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Case report

Case report: Forensic anthropological assessment in a suspected case of child abuse from South Africa

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ABSTRACT

Not many case reports of suspected child abuse as assessed solely on skeletal remains are available. Forensic anthropologists have intimate knowledge of normal skeletal anatomy, bone trauma and processes of healing of bone and may therefore be of help in suspected cases of child abuse. Patterns of trauma in juvenile skeletal remains which are suggestive of abuse include fractures in different phases of healing, multiple fractures, typical fractures on ribs and long bones and severe, complicated cranial fractures. The aim of this paper is to report on the findings of the analysis of the skeletal remains of a 3.5 years old boy. Forensic pathological examination indicated that the boy had died from a massive cranial fracture, with multiple injuries present to the rest of the body. After the body had been buried for some time, it was exhumed and we were requested to look for signs of chronic, long-term abuse. Findings included a massive cranial fracture, another fracture in the roof of the orbit, two areas of non-specific subperiosteal bone growth and several untreated carious teeth. No clear healed fracture could be found, except for a possible healed cranial base fracture which stretched transversely across the petrosal bone. This area showed signs of recent bone activity. The court decided that this was not enough evidence of chronic abuse and found the accused guilty of murder but not of chronic child abuse. This case illustrates the difficulty to obtain clear signs of chronic injury on juvenile remains.

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1. Introduction

Child abuse occurs when the physical or mental health and welfare of a child are harmed. According to the World Health Organization, this includes all forms of physical and emotional ill-treatment, sexual abuse, neglect and exploitation [1]. These cases are not often referred to forensic anthropologists, as the deceased children are usually assessed by forensic medical examiners alone, and evaluation of soft tissues is frequently adequate. However, there are some specific circumstances where the expertise of a forensic anthropologist can make a valuable contribution [2]. Generally, however, published case reports focusing solely on the analysis of skeletal remains in child abuse are rare.

When assessing a child for signs of child abuse, it is necessary to look for evidence of chronic, patterned injuries. Fractures are often in various stages of healing, with healing sometimes disrupted by repeated incidents of abuse (e.g. [2–5]). Post-cranially, fractures sustained due to child abuse most commonly occur in the rib cage [6,7], but they can also be found in any of the long bones. These long bone fractures often present as spiral fractures due to twisting of, for example, an arm, “bucket handle” fractures of the

metaphysis, green stick fractures or injuries involving the epiphyseal plate. A comprehensive up-to-date review of the available literature on long bone fractures in child abuse can be found in Kemp et al. [6] and Bilo et al. [5]. Because children's bones are more pliable and soft tissues such as the periosteum are stronger than those of adults, dislocations, displaced fractures and complete fractures are less commonly seen.

Cranial fractures sustained in cases of child abuse also have a number of specific characteristics, but it can be very difficult to distinguish fractures resulting from accidents from those due to child abuse. According to Wood et al. [8], between 17 and 33% of infants and children admitted to hospital with head injuries are victims of child abuse. Simple linear fractures, often in the parietal bone, occur most commonly but they are also frequently seen in accidental trauma. Complex or multiple fractures, fractures crossing sutures as well as depressed fractures are suggestive of externally applied force such as may be the case in physical abuse [5,6,8,9].

Walker et al. [2] discussed the results of skeletal analysis of four children where child abuse was suspected. They found that skeletal injuries in these cases have a number of distinctive characteristics, which include multiple localized areas of asymmetrically distributed subperiosteal bone growth in different phases of healing. These lesions may be either the result of stripping of the periosteum of the bone as a limb is used as a handle to punish

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the child, or the result of direct hitting, e.g., with an object held in the hand of the abuser. Stunting of growth [10–13] and poor dental care are also common findings.

The features described above can usually be observed on skeletal remains even in the absence of soft tissues, thus implicating that an experienced forensic osteologist can contribute to identifying signs of suspected abuse. However, the very fast healing rates of children and infants as well as poor preservation of skeletal material often found where juvenile remains are concerned may confound matters [2].

It is difficult to get statistics relating specifically to child abuse in South Africa. Nearly 200 pre-school (6 years and younger) violent child deaths were reported for 2008/2009, but it is not stated which proportion of these are related to abuse. "Neglect and ill-treatment of children" younger than 18 years are reported as occurring in 8.3 per 100,000 of the population, but once again quoted figures are very non-specific [14].

