

Thoracolumbar spine injury associated with aerial silk practice. Cases report

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ABSTRACT

Introduction: Aerial silk is a circus practice that has become very popular in urban populations. It involves hanging from two pieces of fabric in order to make fixed positions and change between them by sliding and dropping from different heights. The professional practice is not free of injuries. **Objective:** To learn the nature of the injury, to recognize the injury predisposing factors and the safety measures used, to study the kinematics, to classify the injury, and to analyze the treatment. **Materials and Methods:** Six patients were included. The evaluation included individual body structure, drop kinematics, safety measures, classification of fractures according to the new AO classification, neurological symptoms, treatment, and complications. **Results:** The study included six female patients, averaging 24 years, a body mass index of 19.29 and a fall from 3.08m, 4 of which included mattress <5cm. The main injuries classification resulted in 6 A1, 4 B2 and 1 C. No neurological deficit was found. Four patients underwent surgical treatment. **Conclusions:** Aerial silk is a circus activity that has recently become a worldwide practice. Women are more exposed. Rigorous training and the use of safety elements are necessary to avoid injuries. We did not observe a unique pattern of injury, because of its multifactorial cause. The therapeutic decision-making is related to the spinal injury.

Key words: Spinal injury; thoracolumbar spine; high fall; aerial silk; circus practice.

Level of Evidence: IV

Lesiones toracolumbares en la práctica de acrobacia en tela. Reporte de casos

RESUMEN

Introducción: La acrobacia en tela es una práctica circense con muchos adeptos en la población urbana. Consiste en sostenerse en altura tomado por dos extremos de tela, para realizar posturas fijas y cambiar entre ellas mediante deslizamiento y caídas. La práctica profesional no está libre de lesiones. **Objetivo:** Conocer la naturaleza de la lesión, reconocer los factores predisponentes de lesión y las medidas de prevención utilizadas, evaluar la cinemática, clasificar la lesión y analizar el tratamiento. **Materiales y Métodos:** Se incluyeron seis pacientes. Se evaluaron la estructura física personal, la cinemática de la caída, los sistemas de protección, la clasificación de las fracturas según la nueva clasificación AO, el cuadro neurológico, el tratamiento y las complicaciones. **Resultados:** La muestra incluyó a 6 mujeres, con un promedio de edad de 24 años y un índice de masa corporal de 19,29. Caída de 3,08 m de altura, cuatro con colchoneta <5 cm. Las lesiones principales fueron: 6 A1, 4 B2 y 1C. No se observaron déficits neurológicos. Cuatro pacientes fueron sometidas a cirugía. **Conclusiones:** La práctica de acrobacia en tela es una actividad circense de reciente aparición global. Las mujeres están más expuestas a las lesiones. El entrenamiento riguroso y el empleo de elementos de seguridad son necesarios para evitar las lesiones. No se observó un patrón único de lesión, la causa fue multifactorial. El tratamiento indicado depende de la lesión vertebral.

Palabras clave: Lesión vertebral; columna toracolumbar; caída de altura; acrobacia en tela; práctica circense.

Nivel de evidencia: IV

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INTRODUCTION

Aerial silk, also known as aerial fabric and aerial contortion, among others (Figure 1), is a circus practice that has developed over the past years. Acrobats perform at heights, hanging from two pieces of fabric at 14 to 20 meters high, which results in two pairs of elements from 7 to 10 meters long each. Aerial silk practice consists of performing different static and dynamic poses (Figure 2), and changing from one to another by aerial skills known as “drop” and “slide”. Every movement within aerial silk practice involves different ways of resorting to the pieces of fabric (together-apart, taut-loose, fixed-free), the hands, the trunk, and the feet. As with any other activity, its training and performance may be divided into different levels, for beginners, intermediated and advanced acrobats, with increasing demand in movements and poses.^{1,2} Training requires the use of some safety elements at ground level, namely mats of different thicknesses. Aerial circus practice is associated with an injury rate of 7-9/1000, the spine and knees being the most prevalent segments (odds ratio (OR), 0.67 for the thoracolumbar region); however, most of these injuries are mild injuries and present a high rate of injuries without an early diagnosis.^{3,4}

A kinematics study on spine injuries showed that the most severe injuries were associated with over 6m high falls.⁵ Landing surfaces play a key role in fall injuries, since falls on surfaces with short impact duration, such as concrete, have an increased injury severity rate when compared to other surfaces like snow, soil or sand.⁶⁻⁸ Snyder *et al.* conducted a high fall study on 128 patients and found that body position at impact directly affects injury extension and nature. They concluded that the “feet-first” position was the most common, which results in an axial-loading that injures pelvis, spine and extremities big bones.⁷ Spine injuries in high fall patients may pass unnoticed, especially in polytraumatized patients without neurological deficit.^{6,9,10}

The aim of this study is to learn the nature of the injury, to recognize the injury predisposing factors, to evaluate the safety measures used, to study the kinematics, to classify the injury and to analyze the available treatment options.

