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Radial Nerve Injury from Distal Humerus Fracture Instrumentation and Symptom Aggravation with Tourniquet Closure: A Case Report

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Abstract

In orthopedic surgeries, instrument-attributed neural injury is rare because nerve exploration is commonly performed. In this study, we report the case of a 50-year-old woman who underwent medial and lateral distal humerus plating surgery three years ago due to right distal humerus fracture (Fx). Postoperatively, the patient had symptoms of pain and paresthesia and progressive motor dysfunction across the radial nerve course, which was further aggravated by tourniquet closure during the second operation to remove part of the fixation device (tension-bond wire) and transpose the ulnar nerve. On admission, the patient reported pain and paresthesia in her right hand, as well as loss of strength in her wrist, fingers and thumb. The patient had signs of high radial nerve injury on electrodiagnostic study (EMG / NCS) and was a candidate for radial nerve neurolysis. During the second-look operation, partial damage to the radial nerve caused by a lengthy screw in the distal third of the arm, with neuroma formation was found. Within two years of replacing the screw with a shorter screw, removing the neuroma, and repairing the nerve, the patient's sensory and motor symptoms improved significantly. This case suggests that long screws in instruments can cause serious damage to nerves adjacent to the opposite bone cortex that are unexplored and inaccessible. Furthermore, when a tourniquet is used and there is an over length screw in the nerve's pathway, it can irritate the nerve and cause damage after surgery. Therefore, device irritation should be considered if worsening symptoms of nerve irritation occur following use of the tourniquet during surgery.

Keywords: Instrumentation neuropathy; Radial nerve; Screw; Nerve irritation; Tourniquet

Introduction

Most of the distal arm fractures occur due to an energetic incident, such as receiving a direct blow to the elbow when colliding with a car. However, in elderly with osteoporotic bones, even a slight fall may be enough to cause a fracture [1]. Surgery is frequently indicated for distal humerus fractures' treatment to restore normal anatomy and elbow movement [2]. Radial nerve travels a long path in the upper limb, adjacent to humerus bone in the helical groove, making it prone to injury. The prevalence of radial nerve palsy following humerus shaft fracture is 11.8% [3]. At the same time, it has been shown that the incidence of iatrogenic damage to the radial nerve during surgery is approximately 4.2% [4]. Clinically, radial neuropathy appears as a wrist drop, with or without loss of sensation along the posterior surface of the arm, forearm, and three and a half radial side fingers, depending on the site of injury. Typically, neuropathies are diagnosed based on clinical examination, tunnel signs, and electrodiagnostic (EMG-NCS) findings [5].

Primary or secondary radial nerve palsy concomitant with a humerus fracture (Fx) is determined by whether the palsy occurred at the time of presentation or after treatment. According to literature, a 3- to 4-month period of watchful waiting is suitable before surgical intervention [3,6-9]. There are several causes of secondary radial nerve palsy consisting of trauma from fracture manipulation or surgery, impingement by or between fracture fragments, entrapment by fracture callus, [10] and scar tissue formation [11]. This paper reports a case suffering from pain, paresthesia, and progressive motor symptoms caused by a long screw three years ago.

Case Report

Case history/examination

The patient was a 50-year-old woman with falling and subsequent distal humerus fracture who underwent open reduction

and internal fixation (ORIF), applying medial and lateral humerus plate, three years ago. The patient developed postoperative pain, paresthesia, and progressive movement disorder corresponding to the radial nerve territory. She was diagnosed with complex regional pain syndrome (CRPS) following the procedure, and despite receiving Gabapentin, Vitamin C, physiotherapy and acupuncture treatments, no improvement was seen. Due to the device stimulation, patient was re-operated for the olecranon pin and wire removal, as well as the ulnar nerve transposition. After the second operation under tourniquet control, the symptoms of pain, paresthesia and movement disorders in the patient's radial nerve pathway have dramatically worsened. On history taking, patient complained of pain, paresthesia and sensory deficit in the dorsal and radial aspects of her right hand, furthermore, a decreased motor strength was detected in extension movements of the wrist, fingers, and thumb (Force: 3/5). A subsequent X-ray investigation revealed the position of screws in distal humerus (Figure 1A).

Investigations and treatment

Radial nerve injury findings were reported above the elbow level on EMG-NCS study. Considering the further aggravation of symptoms across the radial nerve due to the inflation of the tourniquet, the patient became candidate for nerve exploration and release in radial groove, from distal to proximal aspect of the humerus. During the procedure, the nerve was first explored and neurolysis was performed from the distal anterolateral of the arm. The lengthy screw had injured the radial nerve between the distal 1/3 and the proximal 2/3 of the Humerus (Figure 1B). The over length screw was protruded about 5 mm out from the opposite cortex, causing about 30% damage to the radial nerve adjacent to the humerus bone, leading to neuroma formation (Figure 2).

