

Accepted Manuscript

Title: Scissors stab wound to the cervical spinal cord at the craniocervical junction

Author: Xiao-Yong Zhang, Ying-Ming Yang

PII: S1529-9430(16)00302-8

DOI: <http://dx.doi.org/doi: 10.1016/j.spinee.2016.01.189>

Reference: SPINEE 56853

To appear in: *The Spine Journal*

Received date: 10-12-2014

Revised date: 26-11-2015

Accepted date: 22-1-2016

Please cite this article as: Xiao-Yong Zhang, Ying-Ming Yang, Scissors stab wound to the cervical spinal cord at the craniocervical junction, *The Spine Journal* (2016), <http://dx.doi.org/doi: 10.1016/j.spinee.2016.01.189>.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Scissors stab wound to the cervical spinal cord at the craniocervical junction

Xiao-Yong Zhang¹, Ying-Ming Yang²

¹Shantou University Medical College, Shantou, Guangdong Province, China.

²Department of Neurosurgery, The First Affiliated Hospital of Shantou University Medical College,
Shantou, Guangdong Province, China.

Correspondence information

Designated corresponding author's name: Ying-Ming Yang

Mailing address: Department of Neurosurgery, The First Affiliated Hospital of Shantou University
Medical College, No. 57, Changping Road, Shantou, Guangdong Province, People's Republic of
China.

Telephone number: +8613502973738

Fax number: 0086-0754-8259850

Email address: ymyang@stu.edu.cn
zxy924475890@163.com

Keywords: scissors stab wound; cervical spinal cord; craniocervical junction; Brown-Séquard-plus
syndrome; conservative management; complete recovery

ABSTRACT

BACKGROUND CONTEXT: Stab wounds resulting in spinal cord injury of the craniocervical
junction are rare. A scissors stab wound to the cervical spinal cord has only been reported once in
the literature.

PURPOSE: To report a case of Brown-Séquard-plus syndrome in an 8-year-old boy secondary to
a scissors stab wound at the craniocervical junction.

STUDY DESIGN: Case report and review of the literature.

1 PATIENT SAMPLE: Case report of an 8-year-old boy accidentally stabbed in the neck by scissors,
2 which were thrown as a dart.

3 METHODS: The case study of an 8-year-old boy who was hospitalized because of a scissors stab
4 wound at the craniocervical junction. The patient developed Brown-Séquard-plus syndrome on the
5 left side of the body. Magnetic resonance image revealed a laceration of the spinal cord at the
6 craniocervical junction with cerebrospinal fluid (CSF) leakage. Careful cleansing and interrupted
7 sutures of the wounds were performed to prevent CSF leakage. Rehabilitation therapy was
8 performed 2 days later.

9 RESULTS: A follow-up examination revealed complete recovery of the neurologic deficit 8
10 months post-injury.

11 CONCLUSION: Treatment of scissors stab wounds to the cervical spinal cord, whether
12 conservative management or thorough surgical exploration, should be individualized based on
13 history, examination, and imaging. Despite conservative management, complete recovery, which
14 was unexpected, was attributed to the initial mild laceration of the spinal cord and ipsilateral spinal
15 cord functional compensation.

16 INTRODUCTION

17 Scissors stab wounds resulting in spinal cord injury at the craniocervical junction are rare (2,13).
18 There is only one large review of such injuries published from Cape Town by Peacock et al. (13);
19 most of the remaining data have come from case reports. According to the review conducted by
20 Peacock et al. (13), 25% of spinal cord injuries have been reported to result from sharp injuries and
21 84.2% of these sharp injuries resulted from stabbing. The most commonly reported site for a stab
22 wound is the thoracic spine, followed by the cervical and lumbar spine (13,19,23). Reports of stab
23 injuries at the craniocervical junction are rare (2,4,12). Scissors stab wounds to the spinal cord have

only been reported once before by Karadag et al. (7), which was a case of penetrating cervical spinal trauma with an ipsilateral vertebral artery injury. We report a unique case of an 8-year-old boy with a scissors stab wound at the craniocervical junction that resulted in Brown-Séquard-plus syndrome.

