CLINIC

Neurological assessment of the child with head trauma

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It is estimated that 30 percent of all children in the United States will, at some time, experience dental trauma.[1] Since dental trauma is a subset of head trauma, the emergency appearance of a child in the dental office may present as a true medical emergency.[2] Approximately 25,000 children die in the United States each year from head injury. In addition, it is a major cause of physical disabilities, seizure disorders, and developmental delay in children.[3]

A force that is strong enough to fracture, intrude, or avulse a tooth in a child is clearly strong enough to result in cervical spine or intracranial injury.[4] A critical need exists at the time of presentation in the dental office to triage the child who may have head and/or cervical injuries. The dental practitioner must be particularly alert to a number of difficult-to-diagnose problems associated with head trauma. Among these are acute subdural hematoma, skull fracture, facial bone fractures of the orbit, zygoma or midface, and subcondylar fracture. Internal bleeding or compromise of brain stem function may become obvious slowly over several hours or even days subsequent to the traumatic incident. This is true of the subdural hematoma, one of the most difficult to manage sequelae of head injury.[5] An acute subdural collection of blood is typically associated with laceration or contusion of the brain. Prospects for recovery are poor; the fatality rate approximates 90 percent.[6]

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EPIDEMIOLOGY

The incidence of dental trauma and head injury is escalating due to increased participation by both girls and boys in such sports as soccer, field hockey, lacrosse, volleyball, softball, football, basketball, skating, bicycling, and motorbiking.[7] Zeng recently reported that 60 percent of the visits at Seattle Children's Hospital from 1982-1991 were the result of trauma; further, the number of visits was 2.1 times greater in 1991 than in 1982.[8] Duus observed that 17 percent of children assessed in the hospital for so-called "minor" head injuries actually had intracranial complications.[9] Male children have about a 50 percent higher occurrence of head trauma than do female children, but the individual female sports participant has a generally higher incidence of injury. Collegiate female basketball players have an orofacial injury rate of 7.48 percent, for soccer 3.11 percent, for field hockey 2.48 percent, for lacrosse 2.27 percent, for volley ball 1.59 percent and for softball 1.55 percent. This compares with a rate of 0.5 percent for male football players.[10]

Dental practitioners must play an important role in prevention of head-trauma sequelae through encouraging patients, both female and male, to wear properly constructed and well-fitted mouthguards. Mouthguards not only offer protection from orofacial injury, including fractures of teeth and jaws, but they also provide significant cushioning of blows to the chin, thereby obtunding potential cervical and intracranial injury.[11]

CLOSED HEAD-INJURIES

The most common type of head-injury in children and adolescents is the closed head-injury. In closed head-injury, serious damage may result from the brain oscillating within the skull, and in the process stretching or severing neural pathways within the brain or brain stem. Contusions and hematomas may form from the impact of the brain against the inner table of the skull. Brain lesions such as contusions, hematomas, and the mechanical shearing of neural pathways are considered to be primary injuries. Such crushing and shearing injuries may rapidly manifest signs or symptoms of closed head-injury. Alternatively, these injuries also create conditions that only appear as sequelae over time. This latter group of slowly evolving sequelae demands that particular attention be paid to the neurological status of a child presenting with dental injuries.[12] Critical to a positive prognosis for the patient with closed head-injury is the early effective triage and, when indicated, aggressive treatment in a special intensive care facility.

While primary injury is related to mechanical forces, secondary injury is related to physiologic disruption that can compromise otherwise viable cells. Only recently has the importance of aggressive, immediate treatment directed at interrupting and attenuating secondary types of subcellular, metabolic, and ultrastructural derangement been fully appreciated. These are the processes that render neurons and astrocytes of the brain extremely vulnerable to damage and destruction.[3] Common pathophysiologic factors in brain trauma include intracranial hypertension and cerebral ischemia, disturbances that are responsible in large part for secondary injury and cell death during the first few days following a head injury. Another pathophysiologic process responsible for tissue loss is secondary cerebral hypoperfusion due to posttraumatic cerebrovascular dysfunction.[3,12]

There is a reported clustering of dental trauma incidents at age one and again at age six.[13] This pattern reflects distinct physical and intellectual stages in a child's development. As an infant learns to walk and run, his or her balance is affected by having a greater body mass above the waist. The size of the infant's head is disproportionately large, as compared to body size, making the infant "top-heavy" and subject to falls. The propensity for a six-year-old to injure his head results in part from the child becoming more independent, expanding relationships and interests, and being exposed to more en vironmental hazards such as playground injuries.

