

Case Report

Unusual case of a migrating spinal bullet: An opportunity for reflection

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ABSTRACT

The following case report documents the presentation of a 28 year old male who presented to the Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) trauma unit following a single gunshot wound to the spine. He presented walking, with no neurological dysfunction. On further investigation he was found to have a retained bullet at the L3 level of the spinal canal, which migrated within the canal from its initial point of entry. He was subsequently taken for a laminectomy and bullet removal under fluoroscopic guidance. Post operatively he was noted to have reduced proprioception bilaterally.

Background

Gunshot wounds to the spinal column are not infrequent in South Africa, a country with significant gun violence¹. However, the migration of a bullet within the spinal canal is extremely rare locally and globally. A case report by Baldawa et al. in 2017, reviewed cases of reported bullet migration in the literature, this found 29 documented cases between 1982 and 2016 [2]. Furthermore, when it does occur, bullet migration happens in a cranio-caudal direction in the majority of cases². The following case describes an incident of this rare phenomenon (bullet migration in a caudo-cranial direction within the spinal canal) by outlining the presentation, investigation and management of a patient in a level 1 trauma unit in South Africa.

Case presentation

A 28 year old male presented with a history of sustaining a gunshot wound to the right upper buttock/lower back. He initially presented to a community health centre where he presented ambulant, without any apparent neurological dysfunction. There was no significant active bleeding noted. The health centre performed a plain film abdominal XR, which demonstrated a bullet possibly lodged near or in the spinal column. He was therefore referred to the Charlotte Maxeke Academic Hospital level 1 trauma centre for further investigation and management. On brief history, he had no significant past medical or surgical history. He had no allergies and social history included a 0.1 pack year history of smoking.

On presentation to CMJAH, his airway was self-maintained and he was breathing spontaneously. He was haemodynamically stable with a blood pressure of 133/73 mmHg and a heart rate of 68 bpm. He had an oxygen saturation of 96% on room air and a respiratory rate of 17 bpm. There was no significant active bleeding noted. His Glasgow Coma Scale (GCS) was 15/15, his pupils were equal and reactive to light and he had no obvious focal neurology clinically. On external examination, a single bullet wound roughly 1 cm, was noted at the level of the right posterior iliac spine. This was not actively bleeding, and was covered with a sterile dressing.

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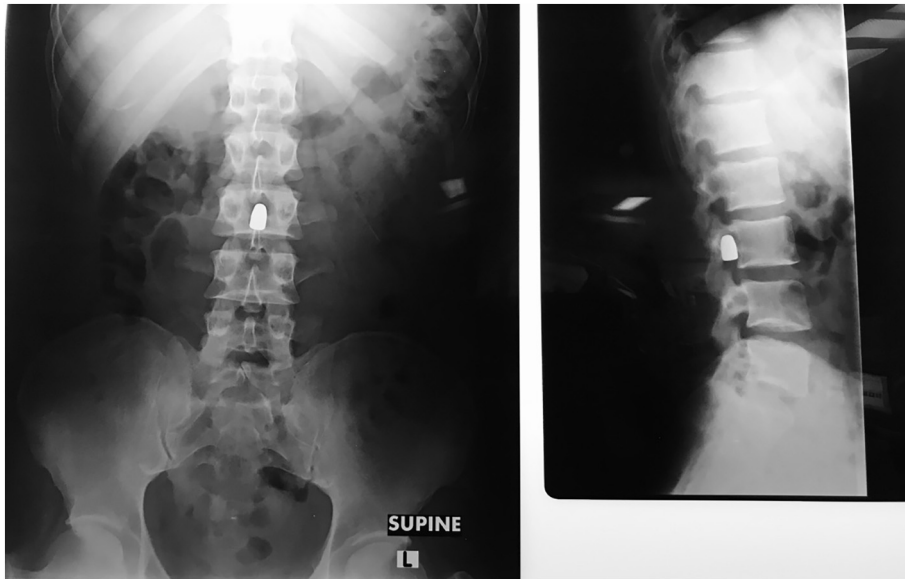


Fig. 1. Anteroposterior and Lateral views of plain film X-rays demonstrating a bullet at the level of the L3 Vertebra.

On neurological examination, he had 5/5 power with no notable sensory deficits to pain, temperature or light touch. He had normal upper and lower limb reflexes and had a normal Babinski reflex. On spinal survey, there were no external injuries noted and no significant swelling. He had bony tenderness at the lower lumbar spine at the L3-L5 level.

