

An atypical clay shoveler's fracture: a case report

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A case of an atypical clay shoveler's fracture with involvement of the spinolaminar line is described. Causative mechanisms of injury, radiographic appearances, differential diagnosis, treatment and prognosis are reviewed. Classic clay shoveler's fractures are considered stable fractures. However, when the spinolaminar line is disrupted, spinal cord involvement must be ruled out.

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KEY WORDS: clay shoveler's fracture, spinolaminar fracture, spinous process, chiropractic.

Un cas de fracture du terrassier atypique et touchant la ligne spino-laminaire est décrit. Les mécanismes à l'origine de la blessure, les radiographies, les diagnostics différentiels, le traitement et le pronostic sont examinés. Les fractures du terrassier classiques sont considérées comme des fractures stables. Toutefois, lorsque la ligne spinolaminaire est touchée, les répercussions sur la moelle épinière doivent être exclues.

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MOTS CLÉS : fracture du terrassier, ligne spino-laminaire, apophyse épineuse, chiropractie.

Introduction

The term clay shoveler's fracture can be traced back to clay shovelers of Western Australia in the 1930's. It was here that the term was applied to one or more spinous process fractures typically involving the lower cervical or upper thoracic spine.¹ Since then, numerous alternative terms have emerged including shoveler's fracture, root-puller's fracture, coal miner's fracture, shoveller's disease, schipper's disease, gold-digger's fracture, and snow shoveller's fracture.^{1,2,3,4,13} A juvenile form may occur due to traumatic avulsion of the secondary ossification centre of the spinous tip and is referred to as Schmitt's disease.⁵ A clay shoveler's fracture may occur anywhere between C₆-T₃, with the most common level being C₇.^{1,2,4} One case describes multiple spinous frac-

tures from C₆ to T₅.⁶

We report a case of a clay shoveler's fracture consequent to a motorcycle accident with serial radiographs showing healing of the fracture. Our case is atypical, with the fracture extending into the lamina thus disrupting the spinolaminar line.

Case report

A 27-year-old male presented to a chiropractic office four weeks after being involved in a motorcycle accident. The patient was propelled forward over the handlebars, landing on his helmet with the cervical spine in a flexed position. No loss of consciousness was experienced. Immediately following the accident, mild neck pain was reported. Plain

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Figure 1 Lateral view. Initial injury showing avulsion fracture through the spinous process and lamina of C7. The fracture extending into the lamina raised the possibility of spinal cord involvement. Note the minimal inferior displacement.

film radiographs performed the same day demonstrated a C7 spinolaminar fracture with minimal inferior displacement of the spinous process fragment (Figure 1). Because of the interruption in the spinolaminar line, computed tomography (CT) was performed to further evaluate the osseous integrity of the region. The results showed no other osseous involvement. The patient was sent home with a hard cervical collar, and was instructed to rest for four weeks, and referred back to his family physician.

One month later the patient presented to the H.K. Lee outpatient clinic at the Canadian Memorial Chiropractic College for residual neck pain. At the time of initial presentation, radiographs revealed that the spinous fragment was still ununited. This type of avulsion fracture is referred to as a clay shoveler's fracture. Physical examination revealed that his active cervical range of motion was reduced by 60% in flexion, left and right lateral flexion, left and right rotation, and reduced by 15% in extension. Left rotation and left lateral flexion produced pain on the left side of the cervical spine. Trigger points were present in the right trapezius, levator scapulae, and rhomboids. The left scalenes were hypertonic. Vertebral joint dysfunction was present from C2–4 in left anterior rotation. Neurological status was normal.

The patient received four weeks of treatment which included trigger-point therapy and light massage 1–2 times per week. Following this, the patient reported a 60% subjective increase in range of motion and a decrease in pain and stiffness. During this time, the patient was also receiving acupuncture therapy at another clinic.

Follow-up radiographs 2.5 months post-injury revealed osseous callous formation at the fracture site (Figure 2). At this time, spinal manipulative therapy (SMT) was introduced to the upper cervical segments. The patient also continued receiving acupuncture therapy. The patient then began active rehabilitation that included upper body strengthening exercises and neck rehabilitation, using the Hanoun Multi Cervical Unit, and was able to return to more activities of daily living. Hapkido was included in his exercise routine with the exception of upper body ballistic movements. The patient was treated 1–2 times per week for the next eight weeks. Following eight weeks of treatment, the patient reported a complete resolution of symptoms.

Follow-up radiographs five months post-injury revealed that the spinolaminar fracture had healed (Figure 3).



Figure 2 Lateral view. Follow-up films 2.5 months post injury reveal osseous callous formation at the fracture site.

Discussion

Mechanism of injury

There have been numerous articles with varying opinions on the causative mechanism of clay shoveler's fracture.^{2,3,4,7,8,9,10,11} However, one well-organized approach is presented by Rowe.² He proposes three general mechanisms: direct, indirect and stress-related. The direct mechanism is characterized by a blow directly applied to the spinous process leading to a fracture. This mechanism often occurs in high contact sports such as basketball, football and wrestling.^{2,4,9}

