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CASE REPORT

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The clay-shoveler's fracture, a rare occupational injury in the modern era: a case report

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Abstract

Background The clay-shoveler fracture, named after Australian clay shovelers from the 1930s, results from high-energy, repetitive pulling mechanisms and is commonly associated with shoveling or digging. This injury primarily affects the lower cervical and upper thoracic vertebrae, particularly the C7 and T1 vertebrae. The avulsion mechanism, caused by stress on the spinous processes, may lead to sudden, severe upper back pain, limiting the affected individual's ability to work effectively.

Case presentation This report presents the case of a 27-year-old boiler operator who experienced persistent neck pain, which did not respond to conservative management. Imaging studies revealed a T1 spinous process fracture with associated soft tissue edema, diagnosed as a clay-shoveler fracture. Conventional treatment with a semirigid cervical collar, analgesia, and rest was administered, leading to a favorable outcome.

The clay-shoveler fracture, though rare, should be considered in cases involving repetitive stress on the cervical and thoracic spine, especially in occupations that require heavy lifting. In most instances, conservative management proves effective in relieving pain and enabling recovery.

Conclusion Recognizing the clay-shoveler fracture is crucial for timely diagnosis and treatment. This case report underscores the occupational nature of the injury and its association with specific work activities. Further research and reporting of similar cases will contribute to a deeper understanding of this unusual fracture pattern, its risk factors, and optimal management strategies.

Keywords Spinous process, Fracture, Cervical spine, Thoracic spine, Occupational injuries, Case report

Background

The clay-shoveler fracture is an isolated fracture of the spinous processes midway between the spine laminar line and the tip of the spinous processes, seen in the lower cervical or upper thoracic region of the spine (between the C6 and T3 vertebrae), more frequently on the C7 and T1 vertebrae [1] . It is a stress avulsion fracture named after Australian 1930s clay shovelers who dug trenches and hurled clay several feet above their heads with shovels [2]. This clay got wet and stuck to the blade, causing a flexion force in the neck or back muscles, causing the fracture to which we refer in this report (Fig. 1).

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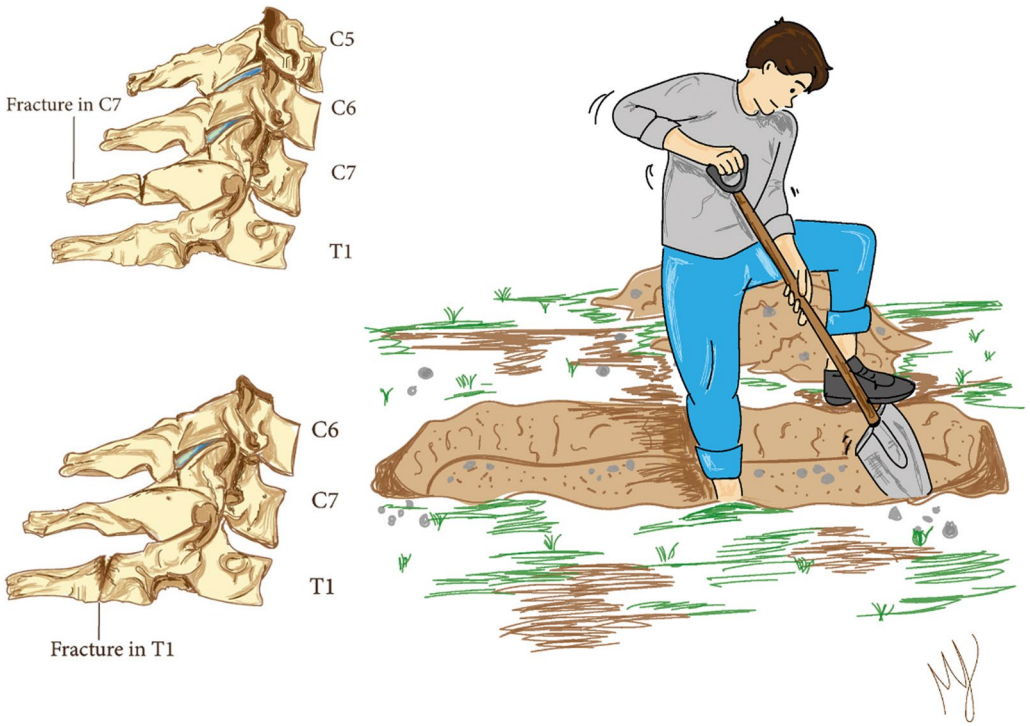