OFFICE NEUROLOGICAL ASSESSMENT

In their earliest years, children may have difficulty com municating. Even at a later age, frightened and emo tionally distressed children may report symptom inadequately and may be unaware of the seriousness o their injuries.[2] Moreover, their emotional state may mir ror that of the accompanying parent or guardian, a facto that can further complicate the diagnostic process. Un hurried and gentle handling of these children is critica in assuring cooperation and a favorable treatment out come.[14]

If the child presents after head-injury to the denta office, rather than to a hospital, the child almost withou exception will be conscious. For reference, a scale exist to describe comatose patients, the Glascow Coma Scal (GCS). It provides a practical means for monitorin changes in the level of consciousness based on eye open ing and verbal and motor responses. The lowest score i 3; the highest is 15. Scores of 8 or lower are associate with permanent cognitive, emotional, and beh problems. It may be impossible to distinguish be mild and severe head-injury on initial examination. Th patient's course after injury, as documented by sequen tial examinations, can truly reflect the original severit of injury. If in doubt about the significance of the injur follow the safest course and refer the patient to th emergency department of a hospital, where the child ca be evaluated and admitted for observation if necessar

Following the two basic guidelines of all emergen management: "primum non nocere", first do no harn and secondly, "never treat a stranger", a proper medic history must be obtained. Information should be secur about a loss of consciousness, neck or head pain, a numbness anywhere in the body. Assuming that t child is conscious, the patient should be asked to provi a history of the traumatic event. Amnesia of the episo may be indicative of a previous loss of consciousne Additional signs meriting immediate concern inclu nausea, vomiting, drowsiness, or blurred vision. T child should be tested for "oriented x 3" and shou respond appropriately when asked: "What is yc name?", "What place is this?", "Is it morning, afterno or night time?" These queries should be made with se sitivity to the child's age, communication level and en tional overlay at the moment. The head sh carefully examined for signs of trauma such as sc eration, hematoma, and evidence of skull fracture. Bl or clear fluid draining from the ear (otorrhea) or the nose (rhinorrhea) should alert the dentist to the possibility of a cerebrospinal fluid leak due to the presence of skull fracture. Temperature, pulse, respiratory rate and blood pressure should be recorded. A particularly slow pulse (bradycardia) in the presence of an elevated systolic blood pressure with widening between the levels of systolic and diastolic pressures is an indicator of rising intracranial pressure.

Certain of the Cranial Nerves (C.N.) should be assessed for normal function. Most important are C.N. III, IV, VI, and VII. The oculomotor nerve, C.N. III, can be tested by observing whether "Pupils are Equal, Round, and Responsive to Light and Accommodate" (PERRLA). Failure of the pupils to constrict or the presence of eyelid ptosis suggest that damage has occurred to the third cranial nerve. "Extraocular Movements Intact", or EOMI, provides a rapid assessment of C.N. III, IV, and VI. The dentist should check to see whether the child is able to track the examiner's finger as it moves laterally and vertically across the visual field. Failure of the child to track the dentist's finger may indicate that the midbrain or pons had been injured.[15] Abnormal ocular function or pupil alignment may signal impending cerebral herniation. Head trauma frequently involves C.N. VII, the facial nerve. Routine testing of motor function involves examination of the strength of facial muscles by asking the patient to close her eyes, smile and then frown. Facial muscle movements should be symmetrical. If a lesion is suspected, taste also may be impaired and should be assessed.

Damage to C.N. I, II, V, VIII, and IX through XII is uncommon. Testing the olfactory nerve, C.N. I, involves having the patient identify various scents while the eyes are closed. When testing children, familiar nonoffensive scents such as coffee or peppermint should be used. Testing the optic nerve, C.N. II, includes a light flashed in the eye. Loss of both direct and consensual pupillary constriction in an eye is diagnostic of damage, as is the absence of the blink reflex. Asking the patient to identify a letter or color is an additional test. Direct injury to the branches of the trigeminal nerve, C.N. V, causes a loss of touch or pain sensation and the experience of paresthesia. These are so troubling to the patient that evaluation is almost mandatory. A cotton swab or finger is brushed successively against each side of the forehead (ophthalmic branch), cheek (maxillary branch) and lower lip (mandibular branch). The patient is asked whether the sensation is of equal intensity bilaterally; if it is not, C.N. V probably has been harmed.[16] Injury to C.N. VIII, the acoustic nerve, will be evident through a loss of balance (vestibular nerve) or hearing (cochlear nerve). Spontaneous nystagmus is an objective sign of vertigo. The precise measurement of hearing is outside the scope of the usual dental office; gross hearing can be tested, nevertheless, by the dentist whispering into one of the patient's ears or rubbing the fingers while covering the patient's other ear. These simple tests will detect significant hearing loss.