The remaining systemic examination on secondary survey was unremarkable. He had no abdominal pain/distention or tenderness. He had an unremarkable per rectal examination with good rectal tone and no blood noted on the glove. A urinary catheter was placed, and clear urine was noted to be draining with no haematuria on urine dipstick.

Investigations

He was put onto the Low Dose X-ray (LoDoX) which revealed no abnormalities apart from a bullet at the level of the L2/L3 spinous process.

An extended focused assessment with sonography in trauma (eFAST) was performed which showed no blood in the peritoneal cavity and plain film radiographs of the abdomen/lumbar spine showed a bullet lodged around the spinous process and vertebral body of L3 (Fig. 1).

He was then sent for an urgent Computed Tomography (CT) scan which confirmed the location of the bullet within the spinal canal at the level of L3 (Fig. 2). On further inspection it also confirmed the following: Fracture of the right posterior superior iliac blade (Fig. 3), fracture of the right sacral alar through the first neural foramen with some widening of the right sacroiliac joint with small bony fragments in spinal canal (Fig. 4). There were no other fractures noted of the lumbar spine but a bullet was seen at the level of L3 (Fig. 5). When following the bullet tract, it appeared apparent that the bullet had travelled through the right iliac bone and the sacral alar, into the spinal canal from where it migrated superiorly within the spinal canal to L3. No intra-abdominal injury noted.

Formal blood results showed normal renal function (Urea 4.5 mmol/L and Creatinine 73 μ mol/L) with a normal haemoglobin (13.5 g/dL).

Treatment

After arrival, he was observed in the resuscitation area. He was given analgesia and tetanus prophylaxis. Intravenous lines were inserted and he was given cautious fluid rehydration while awaiting imaging. After the CT scan was reviewed, a neurosurgical consultation was requested. He was seen by the neurosurgeons who admitted him to the neurosurgical ward. After discussion with the patient and with the neurosurgical team, a decision was made to take him to theatre for removal of the bullet to avoid the potential risk of progression of neurology if left in situ. It was also considered that the current location (below the level of the spinal cord) would be less challenging and risky than a later operation should the bullet continue to migrate cranially, or complicate with reactive fibrosis if delayed. This offered a window of opportunity for early bullet removal.

He was counselled and consented for a laminectomy and removal of bullet. He was taken to theatre the following day where he was placed under general anaesthesia. He was positioned prone on the operating table. Fluoroscopy was made available to locate the bullet prior to incision, which was noted to be at L3 (Fig. 6). There were no external markings or injuries at this level. A fresh skin incision was made and the subcutaneous tissue and muscle was dissected to the bone. An L3 laminectomy was performed and the foreign body identified. Minimal cerebrospinal fluid (CSF) was released when the dura was opened and the bullet was identified,

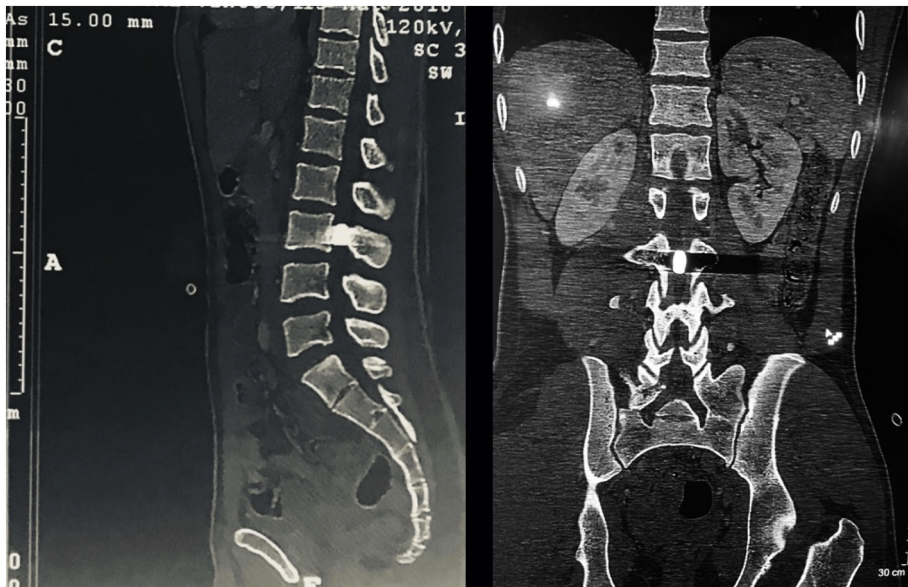


Fig. 2. Sagittal and Coronal Views of CT scan of the abdomen and pelvis demonstrating bullet at L3 vertebral level within the spinal canal. Associated right Sacral Alar Fracture noted on coronal film with bone fragments in spinal canal. No other intra-abdominal injuries noted.