The aim of this paper is to report on the skeletal findings in a case of a murdered child where long-term child abuse was suspected. An attempt was made to look for signs of repeated, patterned physical abuse, but some difficulties were experienced which will be discussed.

2. Case history

A 3 and a half-year old boy died in 2004 in the Gauteng Province of South Africa, as a result of several massive injuries, among them a cranial fracture. The child was in the care of his step-father when he died, and inconsistent accounts of the events surrounding his death were given as is typically the case in battered children. It was said that the boy had earlier fallen in the bath, and injured himself. The step-father claimed that the boy later suffered an epileptic fit (although he was not a known epileptic), and that he had hit the floor with his head first. He died before medical help could be obtained.

According to eye witnesses who arrived at the scene of the crime some time after the event, the boy's room smelled of blood, there were blood spatters everywhere and his mattress and pillow were wet as someone had apparently tried to clean it of blood. The room itself was only investigated by forensic scientists at a much later stage after everything was completely cleaned.

At autopsy it was found that the child had several bruises and lacerations, a blue eye (right) and abdominal injuries. He also had a massive cranial fracture. No X-rays were taken at the time, and the child was buried shortly after the autopsy was done. He weighed 10 kg at the time of death.

About a year later the prosecutor dealing with this case decided to have the body exhumed, in order to have the remains assessed for signs of chronic abuse. The aim of this was to obtain evidence that would allow her to not only charge the step-father with murder, but to also look for evidence of a prolonged period of repeated abuse. Both the step-father and the biological mother, who was not at home when the child had died, were accused of child neglect, ill-treatment of a child and murder.

3. Results

The remains submitted for forensic anthropological assessment comprised of an almost complete skeleton of a juvenile individual. Some soft tissues were present, which were removed before analysis. The skull was in several pieces, and needed reconstruction. Due to plastic deformation resulting from the blunt force injuries sustained, the reconstruction could not be perfectly executed. The skull was opened, indicating that a post mortem examination had been done before.

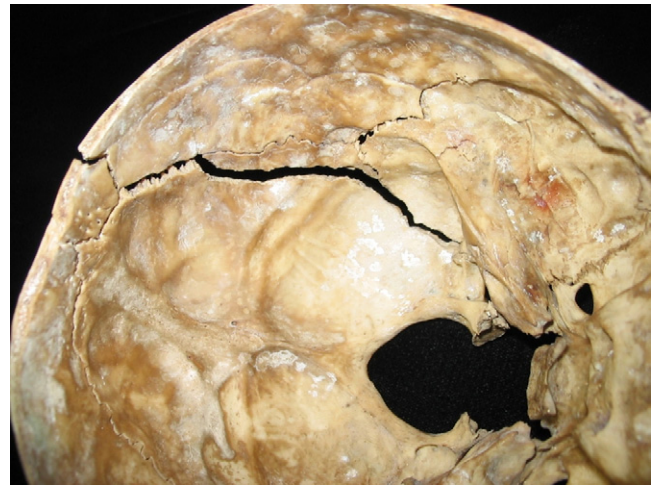


Fig. 1. Close-up view of the cranial fracture that was the probable cause of death. Superior view of opened skull.

No attempt was made to determine the sex of this individual, due to its young age. The full set of deciduous teeth had erupted and was in occlusion but none of the permanent teeth had erupted, as would be expected in a child of this age. Dental eruption was not delayed relative to the age of the child.

When analyzing the cranial remains, two unhealed, peri-mortem fractures were clearly visible. The most obvious of these fractures, which was also most probably related to the cause of death, was a massive fracture on the left side of the skull (Fig. 1). This fracture originated from the skull base, in the occipital bone, and stretched through the occipital bone and the left parieto-occipital suture into the left parietal bone (Fig. 2). Widening of several of the cranial sutures was visible, for example the right parieto-occipital suture. The second fracture was present in the roof of the right orbit, which is consistent with the evidence of the pathologist that the child had a blue eye on the right side (Fig. 2). This fracture was not picked up at autopsy, but it should be kept in mind that the skull of a small child is very delicate therefore making it susceptible to fractures caused by, for example, a craniotomy or post-mortem handling. The tooth socket of the right lower lateral incisor was also fractured.

