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CASE REPORT

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Unusual craniocerebral injury caused by a pneumatic nail gun

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Abstract A man was found unconscious near a ladder in a house. After resuscitation he was brought to a hospital and X-rays of the skull showed that two 12 -cm long nails had completely penetrated the cranial cavity. The nails were operatively removed and after treatment for 5 weeks, the patient was transferred to a rehabilitation centre with a decreasing hemiparesis on the left side and general deterioration and then, after an attempted suicide to a psychiatric hospital. The perforating cranio-cerebral injury from a pneumatic nail gun known to reach only low muzzle velocities is a very unusual finding.

Keywords Cranial injury · Nail gun

Introduction

Compared to firearms and blunt force injuries, penetrating injuries of the skull are uncommon with other mechanical devices, such as pneumatic nail guns [3, 5, 7, 9, 14, 15].

While an incomplete penetration of the skull, often with an entrance site of the nail in the orbital region or nasal cavity, has been reported several times [1, 3, 6, 10, 11, 12, 13, 15], to our knowledge only two cases with a complete penetration of nails into the intracranial cavity have been published [12]. However, in these cases explosive-powered nail guns with a blank cartridge as a source of energy were used. The explosive force of projectiles fired by this type of nail gun can be equated with the firing capacity of a .22 calibre (5.6 mm) handgun or rifle [2, 4, 6, 17]. In contrast to these high-velocity tools, pneumatic nail guns as a sub-type of so-called low velocity nail guns are considered to cause injuries of less importance [13].

A case is reported to underline the potential of low velocity nail guns for serious injuries and in particular a perforating cranio-cerebral injury is very unusual for this type of nail gun.

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Case report

An assembler of a prefabricated house was found unconscious lying near a ladder on the floor of a construction site. Other employees reported that the man had been engaged with the attachment of a bay roof and had been standing on a ladder placed on two stacks of polystyrene blocks.

After resuscitation and intubation, X-rays were performed and showed two long nails which had completely penetrated the skull and were localised in the cranial cavity (Fig. 1A, B). One entrance wound was located at the back of the head, adjacent to the midline, the other one on the right temporal bone. The size of the skin lesions corresponded to that of the nail heads. The wound edge and the surrounding skin of both wounds showed no abrasions. The nails, with a length of approx. 12 cm and a diameter of approx. 0.35 cm were removed neurosurgically on the same evening.

The man was later released from hospital, with a decreasing hemiparesis of the left side and a persistent general deterioration to a rehabilitation centre. After an attempted suicide he was transferred to a psychiatric hospital.

A complete amnesia was reported for the time of the incident. The police inquiries yielded that the assembler had worked some of the time with a nail gun above his head.

The weapon

The pneumatic nail gun used in this case was a HAUBOLD model R (Fig. 2) with a working pressure of 6–8 bar (maximum permissible pressure 8 bar). Experiments with this nail gun were performed in the Central Bureau of Criminal Investigation of Bavaria. Measurements with a projectile mass of 10.72 g provided evidence of a pressure at the pressure-reducing valve of 6 bar, a median speed of 37.33 m/s (maximum speed 38.92 m/s, minimum speed 35.21 m/s) and a median energy of 7.50 J.

The penetration behaviour of the nails depends on the distance between the instrument and the object, particularly with low-velocity nail guns. Experiments with the original nail gun used in this case revealed that a 12 -cm long nail fired from a distance of 0.5–1 m

