

CASE REPORT



Isolated L5 nerve root injury without osseous disruption in a case of gunshot injury to the paediatric spine—A case report

Shivaprasad Sharangouda Kolar^{1✉}, Tushar Narayan Rathod¹, Rudra Mangesh Prabhu¹, Vinod Kumar Yadav¹, Bhushan Sunil Hadole¹ and Abhishek Kumar Rai¹

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INTRODUCTION: There exists sparse literature on Gunshot injuries (GSI) to the pediatric spine, its natural course, management protocols and outcomes following surgical intervention. Here, we present a projectile injury to the paediatric lumbar spine without any osseous disruption in a 5-year-old child requiring surgical management.

CASE PRESENTATION: A 5-year-old child presented with a gunshot injury to the pediatric lumbar spine. On radiological imaging, there was no osseous disruption and an intraspinal canal projectile was embedded in an organised infected complex, compressing onto the left-sided L5 traversing nerve root with resultant grade 4 motor power of the left Extensor Hallucis Longus (EHL). Under fluoroscopic guidance using two separate mini-open incisions, the pellets were extracted. One from the spinal canal through left-sided L4 laminotomy and the other from the right paraspinal region. Post-surgical decompression and pellet retrieval there was gradual recovery to grade 5 motor power of Left EHL and improvement in the general condition of the child.

CONCLUSION: The absence of osseous disruption can be attributed to the size of the projectile, widely spaced interlaminar spaces in the lumbar spine due to the absence of lumbar lordosis in the pediatric group and flexibility of the pediatric spine owing to its ligamentous laxity.

Spinal Cord Series and Cases (2022)8:45; <https://doi.org/10.1038/s41394-022-00516-8>

INTRODUCTION

Gunshot injuries (GSI) is the second most common cause of penetrating spinal injuries [1]. The strict firearm laws in India as compared to the west is the reason for lower incidences of such injuries in India [2]. This gives rise to a paucity of data on the demographics, epidemiology and incidences of GSI to the pediatric spine in particular [3]. The nature of injury depends on various factors such as the type of ammunition, number of pellets, bullet design, constituents, firing distance, direction and velocity of the projectile, impaction surface and the organs injured. These injuries present on a spectrum of severity from a simple bullet graze to multi-organ damage.

Civilian GSI are usually caused by low-velocity firearms. The projectile results in an entry wound and sometimes an exit wound, multiple injuries to various organs and cavitation along the path of the bullet. The reduction in velocity causes dissemination of energy in the form of heat causing charring of the tissues [4]. Damage is imparted to the spine, its neural tissue and Osseo ligamentous framework by direct impaction, pressure waves, heat necrosis, migration of fragments and metal toxicity [5–7]. Management depends on the timing of presentation, general condition, vitals on admission, spinal instability, neurological course overtime, associated injuries and path of the projectile. Surgical management is indicated in incomplete spinal injury and progressive neurological deficit, cerebrospinal fluid (CSF) leak and infection [1, 8]. The prognosis for surgical intervention is better for injuries below the level of conus

medullaris and poor for those at the conus and above it [1]. Complications like persistent CSF fistula, neurological deficits, decubitus ulcers, deep vein thrombosis, sepsis, meningitis, pneumonia, wound infection and systemic features of metal toxicity are seen [5, 8]. The Management of GSI in the published literature is mainly based on data from the adult population and there exists a lacuna in our understanding of these injuries in the paediatric population because of their rarity. We present a case of a GSI to the paediatric spinal canal resulting in neurological deficit and the outcomes post-surgery. Informed consent for the same has been obtained from the parents of the child. A literature review of the PubMed database revealed no such reported case of a GSI to the paediatric spine with a lack of osseous disruption and an isolated nerve root injury.

CASE PRESENTATION

A 5-year-old child presented to the emergency department of our institute with a history of accidental firearm injury. Six of the pellets embedded superficially in the soft tissues of the dorsolumbar region were removed before arrival. Upon subjecting the child to radiographic examination, one pellet was located in the lumbar spinal canal and another one was located in the left dorsolumbar paraspinal region (Fig. 1). Eight entry wounds were seen on the dorsal thoracolumbar region without any exit wounds (Fig. 2). Neurological examination revealed motor power of 4/5 of the left Extensor hallucis longus (EHL), with the rest of the

¹Department of Orthopedics, Seth GS Medical college and KEM Hospital, Mumbai, Maharashtra 400012, India. ✉email: shivaprasadkolar@gmail.com

