



# Posttraumatic Parinaud's Syndrome as a Contrecoup Injury in a Case of Closed Head Trauma

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## Abstract

The purpose of the study was to present a rare case of post-traumatic Parinaud's syndrome with a history of closed head injury. The clinical characteristics, examination, and management are presented in a 12-year-old boy who was a victim of physical violence at the hands of a young boy who punched him in his chin with his fists, with associated paralysis of the upward gaze of the left eyeball, and convergence nystagmus with pupillary involvement. CT examination indicated posttraumatic lesions in the dorsal midbrain and in the cavity of third ventricle, suggestive of acute hemorrhages. Posttraumatic Parinaud's syndrome is a rare phenomenon that can occur in a case of closed head trauma as contrecoup injury.

## Keywords

closed head trauma, contrecoup injury, CT examination, Parinaud's syndrome, traumatic brain injury

## INTRODUCTION

Child abuse syndrome is a serious medico-social problem, which unites different forms of abuse against children – physical, sexual, or emotional maltreatment, and child neglect. Many traumatic injuries are determined as predictors of physical child abuse, including presence of abusive head trauma, fingertip bruises on arms, fractures of ribs, corner or bucket handle fractures, bilateral rib fractures, fractures of different ages, human bite marks, and also scalding burns.<sup>1</sup> Numerous cases have been described in the forensic literature that present with uncommon clinical and morphological manifestations, which also can be evidence of physical child abuse. Parinaud's syndrome (PS), also known as the dorsal midbrain syndrome, was first

described by the French ophthalmologist H. Parinaud in 1883. This syndrome manifests with specific clinical features such as vertical paralysis of eyeball movement, convergence paralysis, and pupillary involvement.<sup>2</sup> The causes of this pathological condition usually include pineal gland tumors, midbrain infarction, multiple sclerosis, midbrain hemorrhages, infections of the brain, obstructive hydrocephalus or arterio-venous malformations.<sup>3</sup> Encephalitis, demyelination, brain abscess, trauma, posterior tentorial herniation, and Wernicke's syndrome are rare causes of the syndrome.<sup>4</sup> The basic cause of PS is dependent on age. Neoplastic causes are more common in children and young adults, and vascular damage causes are more common in the middle-aged and older people. We present an uncommon case of the post-traumatic PS in a child to

underline the importance of this disease which must be listed in the differential diagnosis of the traumatic brain injury. It is a rare phenomenon reported in the literature that can occur in isolation, without any other neurological deficits, cerebral damage, and skull fractures after traumatic brain trauma. It can cause significant difficulties during the examination of dead bodies and skeletal remains as a result of traumatic brain injury. Thus, the post-traumatic PS can be the weak link in a clinical practice, the forensic pathology and forensic anthropology.<sup>5-9</sup>

Alberto Galvez-Ruiz reviewed nine patients with a history of brain trauma secondary to automobile accidents and associated vertical gaze paresis with post-traumatic contusion of thalamic-mesencephalic region corresponding to the artery of Percheron.<sup>10</sup> In general, the available studies in the literature explained this pathogenesis by the unique anatomy of the angle of penetration of the thalamoperforating and lenticulostriate arteries. It makes these vessels more susceptible to selective vascular damage in a traumatic brain trauma. In the literature, post-traumatic cerebral infarction, irrespective of its types, is a complication that occurs in 1.9% to 10.4% of all cranioencephalic traumas.<sup>11,12</sup> A lot of mechanisms take part in the pathology of posttraumatic cerebral hemorrhage: vascular compression due to cerebral edema, cerebral vasospasm, embolism<sup>13</sup>, formation of cavitation bubbles at the contrecoup<sup>14</sup>, bursting of brain vessels due to the vascular pressure spike<sup>15</sup>, etc.

In this study we present a patient with a history of closed head impact and clinical signs of PS. This study evaluates the etiopathogenic mechanisms of damage in this specific region (dorsal midbrain) in this patient. We hypothesize that the pathogenesis of this damage occurs as a contrecoup injury. On the other hand, the forensic pathologist must check very carefully this region for the presence of any injuries to reconstruct the mechanism of the brain trauma in the case of examination of a dead body. In some cases the posttraumatic PS must be discussed as a presentation of contrecoup injury.

