cases (17 out of 70), the imaging feature was homogeneous, intense and well delimited, and thus suggested the presence of effusion into the disc space. In 15 of 70 cases, the feature was too localised, too small or poorly defined, and thus prevented us from differentiating between normal and pathological situations.

Quite often, well-defined cyst images, hyperintense on T2 and hypointense on T1, develop from the disc and sometimes within the vertebrae [Fig 3]

2 Abnormalities of the soft tissues

2.1 BURSITIS

At the tip of the coccyx dense, fairly well-defined images called bursitis may be found. They give a hypersignal on T2-weighted imaging and an isointense signal on T1-weighted imaging in the soft tissues around the lower tip of the coccyx [Fig 4]. This image of bursitis can go up behind the last vertebra of the coccyx [Fig 5,6].

2.2 INFLAMMATION OF THE SOFT TISSUES

MRI can show a T2 hypersignal behind the caudal vertebrae, poorly defined, a less intense signal in T2 than that observed for bursitis and appearing to correspond to inflammatory changes of the soft tissues [Fig 7].

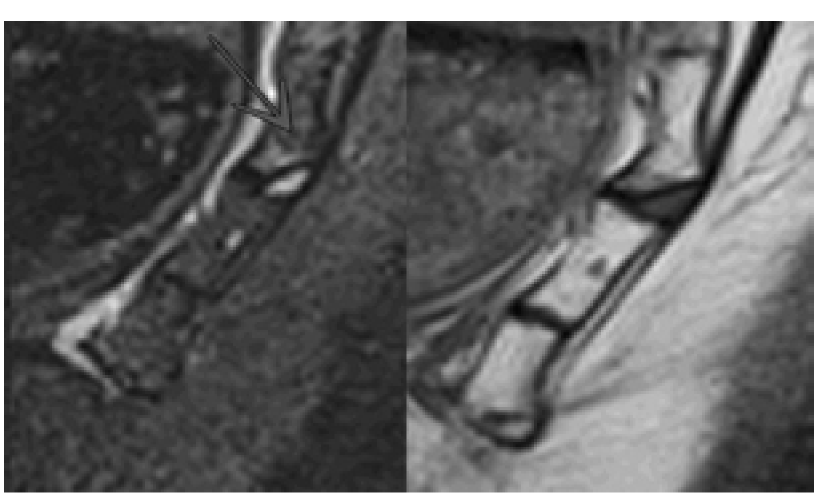

Figure. 3 Sagittal STIR (right) and T1 (left) MRI. Well-defined cystic image developed from the disc, eroding the posterior part of the overlying vertebra, with inflammation of the anterior part (T2 hypersignal). The discontinuous image within the apex, hypointense on T1, could reflect a non-consolidated fracture but there is no hypersignal in T2. It is therefore more likely to be a congenital aspect of partial segmentation.

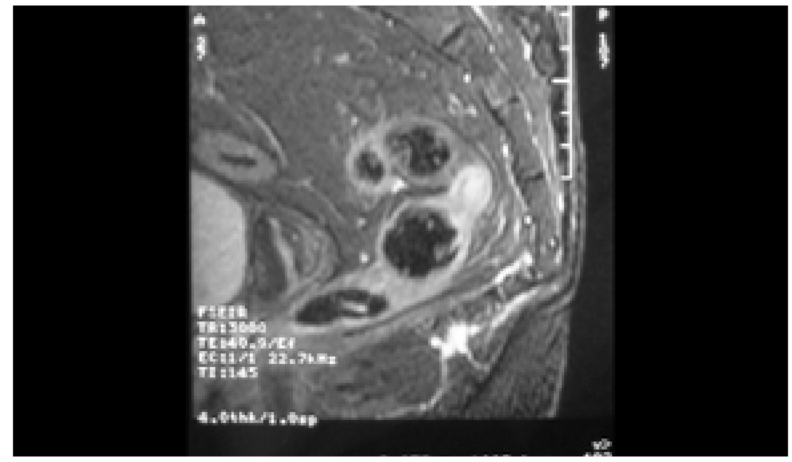

Figure 4. Sagittal T2 STIR image: very intense picture behind the apex consistent with bursitis.