CASE REPORT

History and Examination

An 8-year-old boy was accidentally stabbed in the neck by scissors, which were thrown as a dart by his little brother while playing. The boy immediately fell to the ground and could not stand up. He presented to the emergency department of the local hospital. The wounds were superficially debrided and closed, then the patient was transferred to our hospital for further treatment. At the time of admission, the blood pressure was 110/65 mmHg, the heart rate was 96 beats/min, the respiratory rate was 20/min, and arterial oxygen saturation was 100%. The physical examination revealed two sutured skin wounds (approximately 0.9 cm on the right and 1.3 cm on the left), with minor seeping of blood and exudate in the occipitocervical region (Figure 1). A neurologic examination showed motor weakness of the left upper and lower extremities (grade 0/5). Sensory disturbances of vibration and positional sensation were present on the left side below the C1 level. Impaired perception of pain and temperature stimuli were also noted on the right side below the C1 level. The patient had absent abdominal reflexes, brisk limb reflexes, bilateral ankle clonus, and extensor plantar responses. He also developed urinary retention. Together, these findings were consistent with Brown-Séquard-plus syndrome caused by a disturbance to the left side of the high cervical cord plus some a disturbance on the right side based on urinary retention, bilateral brisk reflexes, and extensor plantar responses (14).

Imaging

1 T2-weighted magnetic resonance imaging (MRI) of the craniocervical junction showed a linear,
 2 high signal passing obliquely between the basiocciput and the arch of C1 to the spinal canal. Fluid
 3 collection in the paravertebral region at the level of C2 was also identified ([Figure 2](#)).

4 **Management**

5 The patient was managed conservatively. Careful cleansing and interrupted sutures of the wounds
 6 were performed to prevent CSF leakage. After closing the wounds, the patient was treated with a
 7 glucocorticosteroid protocol (NASCIS II), prophylactic broad-spectrum antibiotics,
 8 anti-dehydration, and neurotrophic drugs. Rehabilitation therapy was performed 2 days later.

9 **Post-operative Course**

10 On the 4th day of admission, the muscle strength of the left upper limb and left lower limb was
 11 grade 1/5 and grade 2/5, respectively. The muscle strength of the left limbs continued to improve
 12 gradually during hospitalization. Sensory and motor function achieved normal levels on the 27th
 13 post-injury day. When the patient was discharged from the hospital, he had a stable gait with an
 14 improvement in muscle strength of the left limbs to grade 5/5 and restoration of bladder function.
 15 At 8 months post-injury, the follow-up examination revealed complete recovery of the neurologic
 16 deficits.

17 **DISCUSSION**

18 Stab wounds to the spinal cord have rarely been reported. Cases of stab wounds to the spinal cord
 19 caused by sharp objects, such as knives, screwdrivers, penetrating drill bits, fishing harpoons,
 20 spear guns, bicycle spokes, garden forks, pencils, and glass fragments, have been reported
 21 ([1,6,10,11,13,16-18,21,22,24](#)). Scissors stab wounds to the spinal cord have only been reported
 22 once by Karadag et al. ([7](#)). Karadag et al. ([7](#)) described a case of scissors penetrating the cervical
 23 spine with an ipsilateral vertebral artery injury. An exploratory operation and glucocorticosteroid

protocol (NASCIS II) were performed. A follow-up examination 6 months post-operatively revealed complete recovery. The scissors blade penetrated the dural sheath, and compressed the spinal cord in the subarachnoid space rather than a direct laceration (7). There are four interesting aspects to discuss in our case report (trajectory of penetration, specialties involved in management of scissors stab wounds, neurologic condition, and individualized treatment).

With respect to stab wounds to the spinal cord at the craniocervical junction, the stabbing instrument rarely penetrates the occipital squama due to the oblique orientation and thickness of the bone. Instead, the stabbing instrument usually slides along the undersurface, being deflected by the slope of the occipital bone and by the mastoid process into the atlanto-occipital or atlanto-axial interspace (2). In the current case, the blade of the scissors entered the spinal canal obliquely through the atlanto-occipital interspace and partly severed the spinal cord without significant bony or ligamentous injury.

