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CASE REPORT

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Isolated Transverse Clivus Fracture without Neurodeficit: Case Report and Review of Literature

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Summary

Background: Clivus is a bony surface in the posterior cranial fossa, serving as the support of the brainstem and thus neighboring important structures because of its location. Skull base fractures that cannot be shown by conventional radiography can be clearly imaged by high-resolution bone window computed tomography.

Case Report: A 44 years-old male referred to the emergency department because of a traffic accident in the car. His only complaint was a severe neckache. His X-ray examination showed no pathology. The computed tomographic examination showed no parenchymal pathology, but a isolated transverse fracture in the clivus.

Conclusions: The computed tomographic examination showed isolated transverse fracture in the clivus our case presented in this paper is the first case of transverse clivus fracture without additional cranial bone fracture and neurologic deficit in the literature.

MeSH Keywords: Fractures, Bone • Neurologic Manifestations • Tomography, Spiral Computed

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Background

Clivus is a part of the posterior cranial fossa, serving as the support of the brainstem and thus of the neighboring important structures because of its location. Synchondrosis between the exo-occipital bone and the basi-occipital bone starts to fuse at the age of 3–4 and that between the exo-occipital bone and the spheno-occipital bone at puberty. The fusion is completed at the age of 18. These structures cannot be visualized in radiography [1].

In the past, the diagnosis of clivus fractures was established by an autopsy of cases that had a serious head trauma with a high mortality rate, and generally by symptoms such as cerebro-spinal fluid rhinorrhea or fistula, due to the insufficiency of radiological methods before the introduction of computed brain tomography. With the implementation of computed brain tomography, the number of diagnosed cases of clivus fracture has increased, and with retrospective screenings, the incidence of clivus fracture has been found to be at 0.33–0.56% [2]. Because of the location of the clivus, its fractures can cause multiple cranial nerve deficits, brainstem trauma, and vascular complications. Brainstem trauma and vertebrobasilar artery occlusion are the causes of a high mortality rate [2].

Currently, skull base fractures that cannot be shown by conventional radiography can be clearly imaged by high-resolution bone window computed tomography (CT) [3]. Therefore, clivus fractures can be diagnosed easily, and their location and complications can be determined immediately [2,3]. The frequent use of CT in cases of skull base fractures has necessitated the classification of these fractures into three groups: transverse, longitudinal, and oblique fractures.

As far as we know, the case presented in this paper is the first one of transverse clivus fracture without additional cranial bone fracture or neurologic deficit in the literature.

Case Report

A 44-year-old male was referred to the emergency department because of a traffic accident. When he arrived to the department, his general condition was good; he was conscious, oriented, and cooperative. His Glascow coma scale (GCS) was 15. His only complaint was a severe neck ache. His X-ray examination showed no pathology. The computed tomographic examination showed no parenchymal pathology but rather an isolated transverse fracture in the clivus (Figure 1). No vascular pathology was detected in his CT angiography. The patient was hospitalized, and his pain was reduced with medical therapy. The patient was discharged wearing a Philadelphia cervical collar. No pathology was found in his monthly follow-up.

Discussion

Isolated clivus fractures are rare cases. With the use of computed brain tomography, the number of diagnosed cases with clivus fracture has markedly increased. Three-dimensional CT images are helpful in the diagnostics of clivus fracture.

Clivus is a part of the skull base that forms a sloping process at the anterior portion of the basilar occipital bone at its junction with the sphenoid bone and neighboring brainstem, cranial nerves, and vertebrobasilar vascular system. Clivus fractures have been reported in severe blunt skull traumas and mild traumas of the skull [2]. Cases with clival fractures reported in the literature have increased in number following the introduction of CT as a diagnostic method. One of the largest series reported on is that by Ochalski et al. [4], who presented 6 (14.6%) cases with a transverse fracture from among 41 cases of clival fracture. Four of the patients in that group had a fatal prognosis. Among the 41 patients, 33 (80.5%) had intracranial hemorrhage, 40 (97.6%) an additional cranial fracture, 10 (24.4%) neurological deficit, and 2 (4.9%) vascular injury [5–12]. The studies conducted on transverse clival fractures are summarized in Table 1. In retrospective studies on the incidence of clivus fractures, Corradino et al. [2] diagnosed clivus fracture in 17 (0.56%) out of 3,000 patients, Menku et al. [4] in 9 (0.36%) out of 2,500 patients, and Joslyn et al. [5] in 11 (0.55%) out of 2000 patients. Ochalski et al. [6] determined the incidence of clivus fracture at 0.33% in the pediatric group of patients. No study has been conducted yet on the incidence of an isolated clivus fracture [6].

Clivus fractures are most frequently observed in male subjects of young age and in traffic accidents. Longitudinal clivus fractures have been considered to usually occur following a severe concussion to the occipital region and transverse and oblique fractures after a severe axial blow. Our case had a severe axial blow. Direct radiography plays a small role in the diagnostics of clivus fractures. CT scan is important in the diagnostics. Magnetic resonance (MR) imaging is superior to CT in showing the brainstem and parenchymal structures [1–7]

Clival fractures are classified according to their image in computed brain tomography as longitudinal, transverse, and oblique [2]. These fractures may have different clinical

Figure 1. Sagittal CT image showing a clivus fracture (black arrow).

images. Longitudinal fractures occur between the foramen magnum and the corpus of the sphenoid bone. They are generally rare. In such fractures, the possibility of vascular damage is high and the rate of mortality is higher than in any other clival fractures [2,3,7,8]. A mortality rate of 67–80% has been reported on [2]. Longitudinal fractures may cause occlusion, narrowing, trapping in the fracture, and aneurysm, particularly in the vertebrobasilar system [1–3,6,7]. Transverse fractures are more common, have a low rate of mortality, and may cause multiple cranial nerve deficits and vascular damage in the front part of the brain [1–7,9]. Oblique fractures extend from the lateral of the dorsum sellae to the petroclival fissure on the other side.