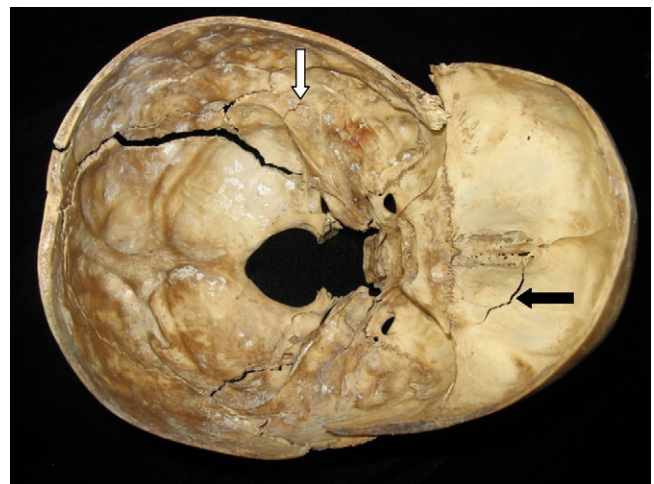


Fig. 2. The opened skull from above. The large fracture of the left parieto-occipital area is clearly visible. The white arrow indicates the defect in the petrosal bone. Note also the fracture of the roof of the right orbit (black arrow). The skull is somewhat distorted due to plastic deformation.

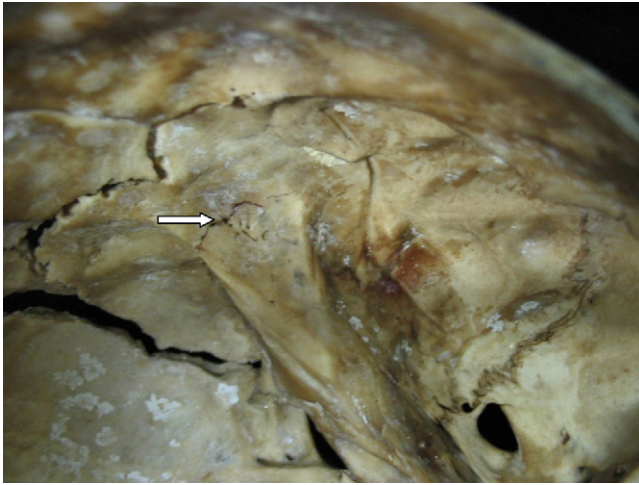


Fig. 3. Close up view of the possible partially healed transverse fracture of the left petrosal bone.

An unusual, smaller crack-like structure was also evident in the left temporal bone, on the pars petrosus inside the skull (Figs. 2 and 3). This feature looked as though it may have been a partly healed earlier injury, although this was not clear. It seemed to show signs of bone activity (healing), and was considered to may have been the remnants of an earlier cranial base fracture. This “crack” ran at right angles to the long axis of the os petrosus, and was therefore not in the area where normal ossification between the various parts of the temporal bone occurs [15]. The possibility of this being a normal anatomical variation was considered, but it was clearly not a left-over from the normal ossification process of the various parts of the temporal bone and it was difficult to decide what exactly caused it. This is an unusual part of the skull to fracture as the os petrosus is a very sturdy bone, but transverse fractures of the petrous bone can occur in some cranial base fractures, especially ring fractures [16–19]. No other evidence of a previous ring-like cranial base fracture, however, could be seen in the skull.

No other signs of previous fractures could be found on any of the post-cranial bones, including the ribs which were fairly well preserved. Small bony protrusions or areas of subperiosteal bone growth could be seen on the medial side of the right femur (distally) and the antero-medial surface of the right tibia. These may have been related to previous infection or trauma in the area.



Fig. 4. The untreated carious lesions on the mandibular teeth.

As Walker et al. [2] indicated, this type of lesion may occur as a result of subperiosteal bleeding. However, these lesions were very small and inconclusive.

All upper teeth were present, as were all the left lower teeth as well as the right lower central incisor, first and second molars. Large, untreated carious lesions were present on both upper and both lower first molars and the left lower second molar (Fig. 4).

