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Article

# Medico-legal implications of C1 vertebral fractures. Case report

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## Medico-legal implications of C1 vertebral fractures. Case report

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**Abstract:** *Introduction:* The upper C1-C2 column is the subject of several erroneous diagnostics. The most common mechanisms of injuries include fall from high-impact skulls, car accidents, etc. Vertebra C1 can also be injured by mild trauma. The Japanese show that atlas fractures occur in about 2-13% of the cervical spine fractures and about 1.3% of the total spinal cord injuries. It is underlined that CT examination is the most useful diagnostic method. The Czechs show that the atlas lesions appear in 1-2% of the cervical spine lesions. Americans reported fracture of the atlas in 7% of the cervical spine fractures. Even if CT has shown its value, lateral radiography is recommended in C1-C2 fractures. When victims are children or people injured in high-speed car crashes, the reported mechanisms were the fall from a high level and the impact on the tip of the flexed skull. The Italians mention that the C1-C2 area is the most exposed diagnostic area with errors. *Material and methods:* given the difficulty of establishing a diagnosis of C1 type fractures, we present in this paper such a case. We highlight the value of a CT scan. The victim is a 26-year-old woman with a trauma from the wall. The main issue in this case is that the diagnosis made by the radiologist seems to be wrong, the electronic and imprinted copies are of inferior quality. A second opinion revealed a very fine fracture that seemed to come from an older date than the date when the victim claimed she was assaulted. The better the lesions, the more misleading the interpretations. Any imaginary imaging lesion, especially if it is obvious in electronic reconstructions, must be brought to the attention of the physician if they are taken into account by "image". The axial CT sections may omit some lesions under certain conditions, for example at the upper and lower poles of a spherical, ovoid or cubic structure, such as the atlas lateral mass. *Conclusions:* the diagnostic solution in this case is the reconstruction of the axial sections in several planes. The crack can be highlighted, in the case of a reconstructed image, only after stacking the axial images. The mechanism could be through sudden

compression, during a sudden head movement, uninitiated and uncontrolled by the neck muscles, when a movement occurs over the degree of elasticity of the occiput-atlas joint, the occipital condyles compressing abruptly, unilaterally one of the atlas masses. In such clinical cases, we experience pain, muscle contraction and torticollis, on a normal neurological background.

**Key words:** C1 fracture, diagnosis, injury mechanism

### **Literature data**

The upper cervical vertebral spine (C1-C2) is the most predisposed area for an erroneous diagnosis. The most frequent mechanisms in such injuries are fall from a height with cranial impact, active hitting of the skull, traffic accidents. The C1 vertebrae can also be injured in minor trauma, often miss looked.

The Japanese studies show that atlas fractures are encountered in 2-13% of all cervical spine injuries and approx. 1,3% of all vertebral injuries. Also, it highlights the importance of the CT examination in the diagnosis of cervical fractures. (1)

Czech studies reveal that atlas injuries account for 1-2% of all vertebral fractures and 7% of all cervical fractures. Atlas fractures are either isolated or associated with axis or occipital condyle injuries (2).

The Americans show that atlas fractures make up for 10-10,7% of all cervical fractures. Although the CT examination is, usually, superior to the X-ray, in case of C1-C2 fractures it's recommended a lateral incidence X-ray investigation. In children, the reports of C1 isolated fractures only involved the anterior arch. As a mechanism of injury in children, there are mentions of falling from a height with vertex impact, while the cervical area is flexed or after high-speed traffic accidents (3, 4).

The Italians mention the upper cervical area (C1-C2) is the topographical area most predisposed to an erroneous diagnosis. Missing if such fractures in x-ray examination involves neurological complications for the patients and subsequent medico-legal involvement of the physician. Diagnosis error may occur due to a confusion with osteoporosis or to the poor quality of radiological examination. Suspicions of C1-C2 injuries can be clarified after CT examination (5).

### **Aim of the paper**

We report such a case due to its rarity and to accentuate the utility of correct interpretation of the CT scan in order to avoid juridical errors.

