

Journal of Physical and Rehabilitation Medicine Forecast

Arm Wrestling and Humerus Fracture: A Challenge for Rehabilitation

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Abstract

Introduction: Arm wrestling can lead to injuries, most of them are soft tissue, but different types of fractures can occur.

Method: We present two clinical cases of humeral fractures in arm wrestling, we characterize the biomechanical mechanism, prevention mechanisms and prognosis and we present a pertinent review of literature by searching PubMed and MEDLINE databases.

Clinical cases and Literature review: Both patients had spiral fracture of the distal third of the humerus, one of them with an associated radial nerve injury. Treatment included surgery, cast immobilization, arm suspension and an individualized rehabilitation program. Both patients completely recovered muscle strength and function of the upper limb, but in second case it took 10 months to recover. Several biomechanical mechanisms and factors may contribute to these injuries. Usually, the moment of fracture occurs when the participant is attempting to counteract the increased force of external rotation generated by the opponent with a strong internal rotation generated by several muscles. Fractures are more frequent in the distal third, due to smaller bone circumference, low mineral density and a thin metaphyseal-diaphyseal junction. Sometimes, nerve damage is associated, making recovery slower and more difficult, with the need for close and prolonged monitoring to avoid permanent damage.

Conclusion: It is crucial for wrestling practitioners to properly perform muscle strengthening and avoid fatigue, in order to prevent associated lesions. When they occur, it is essential to scrutinise the biomechanical factors, to correct them and to treat associated lesions. An adequate rehabilitation plan is crucial to full recovery.

Keywords: Arm wrestling; Humeral fractures

Introduction

Arm wrestling, is a game, in which two opponents sit face to face, grip hands with their elbows on a table, and try to force the other's arm back. Several factors can play a part in one's success, but technique and overall arm strength are the two greatest contributing aspects [1,2]. Most of the injuries associated with arm wrestling are soft tissue injuries as muscular strain and sprain of the shoulder, elbow and wrist joints [3]. However, according to the literature, different types of fractures can occur, either by prolonged effort or lack of endurance [1]. Spiral fracture of the humeral shaft with or without butterfly fragment, fracture of the medial humeral epicondyle, radial head fracture with anterior dislocation and even a radial shaft fracture have been described [4].

The aim of our article is to present two clinical cases of arm wrestling injuries and characterize the biomechanical mechanism, to understand risk factors, prevention mechanisms and prognosis of these injuries.

Method

We describe 2 clinical cases of humeral shaft fracture following arm-wrestling, one of them with nerve injury. We also conducted a pertinent review of the literature by searching PubMed and MEDLINE, using the keywords "arm wrestling", "indian-wrestling". A total of 32 articles was found, from which 10 were included in this review.

Case Report 1

A 26-year-old man, civil engineer, frequent gym user (strength training) with irrelevant past

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Received Date: 23 Oct 2020

Accepted Date: 30 Nov 2020

Published Date: 04 Dec 2020

Citation: Silva J, Tomé S, Carneiro I, Matos J, Pereira V, Barreto J, et al. Arm Wrestling and Humerus Fracture: A Challenge for Rehabilitation. *J Phys Rehabil Med Forecast.* 2020; 3(1): 1015.

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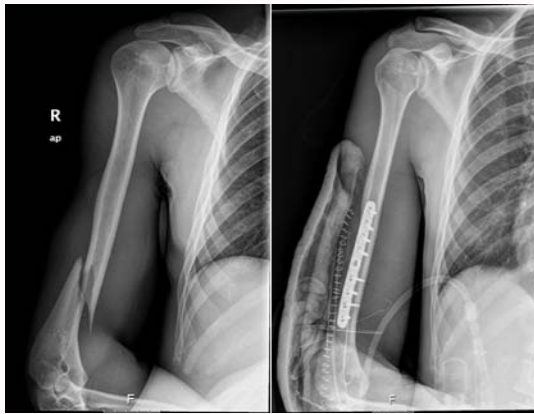


Figure 1: X-rays of the elbow and arm that showed spiral fracture of the distal third of the humerus.

medical history and no use of medication. After more than 40 minutes of arm wrestling, he felt a snap on his right arm, followed by intense pain and limitation of elbow mobility. At the Emergency department, he performed X-rays of the elbow and arm that showed spiral fracture of the distal third of the humerus (Figure 1). He then underwent surgery (open reduction and internal fixation with plate and screws), and cast immobilization for 2 weeks, followed by arm suspension with a Gerdy Splint for 2 weeks.

