CASE REPORT

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Migration of the retained intracranial bullet to the spinal canal: A case report

Migracija zaostalog metka iz lobanjske šupljine u spinalni kanal

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Abstract

Introduction. Retained intracranial missiles migration is rarely reported. Most of the time, the missile will migrate and remain intracranially, but in extremely rare cases, it may reach the spinal canal. The aim of the study was to present a patient with this rare clinical entity. **Case report.** The 29-years-old male suffered from the gunshot wound to the head through the left external auditory meatus. The bullet was located in the posterior *fossa*. Initial debridement without bullet removal was performed. Four months after the injury, the patient came back complaining of neck stiffness and progressive weakness of all extremities. Plain radiography revealed the bullet in the spinal canal at the level of C2 vertebra and computed tomography confirmed localization in the posterior aspect. An emergency procedure was performed for bullet removal and spinal cord decompression. **Conclusion.** The bullets tend to migrate. Migration to the spinal canal is rare, but takes a significant risk, due to the potential secondary injury. The removal of a bullet at-all-costs may not be justified. However, the prediction of migration based on the predisposing factors would be of great value to treating these patients adequately.

Key words:
head injuries, penetrating; neurosurgery; spinal cord compression.

Apstrakt

Uvod. Migracija zaostalih metaka u intrakranijalnom prostoru je opisana u malom broju slučajeva. Najčešće, metak migrira i ostaje unutar lobanjske šupljine, ali, u veoma retkim slučajevima može dospeti i u spinalni kanal. Cilj rada je bio da se prikaže bolesnik sa ovim retkim kliničkim entitetom. **Prikaz bolesnika.** Muškarac star 29 godina je zadobio ustrelnu povredu glave kroz levi spoljašnji slušni kanal. Metak je bio lokalizovan u zadnjoj lobanjskoj jami. Učinjen je inicijalni debridman rane bez uklanjanja metka. Četiri meseca nakon povrede, bolesnik je osetio ukočenost vrata i slabost svih ekstremiteta zbog čega se javio lekaru. Radiografijom je pokazano da se metak nalazi u spinalnom kanalu na nivou C2 pršljena, a kompjuterizovanom tomografijom je potvrđena lokalizacija u posteriornom aspektu. Bolesnik je hitno operisan radi evakuacije metka i dekompresije kičmene moždine. **Zaključak.** Meci imaju tendenciju da se pomeraju. Migracija u spinalni kanal je retka i nosi značajan rizik zbog moguće sekundarne povrede. Uklanjanje metka po svaku cenu nije opravdano, ali predviđanje njegove migracije na osnovu predisponirajućih faktora bi bilo od velikog značaja za adekvatnije lečenje ovih bolesnika.

Ključne reči:
povrede glave, penetrirajuće; neurohirurgija; kičmena moždina, kompresija.

Introduction

Gunshot wounds to the head (GSWH) are among the deadliest injuries known, with up to 70% fatality at the place, up to 90% dying before admission, and about 50% of the remaining who die in the emergency room [1]. These appear in both civilian and military circumstances, and the overall incidence is hard to be estimated.

The outcome is worse in those patients with extensive bullet tracts, in those with brainstem involvement and when the deep midline structures of the brain are wounded [2]. Although GSWH are severe, there are survivors, and complications in this group of patients are related to further decrease of favorable outcome. The most common are various kinds of infections, cerebrospinal fluid (CSF) leaks and fistulas and posttraumatic epilepsy [3].

Intracranial missile migration is considered to be very rare, in cases when the metallic foreign body is left over. Rapp et al. [4] have previously reported an incidence of more than 4%, contrary to other studies that have neglected the

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migration [5, 6]. The migration is usually constrained to the cranial vault, but sometimes, the missile might find its way out through the blood vessels to distal vascular structures or through the *foramen magnum* to the spinal canal [7, 8]. We present a case of delayed spinal cord injury due to the migration of the retained intracranial bullet.

Case report

The 29-years-old male suffered from the GSWH through the left external auditory meatus in an armed conflict. He was delivered to the Emergency Department, where the initial surgery, which included wound debridement, was performed. Due to the distal localization, the bullet was not evacuated and was instead left behind. Postoperative computed tomography (CT) revealed the bullet located in the *posterior fossa* near *foramen magnum* (Figure 1). The patient recovered well and was referred to the regional rehabilitation center for further treatment. The left-sided ear deafness persisted.

During his regular activities at the rehabilitation center, after impetuous verticalization, the patient started to develop symptoms of spinal cord compression in the form of neck stiffness and progressive tetraparesis. Plain radiography was performed right away, which revealed the bullet in the spinal canal at the level of C2 vertebra (Figure 2).