Fig. 1 Mechanism of Trauma. Copyright senior author (Dr. Maria José Muñoz Alvis), published with permission

This type of fracture was first documented in 1875 among workers performing repetitive tasks on the upper back muscles [2]. It is described as a violent and sudden pain in the upper back region, accompanied by a crunch, which prevents the worker from continuing his work. In the early years of the twentieth century, there were numerous reports of cases worldwide, but under various names; however, it was found in common that the activity of these workers had to do with shoveling or digging the ground, until in 1940 with jobs such as that of McKellar, the name "Clay Shoveler Fracture" was created [2].

The trauma is caused by a high-energy, repetitive pulling mechanism, especially acceleration, and deceleration, that is complementary to the shear forces caused by contraction of the upper back muscles (especially trapezius, rhomboids, and the nuchal ligament) exert repetitive traction at their attachment sites to the spinous processes of the vertebrae mentioned above, which have a long and thin structure that makes them vulnerable to the development of fatigue fractures (Fig. 2). Excessive rotational forces exerted by these same muscles on the aforementioned spinous processes, reflex traction of the supraspinous ligament, or direct trauma to the posterior neck in a flexed position are also involved.

According to Eduardo Moreira et al. Only ten cases are described in the literature on contiguous spinous process fractures [3], most of which are related to sports activities

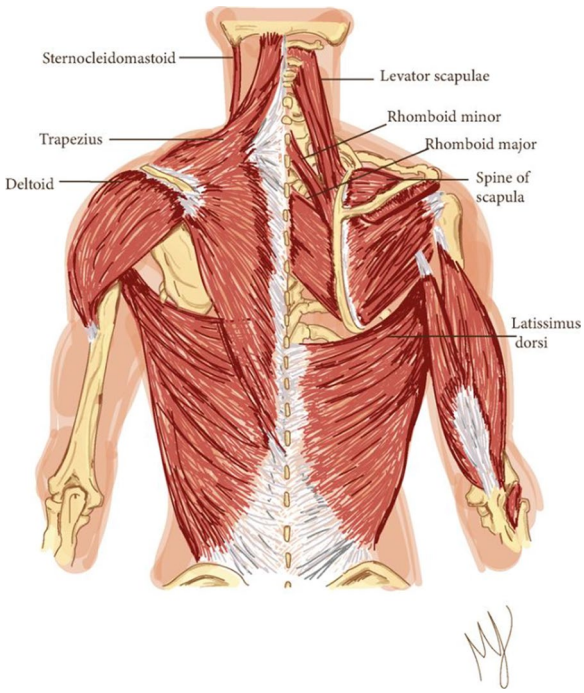

Fig. 2 Anatomical Overview of the Muscles in the Human Dorsal Region. Copyright senior author (Dr. Maria José Muñoz Alvis), published with permission

and traffic accidents. This case report and literature review describe the mechanism formerly defined as an occupational type of injury in a worker handling heavy loads.

Case report

A 27-year-old boiler operator with a history of obesity consults the emergency department for presenting pain in the posterior cervical region without improvement to the established medical management. Subsequently, he was readmitted due to the persistence of pain, and on physical examination, a general condition was evident, with pain on extension and rotation of the neck and on palpation of the lower cervical and upper thoracic spine with trigger point, for which plain radiographs were requested, where there is evidence of a fracture line that compromises the spinous process of T1, with a slight thickening of the adjacent soft tissues. Due to the above, an MRI of the cervicothoracic spine was performed, which reported a T1 fracture with edema of the supra and interspinous ligaments and in the cervicothoracic paravertebral musculature (Fig. 3). The patient said that the pain has persisted despite analgesic management.