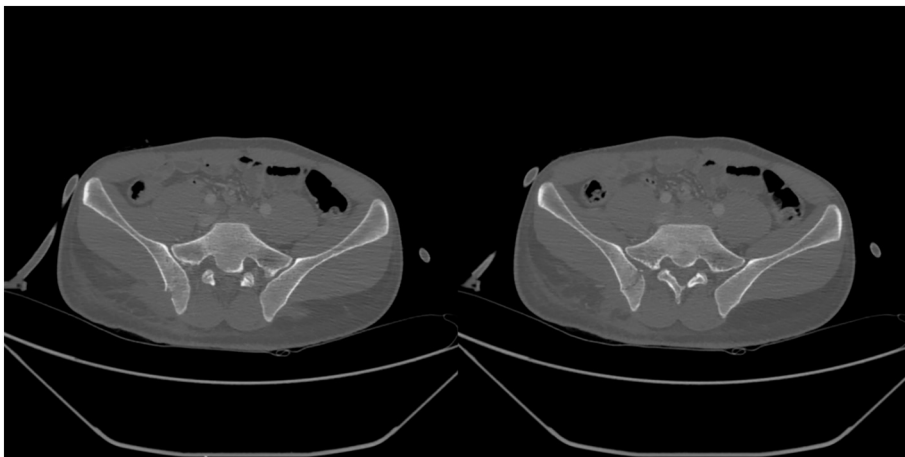


Fig. 3. Axial views of CT of the pelvis on a bone window, showing fracture traversing the right iliac blade towards the sacral alar.

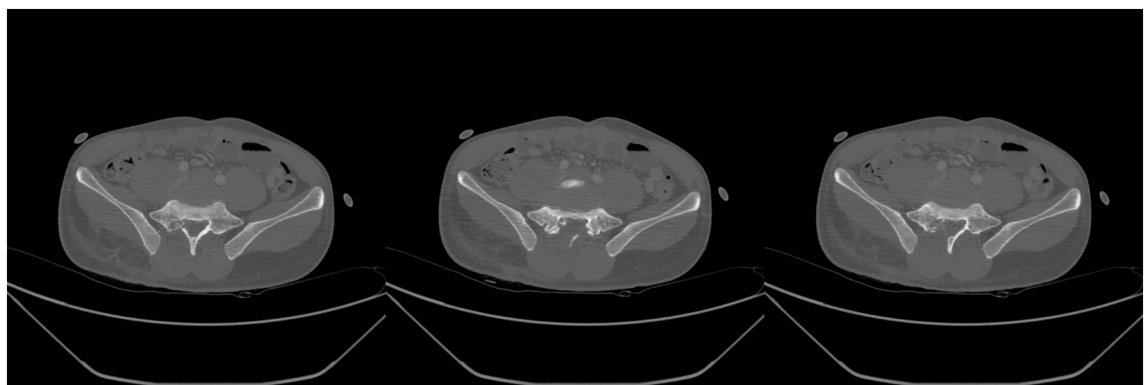


Fig. 4. Axial views of CT of the pelvis on a bone window, showing right Sacral Alar fracture, with bone fragments in the spinal canal.

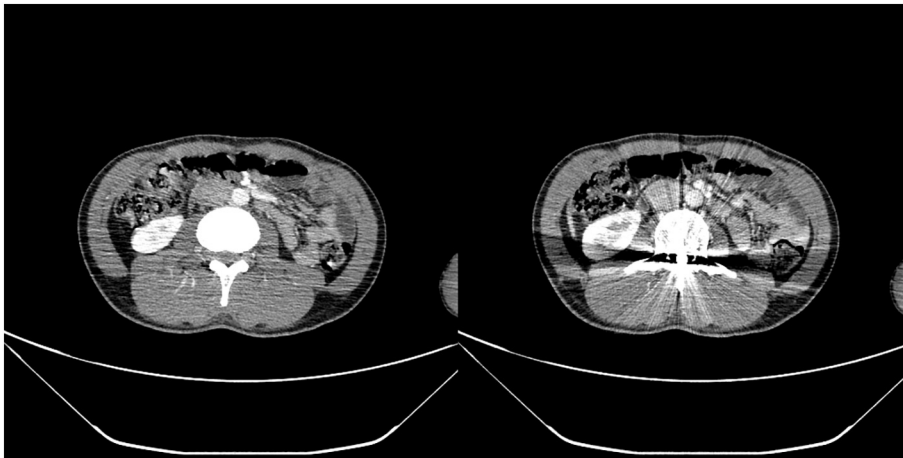


Fig. 5. Axial view of CT of the Lumbar spine showing intact L5 vertebra with no fracture or bullet fragments (left) and L3 Vertebra with bullet lodged in the spinal canal with associated scatter (right).