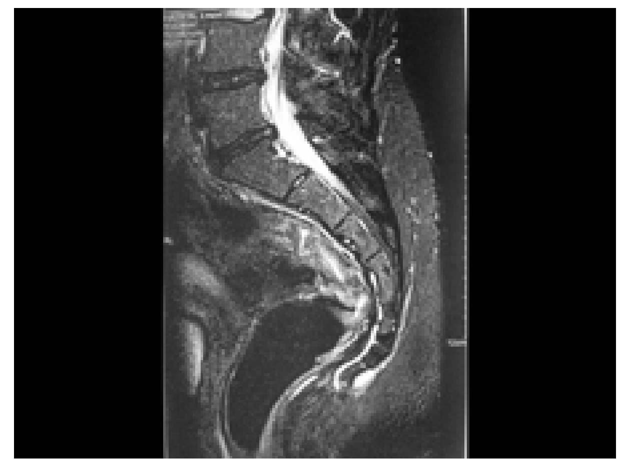

Figure 5. Sagittal STIR series. Bursitis on distal retroversion of the coccyx. The bursitis seems to go up behind the last piece of bone. Note the large drainage vein in front of the coccyx.

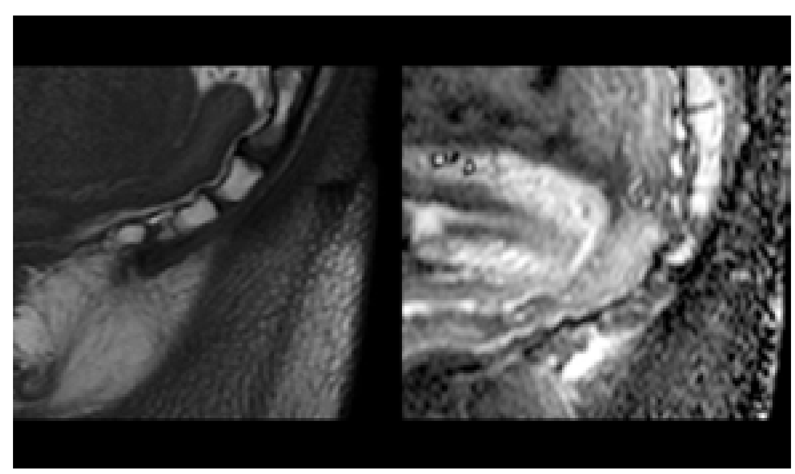

Figure 6. Sagittal T1 series on the left and T2 STIR on the right. T1 hyposignal and T2 hypersignal, fairly well defined behind the two caudal parts, compatible with a dorsal bursitis.

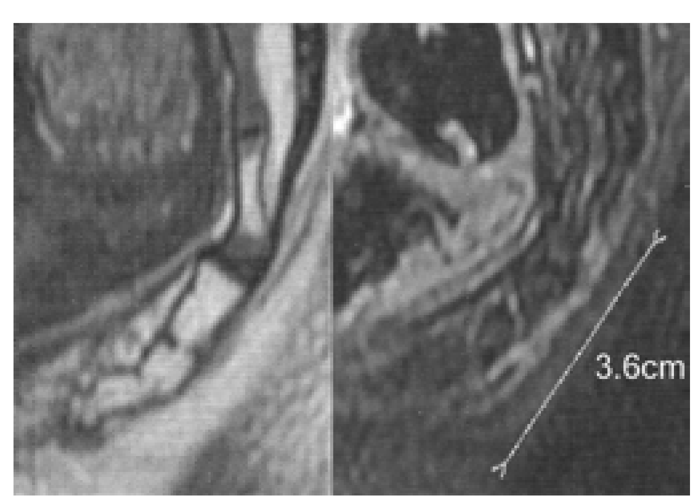

Figure 7. Sagittal T1 sequence on the left and T2 STIR on the right. T2 hypersignal behind the caudal vertebrae extended over 3.6 cm and reflecting inflammatory injuries of the soft tissues.

3. BONE CONTUSION

After trauma, the MRI can show intra-bone abnormalities, with a hyperintense signal on T2-weighted images and an isointense signal on T1-weighted images for the whole vertebral body, with no associated joint abnormalities **[Fig 8,9]**. These signal changes are associated with inflammatory and haemorrhagic phenomena, which should slowly resolve within 3 to 4 months. Sometimes abnormalities are found in T1, suggesting a stress fracture **[Fig 10]**.