The patient was transferred to the Emergency Department of the Military Medical Academy in Belgrade for further diagnostic assessment and surgical treatment. CT revealed the bullet in the posterior aspect of the C2 vertebra (Figure 3). Emergency surgery was performed for bullet removal, which included extended C2 laminectomy end evacuation of the foreign body.

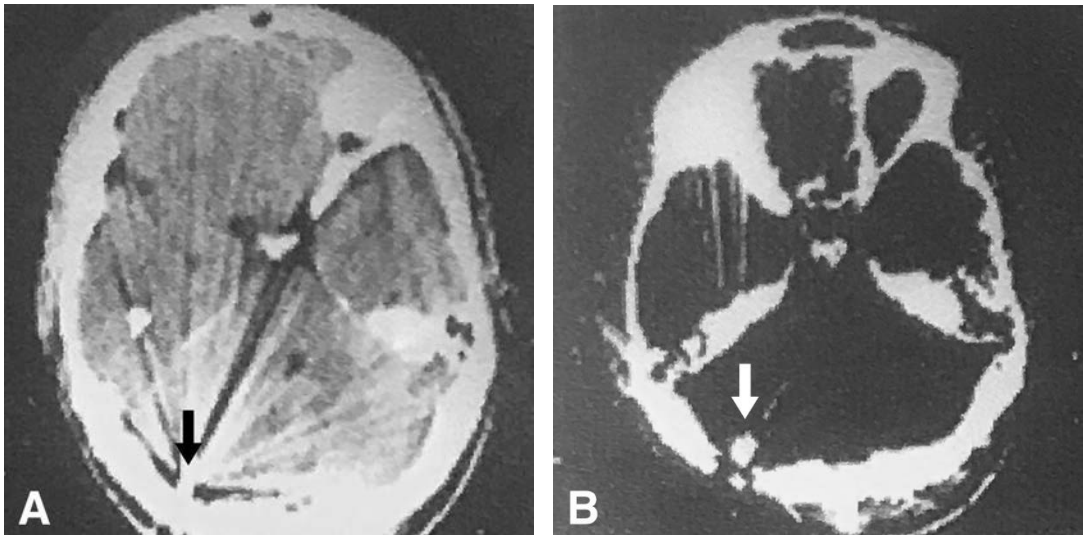

Fig. 1 – Initial postoperative computed tomography showing the retained bullet located in the *posterior fossa* near *foramen magnum*: A) Axial brain scan with many artefacts (arrow pointing to the bullet); B) Axial hard structures scan (arrow pointing to the bullet).

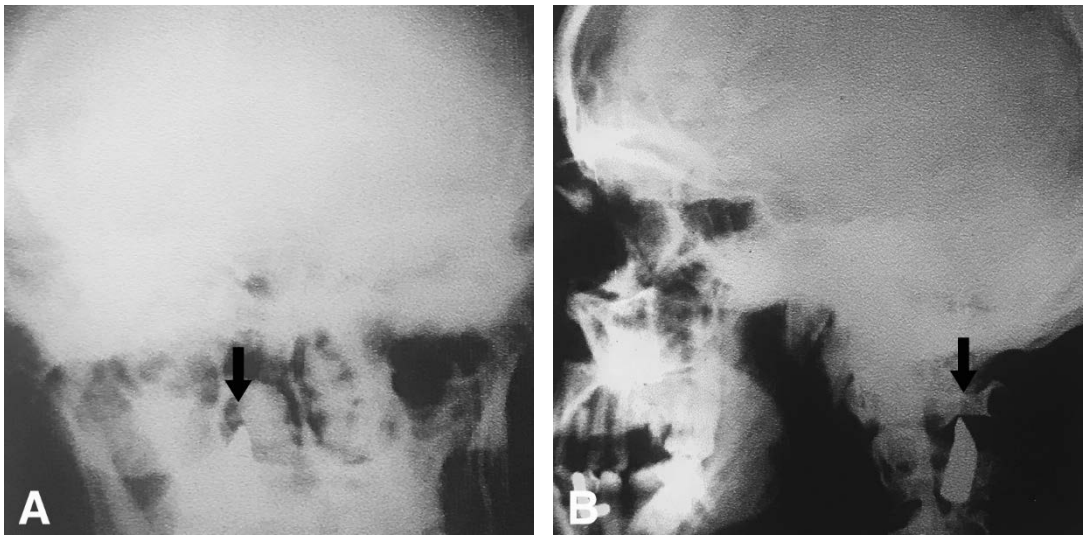

Fig. 2 – Plain radiography performed after the spinal cord related symptoms have occurred. The bullet had migrated to the spinal canal extending from the lower edge of C1 to the C3 vertebral body: A) Anterior view; B) Lateral view.