After removing the cast, he was evaluated by a Physical Medicine and Rehabilitation (PMR) doctor. The patient presented with muscular atrophy in right arm and forearm, limitation of elbow mobility (flexion: 120°, deficit 60° in the extension and 10° in the supination) and loss of strength in the upper limb (muscle power was graded 4/5 by Medical Research Council (MRC)). He also complained of functional limitation on dressing and eating or performing other activities with the right hand, as a result of pain and limited range of motion.

He completed a rehabilitation program with physiotherapy sessions (3 times a week) and daily home exercises focused on decreasing pain (cryotherapy, massage, analgesic currents-Transcutaneous electrical nerve stimulation, gaining mobility of the elbow and strengthening exercises (starting with isometric exercises of the shoulder and elbow after the immobilization period and at 6 weeks he started dynamic concentric exercises, functional re-education and technical gesture training). Four months after the fracture, he completed 8 weeks of treatment and presented without pain and with complete mobility and functionality of the arm, and he began his usual physical and professional activity.

Case Report 2

A 23-year-old-man, medical student, who performed frequent aerobic and strength training at the gym. Past medical history was irrelevant. After more than 30 minutes of “Arm Wrestling” he felt an intense pain in the upper right limb that forced him to stop. When he arrived at the Emergency department a right “wrist drop” was apparent. The X-ray of the elbow and arm showed a spiral fracture of the distal third of the humerus (Figure 2). He underwent surgery (open reduction and internal fixation with plate and screws) and then immobilization with Gerdy splint for 4 weeks. Because he presented with “wrist drop”- no muscle power on wrist and finger extensors (MRC 0/5), he was prescribed a dynamic splint for the right wrist and hand that he used during the day (Figure 3). And at night he wore an

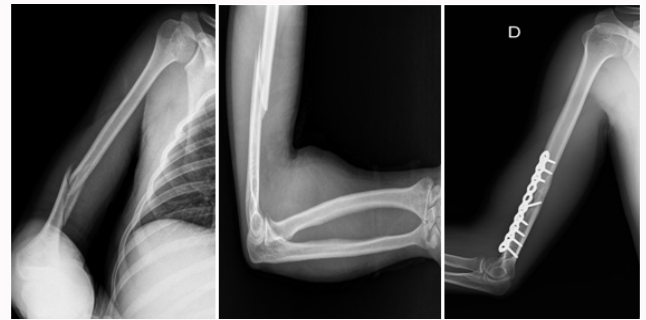


Figure 2: X-ray of the elbow and arm showed a spiral fracture of the distal third of the humerus.



Figure 3: Dynamic splint for the right wrist and hand.

elastic wrist splint.

Four weeks after the surgery he was evaluated by a PMR doctor. On clinical assessment he had atrophy in right arm and forearm muscles, elbow stiffness (deficit of 90° of extension), and intense pain (8/10 in visual numeric scale- VNS) when trying to mobilize the elbow. Muscle power was 0/5 by MRC in the wrist and finger extensors. He was able to extend the interphalangeals (innervation by the ulnar nerve). An electromyography was performed and revealed: “focal, sub-acute, neuropathy of the right radial nerve, with severe partial axonotmesis”. He started daily treatment with physiotherapy (4 sessions/week) and home exercises, focused on decreasing pain, gaining range of motion and strengthening exercises. Electrical neuromuscular stimulation with exponential currents for partially innervated muscles was used for strengthening wrist and finger extensor muscles. Four weeks after starting treatment he presented extension deficit of 20° on the elbow, wrist paresthesia in the last degrees of passive extension, muscle power of the wrist and finger extensors was 1/5 by MRC. The patient continued treatment with progression to concentric isotonic exercises of the flexor and extensor muscles of the elbow and neuromuscular electrostimulation of wrist and finger extensors. After 12 weeks he had muscle power 5/5 (MRC) in all upper limb muscles, except wrist and finger extensors (1/5 MRC). Only 6 months post-injury, with daily treatment, he obtained 3/5 (MRC) in the wrist and finger extensors and ability to perform finger and hand grasp. Ten months after injury he completely recovered muscle strength, symmetry and normal function of the right hand.