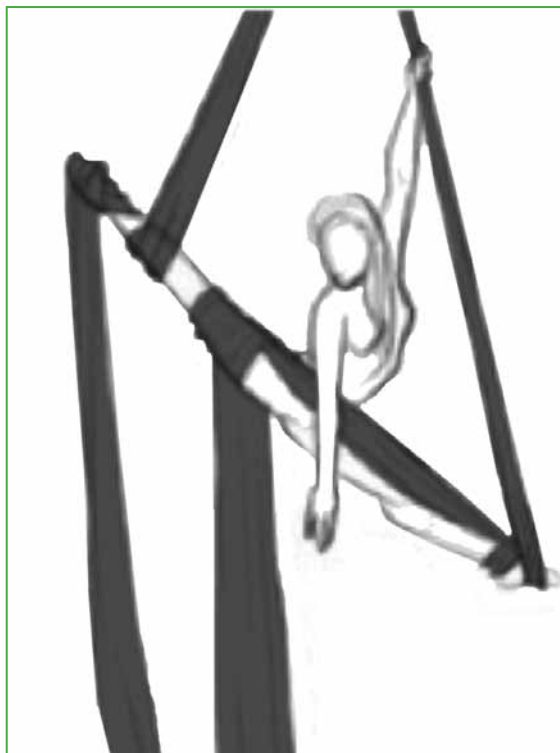


Figure 1. Image showing how acrobats use the pieces of fabric to perform at height.

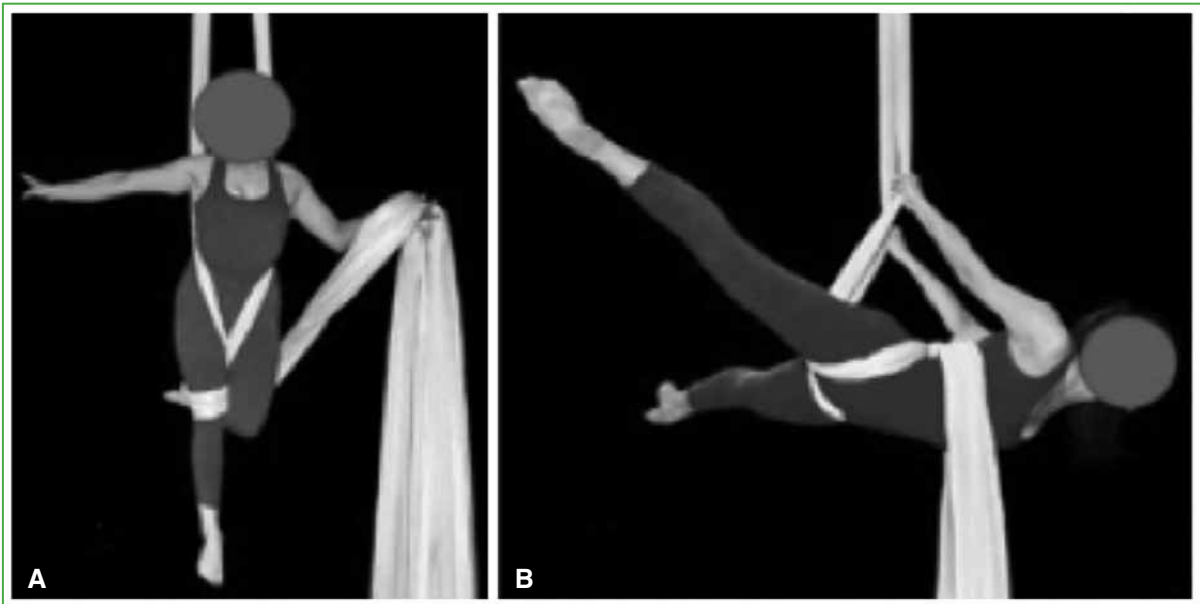


Figure 2. Images showing aerial silk poses: **A.** Slide. **B.** Drop. From: Diaz Collao D, Reyes Camacho N, Sepúlveda Fuentes S. *Metodología para la enseñanza de tela aérea vertical.*

MATERIALS AND METHODS

We carried out a multicenter, observational, retrospective study on a population consisting of 6 patients that were admitted with a spinal fracture diagnosis, resulting from an aerial silk fall.

The evaluation included individual body structure, drop kinematics, safety measures, classification of fractures according to the new AO classification,¹¹ neurological symptoms, treatment, and complications.