Postoperative clinical examination confirmed symptoms relief, but with the persistence of spinal cord compression injury signs. No signs of bullet fragments were found on follow-up plain radiography (Figure 4). The patient remained in the Intesive Care Unit for a few days to exclude late complications. He was discharged without any newly developed neurological symptoms.

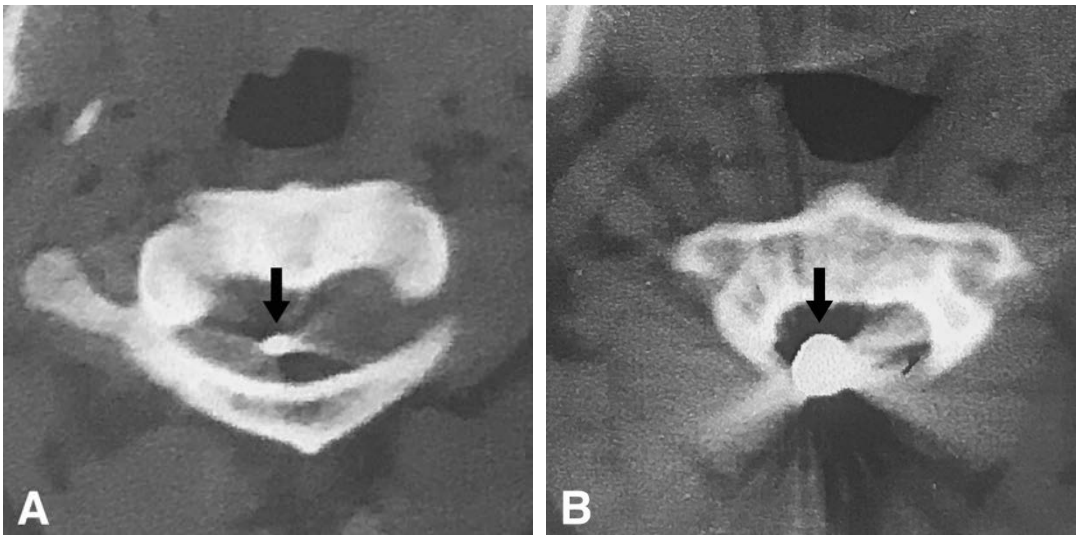

Fig. 3 – Complimentary computed tomography revealed the bullet positioning in the posterior aspect with the narrow tip at the lower edge of C1 vertebra (A) and the main bullet calibre at the C2 level (B).

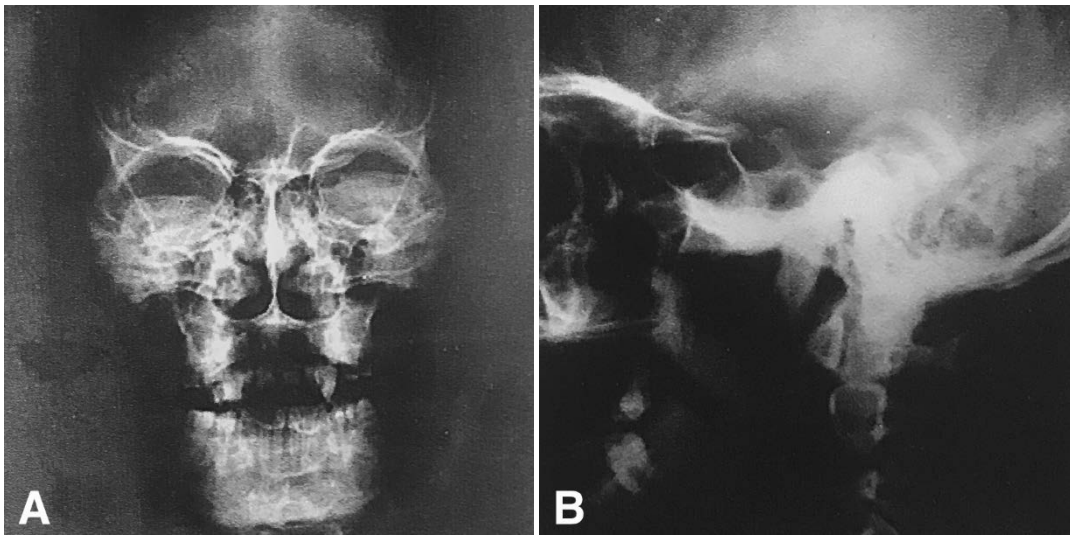

Fig. 4 – Plain radiography performed after bullet evacuation through a laminectomy. No signs of bullet fragments were found on the: A) anterior view; B) Lateral view.