Cranial Nerves IX through XII rarely sustain damage as a result of head trauma. Of possible clinical relevance to the dentist are C.N. IX and XII. Cranial nerve IX, the glossopharyngeal nerve, is tested by stimulating the soft palate to elicit the "gag reflex". Cranial nerve XII, the hypoglossal nerve, is responsible for motor functions of the tongue and is tested by asking the patient to extrude the tongue. Lateral deviation of the tongue suggests potential injury of the medulla.

These simple tests will facilitate the rapid evaluation of cranial nerve function in the dental office. The preceding neurologic assessment can be accomplished in a matter of minutes and will assist the practitioner in ruling out impending neurologic crisis subsequent to head trauma.

POSTTREATMENT PRECAUTIONS

If the history of the accident seems incompatible with severe brain-injury, the neurological examination is within normal limits, and necessary dental emergency care has been provided, the pediatric dental patient may be discharged to home provided that the patient is accompanied by a parent or reliable adult. The parent or guardian must understand the need for careful observation of the child at home and the following reasons why the patient should be brought to the hospital without delay: somnolence that cannot be easily interrupted, protracted vomiting, severe headache, and any other observation or symptomatic complaint thought to be abnormal by the adult. The patient should be scheduled to be seen by the dentist within a few days for a follow-up appointment.

LEGAL ASPECTS

The dental practitioner should be aware of the necessity for detailed chart entries regarding head trauma with dental involvement. The chart should contain the patient's medical and dental histories, a record of the incident, diagnoses and treatment rendered. The record may be a critical reference for the dentist asked to appear as an expert witness in future litigation or as the

Table ☐ Gross neurological examination summary.

- ☐ Medical history
- ☐ History of traumatic incident
  - o Loss of consciousness
  - o Amnesia of event
- ☐ Nausea, vomiting, drowsiness
- ☐ Blurred vision
- ☐ "Oriented × 3"
- ☐ Skull fracture; CSF leakage
- ☐ Lacerations; facial bone fracture
- ☐ Temperature, pulse, blood pressure, respiratory rate
- ☐ Cranial nerve examination
  - o EOMI
  - o PERRLA
  - o Sensory function
  - o Motor function
- ☐ Post-op instructions

subject of a professional liability claim. It is exceedingly important that the dental clinician keep accurate records of how the trauma occurred, as reported by the patient and parent, the nature and findings of the neurological examination, and how the patient was subsequently managed.

The use of a "trauma chart insert", placed in the patient's permanent record, that leads the practitioner through proper triage, an orderly neurological assessment, and dental treatment is strongly urged (see Table). Such forms are available generally and from the authors upon request.

SUMMARY

Dental trauma is a type of head trauma. It is essential that the dentist be able to assess the gross neurological status of the child presenting with head injury and to recognize acute and delayed signs of nerve injury. Time does not permit the dentist a leisurely review of necessary skills at the time of an emergency visit. He or she must be prepared in advance with a consistent and simple approach for the management of head trauma in children. Time of entry into care is critical to the prognosis.

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PEDIATRIC EQUESTRIAN INJURIES

During the two-year period of the study, 32 children were evaluated. Two children were injured when a horse stepped on them. Thirty children fell from or were thrown from a horse. Of these, 20 were wearing a helmet. Head injuries were more frequent in those patients not wearing helmets. The mean Modified Injury Severity Scale (MISS) score for riders without a helmet (12.9) was significantly higher (more severe) than that for helmeted riders (2.8). All three patients with a Glascow Coma Score <15 on arrival were not wearing a helmet at the time of injury. The frequency of hospitalization was significantly higher for those not wearing a helmet. Compared with other common mechanisms of childhood injury the mean Modified Injury Severity Scale score of injured riders was exceeded only by that of pedestrians struck by a car.

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