The child's stature and weight were plotted on a growth chart [20] based on entries in the post-mortem report. His stature fell on the 50th percentile, but the weight of 10 kg fell well below the third percentile, indicating that this child was very underweight for his age and stature.

4. Discussion

In assessing the remains of this child for signs of chronic abuse, no real conclusive evidence was found. No medical records were available, so all decisions depended on the post-mortem assessments. A growth chart from a clinic was found by investigating officers, which indicated that at age 2 years, before the step-father came into the picture, this child had weighed 13 kg (3 kg more than at the time of death). Physical evidence presented to court indicating possible long-term child neglect and abuse in this case was thus based on two areas of subperiosteal bone growth (weakly suggestive of previous injury [2]), poor dental health, malnutrition and stunting of growth and inconclusive evidence of a possible previous cranial base fracture.

Cranial base fractures are serious injuries, and it seems unlikely that such a major injury could have been survived without proper, intensive medical care. As far as could have been ascertained no hospital records of previous injury were available in this case, but one can probably assume that the parents would not have offered such information willingly. According to Glarner et al. [18], petrous bone fractures in children are relatively frequent and occur in 6–14% of children with head trauma. They are commonly characterized by leakage of cerebro-spinal fluid (liquorrrhea) and facial nerve palsy, and meningitis often occurs as a complication [16,18,19]. A variety of patterns of cranial base fractures can occur [16,17], but most fractures that involve the petrous bone run longitudinally and do not involve the inner ear [18]. Transverse fractures are less common and pass through the inner ear, thus always leading to deafness in that ear. In the case presented here, the suspected fracture was transverse in nature, which would thus have resulted in deafness in that ear. As stated before no medical records were available, and the child had apparently not attended any day care facility where possible deafness would have been noted. The biological father was in jail at the time the child died, and it is unlikely that he would have been able to contribute any evidence as to the medical history of the deceased.

No conclusive evidence of previous cranial or other fractures could thus be presented in court, and the step-father was subsequently found guilty of murder of this child, but not of chronic abuse. The forensic pathologist stated in court that the massive fracture that had probably caused death would have required major force, for example swinging of the child by the leg and hitting the head against a solid object. The accused was sentenced to 15 years in prison for murder. The mother, however, was found not guilty as she was not at home at the time of death and the evidence as to chronic abuse was deemed by the court to be inconclusive.

The case discussed here illustrates some of the difficulties when looking for signs of previous injuries in juvenile remains. Children's bones are quick to remodel and signs of previous trauma may be very subtle [5,21]. In this case the abuse probably occurred for a period of less than two years preceding death (the period that the

stepfather was involved with the family), and therefore evidence of healing or healed fractures (if there were any) may still have been visible. This was not the case here. In retrospect, histological assessment of the suspected petrosal bone fracture for margin remodeling should have been considered [21,22]. However, in a case such as this it should also be taken into account that making histological slides is a destructive process, and the potential information that could be gained should be weighed against the possible value of preserving the evidence for other possible expert opinions.

Skeletal remains pose special diagnostic problems, but on the other hand it has the advantage that every bone surface can specifically be visually assessed for changes [2]. Cattaneo et al. [23] illustrated that it may be difficult to visualize fractures, and that several diagnostic approaches are needed. In their study the sensitivity of autopsy, radiology and CT-scanning to detect fractures in a pig sample was investigated. Osteological assessment was used as control. It was found that normal autopsy only revealed 31% of cranial fractures, radiology 35% and CT-scanning all fractures. CT-scanning had some problems, though, such as showing more fractures than what are actually present, depending on orientation. CT-scanning is thus advisable in all suspected cases of child abuse, but this may not be practical especially in third world situations. An osteological assessment can thus play an important role, and it is in this regard that the experience of a forensic anthropologist may come in handy.

In conclusion, this case report illustrated some of the difficulties with building up of a firm case of child abuse based on osteological assessment alone. In the presence of clear healed and healing fractures this may be easier to accomplish, but when more subtle and inconclusive signs of trauma are the only evidence to present, it may be more difficult to convince a court that chronic abuse was present. The case presented here showed a possible healed cranial fracture, but as not much literature is available on the diagnosis of healed cranial trauma in children, this diagnosis remained highly tentative.

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