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CASE REPORT

Proposed radiographic protocol for central superior mandibular condyle dislocation into the middle cranial fossa: apropos of a case

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Abstract Some difficulties have been described in the diagnosis of a number of reported cases of central superior mandibular condyle dislocation, which involves intracranial penetration of the mandibular condyle. Given that radiology plays an important role in detecting this condition, we herein propose an imaging diagnostic protocol for the management of suspicious superior mandibular condyle dislocation to identify this condition and properly evaluate the damaged tissues. We make reference to the case of a 13-year-old girl, who presented at the age of 7 years with a superior dislocation of the left condyle, which was clinically diagnosed as a probable temporomandibular joint ankylosis.

Keywords Condyle · Superior dislocation · Intracranial penetration · Radiology

Introduction

Dislocation of the mandibular condyle can be defined as a condition in which the condyle is displaced from the glenoid fossa because of movement beyond the normal range of the temporomandibular joint (TMJ) [1]. Dislocation of the mandibular condyle can be divided according to the place where movement of the condyle occurs. Therefore, there are anterior, posterior, lateral, medial, and superior (central and lateral) dislocations. Anterior dislocation of the mandibular condyle is most commonly seen [1]. Conversely, central superior dislocation of the mandibular condyle into the middle cranial fossa (CDICF) rarely occurs [2].

The diagnosis of CDICF often presents difficulties. In some cases, it is established after the first examination, because the initial clinical and radiographic evaluations have failed. The clinical symptoms and signs do not specifically suggest CDICF. Consequently, it is evident that a radiological study is essential in these types of cases [3]. However, the diagnostic imaging method needs to be appropriate, because otherwise it could fail to identify the lesion and its extent. Therefore, it is a key issue to achieve standardization of imaging techniques used to detect and evaluate the damage to tissues after CDICF. Unfortunately, there is no protocol for a diagnostic imaging method to be used in cases of CDICF at the present time.

We herein report a case of a 13-year-old girl with a unilateral CDICF and delayed diagnosis. The CDICF was the result of a traumatic injury caused by a car accident, and was examined by panoramic radiography (PR), cone-beam computed tomography (CBCT), and magnetic resonance imaging (MRI).

The radiological study of this case is described with the purpose of proposing a protocol for a diagnostic imaging method to correctly identify and evaluate the extent of tissue damage arising from a CDICF, with a view to maximizing the diagnostic process in future similar cases.

Case report

A 13-year-old girl was involved in a car accident at the age of 7 years, which provoked a CDICF in her left mandibular condyle. At the time of the accident, she

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showed evidence of injuries in the mandibular region, without loss of consciousness, and was referred to a local hospital. During physical examination, the CDICF was overlooked because the patient did not have any specific symptoms, just limitation of mouth opening that was attributed to a contusion on the mandible. Six years later, she was referred to a dentist because of the limitation in mouth opening, and clinically diagnosed as probable left TMJ ankylosis. The patient was examined by PR, but the examination failed to show the real condition of the TMJ (Fig. 1). A subsequent CBCT examination was successful in picturing the condition of the bony components of TMJ and diagnosing a CDICF, as it revealed a comminuted glenoid fossa fracture (Fig. 2). However, this technique was not able to show the condition of the surrounding soft tissues, especially that of the intracranial tissue, which was properly represented by MRI (Fig. 3).

Discussion

CDICF is an uncommon complication of mandibular trauma, and its production mechanism has been exhaustively discussed in previous studies [3–7]. Although CDICF has the potential to cause important complications, because it can injure the intracranial tissues, its diagnosis has been overlooked, missed, or delayed in a number of reported cases in the literature, similar to the present case. As described by Melugin et al. [4], this could be caused by its infrequent occurrence compared with the more common condylar neck fractures, which can have a similar clinical presentation, together with the absence of specific symptoms and related signs in both cases [3], thus leading to confusion with other less serious types of dislocation or a simple TMJ contusion. Another important fact that could contribute to misdiagnosis of a CDICF is the incorrect prescription of appropriate diagnostic imaging techniques.