According to the findings, a fracture of the spinous process of T1 AO SPINE A0 was diagnosed (clay-shoveler fracture), without instability or involvement of the spinal canal, which does not require neurosurgical management. Medical management with a semirigid cervical collar was ordered for 1 month, analgesia with NSAIDs (paracetamol and naproxen), rest, ambulatory follow-up by algology, physiatry, and control appointment with neurosurgery by outpatient consultation.

Discussion

The spinous processes of some vertebrae (C7 and T1) have a longer and thinner structure that gives them less resistance to stress forces, predisposing them to destabilize and fracture [2]. Its horizontal orientation and the perpendicular direction of the muscular forces contribute to the development of this type of injury, which less frequently can also present at any lower cervical or upper thoracic level (Fig. 4), either as single or multiple fractures [2, 4].

The nuchal ligament is a sheet of dense fibrous tissue that extends from the spinous process of the first thoracic vertebra to the external occipital protuberance [5, 6], and its function is to limit forward flexion of the head and cervical spine [2, 5]. Forced unilateral traction, specially created by the trapezius and rhomboid minor muscles, and the increase in tension caused by stress on the nuchal ligament play an essential role in avulsion of the C7 or T1 spinous processes (Fig. 5), causing posterior displacement of the fracture and orientation of the distal fragment goes in the direction

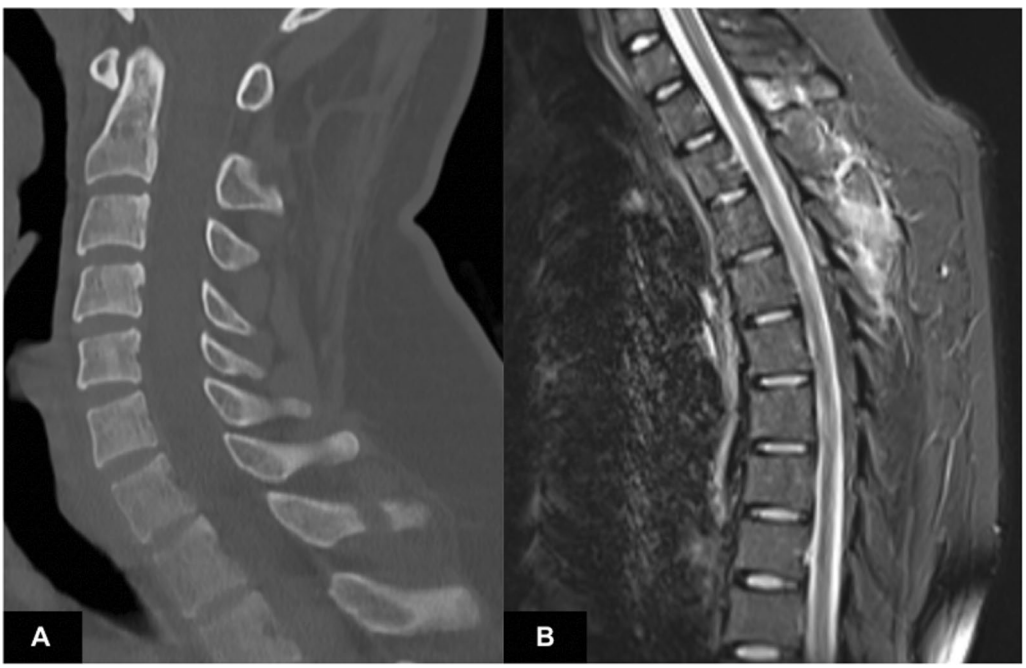

Fig. 3 Radiological findings. **A** Cervicodorsal CT of the spine shows a fracture of the spinous process of the T1 vertebra with a displacement of the distal end of the fracture toward the posterior inferior. **B** Cervical thoracic spine MRI: hyperintensity of the posterior ligament complex is evident from C6 to T2 with edema of the nuchal ligament and hyperintense paravertebral muscles