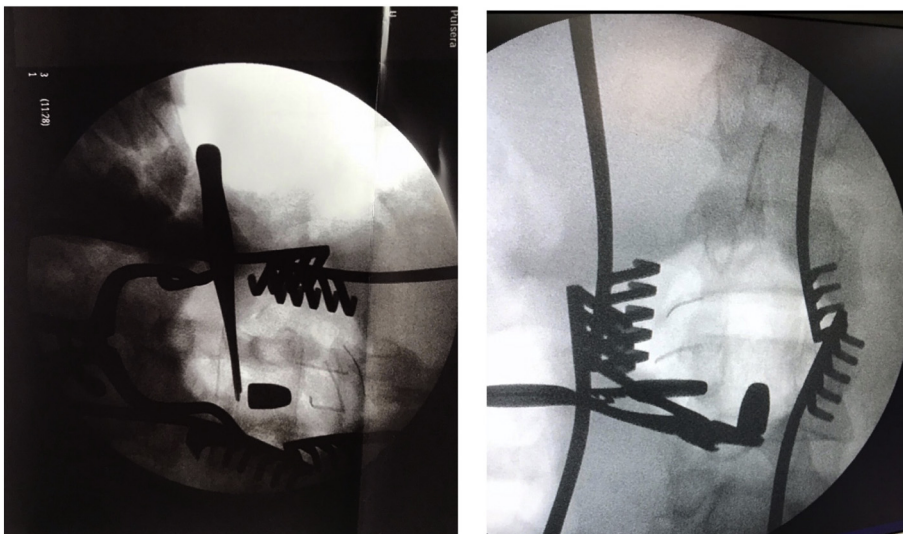


Fig. 6. Fluoroscopic Images taken intraoperatively demonstrating localization of bullet at L3 vertebral level.

facing superiorly, and removed with gentle dislodgement from the bone. There were no other injuries noted to adjacent bones or external structures. The dura was closed and the patient was admitted post-operatively for observation. The operative findings were consistent with those previously hypothesized from the CT (i.e. through the sacral alar into the spinal canal with caudo-cranial migration to L3).

Outcome and follow-up

Post-operatively he was admitted to the neurosurgical ward. He remained haemodynamically stable and had no complaints. Clinically he had full 5/5 motor power of the upper and lower limbs to S1. His sensory examination revealed normal findings for light touch, pain and temperature however he was noted to have bilaterally reduced proprioception. He was referred to physiotherapy for rehabilitation and was subsequently discharged for outpatient therapy and review.

On successive reviews he was shown to have recovery of his sensory neurology and one year later had no persistent deficits.

Discussion

Gunshot injuries are frequently encountered in the trauma setting in South Africa. The Natalspruit Hospital Spinal Unit found that trauma accounted for 89% of spinal injuries and gunshot wounds specifically, accounted for the highest proportion of these at 36% [1]. This is higher than international figures, where gunshot injuries are responsible for up to 17% of spinal trauma [2]. The

neurological deficit that results depends on a number of factors such as: the initial neurological damage, the site, the pathway and fibrosis or sepsis related complications [2]. The pathway that the bullet follows can often be traced on imaging in a somewhat linear trajectory. In the case above the trajectory followed an unusual pathway: the entrance can be traced into the spinal canal, but the subsequent location of the bullet suggests migration within this canal to a higher level. Although this has been described in the literature, such migration is extremely rare [2–6].

Migration within the spinal canal may occur in the epidural space which is extradural, or within the subarachnoid or subdural space which is intradural [3]. The usual direction is caudal as a result of gravity, respiration, peristalsis and normal CSF directional flow [2,3]. This is in contrast to the current case which saw a cranial/cephalad migration following entrance into the canal. This direction of migration may result from supine/prone positioning [2].