Received: 9 January 2022 Revised: 16 April 2022 Accepted: 18 April 2022

Published online: 26 April 2022

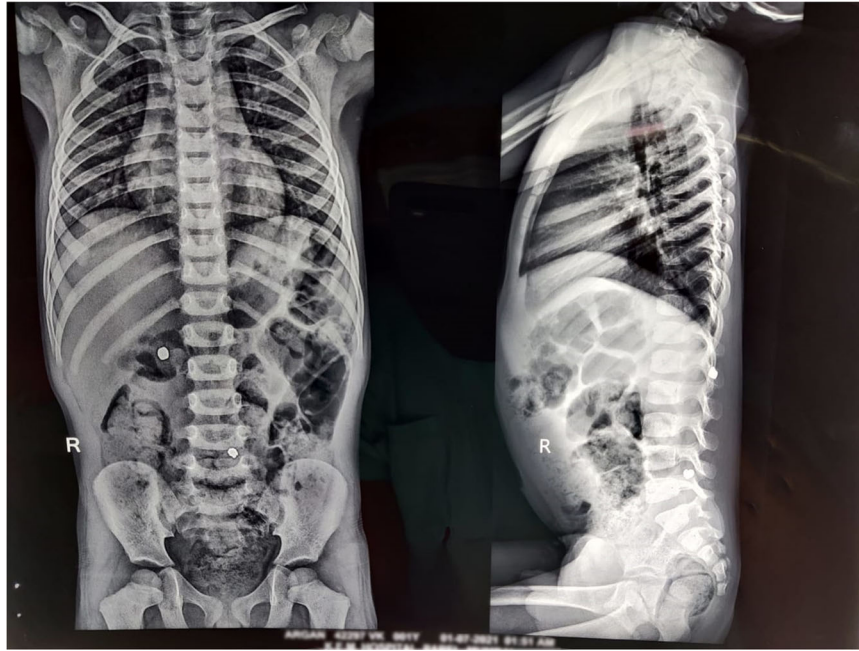


Fig. 1 AP and Lat radiographs showing the position of the pellets preoperatively.



Fig. 2 Clinical picture of the back showing 8 entry wounds.

examination being normal. Empirical antibiotics were administered to provide cover for gram-positive and gram-negative organisms. Computed tomography showed the projectile to lie anterior to the left-sided L4 L5 interlaminar space and the other one lay at the level of L1 L2 in the right paraspinal region (Fig. 3). There were no signs of spinal instability. MRI was not done in our case as the ferromagnetic nature of the projectile was not known and could have led to its migration and resulted in further damage. After preliminary work up the child was taken to surgery in view of incomplete neurological injury (ASIA grade D) and persistent fever. In prone position under general anaesthesia, the location of the projectiles was marked under fluoroscopic guidance (Figs. 4a, b and 5), using a midline incision the L4 L5 interlaminar space on the left side was approached (Fig. 6). On inspecting, the posterior structures were intact and showed no evidence of disruption of the bony framework. Laminotomy of the inferior edge of the L4 lamina was done, the projectile was visualised in the extradural space in a pool of pus, exerting compression onto the L5 traversing nerve root and was found to be covered in a layer of organised pus and debris. Another separate paraspinal incision was taken on the right side at the L1 L2 level to retrieve the other projectile which was found

surrounded by an organised pus- debris complex with charring of the surrounding soft tissue (Fig. 7). The wound was thoroughly irrigated and closed in layers over a drain which was subsequently removed on post-operative day 5. Postoperatively empirical antibiotics were continued for 5 days and the culture from the bullet yielded no growth. There was an improvement in the neurological function with the left EHL regaining 5/5 motor power by the time of suture removal. The general condition of the child had improved and was able to ambulate pain-free and without support. The child was asymptomatic at the latest follow up of 3 months and thereafter was lost to follow up.

DISCUSSION

Paediatric spinal GSI are rare and most of them are accidental [9]. Our patient sustained a low-velocity firearm injury leading to an incomplete neurological injury with weakness in the left side EHL and reduced sensations over the corresponding L5 dermatome. Although described for adults and children >6 years of age with a chronic neurological condition, we were still able to use the ASIA grading scale comfortably to quantify the severity of neurological deficit, which in this case was left-sided L5 traversing nerve root [10]. Our literature search revealed no reported cases of firearm injuries with a projectile in the spinal canal causing no neurological deficit in the paediatric age group. A noteworthy point was the lack of any osseous disruption by the projectile before landing in the spinal canal and such similar case findings were also reported by Jamal Hossin et al. [11] and Erdal Kalkan et al. [12] in the thoracic spine and Mehmet Secer et al. [13] in the cervical spine but none so in the lumbar region. We attribute the lack of any osseous disruption of the vertebral column due to the lack of lumbar lordosis in the paediatric population which opens up the interlaminar spaces, increased flexibility due to ligamentous laxity [14] and chance. The post-operative x-ray showed no retained bullet fragments thereby virtually excluding the possibility of chronic lead toxicity [5, 6] (Fig. 8). The spinal cord is sensitive to minor degrees of compression or insult and is reflected with increased severity of neural deficits whereas the nerve roots much like the peripheral nerves are quite resilient to compression and showcase relatively lower degrees of neurological loss of function,



Fig. 3 Computed tomography showing the location of the bullet within the spinal canal.