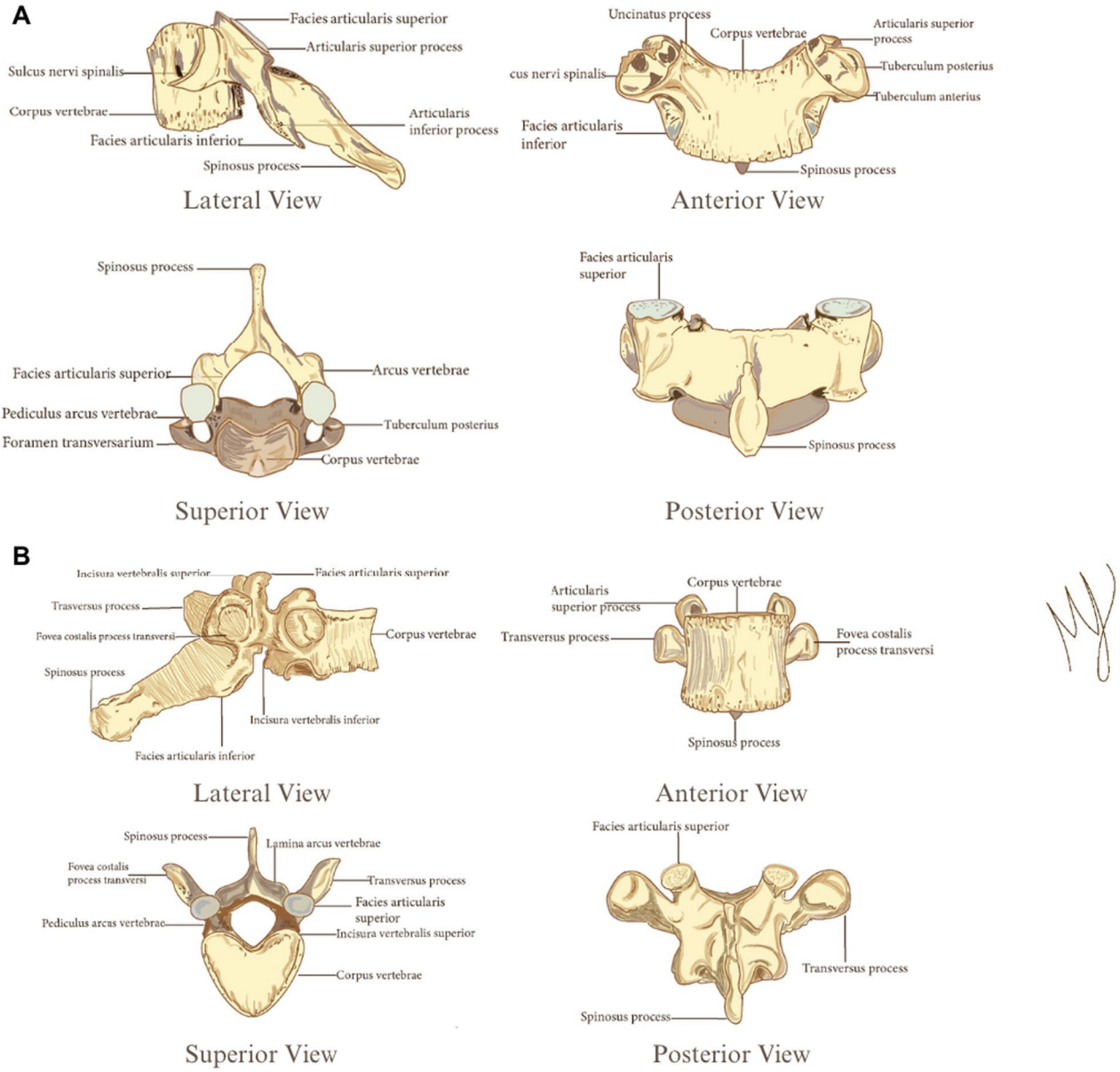

Fig. 4 Anatomical Overview of the Cervical and Thoracic Vertebrae. **A** C7 Vertebra. **B** T1 Vertebra. Copyright senior author (Dr. Maria José Muñoz Alvis), published with permission