RESULTS

The study included six female patients, averaging 24 years (range, 15-36) and a body mass index of 19.29 (normal weight) (Table). All patients presented injuries associated with high falls during their instructor-supervised training of aerial silk, with an average fall of 3.08m (1-5m). In four cases the mattresses used as safety measures were <5cm width. In 1 case, the diagnosis delay was 4 days.

Vertebral injuries were located at the low thoracic spine and the thoracolumbar spine level. Three patients had more than one spinal fracture (patients 1, 3 and 4). We identified 6 axial compression fractures with single end-plate involvement and no posterior wall involvement (A1), 4 posterior tension band disruptions with ligament involvement, and 1 case of translation on the sagittal plane (C). Three B2 injuries and the C injury were considered secondary to A1 injuries and the remaining B2 was associated with a complete burst injury. No patient had neurological deficit.

We found no direct relation between the fall height and the severity or complexity of the spine injury.

Two patients underwent conservative treatment (patients 4 and 5) and 4 underwent posterior approach surgeries (patients 1, 2, 3 and 6) following the treating physician discretion, in relation to the B2 and C injuries. The surgical treatment involved instrumental stabilization using pedicle screws and rods, and autologous bone graft.

We found no direct nor indirect complications associated with the performed treatment. All patients were able to return to their daily routine activities within the expected period. Three patients returned to practice aerial silk.

Table. Patient clinical data

Patient	Sex	Age	Height	Weight (kg)	BMI	Fall	Protection elements	Diagnosis delay	ASIA	Injury	Treatment
1	F	22	1.65	50	18.37	1.5	No	No	E	L1-L2 B2 (A4) T11-T12 B2 (A1)	Surgery
2	F	20	1.64	56	20.82	3	Mattress <5cm	No	E	T12-L1 B2	Surgery
3	F	15	1.58	45	18.03	5	No	No	E	T10-T11 B2 (T11 and L1 A1)	Surgery
4	F	33	1.68	52	18.42	1	Mattress <5cm	No	E	T2, T3, T4, T5 and T6 A1	Conservative
5	F	16	1.61	48	18.52	4	Mattress <5cm	4 days	E	L1 A1	Conservative
6	F	36	1.64	58	21.56	4	Mattress <5cm	No	E	T11-T12 C (L1A1)	Surgery

ASIA: American Spinal Injury Association; BMI: body mass index; F: female.

DISCUSSION

Aerial silk is one of the most recent types of aerial acrobatics. In the circus sphere, the term aerial acrobatics refers to those activities performed with elements hanging from the ceiling. Other common aerial acrobatics activities include trapeze, lyra, and vertical dancing.^{11,12} Aerial silk origins are found around 1959, in the French circus school, where a student presented her act by using two long pieces of fabric. Aerial silk was officially recognized in 1998.^{11,13}

In 1998, the art of aerial silk became widely known through Isabelle Vaudelle and Isabelle Chasse's presentation Quidam, as part of the Cirque du Soleil show.¹⁴ In the mid-90s, teams of British and French acrobats were driven by their spectacular act, which soon became popular worldwide. As from 2002, the BBC aired a television show on acrobatic choreographies that lasted 5 years.¹⁴

Another postulate supports that the aerial silk creator is Andre Simard, in 1987, also as a new attraction for Cirque du Soleil.¹⁴

In general, the people who practice aerial silk may be considered both as athletes and as artists. Their training involves high physical demand and extreme poses and movements.^{15,16} Circus students, most of them teenagers, have a risk of sustaining a severe injury of 2.8%.²

A retrospective epidemiological study on accidents sustained by 169 students aged 11-22 during training in a circus school, reported a total of 28.8% spine injuries: 17.2% at the cervical spine and 10.9% at the lumbar spine level.² Interestingly, unlike our study, no thoracic spine injuries were reported in the said study.

The severity of the injuries sustained by acrobats and students depends on the distance and the position in which they fall as well as the training in preventing injuries they have received and the protection elements used.

Injuries may pass unnoticed when we fail to properly assess patients with pain and trauma history.⁵ The treatment decision-making process has to consider the neurological symptoms and the bone or ligament injury.

CONCLUSIONS

Aerial silk is a circus activity that has recently become a worldwide practice. Most of the acrobats that practice aerial silk are women, and so women are most exposed. Rigorous training and the use of safety elements are necessary to avoid injuries. The lack of neurological symptoms may prevent early diagnosis. We did not observe a unique pattern of injury, because of its multifactorial cause (distance of the fall, training and performed exercise). Therapeutic decision-making is related to the spinal injury.

Conflict of interests: Authors claim they do not have any conflict of interests.

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