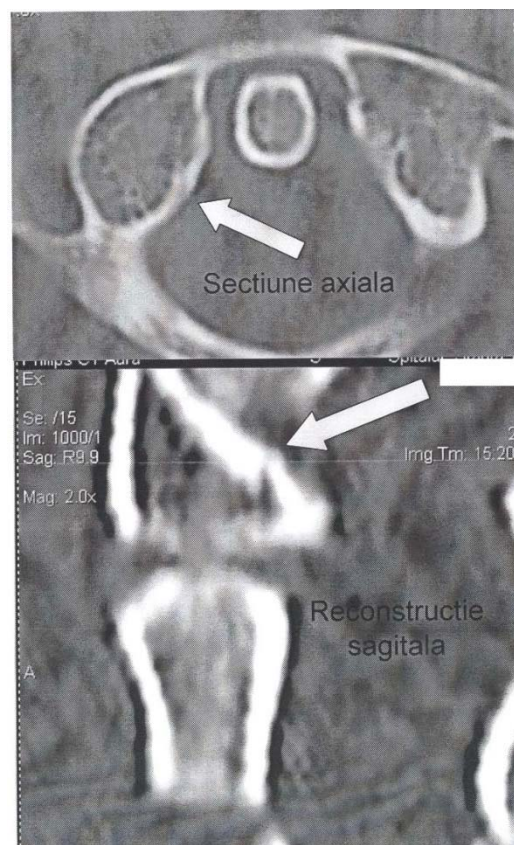
### **Material and method**

A 26 years-old female patient suffered an injury after being hit against a wall. She is examined 7 days later in the medico-legal cabinet, presenting Philadelphia cervical collar. The medical documents mention, at the moment of the initial examination, spontaneous and pressure pain in the upper cervical spinous processes (C1-C3) and right occipital epicranial hematoma. The cervical x-ray didn't reveal any obvious fractures, and correct alignment of the anterior and posterior

wall. The axial CT examination (performed immediately after the injury), reveal a vertical fissure, with no displacement, of the right lateral mass of C1 vertebrae. In the C1-C7 segment, there are no other obvious posttraumatic changes and no signs of medullar compression (figure 1). The therapeutical attitude involved Philadelphia cervical collar for a month and recommended control CT examination after this interval. Due to suspicions on the correctitude of the diagnosis, the CT images (both printed and electronical) were reinterpreted by another specialist, who concludes that the initial diagnosis (“vertical fracture (fissure) with no displacement, involving the right lateral mass of the C1 vertebrae”) has no correspondent in the axial sections, on the Sp 3 spinal slice, where the is no cortical interruption; however, the evaluation may have been limited by the limited visualization capacity of the “windows”. Also, it was mentioned that neither the printed or electronical copies of the CT examination, didn’t have diagnostic quality, especially when it comes to subtle injuries. The diagnosis of such injuries has to be performed on the CT workstation, with special diagnostic software. 18 days after the injury, due to the discordance of the two diagnostics, a new examination was requested, with a higher performance apparatus. The investigation revealed a cortical fracture involving the internal spongious mass of the right lateral mass of C1 vertebrae (incomplete fracture of the lateral mass) (figure 2).



Figure 1 - CT image immediately after trauma





**Figure 2** - CT scan after 18 days

The conclusion was that the patient had a stabile injury, which doesn't need immobilization in more aggressive contention systems (halo-vest or casted minerva), Philadelphia collar being enough for both antalgic purpose in for prevention of vicious consolidation.

Due to the incertitude, the two CT images were compared and discussed in the neurosurgery service, concluding that they weren't conclusive for the diagnosis of right lateral mass fracture. It was recommended a classic tomographical examination (not computer tomography) centered on the assumed injury.

## Results

Even if the x-ray may omit traumatic injuries, especially fissure-type, there would be

no contradiction for the CT examination which would suggest a fracture (10).

Spiral CT is the most performant current examination, the first choice in cervical spine injuries. In hospitals in which this technology is available, it should be applied from the beginning, with no preceding X-ray.

Planning the CT examination, as far as number of sections, finesse and interval goes, depends on the clinical recommendation (actually, no radiological examination shouldn't be performed in the absence of clinical indication). A clinically unoriented examination or excessively detailed can subject the patients to an unjustified large radiation dosage. The examination protocol is configured for revealing the injuries who's reporting may essentially change the therapeutical attitude and not for minimal injuries, in which case the number of injuries may increase if the examination is very detailed.

## Conclusions

The subtler the injuries, the more frequent are the interpretation errors. Any injury imagistically "assumed", especially if it's obvious during electronic reconstructions (computer composed images may be a source of false images – artefacts, unlike classical radiological images which are more subjective) has to be subjected to the clinician's attention, which has to corroborate the results with the clinical picture. The clinical attitude should consider clinically confirmed injuries and not images. On the other hand, if we limit the right of the radiologist to report all imagistic "anomalies", we convert the radiological act

into “judicial” practice and not a diagnostic one (mal-praxis cases in the western world show this tendency of the medical system of working for the lawyers, not for the patients).

Axial CT slices may miss some injuries, in certain conditions as the superior and inferior extremities of a spherical, oval or cubical structure, as the lateral mass of the atlas – case in which the solution is multiple plan reconstruction of the axial slices.

A fissure can be identified, in case of retro-reconstructed image, only after stack-addition of the axial images. The injury, in this case, is limited to the bone spongious area, with no cortical interruption (young bones are elastic and can host such injuries, without cortical interruption). The mechanism could involve sudden compression during a sudden movement of the head, uninitiated and uncontrolled by the neck muscles, when there is a movement exceeding the elasticity limit of the occipital-atlas articulation, the occipital condyles determining a one-sided, sudden compression of the one of the atlas lateral masses.

In such case, we can encounter pain, muscle spasm and torticollis, with a normal neurological exam.

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