4. SPICULE

Highlighting spicules is often difficult with MRI, given their small size relative to the thickness of the sections, which is 2.5 to 3 mm **[Fig 11]**. They are sought on the T1 sequences and especially on CT.

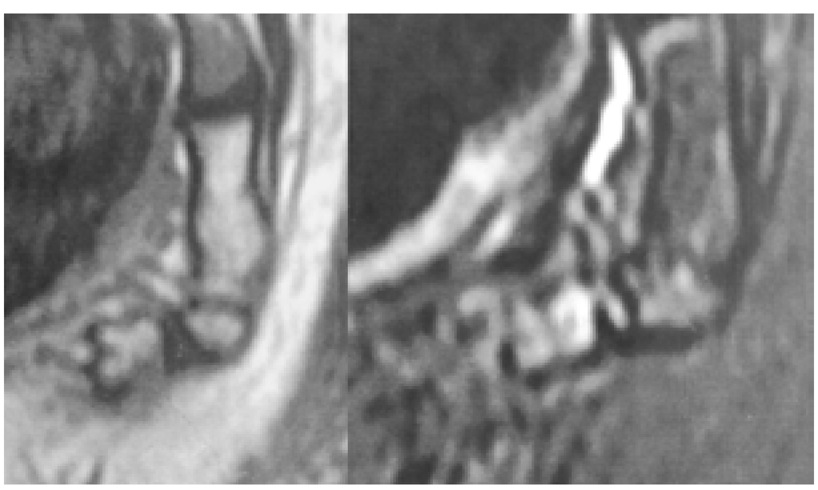

Figure 8. MRI performed 2 months after a fall in a 13-year-old boy. Sagittal T1 (left) and T2 STIR (right) sequence. T2 and also T1 hypersignal of the last caudal vertebra, showing inflammatory and haemorrhagic injuries (contusion). T2 hypersignal of the overlying disc showing the same lesions.

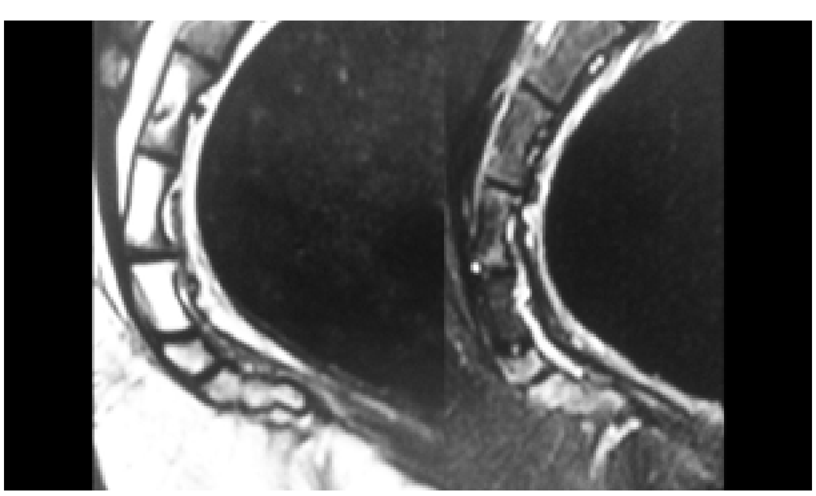

Figure 9. MRI performed X months after a fall in an adult. Sagittal T1 sequence (left) and T2 STIR (right). T2 and also T1 hyperintensity of the last caudal vertebra reflecting inflammatory and haemorrhagic injuries (contusion) of the last two caudal parts.