We suggest that spreading the scissors blades can create resistance to prevent scissors from entering the spinal cord deeper. The penetrating power of scissors with spread blades is less than a knife. Unlike other stabbing instruments, the blade of scissors has a sharp and blunt side (Figure 1). The sharp side lacerated the spinal cord, whereas the blunt side merely caused direct displacement of the spinal cord. Based on the oblique wound of the spinal cord on MRI (Figure 2), it is reasonable to speculate that greater than one-half of the cervical cord tracts are preserved.

The mechanism of acute neurologic deficits secondary to a penetrating stab injury to the spinal cord can be due to direct penetration of the spinal cord neural elements, such as spinal cord infarction, or rarely a spinal epidural hematoma (8). In fact, when direct penetration of the spinal cord occurs, the patient is usually left with an incomplete spinal cord injury. In the English literature, most descriptions of Brown-Séquard syndrome are less pure forms of the syndrome, the

1 so-called “Brown-Séquard-plus syndrome” (14,20). Brown-Séquard-plus syndrome is associated
 2 with additional neurologic findings involving the eyes, bowel, or bladder (5). In the current case,
 3 the neurologic examination on admission confirmed Brown-Séquard-plus syndrome.

4 There was no evidence of vertebral artery injury or bony fragments on the MRI. The right
 5 wound visible on the surface was a superficial blind-ended stab wound. The left wound, which
 6 passed obliquely between the basiocciput and the arch of C1, extended from the skin of the
 7 craniocervical junction to the spinal cord at the level of C1. Due to the presence of CSF leakage,
 8 but no significant bleeding after initial management outside of the hospital, there was no indication
 9 to extend the left wound through exploration. We believe that the treatment must be individualized
 10 for patients with stable neurologic deficits. Therefore, the decision was made to merely close
 11 wounds to prevent CSF leakage, and no sign of CSF leakage after closing. In cases of incomplete
 12 neural injury previously reported, patients usually show significant improvement (9,13). In our
 13 unique case report, the patient had complete recovery of his neurologic deficits.

14 CONCLUSION

15 Treatment of scissors stab wounds to the cervical spinal cord, whether conservative management
 16 or thorough surgical exploration, should be individualized by history, examination, and imaging.
 17 Despite conservative management, complete recovery, which was unexpected, was attributed to the
 18 initial mild laceration of the spinal cord and ipsilateral spinal cord functional compensation.

20 REFERENCES

- 21 1. Beer-Furlan AL, Paiva WS, Tavares WM, de Andrade AF, Teixeira MJ (2014) Brown-Sequard syndrome associated with
 22 unusual spinal cord injury by a screwdriver stab wound. *Int J Clin Exp Med* 7:316-319
- 23 2. de Villiers JC, Grant AR (1985) Stab wounds at the craniocervical junction. *Neurosurgery* 17:930-936
- 24 3. Elgamal EA (2005) Complete recovery of severe quadriplegia caused by stab wound at the craniocervical junction.
 25 *Neurosurg Rev* 28:70-72