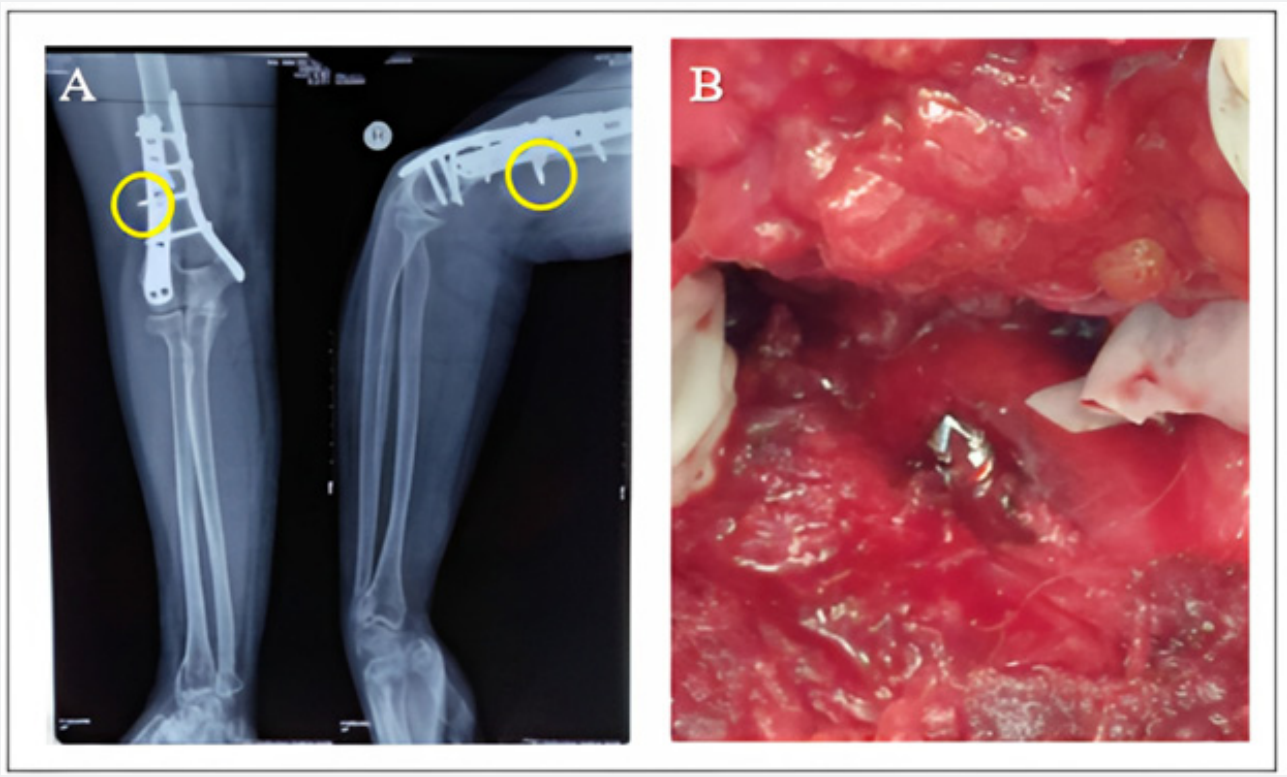

Figure 1: X-ray showing the position of screws in distal humerus (A). The long screw is protruded about 5 mm out from the opposite cortex and is placed near to the nerve adjacent to the humerus bone (B).

Outcome and follow-up

The neuroma was removed; the partial nerve injury was repaired end to end, after neurolysing the intact fascicles. Finally, the indexed screw was removed. Fortunately, the patient's sensory and motor symptoms improved significantly after removal of the irritating screw. Almost complete improvement of signs and symptoms was noted after two years of follow-up.

