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1962

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### Recommended Citation

Andre A. Weil, *Electroencephalography (EEG) in Head Injuries*, 11 *Clev.-Marshall L. Rev.* 541 (1962)

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## *Electroencephalography (EEG) in Head Injuries*

*Andre A. Weil\**

**C**LINICAL ELECTROENCEPHALOGRAPHY has gained remarkably in popularity during the past twenty years. Correspondingly we find it with more frequency in medico-legal problems, particularly the ones pertaining to head injuries.

In general it can be stated that EEG abnormalities found in cases of head injury correspond both in severity and localization with those of brain damage. Often the EEG proves to be a more sensitive indicator for the degree of brain damage than the clinical state and the neurological examination would indicate. The great difficulty the electroencephalographer encounters in assessing "post-traumatic EEG tracings" pertains to the fact that pre-injury electroencephalograms are rarely available on the patient who had or claimed to have had an injury. The EEG in some cases even may be helpful in assessing prognosis of a head injury case, but the experienced electroencephalographer has learned to shy away from records taken too soon after a head injury. Electroencephalograms obtained after several days are a much more reliable guide than those obtained within a few hours after head injury. It also should be mentioned that one single electroencephalogram obtained following a head injury is by no means as meaningful as so called "serial" electroencephalograms which may demonstrate resolution or, in some cases, aggravation of electroencephalographic disturbances, particularly when such serial electroencephalograms are obtained at regular intervals following the head injury in question.

In 1951, fifty patients were studied who suffered from what is commonly called "post-traumatic encephalopathy".<sup>1</sup> The etiology covered a wide variety of cranial traumas, ranging from simple prolonged post-concussion syndrome to open and closed focal injuries to the brain, residuals of penetrating injuries and simple and comminuted fractures. However, recent acute brain

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<sup>1</sup> Weil, *Electroencephalographic Findings in Post-traumatic Encephalopathy*, 1 *Neurol.* 293-297 (1951).

injuries were excluded. In spite of the variety of injuries certain clinical features were common in all case histories, namely headaches, dizziness, (especially on change of posture), psychomotor fatigue, frequent disturbances of equilibrium and forgetfulness. It was noted that: (1) the abnormality of electroencephalograms increased with the severity of trauma, (2) that there was a definite increase of abnormal electroencephalograms in patients who retained clinically demonstrable neurological abnormalities, (3) that there was a significant increase of focal electroencephalographic abnormalities in patients of the latter group. However, perhaps the most significant finding was that 41% of patients without neurological abnormalities showed irregularities of the electroencephalogram indicative of organic pathology even though in repeat tracings such abnormalities eventually frequently diminished in severity or disappeared altogether.

**EEG in mild head injuries.** In mild head injuries the duration of the post-traumatic amnesia amounts to seconds or at most to a few minutes. Most clinicians use the term "concussion" and there is no clinical evidence of focal brain damage and recovery is uncomplicated, speedy and complete. When such a mild injury is experimentally produced in an animal for several seconds there is a reduction of the amplitude of the electroencephalogram followed by slowing of the background pattern for several minutes before the record returns to normal.<sup>2</sup> Dow, Ulett, and Raaf<sup>3</sup> by setting up an EEG laboratory in one shipyard obtained a number of records from workers with mild head injuries within ten minutes of their accident. Even though many of these records were still within normal limits a certain percentage showed very definitely diffuse slowing of background activity, which disappeared within a few minutes to hours. However, if impairment of consciousness was still evident at the time of EEG recording then the EEG was usually abnormal. In some of these cases, however, EEG changes persisted for some time after the head injury.

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<sup>2</sup> Williams & Denny-Brown, *Cerebral Changes in Experimental Concussion*, 64 *Brain* 223 (1941).

<sup>3</sup> Dow, et al., *Electroencephalographic Studies Immediately Following Head Injury*, 101 *Am. J. Psychiat.* 174 (1944). See also, Ulett, *Clinical & Experimental Studies of Mild Head Injuries*, 7 *EEG Clin. Neurophysiol.* 496 (1955).

**EEG in severe head injuries:** When there is a prolonged period of impaired consciousness and of post-traumatic amnesia EEG changes are usually of much longer duration than the one observed in mild head injuries. Occasionally the EEG becomes unusually slow in its basic frequency and in a certain number of cases focal abnormalities are observed. There is not always resolution of these EEG changes in months to come, but in certain cases progressive deterioration of EEG patterns does occur. In children, the EEG's are notoriously labile and the effects of head injuries are usually much more dramatic than the ones observed in adults. Epileptiform EEG discharges following head injuries occur much more frequently in children than in adults. It is always difficult to be sure whether epileptiform discharges did not antedate the injury.