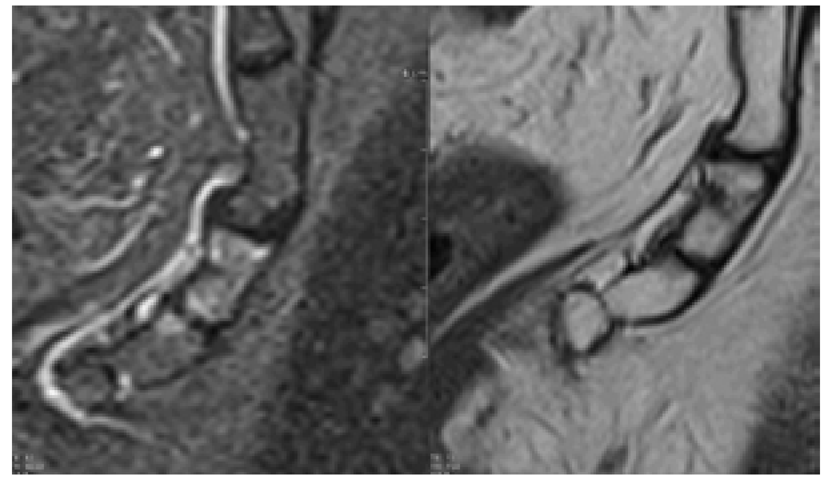

Figure 10. Sagittal STIR MRI on the left and T1 on the right. Recent post-traumatic context.
T2 hypersignal from C1 with intraosseous discontinuity in T1, which suggests a partial fracture.

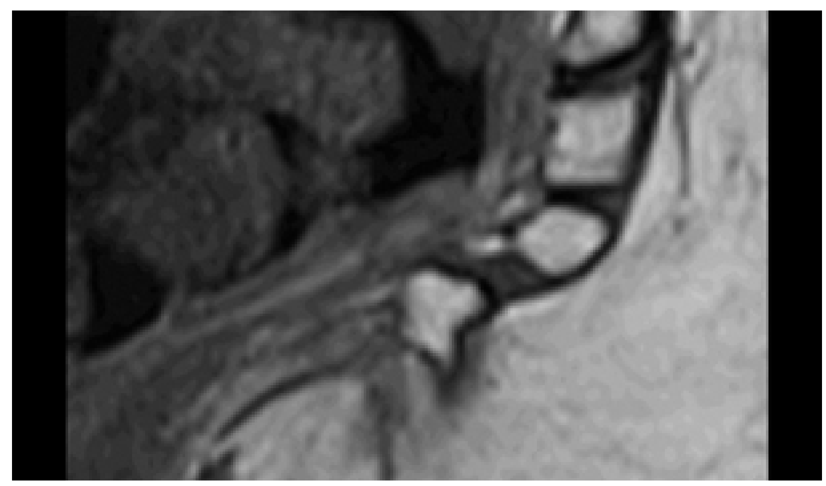

Figure 11. Sagittal T1 series. Posterior apical spicule especially visible in T1, best seen on CT.

5. VASCULAR IMAGES

Very often, MRI provides vascular images, often with veins dilated, not to be confused with bursitis [Fig 12]. They are often associated with other injuries but are sometimes isolated, and their pathological significance is not known.

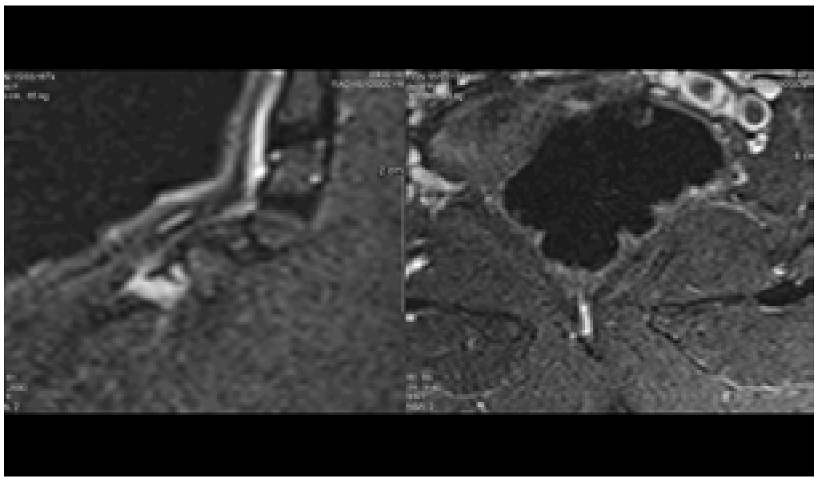

Figure 12. Sagittal (left) and axial (right) STIR sequence. Hyperintense image of the apex on the sagittal section associated with vascular dilatation, not to be confused with bursitis.