Discussion

The first migration of intracranial missile was reported in 1916 [9], however, not many migrations to the spinal canal were reported to time. The first case was reported in 1939 by Kellhammer [10]. As it is the case with any kind of gunshot wounds and its complications, the patients were male in most cases, with age ranging from 19 to 36 years. Table 1 presents all of the previously reported cases of missile migration into the spinal canal (including ours).

The spontaneous migration of a missile or a its fragment within the cranial cavity may occur from a few days after the injury to a few years later [11–18]. In our case, the migration occurred four months after discharge the patient who recovered well and probably provoked migration with a sudden movement (verticalization). This contributes to the conclusion that every missile will eventually migrate if there are no limiting factors (close proximity of bone or other structures in the vicinity of the missile).

Initially, missiles were located in different brain parts and migrated into the spinal canal from C2 to T6, most often to the C2 level [7]. When smaller shrapnel migrated, even the most distal parts were reached [10, 17]. In our case, the bullet migrated from *posterior fossa* into the

Table 1

Reported cases of missile migration into the spinal canal

Reference	Gender	Age (yrs)	Missile (type/size)	Missile location			Neurological finding			Treatment
				initial	intermit.	final	initial	intermit.	final	
10	-	-	bullet	loose bullet in the ventricle	-	*cauda equina*				
11	female	22	7.65 mm - bullet	right suboccipital region	-	C3-4, dorsal to the cord	apprehensive but well oriented	-	electric-like shocks radiating from neck to hands and feet	delayed removal
12	male	15	air gun pellet	right parietal lobe	right parietal paraventricular region	C2, dorsal to the cord	arousable to painful stimuli, fairly cooperative, mild right sided hemiparesis	right-sided parietal motor seizures	severe headache, vomiting, neck pain triggered by movement	delayed removal
13	female	19	bullet	near torcular herophili on the tentorium	quadrigeminal plate cistern in posterior *fossa*.	C5	not fulfilling commands language and memory deficit, right hemiparesis	same	same	initial debridement
14	male	15	baby bullet, 4.6 mm	prepontine cistern	-	lumbar subarachnoid space L5/S1	burning in left eye and a generalized headache	intact	intact	conservative treatment
15	-	-	-	brain	-	spinal canal	-	-	-	-
16	female	36	9 mm - bullet	between hemispheres	?	T4	Intact	flaccid quadriplegia paresthesias and alterations in vibration sense	T4 dermatomal sensory changes, myelopathy signs	delayed removal
7	male	21	9 mm - bullet	right lateral medullary cistern	-	C2	GCS12	spinal cord injury	-	conservative treatment & delayed removal
18	/	19-24	air gun pellet	right lateral ventricle	-	T6	comatose	-	-	conservative treatment
this case	male	29	bullet	posterior *fossa* near *foramen magnum* on the right	-	C1-2	left sided ear deafness	-	neck pain & teraparesis	initial debridement & delayed removal

spinal canal to the C2 level (which is the most common level). Neurological symptoms were dependant on the level of spinal cord migration/compression [7].

The clinical presentation in previously reported cases is different and conditioned directly by the missile size: the small pellets may be asymptomatic and confirmed on follow-up radiography or CT scan, while the larger will present the compression symptoms at the level they reach. Sometimes a bullet may fall from the *posterior fossa* to the spinal canal with sufficient momentum to cause an acute spinal cord injury [7]. However, compression related symptoms are much more common [16]. In our case, the symptoms of spinal cord compression in the form of neck stiffness and progressive tetraparesis were present, although no signs of spinal cord injury were found. The symptoms mitigated to some extent early after surgery. However, due to the compression injury to the spinal cord, mild numbness and mild lower extremities paraparesis remained. The patient had fully recovered in a two-year follow-up period.

Initial debridement was performed in most of the cases with the delayed procedure performed for the missile removal, although sometimes only the follow-up imaging revealed the migration [16]. So far, the prediction of migration is impossible and unreliable, as no reliable influencing factors were identified. The analysis of these could be very helpful to the surgeon, to make the decision-making process on missile evacuation easier and relatively straight forward.

Conclusion

The tendency to migration of intracranial missiles is obvious. Although every intracranial foreign body that is not trapped by the bones or adjacent structures might mi-

grate at some point, it is a matter of patients' survival, time passed, occultness (symptoms absence), and follow-up imaging. Therefore, migration of the retained intracranial bullets or other missiles should be considered as a potential early or delayed complication.

Conflict of interest

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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