The indirect mechanism is often cited as the most common mechanism and is considered to be a true avulsion-type injury. In this mechanism, the cervical spine undergoes a ballistic-type motion in flexion, extension or rotation. During abrupt flexion, as in a motor vehicle accident, the spinous process may be avulsed due to the counterforce of the supraspinous, interspinous and nuchal ligaments, as well as muscle attachments of the rhomboids and trapezius, which serve as protective mechanisms.^{2,7,9} During rapid forced hyperextension, the spinous processes are impacted and may fracture. Because a force of hyperextension may produce a myriad of fractures one must rule out more ominous injuries. These include pedicle, pillar, vertebral teardrop and spinolaminar fractures. The ligamentum flavum has also been implicated as a participant in spinolaminar fractures. This type of fracture has also been associated with other occupational and sporting activities. These include cricket playing, power-lifting, golfing and a less known occupation of metal dipping.^{7,14,15,16} In addition to flexion and extension, rotation of the neck or trunk can play a large role in spinous process avulsions, especially in the cervicothoracic region.^{2,17}

Normally, the fracture occurs along the weakest point in the spinous process. This has been found to be at the narrowest section, approximately one-half to three-quarter inches from the tip.¹

The final mechanism may be regarded as a stress-related, fatigue-type fracture. In this mechanism, repetitive normal stress in abnormal bone may lead to a fatigue fracture. A case of a transverse fracture through the seventh spinous process in the cervical spine has been reported in a patient with secondary hyperparathyroidism.¹⁶



Figure 3 Lateral view. Follow-up films five months post injury reveal complete healing of the clay shoveler's fracture.

Radiology

The radiographic appearance demonstrates very classical features. On the lateral view, the fracture line is more commonly obliquely oriented, transversing midway between the tip of the spinous and the spinolaminar junction (Figure 4a). Atypically, the fracture may extend through the spinolaminar line, as in our case. The fracture margins are



Figure 4a Lateral View. The clay shoveler's fracture is typically located midway between the spinous tip and spinolaminar line.

serrated with the distal spinous fragment either displaced posteriorly or posterior-inferior. Lateral displacement can be best visualized on the AP view. On the AP view, malalignment and displacement of the distal spinous fragment lead to simultaneous visualization of the fractured base and the caudally displaced spinous tip. This feature has been termed the “double spinous” sign (Figure 4b)

which was first described by Zanca and Lodwell.^{4,12,18,20} In addition, the patient often presents with a reduced cervical lordosis due to severe muscle spasm. A careful analysis of the entire cervical and upper thoracic spine should be performed to rule out the presence of co-existent fractures. Although clay shoveler's fractures have historically been considered as stable fractures, one must always exclude the possibility of segmental instability. This can be evaluated with flexion/extension studies. The lower cervical spine may be difficult to visualize due to patient obesity, muscularity, short neck, severe muscle spasm or severe pain.²¹ With regard to blunt trauma, 39% to 47% of patients with bony injury of the cervical spine will also have some form of neurological injury.²¹

If there is a suspicion of a more significant bony injury such as a facet fracture, pedicle fracture or unilateral jumped facet, computed tomography should be performed. Ruling out injuries to specific nerve roots or involvement of the spinal cord such as contusion or impingement from disc material or osseous fragments, is best evaluated with magnetic resonance imaging (MRI). Fortunately, most clay shoveler's fractures are not associated with injury to the spinal cord itself.

Differential diagnosis

Two conditions that are often confused with clay shoveler's fracture are nuchal bone formation and an ununited secondary ossification center of the spinous tip. Other less common entities include omovertebral bones, congenital bent spinous, pathological fracture and spina bifida occulta.²

Ununited secondary ossification centres may appear to simulate an avulsion of the spinous tip. The distinction is made by close observation of three key features. First, the opposing margins are smooth and sclerotic. Second, the distal ununited segment is in close proximity to the remainder of the spinous without caudal displacement. Third, the ununited segment may possess a concave margin, which is continuous with the convex surface of the opposing spinous (Figure 5).²

Nuchal bones occur with ossification of a portion of the nuchal ligament. They are easily differentiated by their slightly elongated shape, and their more posterior position. In addition, the spinous process remains intact (Figure 6). Nuchal ligament ossification is often observed after the age of 40 and is often clinically asymptomatic.



Figure 4b AP View. Inferior displacement of the spinous tip leads to a double spinous appearance known as the “double spinous” sign.

Treatment

Clay shoveler's fractures tend to be stable as long as only the spinous process is involved. However, if the fracture extends into the spinolaminar region, pedicle or pillar, one must rule out spinal instability, nerve root and spinal cord involvement.

The literature is unclear as to whether the avulsed spinous fragment should be excised.⁴ However, treatment should begin with a conservative approach. This typically may involve the use of a soft cervical collar, especially in the acute stage. The collar may be worn intermittently to prevent muscle atrophy over a period of 4–6 weeks.² Modalities such as ultrasound or microcurrent may be applied to damaged soft tissues. If severe pain persists even after conservative management, then surgical excision of the avulsed fragment may be warranted.

Prognosis

Non-union of the avulsed fragment is common due to the muscular pull in this region. However, with minimal displacement of the avulsed fragment, reattachment may occur. Typical clay shoveler's fractures tend to heal without residual sequelae in terms of neck function or pain.

Conclusion

This paper described an atypical clay shoveler's fracture with disruption of the spinolaminar line. In addition this case presented serial radiographs demonstrating complete bony healing of a spinolaminar fracture. Most clay shoveler's fractures are stable, however, with involvement of the lamina additional osseous involvement or more serious spinal cord involvement may be ruled out with computed tomography and magnetic resonance imaging respectively.

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Figure 5 Lateral view. Nonunion of the secondary growth centre of the C7 spinous process. Note the smooth, undisplaced sclerotic margins between the osseous segments.

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Figure 6 Lateral View. Nuchal Ligament Ossification. The elongated shape of the nuchal ossification and intact spinous tip helps differentiate this from a clay shoveler's fracture.

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