4. Garcia-Manzanares MD, Belda-Sanchis JI, Giner-Pascual M, Miguel-Leon I, Delgado-Calvo M, Alio y Sanz JL (2000) Brown-Sequard syndrome associated with Horner's syndrome after a penetrating trauma at the cervicomedullary junction. *Spinal cord* 38:705-707
5. Issaivanan M, Nhlane NM, Rizvi F, Shukla M, Baldauf MC (2010) Brown-Sequard-plus syndrome because of penetrating trauma in children. *Pediatr Neurol* 43:57-60
6. Karacan I, Koyuncu H, Pekel O, Sumbuloglu G, Kirnap M, Dursun H, Kalkan A, Cengiz A, Yalinkilic A, Unalan HI, Nas K, Orkun S, Tekeoglu I (2000) Traumatic spinal cord injuries in Turkey: a nation-wide epidemiological study. *Spinal cord* 38:697-701
7. Karadag O, Gurelik M, Berkan O, Kars HZ (2004) Stab wound of the cervical spinal cord and ipsilateral vertebral artery injury. *Br J Neurosurg* 18:545-547
8. Kulkarni AV, Bhandari M, Stiver S, Reddy K (2000) Delayed presentation of spinal stab wound: case report and review of the literature. *J Emerg Med* 18:209-213
9. Maynard FM, Reynolds GG, Fountain S, Wilmot C, Hamilton R (1979) Neurological prognosis after traumatic quadriplegia. Three-year experience of California Regional Spinal Cord Injury Care System. *J Neurosurg* 50:611-616
10. Mouzopoulos G, Tzurbakis M (2009) Unusual cervical spine injury by fishing harpoon. *Eur J Emerg Med* 16:209-211
11. O'Neill S, McKinstry CS, Maguire SM (2004) Unusual stab injury of the spinal cord. *Spinal cord* 42:429-430
12. Pal HK, Bhatti GB, Deb S, Mishra S (1998) Traumatic pseudomeningocele at cranio-vertebral junction following stab injury. *Injury-international Journal of the Care of the Injured* 29:142-143
13. Peacock WJ, Shrosbree RD, Key AG (1977) A review of 450 stabwounds of the spinal cord. *S Afr Med J* 51:961-964
14. Pouw MH, van de Meent H, van Middendorp JJ, Hirschfeld S, Thietje R, van Kampen A, Group E-Ss, Hosman AJ (2010) Relevance of the diagnosis traumatic cervical Brown-Sequard-plus syndrome: an analysis based on the neurological and functional recovery in a prospective cohort of 148 patients. *Spinal cord* 48:614-618
15. Roth EJ, Park T, Pang T, Yarkony GM, Lee MY (1991) Traumatic cervical Brown-Sequard and Brown-Sequard-plus syndromes: the spectrum of presentations and outcomes. *Paraplegia* 29:582-589
16. Rubin G, Tallman D, Sagan L, Melgar M (2001) An unusual stab wound of the cervical spinal cord: a case report. *Spine (Phila Pa 1976)* 26:444-447
17. Russell JH, Joseph SJ, Snell BJ, Jithoo R (2009) Brown-Sequard syndrome associated with Horner's syndrome following a penetrating drill bit injury to the cervical spine. *J Clin Neurosci* 16:975-977
18. Sinha AK, Adhikari S, Gupta SK (2009) High cervical cord injury after accidental pencil stab. *Neurol India* 57:220-221
19. Takemura S, Sasai K, Ohnari H, Ichikawa N, Akagi S, Iida H (2006) Brown-Sequard-plus syndrome due to stab injury: a case report. *Spinal cord* 44:518-521
20. Taylor RG, Gleave JR (1957) Incomplete spinal cord injuries; with Brown-Sequard phenomena. *J Bone Joint Surg Br* 39-B:438-450
21. Thakur RC, Khosla VK, Kak VK (1991) Non-missile penetrating injuries of the spine. *Acta Neurochir (Wien)* 113:144-148
22. Tuncbay E, Ovul I, Zileli M (1983) Unusual spinal cord injury by a speargun. *Surg Neurol* 20:57-58
23. Velmahos GC, Degiannis E, Hart K, Souter I, Saadia R (1995) Changing profiles in spinal cord injuries and risk factors influencing recovery after penetrating injuries. *The Journal of trauma* 38:334-337
24. Villena-Martin M, Valduviero I, Pinto-Rafael I, Gutierrez A, Vazquez-Barquero A (2012) [Penetrating spinal injury with glass fragments causing CSF leak: case report]. *Neurocirugia (Astur)* 23:36-39

FIGURE LEGENDS

1 **Figure 1.** Image of the patient on hospital admission. Two 1.5-cm sutured skin wounds with minor
2 seeping of blood and exudate on the occipitocervical region were identified. The scissors which
3 caused the spinal cord injury are in the lower left corner of the image.

4 **Figure 2.** Sagittal T2-weighted magnetic resonance image (**a**) showing a penetration of the spinal
5 cord at the craniocervical junction. The slightly increased signal intensity is indicative of a spinal
6 cord injury. The linear high signal passing obliquely between the basiocciput and the arch of C1
7 extends from the skin to the spinal cord, and represents cerebrospinal fluid leakage along the
8 trajectory of the blade. Fluid collection in the paravertebral region at the level of C2 was also
9 identified. Coronal T2-weighted MRI (**b**) shows a slit-like lesion with minimal surrounding edema
10 at the level of C2.