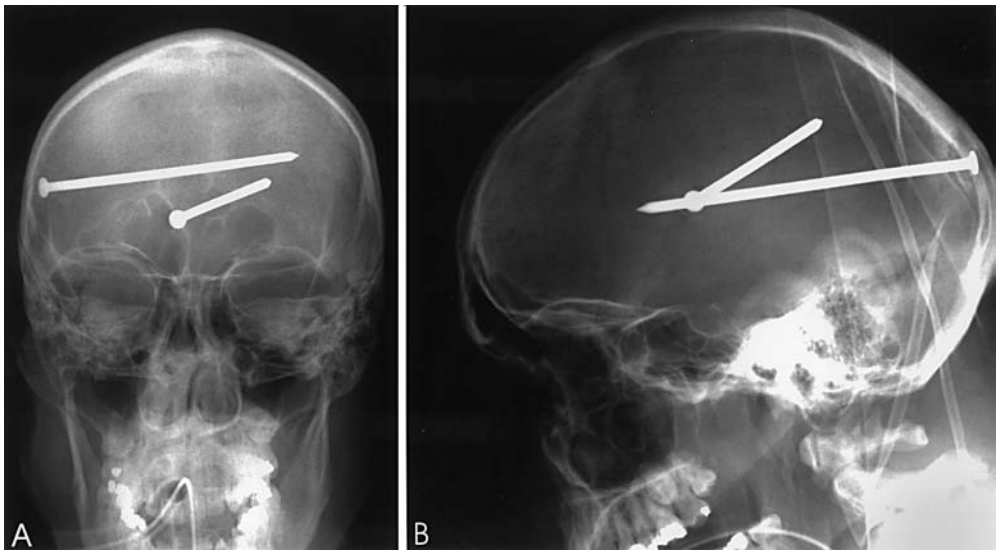

Fig. 1 Radiographs of the head in two projections showing two nails in the cranial cavity in **A** anteroposterior (AP) and **B** lateral views

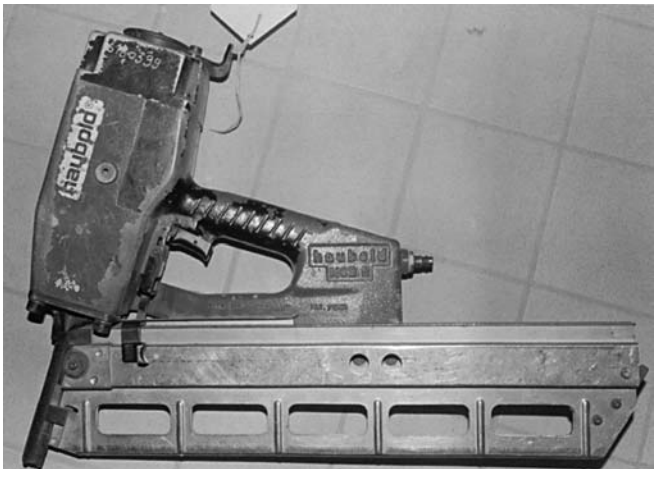

Fig. 2 Low-velocity nail gun Haubold model R

reached a speed around 37 m/s and could penetrate a pig carcass no deeper than 6 cm. The nail penetrated the meat with its complete length only when the nail gun was placed directly onto the skin or was held right next to it.

In order to find out whether the injuries were the result of an accident or a self- or an allo-inflicted incident, the conditions under which it was possible to trigger off two nails had to be clarified. Principally, there are two ways to fire off two nails successively:

1. If the release of a regularly working nail gun is operated and the instrument is put on the target surface, a nail will be shot out. If the device is subsequently removed from the surface and the release remains operated, the next nail will be triggered off as soon as the nail gun is put on any surface again.
2. When there is a defect of the nail gun, the safety catch may remain in the position "shot free" after a shot and a free launching of nails without putting the nail gun on any surface will result.

The examination of the nail gun revealed no signs of manipulation impairing the regular functioning of the device. The safety catch, however, obviously showed some corrosion. Occasionally during the examination the safety catch remained in the position "shot free" and a free shot of a nail was possible, although the device was not put onto a surface.

Further tests showed that the entrance wounds were achievable for the worker if he held the nail gun in his right hand.

Discussion

In forensic practise, the question whether injuries are the result of an accident, were self-inflicted or were caused by another person is frequently raised [8, 16].

According to the police investigations, an involvement of a third party could be excluded. Whether the incident was an attempted suicide or an accident could not be clarified definitely. Due to the results of the experiments with the nail gun used in this case, it may be concluded that the nail gun must have been in the immediate vicinity of the skull when the shots were triggered off. During the straining work in overhead position, the nail gun, with a weight of 7 kg, could have slipped down, resulting in a contact with the head and the expulsion of the first nail. Then the nail gun could have lifted off the head due to the rebound after the first shot. As a result of a malfunctioning of the safety catch, caused by corrosion, or after a renewed contact of the head with the nail gun when the release was still operated, it was possible that a second nail was triggered off.

On the other hand, the attempted suicide during convalescence was suspicious. Even though the suicide attempt could be explained by psychiatric alterations following the severe head injuries, it must be taken into consideration that the injuries were inflicted due to a preexisting suicidal motivation.

Irrespective of the question whether the injuries were caused accidentally or due to an attempted suicide, the fact of a complete penetration of the skull by nails fired from a pneumatic nail gun seems to be remarkable.

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