CT SCAN OF THE COCCYX

The CT scan (GE) is an imaging modality that examines bone. It is therefore indicated when there is a need to clarify a diagnosis of spicule or fracture, two cases in which X-rays of the coccyx may prove insufficient. MRI is also less reliable than CT with regard to the study of the bone cortex, especially given the fact that the sections are at least 2.5 or 3 mm whereas, on CT, they are 0.5 mm [Fig 13].

Figure 13. CT–MRI comparison. The spicule is more visible on CT (sagittal 2D reconstruction, left) mainly due to the use of thinner sections. On MRI, right, the image does not reflect reality.

TECHNIQUE

The examination is performed with an axial helical volume series and 2D reconstruction in three planes, and in oblique planes when the coccyx is offset. A small field of view is used, with sections of 0.5 mm to obtain a high resolution; 3D reconstructions can be acquired if necessary.

1. Spicules [Fig 14,15]

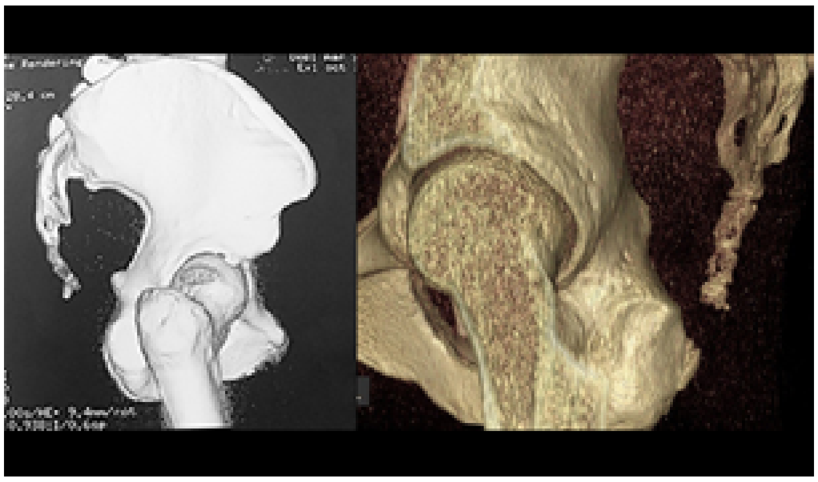

Figure 14. 3D CT scan. Large spicule, left. Right, small spicule at the limit of visibility on standard film.

2. Fractures

Plain radiographs are unable to visualise small displaced fractures, particularly compression fractures of C1, which are the most difficult to see [Fig 16], as well as consolidation delays [Fig 17].

3. Osteoarthritis

CT sometimes shows bone changes compatible with osteophytes, which may fall within the framework of osteoarthritis [Fig 18].

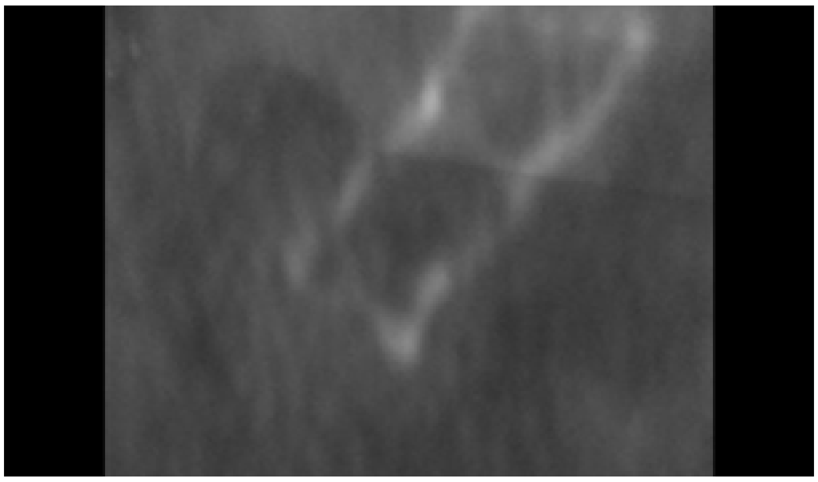

Figure 15. 2D CT: sagittal reconstruction; spicule of 1 mm from the tip, not visible on X-ray