of the caudal and lateral traction of these muscles [2, 5, 7]. Different fracture mechanisms caused not only by repetitive forces have been described. According to Young-Cheol et al., there may be several mechanisms that give rise to this type of fracture, such as muscle or ligament stress resulting in fatigue fracture, direct violent traction, reflex contracture of a muscle, whiplash traction, indirect cervical avulsion due to hyperextension or hyperflexion [8].

Diagnosis

The clinical features of clay-shoveler's fracture can vary depending on the injury's severity and the fracture's location. However, the most frequent clinical presentation consists of a sudden onset of pain located in the lower part of the neck or upper part of the back, specifically around the spinous processes involved in the lesion [4, 9]. The pain can be sharp or dull, and often, patients report a "pop" or sound that denotes a break in some structure

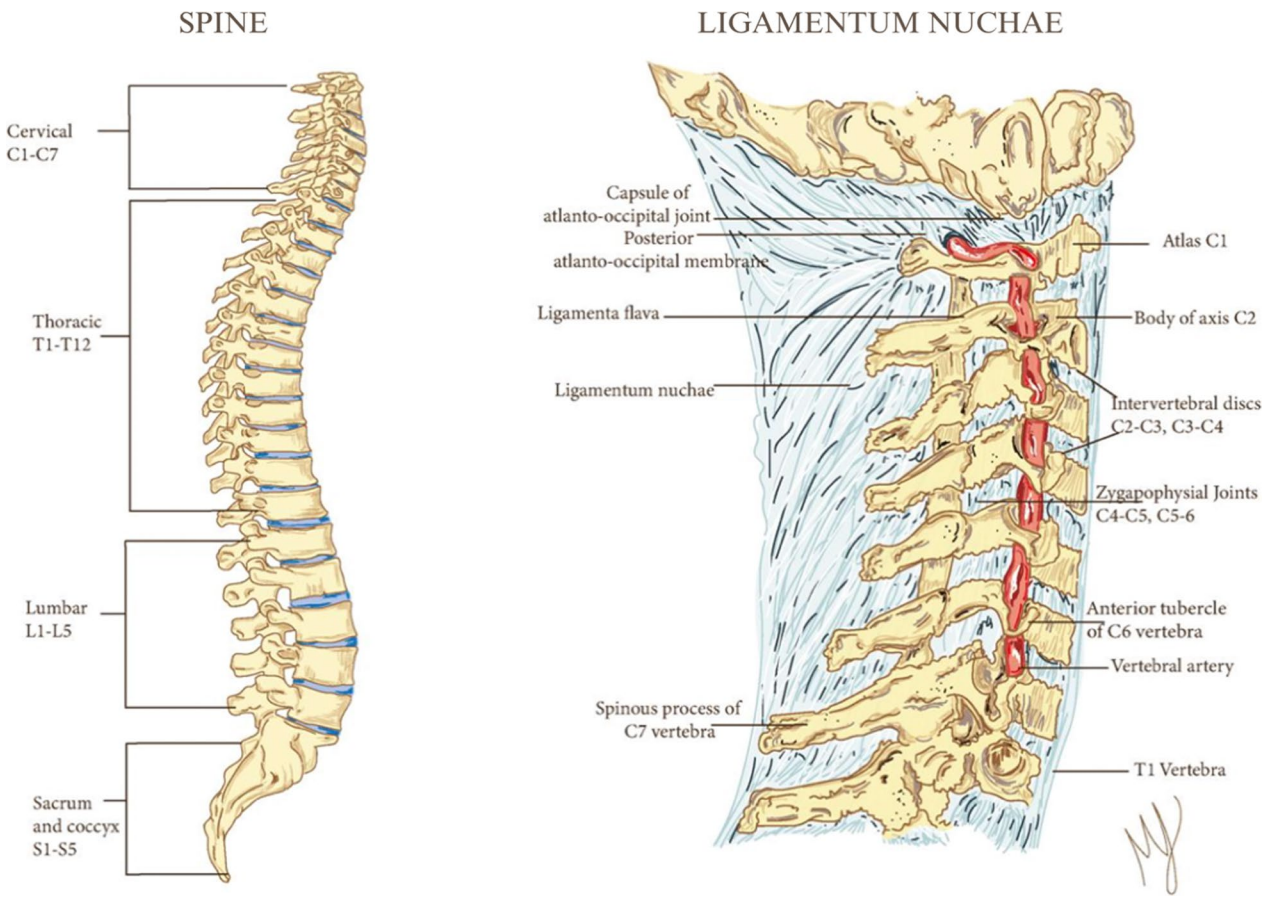

Fig. 5 Structural Relationship: Nuchal Ligament and the Cervical Spine. Copyright senior author (Dr. Maria José Muñoz Alvis), published with permission

[2]. Movements like looking up or tilting the head back or those that involve neck extension tend to exacerbate pain and further restrict movement, which explains why patients present in an antalgic position at the time of medical consultation. With the neck slightly flexed and the scapulae elevated, to decrease activity in this area [5]. Muscle spasms can occur as a protective mechanism in response to injury. These spasms can cause additional discomfort and stiffness in the affected area, further restricting movement of the neck. On physical examination, there is tenderness in the cervical and thoracic spine at the level of the lesion.

Classic clay-shoveler fractures are considered stable [10]. However, if the fracture extends to the body of the vertebra or other regions of the vertebra, spinal cord involvement should be evaluated: spinal instability, spinal cord compression, or radiculopathy.