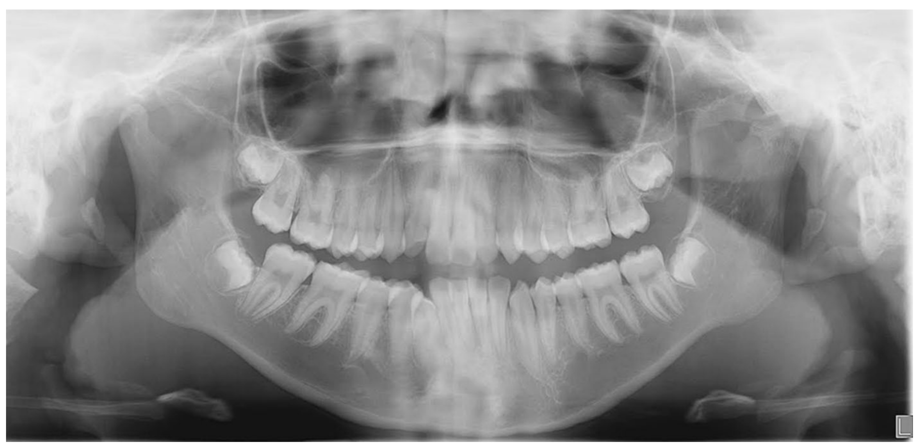

Fig. 1 PR that failed to show a central superior dislocation of the left mandibular condyle. This technique only demonstrated shape alteration of the left condyle together with a more radiopaque area at its neck and mandibular middle line deviation toward the injured TMJ

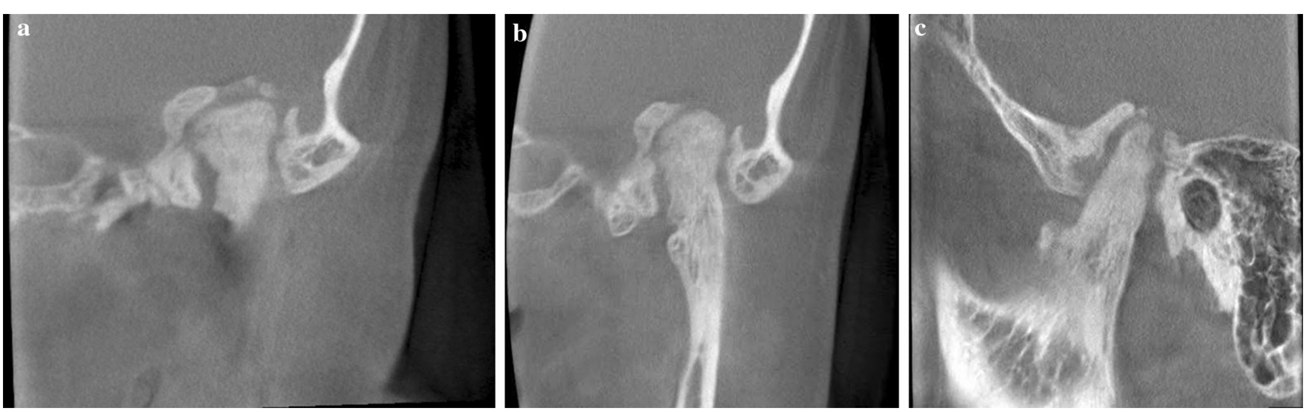

Fig. 2 CBCT images of the left TMJ. **a**, **b** Images of coronal slices. **c** Image of a sagittal slice. The images clearly show that the mandibular condyle has penetrated into the skull, producing a comminuted fracture of the glenoid fossa. The images also show morphological alterations and remodeling in the neck and head of the dislocated left condyle as well as remodeling in the fractured glenoid fossa