A literature review by Baldawa, evaluated 29 cases of intrathecal migration between 1982 and 2016. The majority of these (48%) involved the lumbosacral region however the remainder was seen in the cranial, cervical and thoracic regions combined [2]. Cephalad migration above T10 is thought to be limited by the natural narrowing of the spinal cord at this level [2,3]. This is consistent with majority of cases in the literature occurring between T10-S2 [3]. In the cases presented by Baldawa et al. symptoms ranged from no neurological deficits, as was seen in our case, to complete paraplegia. Lack of neurology for injuries below L2 can be explained by the absence of the cord below this level, after which the space is instead occupied by nerve roots [3]. Migration above this level is more likely to be associated with neurological deficit, the extent of which is determined by: the size of the bullet, the degree of fragmentation and whether the pathway that it subsequently follows is intra or extra-medullary [3]. The majority of cases (82%) in the series involved cranio-caudal migration in the first instance [2]. This finding was supported by a forensic study by Farrugia et al. which found in a review of 11 cases between 1982 and 2006 that 81% of cases involved a cranio-caudal migration [3].

In order to investigate patients with gunshot injuries to the spine, plain film radiograph are obtained initially. These should include posteroanterior (PA) (or anteroposterior) AND lateral views [4]. For more detailed information, a CT scan is then performed [4]. This may assist to identify the bullet location, assess for other associated injuries (i.e. intra-abdominal, thoracic, and skeletal) and may identify bullet or bony fragments. MRI has traditionally been avoided due to the fear of causing further bullet migration and worsening of neurological function [5,6]. This is due to the predicted movement and thermal energy created as a result of the bullet and the magnetic force of the MRI [5,6]. This theory has however been disputed in studies of civilian gunshot injuries due to the copper coating of civilian bullets, which do not have ferromagnetic properties [4].

Regarding the management of intraspinal bullets, this can be non-operative or surgical. Certain factors favour surgical removal, such as: the progression of neurological dysfunction, sepsis, reactive fibrosis and lead toxicity if left in situ [2,4]. Gença et al. argued that even though there may not be an indication for removal at first presentation, symptoms may develop at a later stage necessitating removal. If delayed, the resultant fibrosis may make the surgery more challenging [6]. Several cases have documented progression or delayed emergence of symptoms following conservative management [2,7]. Furthermore, there have been several cases that demonstrated improvement in symptoms following bullet removal and thus advocate for early removal [2,7,8]. Çağavi et al. reported an improvement in neurological function following the removal of a bullet that had migrated from L3 to S2 resulting in paraparesis [7]. Moisi et al. reported a case of bullet removal 4 weeks after the initial injury in a patient with progressive neurology, the bullet was found to be encased in scar tissue making removal more difficult at this time. Initially the patients neurology worsened post-operatively but by discharged it had improved beyond the pre-operative baseline [8]. In the 29 cases reported by Baldawa, 24 of the cases (82%) documented some degree of improvement of neurological symptoms following removal of the bullet [2]. In one of the cases a patient who initially had no neurology developed it when his clinical course was complicated by meningitis three months after leaving the bullet in situ [2]. These authors support removal to prevent migration and possible worsening of neurological outcome if left in situ. Surgical removal may however, not result in any improvement of symptoms or result in iatrogenic neurological dysfunction. As such, the decision to subject someone to operative or conservative management should be carefully considered.

As stated prior, the positioning of a patient may precipitate further migration. Therefore, intraoperative radiographic imaging such as fluoroscopy is advised prior to incision [2]. Alternatively, the use of ultrasound intra-operatively was demonstrated by Gença, to locate the bullet and demonstrate its position in relation to caudal elements [6]. Fluoroscopy was used in the identification of the bullet in the case above however, this did not show any further migration and the bullet was successfully removed at the initial level at which it had lodged.

In conclusion, gunshot injuries are often encountered in the trauma departments around South Africa and in other parts of the world. Despite the frequency of these, there is still much to learn from unusual cases such as this. The intrathecal migration of a bullet migration is rare but not undocumented. This may present with a variety of signs depending on patient and ballistic factors. In investigating such patients, MRI may be cautiously considered for civilian injuries if one is confident that the risk of ferromagnetic coating is low. This was not done in the case above as there are a number of non-civilian weapons in the community. This combined with an inability to confirm the ferromagnetic properties of the bullet prior to imaging, as well as the risk of devastating complications with MRI, made this imaging modality unsuitable. The decision to operate or not remains controversial as this may improve or worsen symptoms. If the decision to operate is made, positioning is important and imaging such as fluoroscopy or ultrasound is imperative.

Prior presentations

Nil.

Author contribution

Both authors contributed to the development of the report in its entirety.

Declaration of competing interest

Nil to declare.

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