Discussion

The practice of moderate to vigorous physical exercise is associated with various types of injuries. In arm wrestling, previous poor muscle strength, unbalanced flexor/extensor muscle power, and prolonged strenuous activity, may lead to a spiral fracture of the distal third of the humerus as presented in the 2 cases described, sometimes with radial nerve injury associated, like in the 2nd case report, which led to a much slower recovery and the need of close follow-up to avoid the permanent sequelae of a radial injury. It took about 10 months to recover the muscle strength of the wrist and finger extensors [5].

High intensity sports without adequate training are associated to several soft tissue injuries and fractures, some of them severe, with associated neurovascular injuries. Muscular strengthening of the internal and external rotators of the shoulder, stabilizers of the scapula and core muscles is essential when performing arm wrestling [1].

Regarding biomechanical mechanisms, several factors may contribute to the injury. Thus, intrinsic muscle torsion alone does not adequately explain the injury [6]. Usually, the moment of fracture occurs as the participant is attempting to counteract the increased force of external rotation on his or her arm generated by the opponent. To achieve this, a strong internal rotation is generated at the shoulder by the pectoralis major, latissimus dorsi, teres major, and subscapularis. So, when the participant goes from a maximum concentric contraction to an eccentric contraction of the internal shoulder rotators associated with a weakness of external rotators, keeping the glenohumeral joint fixed, typically when the athlete tries to recover a disadvantage position, it causes some rotation force on the axis of the humerus, which leads to the fracture of its distal third [6,7].

Fractures are more frequent in the distal third due to smaller bone circumference, low mineral density in the distal third of the bone and a thin metaphyseal-diaphyseal junction [7,8]. Kruczynski et al., showed that the forces generated by the acting muscles predominately stress the distal portion of the bone 11.5 cm above the elbow on the medial-posterior side [9].

A recent study compared the occurrence of fractures of the humeral body during this activity with fractures of the humeral body of another cause (2009-2017) with 93 cases (9 in arm-wrestling). All patients were initially managed with a cast splint and converted to a Sarmiento functional brace at 2 weeks after injury. They had close clinical follow-up with exercises for maintain elbow and shoulder range of motion, and active biceps/triceps strengthening. X-rays of the humerus, were obtained to assess fracture union. At each follow-up visit, range of motion of the shoulder and elbow of the affected extremity were assessed and recorded. In the final follow-up visit, the angulation degree of the humerus, seen on both anteroposterior and lateral radiographs, was measured. These results were then compared with fractures of the humeral body of another cause. Patients were followed for a mean of 20 weeks. One arm-wrestling patient presented with a radial nerve palsy. The mean time for arm-wrestlers' fractures healing was 13.6 weeks. In the end mean elbow flexion was 141.1° and mean shoulder forward elevation was 168.8°. Athletes' radiographic and functional recovery was faster, probably due to younger age and lower soft tissue damage [10].

In both case reports, surgery was performed in the acute phase, because of the young age of the patients and their desire to return to professional life and sports activity as soon as possible. In the second case, injury of the radial nerve was also taken into account [10]. This injury led to a much slower recovery, in which the intervention of PMR was essential in order to maintain and restore joint amplitudes and muscle trophism, avoiding more serious long-term sequelae of the injury [5].

Conclusion

Humeral fractures caused by the practice of arm wrestling are rare in the literature, probably due to the underreporting of these occurrences. Correct muscle strengthening is essential when practicing a sport of this type, as well as optimizing time and effort management during its practice. Severe fractures with nerve injury associated can occur, as reported in second case. We believe that early and multidisciplinary treatment with Orthopaedic Surgery and PMR contributed to a better recovery, avoiding possible consequences of prolonged immobility, which can culminate in permanent damage.

In these cases, it is also essential analyse the predominant biomechanical factors that favoured the injury in order to minimize them, avoiding early return to sports activity and promoting an adequate rehabilitation plan, focused on strengthening and correcting the technical gesture.

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