The radiological diagnosis is made by means of a simple radiograph with anteroposterior (AP) and lateral view. This shows an oblique or vertical avulsion fracture at the tip of the spinous process (Fig. 6). There are some

Fig. 6 Oblique or vertical avulsion fracture at the tip of the spinous process [8]

radiological signs that can guide us to diagnose this type of fracture: the sign of the double spinous process produced by an inadequate alignment and caudal displacement or a double shadow of the spinous process [2, 10]. Usually, the oblique line of the fracture occurs between the spinous processes and the spine laminar intersection. The uninjured spinous processes project as a triangle on the AP radiograph, while the avulsed portion is seen caudally or laterally, and the base of the avulsed portion appears more radiolucent compared to the uninjured ones [2].

Computed tomography (CT) of the cervical and thoracic spine can better characterize the fracture and associated injuries [3, 7, 11] and is necessary when there is suspicion of a fracture with spine laminar rupture as they may have posterior ligament injury associated with an increased potential for late instability, spinal cord injury, and neurologic deficits [11]. Additionally, magnetic resonance imaging (MRI) should be performed because it may provide additional significant findings, including the presence of posterior paraspinal muscle edema and injury, supraspinous and/or interspinous ligament rupture, bone marrow edema, extensive prevertebral edema, and hemorrhage, especially in the context of high-impact trauma (Fig. 2). [3].

Differential diagnosis

When evaluating a possible clay-shoveler fracture, it is essential to consider other etiologies of symptoms, as some conditions can be very similar and dissipate the diagnosis. Causes of cervical pain such as soft tissue injury or sprain/strain of the neck muscles herniated intervertebral discs with radiating pain, cervical radiculopathy, and symptomatic osteoarthritis in the cervical spine should be considered [3].