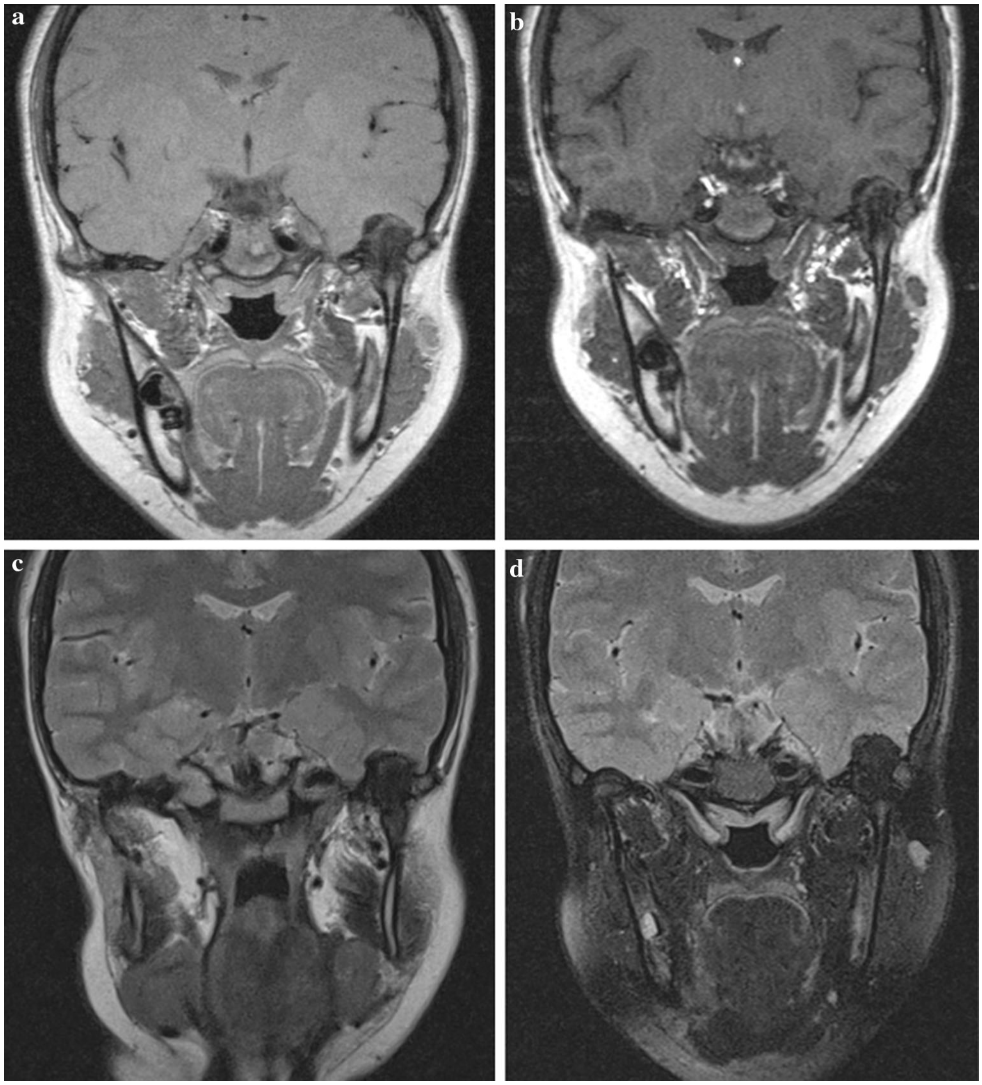

Fig. 3 MRI images. **a** Proton density image. **b** T1-weighted image. **c** T2-weighted image. **d** STIR sequence image. The images show displacement of the temporal lobe tissue of the brain caused by a CDICF of the left mandibular condyle, without changes in the normal signal intensity on the pericondyle tissue of the brain

Currently, diagnostic imaging plays an important role in the assessment of patients with dental and maxillofacial pathology. Although PR has become one of the most requested imaging techniques in dentistry, it has limited efficiency in identifying CDICF, first because PR is a two-dimensional projection that cannot accurately represent the anatomical structures through overlapping and geometrical distortion, and second because it does not allow visualization of fine details, thus affecting its radiographic accuracy and leading to loss of information [8].

