



Management and outcome of pediatric skull base fractures

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ABSTRACT

Objective: The management of skull base fractures in the pediatric age group continues to be a major challenge even for experienced multidisciplinary teams. This retrospective study was undertaken at a tertiary care academic hospital to evaluate the management and outcome of pediatric skull base fractures.

Methods: Retrospective analysis covering a period of 13.5 years (from 1996 to 2009) and 63 patients (mean age 10.7 years; range 1–18 years) was performed.

Results: A road traffic accident was the most frequent etiological factor (38%). The most common skull base fracture type was temporal bone fracture (64%). Longitudinal temporal fractures were observed in 45% and transversal in 23% of these patients; in 10 cases (25%) the fracture was comminuted or mixed type. A fracture involving the sphenothmoidal complex was the second most common type of basilar skull fracture (41%) followed by fracture through the orbital bone (35%). Forty-three percent of the patients had a concomitant intracranial injury. Early neurological deficits were diagnosed in 21 patients (33%) and 10 patients (16%) had permanent neurological deficits. One patient died after 1 week of intensive care treatment. Fifty-four patients (86%) were discharged home and 8 patients (13%) were discharged for further rehabilitation. Glasgow Coma Scale score of 8 or lower correlated with moderate to poor outcome.

Conclusions: We conclude that skull base fracture is a rare injury in childhood. Mortality is uncommon, but this trauma is commonly associated with intracranial injury. Early neurological deficits are caused by traumatic brain injury and were observed in one-third of the patients. However, only less than one-sixth suffered from permanent neurological or neuropsychiatric disorders.

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1. Introduction

The current epidemiology of pediatric skull base fractures is not well characterized. The frequency of these lesions varies from 5% to 14% in children with head injuries [1–3]. The most common mechanism of craniomaxillofacial injury including basal skull fracture and severe head injury is motor vehicle accident [4–7].

Fracture of the base of the skull may involve several bones, i.e. temporal, occipital, sphenoidal and sphenothmoidal complex and orbital portion of frontal bone. The clinical signs of a skull base fracture include retroauricular and/or periorbital bruising, hemothympanum, cerebral spinal fluid (CSF) otorrhea and rhinorrhea. Currently, the method of choice for diagnosing head injuries in all age groups is computed tomography (CT), although all head injuries are not readily visible with this technique [8].

Approximately 10–30% of patients with a skull base fracture have CSF leakage [9]. Furthermore, 10–27.5% of these patients develop meningitis, which is associated with a 10% mortality rate [10,11]. The incidence of meningitis following moderate severe head trauma is estimated to be 1.4%. The majority of patients with meningitis as a complication of closed head trauma have a skull base fracture [12]. This is due to the connection of the subarachnoid space to the sinonasal cavity with an up to 25% associated risk of infection. The median time between injury and onset of meningitis is reported to be 11 days [12,13]. Fractures of anterior cranial fossa (e.g. involving frontal or ethmoidal sinuses) are more commonly associated with CSF leak than those of middle cranial fossa (e.g. involving temporal bone) [11,14].

Imahara et al. reported, that only 25% of pediatric patients admitted after facial fractures underwent operative treatment [5]. Operative treatment seems to be more frequent with higher age and the age group of 14–18 years being most commonly operatively treated. One reason for conservative treatment being used more often in younger children is their enhanced healing and remodeling capacity [5]. Furthermore, operative intervention may

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impair future growth of the immature skeleton. Surgery is warranted in cases of bone displacement, suspected dural tear and active CSF leakage [15].

Fractures of the skull base are potentially fatal and head injury is one of the leading causes of death in the pediatric age group [16]. According to Thomale et al. in a series of 53 children with severe traumatic brain injury the overall 1-year outcome analysis indicated a favorable outcome with good recovery to moderate disability in 86% of patients [7]. After 2–5 years 92% of the head injury survivors had returned to school while 8% of patients remained severely disabled. In general, good functional outcome is seen in 73–82% of pediatric brain injuries [7,17].

Our aim was to study the management and outcome of pediatric skull base fracture patients in a single institution, academic tertiary referral centre, during a period of the past 13 years.

2. Methods

Retrospective clinical data of all patients treated with fracture of the skull base during the period from January 1996 to May 2009 at the Turku University Hospital (TUH), Turku, Finland were reviewed. The health care district included in this study covers an area of approximately 750,000 inhabitants and TUH is the only center treating severe pediatric trauma patients. Hospital surgical and discharge registries were used to identify the patients according to International Classification of Diseases, 10th edition (ICD-10) codes for skull base fracture (S02.10–S02.11). The present study population was identified from this larger cohort of 465 patients using the age criterion of 0–18 years.