Management

Conservative treatment is the first treatment option, and the clinical response is usually very favorable with adequate analgesic management in conjunction with cervical immobilization for a period of 4 to 6 weeks and frequent follow-up [3, 10, 12]. Previously, surgical removal of the fractured fragments was considered [12, 13]; however, the current consensus considers that when dealing with stable fractures, the benefit of conservative management outweighs the risk of surgical complications and invasive therapies [2, 3]. Therefore, surgical management should only be considered in refractory cases. Physical therapy has not shown benefit in the management of these fractures, and, on the contrary, a case report of a 45-year-old female patient, a golf player, was found in which physiotherapy aggravated the symptoms [5, 7]. Despite the promising clinical results, we can also show that the fracture line is generally located in the middle of the spinous process, which is its weakest point, causing the distal fragment to move inferolateral and separate the two ends. This can lead to nonunion of the avulsed fragments, with subsequent nonunion and chronic upper back pain [1, 8, 10]. However, it has been shown that whether consolidation is achieved or not, patients achieve almost complete recovery of activity levels prior to the injury.

The clay-shoveler fracture is an injury that specifically affects the spinous processes of the vertebral bodies of the lower cervical and upper thoracic region, secondary to forced flexion of the head and cervical segments against the opposing action of the interspinous and supraspinous ligaments involving an avulsion of the spinous process generating pain and limitation [3, 12].

This fracture is described most frequently at the level of the first thoracic vertebra, as in the present case, followed by C7, T2, T3, and C6, in order of frequency, respectively; however, in up to 16% of cases, as stated above, more than one spinous process is involved [3].

There are numerous theories about the various mechanisms that cause these injuries; however, two general mechanisms have been proposed to explain this type of injury: direct and indirect. The direct mechanism is characterized by a blow applied directly to the vertebral body, leading to fracture occurring in contact sports. On the other hand, the indirect mechanism is the most common, explained by muscular and ligamentous stress presenting fracture due to fatigue, reflex muscle contraction, indirect cervical hyperextension, and avulsion due to hyperflexion [4, 8, 12].

These lesions tend to be a benign condition that usually resolves spontaneously; in most cases, cervical immobilization and physical restriction for 4–6 weeks associated with the use of anti-inflammatories frequently results in pain relief. These types of operational occupations, which, although in developed countries, are increasingly replaced by machinery, in our country continue to be a representative part of jobs. Hence, injuries such as the one exposed in this review must be known by medical personnel to achieve an accurate diagnosis and establish timely treatment [2].

Conclusion

The case presented highlights the importance of considering the clay-shoveler fracture in occupations requiring repetitive stress on the cervical and thoracic spine, such as this boilermaker operator who performed heavy lifting tasks. Additional research and reporting of similar cases will contribute to a better understanding of this unusual fracture pattern, its risk factors, and optimal management strategies.

Abbreviations

CT	Computerized tomography
MRI	Magnetic resonance imaging
NSAIDs	Nonsteroidal anti-inflammatory drugs

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Author contributions
Conceptualization was performed by Juan Sebastián Reyes Bello; Formal analysis and investigation were conducted by Juan Sebastián Reyes Bello, Jose Luis Rozo Saavedra, and Juan Nicolas Perez Mendez; Writing—original draft preparation was revised by Juan Sebastián Reyes Bello, Jose Luis Rozo Saavedra, and Juan Nicolas Perez Mendez; Writing—review and editing were prepared by Restrepo Lugo Claudia Marcela, Luis Rafael Moscote Salazar, and Castiblanco Varón Diego Fernando. Supervision was done by Restrepo Lugo Claudia Marcela, Castiblanco Varón Diego Fernando, and Luis Rafael Moscote Salazar. All authors contributed to the study's conception and design. The first draft of the manuscript was written by Reyes Bello Juan Sebastián, Jose Luis Rozo Saavedra, and Juan Nicolas Perez Mendez; and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Declarations

Ethics approval and consent to participate
Ethical committee clearance was taken before including this case for study.

Consent for publication
Valid informed consent was obtained from the patient.

Competing interests
There are no financial and non-financial competing interests associated with this case report.

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