Conversely, CBCT is a relatively recent technology capable of providing accurate, submillimeter-resolution images that allow multiplanar visualization of areas of interest [9], and has become a powerful tool in dental and maxillofacial pathology diagnosis. CBCT provides high-contrast images, and is therefore particularly adequate for imaging osseous structures [9], but unfortunately is far from adequate for reflecting differences in soft tissues. Consequently, although it is possible to diagnose damage to hard tissues in a CDICF by CBCT, it is not possible to identify related soft tissue injuries. Thus, in cases of CDICF, it is absolutely necessary to complement the CBCT examination with image acquisition systems that have appropriate contrast resolution to permit distinction of differences between soft tissues to allow a thorough evaluation of potential damage to the cerebral mass.

Multi-slice computed tomography (MSCT) is an appropriate technique to evaluate both osseous and soft tissues. Furthermore, it has been stated that use of MSCT imaging is the gold standard for evaluating intracranial condylar penetration injuries [7], and could thus be used instead of CBCT in cases of suspicion of CDICF.

Nevertheless, despite the fact that MSCT is an important resource for identifying and evaluating the damage provoked by a CDICF, it does not reach the efficiency of MRI for imaging differences among low-contrast tissues [10]. Additionally, clinical applications of MSCT in dentistry have been limited because of the significantly higher equipment cost, less access to this type of technology, and above all, its higher radiation dose to patients [11] compared with CBCT.

MRI is a multiplanar diagnostic imaging technique that has several advantages over MSCT, despite its lower spatial resolution. MRI is the best method to distinguish differences between soft tissues because the image contrast can be finely optimized with a variety of selectable parameters that affect the type and quality of information provided, thereby allowing the depiction of anatomy and pathology in greater detail [12, 13]. This is because the individual gray areas in MRI images represent different local micromagnetic properties of different evaluated tissues [14], providing high-contrast resolution. Additionally, MRI does not use ionizing radiation, and MRI contrast agents have a considerably lower risk of causing potentially lethal allergic reactions. Hence, MRI has become the method of choice in the detection and characterization of disturbances in low-contrast tissues. Therefore, MRI should be the main method for depiction of soft tissues involved in a CDICF, given that its contrast resolution is better than that of MSCT.

In the present case, we demonstrated that PR failed to show a CDICF. Although CBCT showed the bony damage at the TMJ and middle cranial fossa with high efficiency, it failed to demonstrate the soft tissue involvement at the intracranial structures. Finally, MRI properly represented the state of the intracranial tissue adjacent to the condyle penetration. As a consequence, we propose a protocol for an imaging diagnostic method in cases of serious mandibular trauma with suspicion of CDICF, which involves CBCT as an initial screening to confirm or exclude that condition. In cases with condyle superior dislocation, it is necessary to complement the examination with MRI. However, in cases where MRI is not available, both CBCT and MRI could be replaced by MSCT with intravenous contrast.

Conclusions

CDICF may be missed or delayed, and requires thorough clinical examinations and advanced imaging methods because of its potential to produce serious neurological complications. A radiographic examination is very important for both identifying the dislocation and determining the presence and extent of damage to the surrounding hard and soft tissues. We have proposed a protocol for cases of severe mandibular trauma, using CBCT as an initial screening to confirm or exclude CDICF, followed by use of MRI as a complement to CBCT when CDICF has occurred. In cases where MRI is not available, we recommend the use of MSCT with intravenous contrast instead of CBCT and MRI.

Compliance with ethical standards

Conflict of interest Jorge Pinares Toledo and Ricardo Urzúa Novoa declare that they have no conflict of interest.

Human rights statements and informed consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later versions. Informed consent was obtained from all patients for being included in the study.

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