A total of 63 pediatric patients (37 male, 26 female, mean age 10.7 years; range 1–18 years) were identified. The hospital records were reviewed and details were collected on the patients' age, sex, type of fracture, trauma mechanism, physical findings at presentation, Glasgow Coma Scale (GCS) score, CT imaging, intracranial involvement, treatment and length of stay at the intensive care unit (ICU), synchronous trauma, management of the trauma (conservative or operative), length of hospital stay and outcome. For the calculation of trauma incidence the annual number of inhabitants in the health care district (from 1996 to 2008) was obtained from Statistics Finland. All patients with intracranial

injuries and those who were treated surgically typically had a follow-up of 6–12 months.

The Chi-square test was used to determine the statistical significance of non-parametric variables between groups.

An institutional research approval was granted for the study.

3. Results

3.1. Incidence

The annual incidence of pediatric skull base fractures during the period from 1996 to 2008 varied from 0.1 to 1.3 per 100,000 inhabitants.

3.2. Trauma mechanism

The main etiological trauma factor was road traffic accident (24/63, 38.1%), the second most common was falling from heights (20/63, 31.7%), and the third was falling to the ground (6/63, 9.5%). Violence was the trauma mechanism in five cases (7.9%), explosion, e.g. fireworks injury to the orbit and frontobasal area or suicidal attempt with a gun in two cases (3.2%) and in four cases (6.3%) the patient was hit by a heavy object, e.g. concrete swing, coat rack or other heavy object (Fig. 1). In two cases the injuries were related to sports. Of those patients, who were involved in a road traffic accident, 50% (12/24) were passengers in a motor vehicle, 45.8% (11/24) were pedestrians or cyclists struck by an automobile and one patient (4.2%) drove with a bicycle into a tree.

3.3. Physical findings

The physical findings are presented in Table 1. Twenty-seven patients (42.9%) suffered from a verified hearing loss. Three additional patients had subjectively impaired hearing: one had an otoacoustic emission study done with impaired response on the trauma for the first follow-up month, one was transferred to another hospital and one was in poor condition with hemiparesis and inability to swallow and speak. Seven patients (11.1%) had CSF leakage due to skull base fracture. Five of them had otorrhea associated with temporal bone fracture and two of these were treated operatively. Two patients had rhinorrhea associated with anterior skull base fracture and both of them were closed surgically.

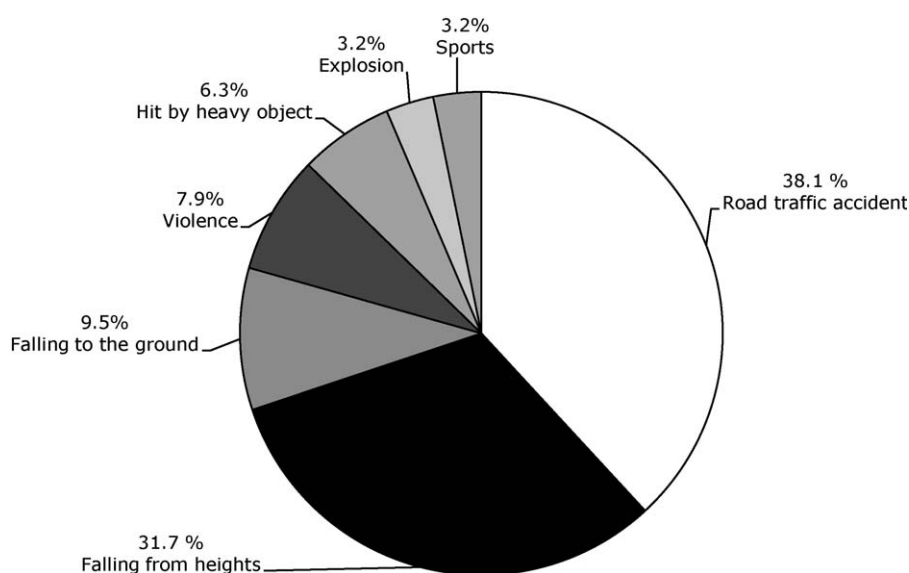


Fig. 1. Percentages of different trauma mechanisms in 63 pediatric skull base fracture patients.

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