

Skull fractures and Abusive Head Trauma



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Abstract

This review is the English and extended version of an already published paper in German language [1].

Skull fractures are part of the paediatric head trauma including battered child. For the following topics radiology is in charge for:

- Confirmation or rejection of the diagnosis of battered child syndrome in case of overenthusiastic interpretation of non-accidental injury (NAI) using the four-eyes principle
- How many injuries?
- Specificity of the injuries for NAI
- Dating of the injuries.

Keywords: Non-Accidental injury; Cranial computed tomographies; Head trauma; Skull fracture; Epidural hematomas; Subdural hematomas; Subarachnoidal, intraparenchymal and intraventricular bleedings

Introduction

Authors Kriss et al. [2] published a paper about skull fractures in “non accidental injury” (NAI) in the American Journal of Radiology in 2021 [2]. They reported, that if more than two sutures are involved by skull fractures it is indicative for NAI. They analysed cranial computed tomographies (cCT) of 57 children with NAI and compared them with 47 further ones, which were caused by trauma, where mechanisms included fall from the arm of the parents or from the table at changing nappies. cCT’s of children due to severe road accidents were not included. Only patients in the age range up to three years were included, of these 66% were younger than six months and 49% younger than three months. In both groups there were more boys than girls (28 versus 19 and 29 versus 18). In 83% of the accidental fractures parietal bones were involved, in 9% involved the occipital and 7% the frontal bone. In NAI children’s fractures involved in 75% the parietal region, in 20% the occipital, in 3% the temporal and in 2% the frontal bone. Sutures involvement in fractures were 89% in NAI group, whereas in 78% in controls.

In 51 NAI victims (69%)³ 2 sutures were involved. In the control group this was only in 3 patients the case (7%). In 12 NAI victims there were³ 3 sutures involved. After traumatic head

injuries there were never more than 2 sutures touched (Odds Ratio 28.4; 95 % confidence interval 7.6 – 105.9 p<0.001). This was the only significant finding. In NAI patients the lambda suture was the most frequent involved one (43%), followed by the sagittal (23%) and the coronal one (21%). There was no difference in suture involvement between the NAI and the traumatic control group. The authors concluded that in traumatic head injuries with skull fractures sutures are frequently involved. In NAI patients there were usually more than 2 sutures touched and this could be a “red flag” for the reporting radiologist. There is no doubt, that skull fractures with suture involvement represent severe injuries and can lead to delayed healing and growing fractures.

But several aspects have to be considered at reading the study of Kriss at al. [2]. First of all, concentration on skull fractures is maybe not be the main focus in patients with NAI suspicion. Further there is a bias in the patient recruiting - by including only those patients where in the report plain text search words like “skull fracture”, “head trauma” or “child abuse/non-accidental trauma” were included. Ratification of these selected patients to the group of battered child or trauma was done by studying the electronic patient records. There was no patient recruitment using adequate diagnosis catalogues. Furthermore, within the sections

“Materials and Methods” and subsection “Image Analysis” there is only information about the image reconstruction (including 3D), but there is no information which parameters were evaluated as well as if CT settings were the same in all cases. In the textbook of the “The American Academy of Pediatrics” a cCT is recommended in cases of head trauma in patients with suspected NAI [3]. Contradictory the “American College of Radiology” (ACR) developed a diagnostic pathway depending on clinical symptoms [4]. The consensus statement of the “European Society of Radiology” and the “American Society of Pediatric Radiology” states in a publication of the Task Force “Battered Child” [5]:

- a) Skull fractures are equally as common in non-accidental head trauma and accidental head trauma, but the complex skull fractures are more common in NAI
- b) Epidural hematomas are more frequent in accidental related head traumas
- c) Subdural hematomas are more frequent in battered child
- d) Subarachnoidal, intraparenchymal and intraventricular bleedings are equal frequent in both entities.

Conclusion

The study of Kriss et al. [2] found a statistic significant correlation between the number of fractures which are involving

a suture and the possibility of a head trauma caused by battered child. This is maybe caused by the selection and the numbers of patient studied. But this knowledge is not really helpful in clinical routine. Even considering, that CT is more sensitive for fractures than the plain films, there is a huge dose difference. Primary is the answer to the question about intracranial injuries. In conclusion it can be stated, that the study of Kriss et al. [2] was published in a well-known journal but from the point of view of paediatric radiology and forensic medicine all involved physicians should primarily follow the guidelines of the corresponding scientific societies.

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