The vascular complications of clival fractures may include carotid cavernous fistula, aneurysm, and vertebrobasilar occlusion [2]. For this reason, in cases of suspected vascular pathology, direct cerebral angiography, CT angiography, or MR angiography should be performed. Although multiple cranial nerve deficits can occur in clival fractures, the most frequently damaged nerve is the 6th nerve adjacent to the clivus. In transverse fractures, the bilateral nervus abducens can also be affected [8]. Endocrine problems, as reported in cases with severe skull traumas, can also arise from clival fractures [2]. Cerebro-spinal fluid fistula has been reported to be a result of brainstem injury because of the location of the lesion [2]. Our case showed no parenchymal or vascular pathology caused by the transverse fracture.

In transverse fractures, a high likelihood of complications may occur because of the proximity. These complications are carotid artery occlusion and narrowing, carotid cavernous fistula, damage to the pericarotid oculosympathetic plexus, multiple nerve damage such as damage to the 6^{th} and 7^{th} cranial nerves, Horner syndrome, and pituitary dysfunction. The mortality rate of transverse fractures is lower than that of other types of clival fractures [1,11,12]. Our case had no other fracture and had normal vascular

Table 1. Cases of transverse clival fracture in the literature.

Cases reported by	Age/ gender	Additional cranial fracture	Neurologic deficit, additional findings	Prognosis
Khan and Zumstein [10]	19/M	• Fracture in petrous bone	• Deficit in cranial nerves 3, 6 and 7	GCS: 15
Arizavakan et al. [12]	18/M	• Left anterior cranial fossa base • Fracture in roof of right orbit	• Ophthalmoplegia and bilateral multiple cranial nerve palsies • Diffuse pneumocephalus with extension into lateral • Subarachnoid hemorrhage	–
Evers et al. [11]	43/M	• Left occipital fracture • Fracture of the atlas, anterior arch	• Retrograde amnesia • Mild motor deficit	Home
Okten et al. [1]	19/M	• Fracture in petrous bone	• GCS: 3-4	Death
Ochalski et al. [6]	32/F	• Petro-occipital fracture • Occipitomastoidal fracture	• SDH	GCS: 5, home
	16/M	–	• SAH • ICA dissection	Rehabilitasyon
	15/F	• Sphenooccipital fracture • Petrooccipital fracture • Occipitomastoidal fracture	• EDH • SDH, contusion • Bilat MCA & ACA infarcts	Brain death
	6/M	• Occipitomastoidal fracture	• SAH, EDH • CN VII palsy • Bilat CN VIII palsy	Home
	16/M	–	• SAH • ICA dissection • GCS: 7	Rehabilitasyon
Menkü et al. [4]	25/M	–	• Right CN VI palsy	Improvement
	17/M	–	• Left CN III palsy • Bilateral CN VI palsy	Death, 7 days
	45/F	–	• CN II palsy • Bilateral CN VI palsy • Left CN VII palsy • Left Blindness	
	54/M	–	• Left VI	Improvement
	6yo	–	–	Death
Sanders and Vander [7]	16/F	–	• CN V, VI, VII paralysis • Horner syndrome	GCS: 15
	-	–	• CN VI,VII paralysis • Horner syndrome	GCS: 15
	9/F	–	• CN III, IV, V, VI,VII paralysis • Horner syndrome • ICA stenosis	GCS: 15
Kapila and Chakeres [9]	21/M	–	• Bilateral CN VI paralysis • CSF otorrhea • CCF	GCS: 15
Corradino et al. [8], Joslyn et al. [5]*	6/17 Transvers clivus fracture case, 32 yo (mean)	–	• CN III, IV, V paralysis • Bilateral CN VI, VII paralysis	Death, 10–58.8%
Our case	38/M	–	–	GCS: 15, home

M – male; F – female; GCS – Glasgow coma scale. * Previous study included 11 of the 17 patients presented in the study by Corradino et al. [8].

structures as determined by CT angiography and bone window CT.

Therapy for clival fractures is determined according to the clinical picture and symptoms of the patient. If no ligament instability or C0/C1 dislocation is present, the patient is required to wear a halo device and be followed up for three months. In case of radiological stability, follow-ups are continued. If ligament damage or C0/C1 dislocation or instability occurs while wearing the halo at the end of the follow-up, C0/C1 fusion should be performed. In cranial pathologies, patients with a poor general condition or asymptomatic patients should be followed up. Symptomatic patients should undergo surgical decompression based on their clinical findings. Surgical therapy is difficult and leads to high morbidity and mortality [1–4,6,7,10]. As our case was asymptomatic, he only required follow-up.

Conclusions

Clival fractures, which have been increasingly diagnosed after the introduction of CT scan as a diagnostic method, are reported on much in the literature. As shown in our case, clival fractures can occur without causing neurologic deficit and/or without an accompanying skull base fracture. Moreover, they can give normal radiological findings. Therefore, bone window CT scans of high-energy trauma patients should be studied carefully.

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