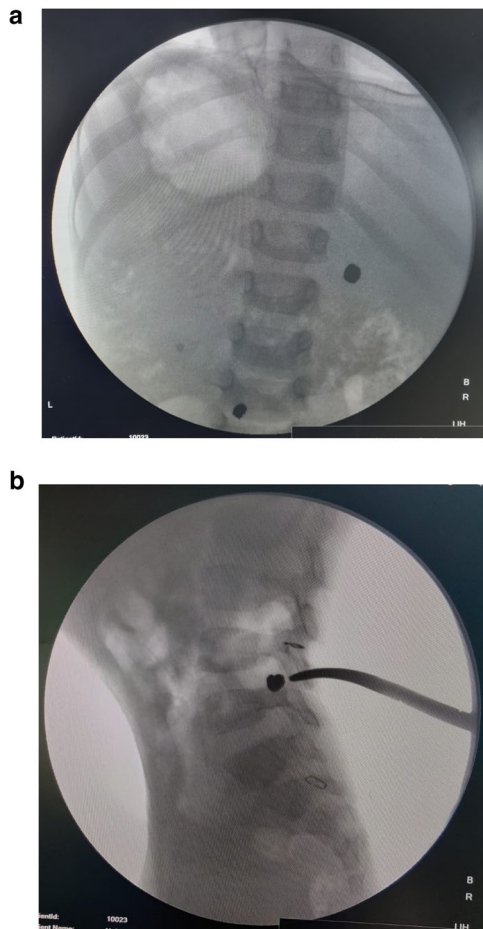


Fig. 4 **a** Fluoroscopy showing the position of the pellet on AP. **b** Fluoroscopy showing the position of the pellet on lateral.



Fig. 5 Prone position of the child for surgery.

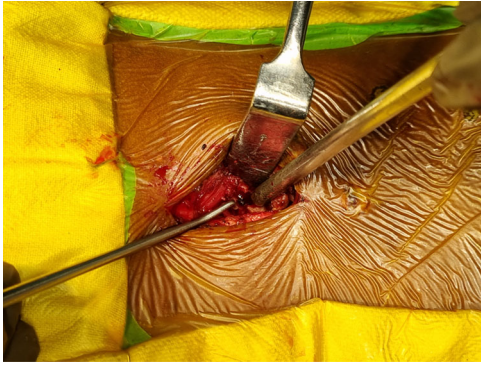


Fig. 6 Minimally invasive surgery with ipsilateral laminotomy to retrieve the pellet.

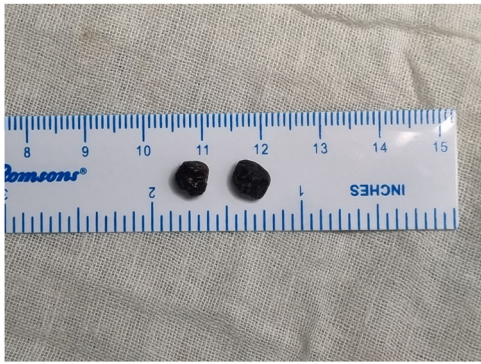


Fig. 7 Two pellets with an approx diameter of 6–7 mm.

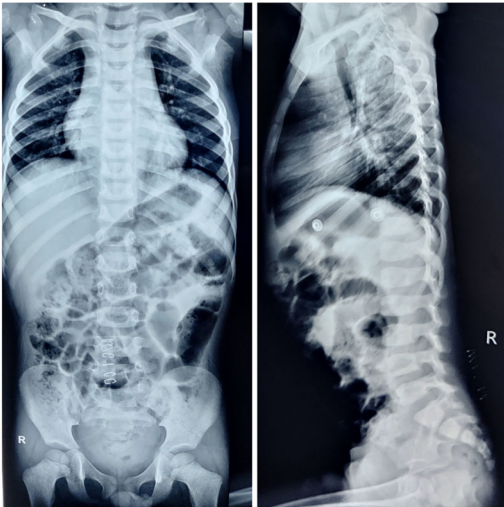


Fig. 8 AP and Lat radiographs postoperatively showing no retained fragments.

along with the fact that the spinal cord ends at the lower level of L1 vertebrae in this population [15] explains the lack of cord involvement and a grade 4 power in the left EHL in our case. There exists a need for formulating a spinal gunshot injury severity score for standardising the reporting of these injuries [8] and more such cases should be reported when encountered to understand the natural history, demographics, and for establishing management principles in these cases amongst the paediatric population. Spinal GSI are challenging and the management should be tailored according to the individual patient.

CONCLUSION

The low grade of neurological deficit and absence of osseous disruption in pediatric gunshot injury to the spine can be attributed to the size of the projectile, widely spaced interlaminar spaces in the lumbar spine due to the absence of lumbar lordosis in the pediatric group and flexibility of the pediatric spine owing to its ligamentous laxity.

DATA AVAILABILITY

All data generated or analysed during this study are included in this published paper.

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AUTHOR CONTRIBUTIONS

All the authors have made substantial contributions to the conception, design of the work; the acquisition, analysis and interpretation of data; it's drafting, revision and have approved the submitted version.

COMPETING INTERESTS

The authors declare no competing interests.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Informed consent was obtained from all individual participants included in the study.

CONSENT FOR PUBLICATION

Due consent has been obtained from the parents of the child for submission of the patient's data to the journal.

ADDITIONAL INFORMATION

Correspondence and requests for materials should be addressed to Shivaprasad Sharangouda Kolar.

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