Posterior Cervical Laminectomy for Removal of an Intradural Extramedulary Bullet Fragment with Significant Clinical Improvement and Review of the Literature on Intradural Bullet Migration

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Introduction

Neurosurgeons are well aware of the devastating injuries which can be caused by gun shot wounds to the spine. The literature however remains unclear on the best management approaches of GSWs to the spine with retained fragments. To date there are very few reports in the literature describing intradural migration of bullets. There are no reports in the literature describing bullet entry into the thoracic spine with dural penetration cephalad migration into the cervical spine. All previous reports within the literature describe a caudal migration usually settling in the lumbar cistern. Most agree that surgery should be reserved for patients with progressive neurological deficits. In this case report we describe the management of our patient and a review of the literature on intradural migration.

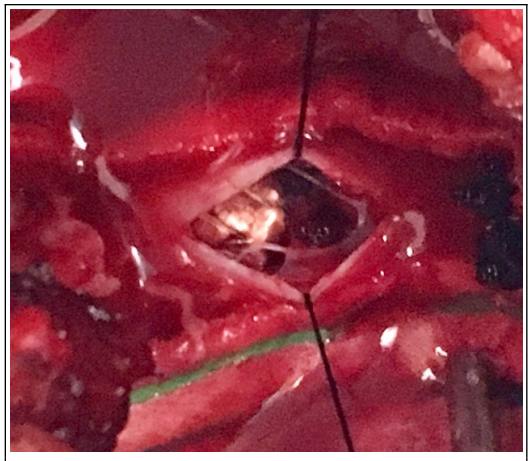
Case Presentation

In this case a 31yr m presented to the trauma service after a gsw to his left shoulder. The bullet passed through the left scapula where it caused a T2 lamina fracture, penetrated the dura causing a complete spinal cord injury at the T2 level, then lost its kinetic energy and migrated up to the C6 spinal level, resting within the spinal canal and compressing the spinal cord. Physical exam was which was notable for weakness in bilateral upper extremities. Triceps and biceps strength were diminished, as were wrist extension, grip, and finger abduction. A bilateral sensory deficit to painful stimuli was found beginning approximately 1-2 cm above the level of the clavicle and extending caudally. The patient exhibited no motor tone or strength in bilateral lower extremities, and decreased rectal tone. The CT c-spine can be seen below depicting the bullet fragment retained within the canal

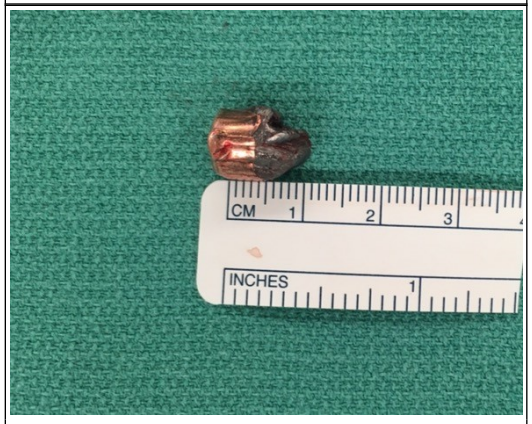
Sagittal CT of cervical spine Bullet entry at the level of T2 showing comminuted and displaced fracture involving the left T2 lamina, with migration of the bullet to a resting level of C6 in the spinal canal

Surgical Intervention

A C6 laminectomy was performed, the dura was opened and the bullet successfully removed. The patient made a significant clinical improvement immediately after the procedure with improvement in strength and sensation in the upper extremities. There were no post operative complications or infection. The 2 images below show an intraoperative view of the bullet fragment which was found resting on the spinal cord after opening the dura and the bullet fragment after it was removed from the patient.



Dural incision at C6 reveals intradural bullet fragment



Removed bullet fragment

Literature Review

We performed a literature review and identified 14 other cases of GSWs to the spine with intradural migration. A table can be seen below summarizing the other cases. In all cases where the fragment was removed there was significant improvement in neurological exam. Migration typically occurs between T10 and S1. There are also two reports of bullets migrating in a cephalad direction, one from S1 to L3 and the other from S1 to L4. No other reports found in the literature have shown cephalad migration from the thoracic spine to the cervical spine. Indications for bullet removal, included progressive clinical deterioration of the patient's neurological function with an incomplete spinal cord injury, migration of the bullet within the canal, CSF leaks, impending meningitis, and possible metal toxicities.

Article	Patient	Entry Level	Migration	Resting Level	Deficit	Reversed
Tanguy 1982	10M	C7	subarachnoid	S2	none	3 months later
Oktem 1995	20M	T6 via chest	subarachnoid	S2	T6 complete	no
Arpali 1982	22F	foramen magnum	subarachnoid	C4	Lhermitte's sign	yes
Rawlinson 2007	16M	C2	unknown	mid/lower T-spine	C2 complete	no
Kafadar 2006	44M	L1 via abdomen	intradural	S2	L1 complete	yes
Avci 1995	30F	S1	subarachnoid	L4	L4-S1 radicular	yes
Karim 1986		T12		L4	radicular	yes
Genc 2016	32M	R L3 pedicle	epidural	S1	radicular	yes
Farrugia 2010	22M	T12	intradural/ricochet	T12	unknown/died	no
Castillo-Rangel 2010	9F	intracranial		T4	none, then paraplegia	27 years later
Young 1993		L maxilla/orbit	subarachnoid	C5 after 4 yrs	none	
Gupta 1999		S1	subarachnoid	L3	b/l foot drop, 8/8	
Rajan 1997	24M	C1	intradural	T6; S2 after 3yrs	RUE prox 4/5; none	no
Bordon 2014	27 ?	L2/3	intradural	S1/2	sacral sensory def	yes

Conclusion

This case identifies for the first time the cephalad migration of an intradural bullet fragment from the thoracic spine to the cervical spine and is notable for the significant improvement in bilateral upper extremity strength and sensation following removal of the bullet fragment. Laminectomy and Removal of accessible bullet fragments should be carefully considered for patients with incomplete injuries or progressive neurological deficits.