## CASE REPORT

*The presented case is a 12-year-old boy who was a victim of physical violence at the hands of a young boy who punched him in his chin with his fists. The boy was found unconscious on the ground, with froth around his mouth. The boy was admitted to the Emergency Department at St George University Hospital in Plovdiv. After a prompt CT examination of the head, and review from a neurosurgeon, he was transferred to the Neurosurgery Department of the same hospital with a severe brain trauma. The patient was admitted to the Neurosurgery Ward slightly disoriented, with a blood pressure of 120/80, pulse rate of 55 beats per minute, paralysis of upward gaze of the left eyeball, and convergence nystagmus with pupillary involvement – the Parinaud's syndrome. A CT scan of the cranium highlighted poorly circumscribed hyperdense*

*lesions in the dorsal midbrain and in the cavity of the third ventricle, suggestive of acute hemorrhage (Fig. 1).*



**Figure 1.** CT scan of the cranium highlighting poorly circumscribed hyperdense lesions in the dorsal midbrain and in the cavity of the third ventricle, suggestive of acute hemorrhage.

*With conservative therapy including methimazole, dicyanone, calcium gluconate, and mannitol, ocular symptoms improved in approximately one week, and when the patient was completely symptom free, he was discharged without any negative outcomes.*

## DISCUSSION

There are few reported cases of Parinaud's syndrome of traumatic origin.<sup>16-18</sup> In most cases of head injury, there are two main mechanisms resulting in head trauma: linear acceleration and angular acceleration of the head. In the first case, force is applied through the center of gravity of the brain, and there is only a linear transmission of the energy. It usually manifests with injuries in the area of the impact, and sometimes with injuries located on the opposite side of the impact as contrecoup. In angular acceleration, the direction of the impact and energy does not pass through the center of gravity of the brain. The direction of the energy is usually below or above the center, and it results in a rotational movement of the brain. In this condition the brain is unable to follow the rapid and sudden rotation of the head and skull, resulting in a typical brain injury. Anatomically, the brainstem is firmly fixed in the area of the cerebral falx, and thus, injury results in deformation of the brain matter in the region of the greatest pressure.<sup>19</sup> Some

authors explain brain trauma in the region of the brainstem by setting up a wave of fluids in the third ventricle, which breaks with the greatest force the aqueduct of Sylvius<sup>20</sup> or the posterior commissure. The posterior commissure consists of a number of neuronal cell bodies that form its core. Its lesions often cause impairment of the vertical gaze associated with PS.<sup>10,21</sup>

Basically, the signs and symptoms of Parinaud's syndrome are caused by compression of the rostral midbrain and pretectum at the level of the superior colliculus. Limited conjugate up gaze occurs because of the involvement of the vertical gaze centres that are in close proximity to the superior colliculus. Retraction nystagmus is caused by the damage of the supranuclear fibers, which have an inhibitory effect on the midbrain convergence or divergence neurons. The third component of the Parinaud's syndrome is pupillary involvement. The pupillary light reflex fibers synapse at the pretectal nucleus, pass through to the Edinger-Westphal nucleus and the posterior commissure.<sup>3</sup>

Based on the anatomical location of the lesions on brain CT scan and the clinical examination of characteristics of the upward gaze paresis in the patient, it was assumed that there was an injury to the superior mesencephalic region and posterior commissure in the territory of posterior cerebral artery. The absence of thalamic signs ruled out damage to the artery of Percheron. We propose the mechanisms of formation of contrecoup injury (as already discussed) as the pathogenic cause of post-traumatic PS during a front head trauma.

## CONCLUSIONS

Usually, injuries in the area of the brainstem are severe and in most cases they are fatal without any treatment. In rare cases brainstem trauma could be firstly manifested with Parinaud's syndrome. Timely diagnosis and adequate treatment in such case is crucial to saving the patient's life. Medical staff should be aware of this rare clinical presentation of head trauma in children, as it is an avoidable cause of death with the proper knowledge.

Finally, in dead bodies suspected of closed head injury, the forensic pathologist must take samples from the brain tissue around the aqueduct of Sylvius, the posterior commissure, dorsal midbrain, and pineal gland for the presence of any contusions or cerebral hemorrhages as contrecoup injuries. This will be necessary to reconstruct the direction of traumatic force and determine the cause, mechanism, and manner of death.

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# Посттравматический синдром Парино как контррецидивное повреждение при закрытой черепно-мозговой травме

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## Резюме

Целью данного исследования было представить редкий случай посттравматического стрессового расстройства Парино с закрытой черепно-мозговой травмой в анамнезе. Клинические признаки, обследование и лечение были представлены у 12-летнего мальчика, подвергшегося физическому насилию со стороны подростка, который ударил его кулаком в подбородок, с сопутствующим параличом взора вверх по левому главному яблоку и конвергентным нистагмом, включающим зрачок. Компьютерная томография показала посттравматические поражения дорсальной части среднего мозга и полости третьего желудочка, предполагающие острое кровоизлияние. Посттравматическое стрессовое расстройство Парино — редкое явление, которое может возникнуть в случае закрытой черепно-мозговой травмы, такой как контрацептивная травма.

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## Ключевые слова

закрытая черепно-мозговая травма, противорецидивная травма, КТ, синдром Парино, черепно-мозговая травма

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