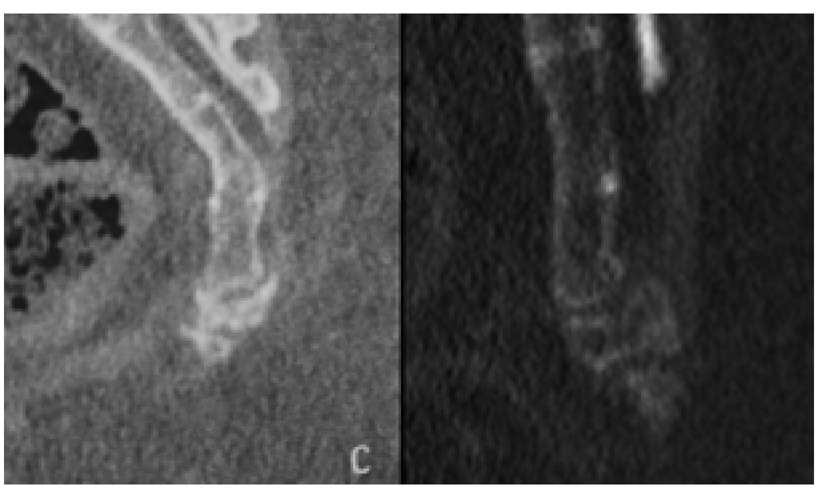

Figure 16. Two cases of compression fracture of C1, virtually invisible on standard films.

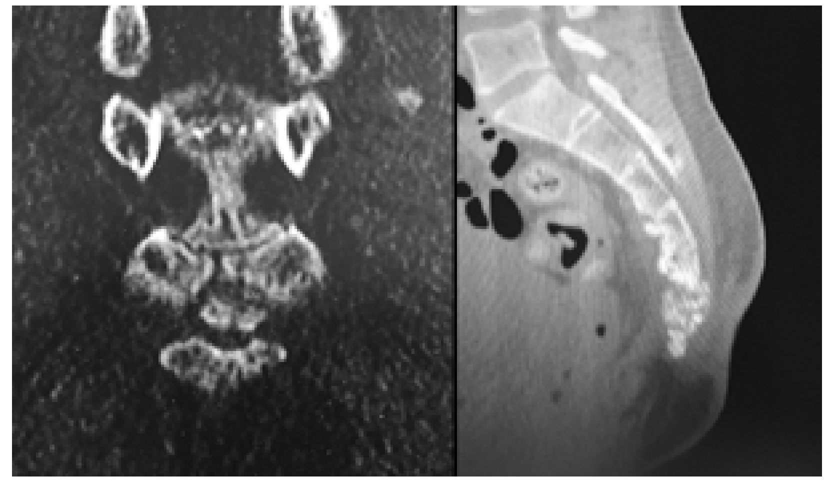

Figure 17. CT in sagittal and coronal sections in two different patients. Non-consolidated fracture of C1. Persistent bone fragmentation is noted on the right.

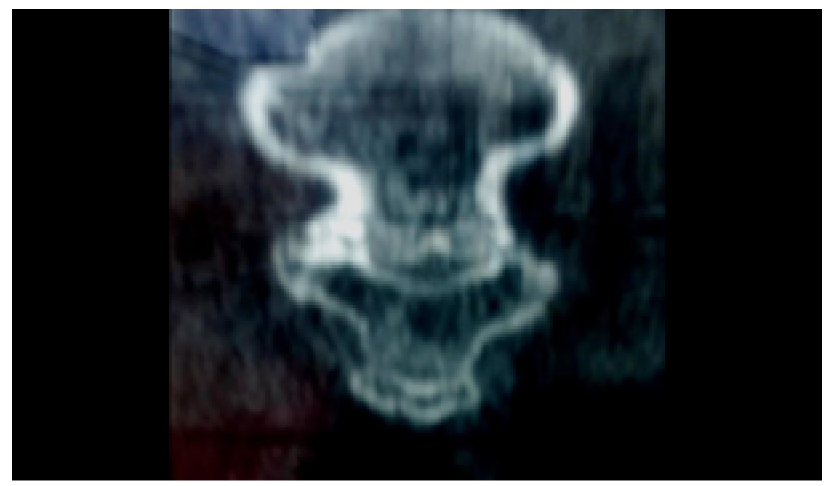

Figure 18. CT in coronal section. Bone disturbances consistent with lateral osteophytes with condensation of the subchondral bone, which may fall within the framework of osteoarthritis.

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