Revisiting the hangman's fracture

Shantel Garnham 3rd Year student radiographer, Central University of Technology, (CUT). Free State , Bloemfontein, South Africa

Abstract: A case report of a 7-year-old female diagnosed with a hangman's fracture is discussed with criteria to help identify this fracture on a lateral projection of the cervical spine [1-7].
Keywords: Spinal lines, Swischuk line, subluxation, pseudosubluxation, pattern recognition.

Case report

A 7-year-old female was brought into the trauma unit following a motor vehicle accident. Her neck was fully immobilised and she had sustained facial injuries. According to her clinical history she had been sitting on her mother's lap on the passenger side of the car when the accident occurred. It is protocol to refer patients with neck injuries for a lateral horizontal beam radiograph of the cervical spine [1]. A hangman's fracture was identified on the radiograph (See Figure 1).

Figure 1. Lateral cervical spine radiograph showing Hangman's Fracture. (Courtesy of Loren Yamamoto).

Discussion

Although old-age executions do not take place anymore hangman's fractures still occur usually as a result of motor vehicle accidents. In the Royal South Hants Hospital, Southampton, four hangman's fractures were reported out of 56 cervical spine fractures in 2006. Three of the cases resulted from motor vehicle accidents [6]. A hangman's fracture consists of bilateral pedicle or pars interarticularis fracture. The latter means that part of the vertebra located between the inferior and superior articular processes of the facet joint involving the second cervical vertebrae (C2) is fractured. Associated with this fracture is anterior subluxation or dislocation of the C2 vertebral body [3]

A hangman's fracture is caused by hyperextension of the neck as what happened with the patient discussed: her head had moved rapidly backwards and forwards during the collision. The backwards movement caused both the pedicles of the second cervical vertebrae (C2) to fracture and to disrupt the anterior ligament. When the head moves forward again, returning to its natural position, C2 will be displaced anteriorly to C3 [5].

There are four types of hangman's fractures (see Table 1) and these are classified as Type 1, 2, 2A and 3, respectively [2]. These fracture types are distinguished by the position of the second vertebral body as presented on a lateral cervical spine projection. In Type 1 C2 is displaced anteriorly by

Table 1. Types of hangman's fractures (Courtesy of Igor Boyorski).

	Type 1	Type 2	Type 2A	Type 3
Percentage	29%	56%	6%	9%
Indication	Bilateral pedicle fractures with less the 3 mm anterior displacement of C2	Bilateral pedicle fractures with severe displacement and angulation	Bilateral pedicle fractures with no displacement and severe angulation	Bilateral pedicle fractures with severe displacement and severe angulation and facet dislocations
Mechanism	Hyperextension with loading. Force efficient to cause fracture but not to disrupt anterior ligament	Hyperextension with loading followed by flexion with compression	Flexion with distraction	Flexion with compression
Stable / Unstable	Stable	Unstable	Unstable	Unstable
Associated injuries	C1 posterior arch fractures, C1 lateral mass fractures, odontoid fractures	Wedge compression fracture of C3		High incident of mortality

< 3mm. Associated injuries could be fractures of C1's posterior arch, lateral mass fractures and odontiod process fractures [1]. In Type 2, which is the most common fracture type, C2 is severely displaced and might be associated with a compression fracture of C3 [1]. In Type 2A there is no displacement but severe angulation of the anterior spinal line [1]. Type 3 has a high incident of mortality and presents with severe angulation of the anterior spinal line, displacement of C2 and facet dislocations of the cervical spine [1].

In pattern recognition three spinal lines have been distinguished for evaluation of the lateral cervical spine, namely the anterior spinal line, the posterior spinal line and the spinal laminar line [5]. The anterior spinal line joins all the anterior aspects of C1 to the first thoracic vertebrae (T1). The posterior spinal line joins all the posterior aspects of the vertebral bodies (C1 - T1) and the spinolaminar line joins all the posterior neural arches. All three lines should be present as smooth lines without any angulation on a normal radiograph.

Figure 2. View of Swischuk line in case of a Hangman's Fracture. (Courtesy of Loren Yamamoto).

Figure 3. Good alignment of Swischuk line. (Courtesy of Loren Yamamoto).

Pre-vertebral soft tissue swelling is always an indication of a cervical spine injury. Normal ranges for prevertebral soft tissue widths have been established. The soft tissue anterior to C1 to C3 should not exceed 5mm and should not measure more than 15mm from C4 to C6 [4]. The measurements taken on the lateral cervical spine radiograph of this case report were within normal limits.

The Swischuk line may be helpful in identifying some hangman's fractures. This line is drawn from the anterior aspect of the posterior arch of C1 to the anterior aspect of the posterior arch of C3 [7]. The anterior aspect of the posterior arch of C2 should be within 1-2mm of this line. If it deviates more than 2mm, this is indicative of a true subluxation (see Figures 2 and 3). If deviation is < than 2mm, this is consistent with pseudosubluxation. The Swischuk line alone is not always sufficient to rule out a hangman's fracture. Note that in the case discussed, the Swischuk line was in good alignment in the presence of a hangman's fracture (see Figure 3). It is therefore of the utmost importance to take all clinical indications into consideration when diagnosing a patient with a hangman's fracture.

It is important to recognise a subluxation and a pseudosubluxation. It often occurs that the bilateral pedicle fractures of C2 cannot be visualised on a lateral cervical spine radiograph because of the complex anatomy of the cervical spine. The only indication of such an injury is misalignment of the vertebrae which is also an indication of pseudosubluxation. While subluxation is partial loss of continuity of joint spaces, pseudosubluxation is a false appearance of this type of dislocation [3]. There are however a few differences between subluxation and psuedosubluxation. A normal laxity of the longitudinal ligaments in children appears as pseudosubluxation on a lateral radiograph of the cervical spine. In the case of subluxation, the spinolaminal line will be not appear smooth and evident angulation will be visualised [4].

The clinical history is more benign in the case of pseudosubluxation whereas a hangman's fracture is associated with severe motion which typically involves acceleration and deceleration of the head. A patient with pseudosubluxation will have far less trauma than a patient with a hangman's fracture. Thus a patient's history, origin of the injury and the trauma attached to it should always be taken into consideration.

Conclusion

As described in this case report a hangman's fracture involves severe acceleration and deceleration of the cervical spine or head of a person. There are four types of hangman's fractures; each has different indications and may be associated with different injuries. A hangman's fracture can easily be mistaken for pseudosubluxation. Radiographers must always ensure that patients with suspected cervical spine injuries are subjected to limited movement to minimise risks of causing further spinal injuries including possible paralysis.

The clinical history of a patient who presents with cervical spine injuries should, where possible, state whether a patient's head and/or neck had been subjected to severe acceleration and deceleration. This information would then alert the radiographer to consider the possible presence of a hangman's fracture. When evaluating a lateral cervical radiograph the spinal lines and the Swischuk line should be routinely checked.

References

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