Discussion

Nerve damage attributed to screws and other mechanical devices is rare in surgery due to nerve exploration procedure. However, using long screws and absence of vision in the opposite cortex may cause damage to important tissue elements, such

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as arteries and nerves. Nerve compression leads to edema, ischemia, thinning of the myelin sheaths, and the formation of local neuroma, which can consequently cause neuropathic pain, sensory impairment, and motor dysfunction [12]. A complete recovery can be expected following removal of the causative factor, the resultant neuroma and repairing the nerve. In the present case report, progressive symptoms of radial nerve damage were promoted by stimulation and destruction of the nerve induced by a long screw. Surgeons must be careful while drilling the bone and choosing the right size of screw to prevent damage to the arteries and nerves as the opposite cortex cannot be seen and explored. Emerging new sensory and motor symptoms after surgery should promote suspension to nerve damage attributed to surgery procedure [13]. When a patient present with progressive symptoms of nerve dysfunction after instrumentation for bone fracture, it is crucial to pay close attention to the direction and size of the screws. In one study, a median-nerve injury was reported after screw instrumentation in Scaphoid Fx. The symptoms were immediately improved after screw removal and complete clinical restoration of the nerve function was reported after two months [14]. Also, in a meta-analysis study the rate of neurological complication after spinal surgery due to screw instrumentation was reported 1.1% [15]. Streufert et al. [16] assessed 261 patients and showed a sensitivity of about 89% for the ultrasound (US) in diagnosing the radial nerve continuity and probable rupture after ORIF procedure; and therefore suggested US to be used for nerve damage assessment [16]. Another marker of device stimulation is a worsening of symptoms after using a tourniquet. Nerve injury after inflating the tourniquet is the most common complication which is due to several mechanism including ischemia and direct compression. Direct compression causes microvascular congestion and insufficient perfusion. Therefore, axonal damage occurs [17].

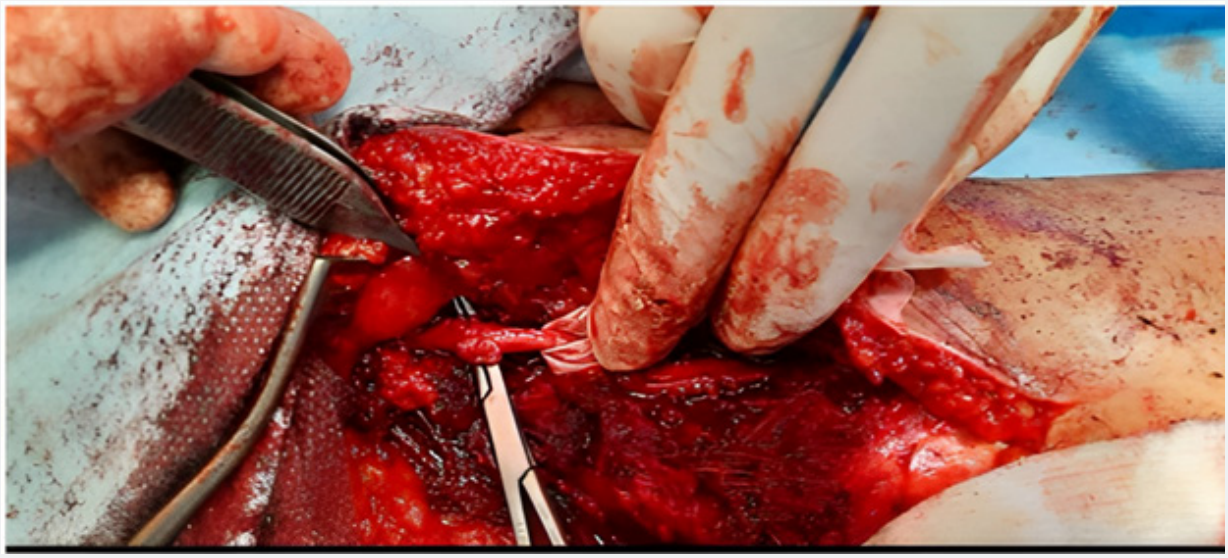

Figure 2: Nerve damage due to a long screw in the arm (distal 1/3) with the neuroma formation.

Even low-energy incidents might cause damage to the radial nerve. In one study, complete radial nerve paralysis including motor and sensory fibers, was shown to occur after attempting a cephalic vein venipuncture [18]. Application of threaded pins seems to be a risk factor, considering these tools reduce the surgeon's sensation for the opposite bone cortex so that it is much more likely to progress beyond the second cortex. Second, the unique relative anatomy between radial nerve and humerus shaft, humerus fracture and following fixation treatment of the two cortices, using screws, puts the nerve at direct risk [13].

This case study examines a progressive radial nerve disorder caused by a lengthy screw and the creation of a neuroma as a result. The diagnosis was initially missed, and the patient underwent unnecessary ulnar nerve transposition and several physiotherapy sessions, which caused the patient's recovery to be delayed. The use of a tourniquet during the second surgery significantly aggravated the symptoms. Therefore, device irritation should be considered if worsening symptoms of nerve irritation occur following use of the tourniquet during surgery. Accurate neurologic physical examination in terms of the affected nerves territory could prevent the ulnar nerve transposition surgery, when the radial nerve was actually affected.

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