

## Case Report

# Ultrasound Diagnosis of Double Crush Syndrome of the Ulnar Nerve by the Anconeus Epitrochlearis and a Ganglion

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Double compression of the ulnar nerve, including Guyon's canal syndrome associated with cubital tunnel syndrome caused by the anconeus epitrochlearis muscle, is a very rare condition. We present a case of double crush syndrome of the ulnar nerve at the wrist and elbow in a 55-year-old man, as well as a brief review of the literature. Although electrodiagnostic findings were consistent with an ulnar nerve lesion only at the elbow, ultrasonography revealed a ganglion compressing the ulnar nerve at the hypothenar area and the anconeus epitrochlearis muscle lying in the cubital tunnel. Careful physical examination and ultrasound assessment of the elbow and wrist confirmed the clinical diagnosis prior to surgery.

**Key Words :** Double crush syndrome · Ulnar nerve · Ultrasound · Anconeus epitrochlearis.

## INTRODUCTION

Upton and McComas first reported double crush syndrome in 1973, postulating that proximal compression could render the distal nerve more susceptible to a second compression<sup>14</sup>. In clinical practice, we often observe cervical radiculopathy and carpal tunnel syndrome occurring together in what is known as double crush syndrome<sup>4,11,12</sup>.

Double compression of the ulnar nerve at the elbow and wrist is a very rare condition, however. In the present study, although electrophysiologic findings were consistent with an ulnar nerve lesion around the elbow, ultrasonographic findings showed that the anconeus epitrochlearis muscle lay in the cubital tunnel compressing the ulnar nerve, and that a ganglion cyst had compressed the motor branch of the ulnar nerve around the wrist. Awareness of the double crush syndrome of the ulnar nerve by preoperative diagnostic ultrasonography can improve the accuracy of the clinical diagnosis and prevent possible operative complications.

## CASE REPORT

A 55-year-old man presented with a 3-month history of a tingling sensation and weakness in the right hand. He also re-

ported tenderness in the hypothenar eminence. A neurologic examination revealed weakness in the abductor digiti minimi and first dorsal interosseous muscles, whereas the right forearm and arm muscles were strong. A slightly decreased sensation was noted in the fourth and fifth fingers of the right hand. The Tinel sign was present over the elbow.

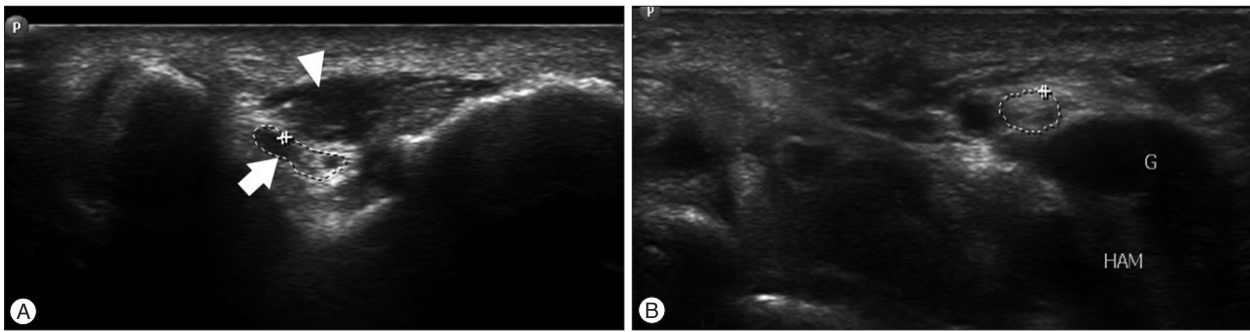
In the electrodiagnostic examination, nerve conduction studies were performed on bilateral upper limbs, and needle electromyography was performed on the right upper limb. The ulnar compound muscle action potential amplitude was low, and a decrease in conduction velocity over the elbow focal lesion was observed by the inching technique. The right ulnar sensory nerve action potential (SNAP) was normal, but the dorsal ulnar cutaneous SNAP amplitude decreased slightly, compared with the left side. Electromyography revealed spontaneous activity in the first dorsal interosseous muscle, whereas the flexor carpi ulnaris, the other non-ulnar innervated right arm, and hand muscles were normal. Electrophysiologic findings were consistent with an ulnar nerve lesion around the elbow; however, ultrasonographic findings showed that the anconeus epitrochlearis muscle lay between the medial epicondyle and olecranon in a close proximity with a swollen ulnar nerve around the elbow (Fig. 1A), and that a hypoechoic ganglion cyst had displaced the ulnar artery and compressed the ulnar nerve around the wrist

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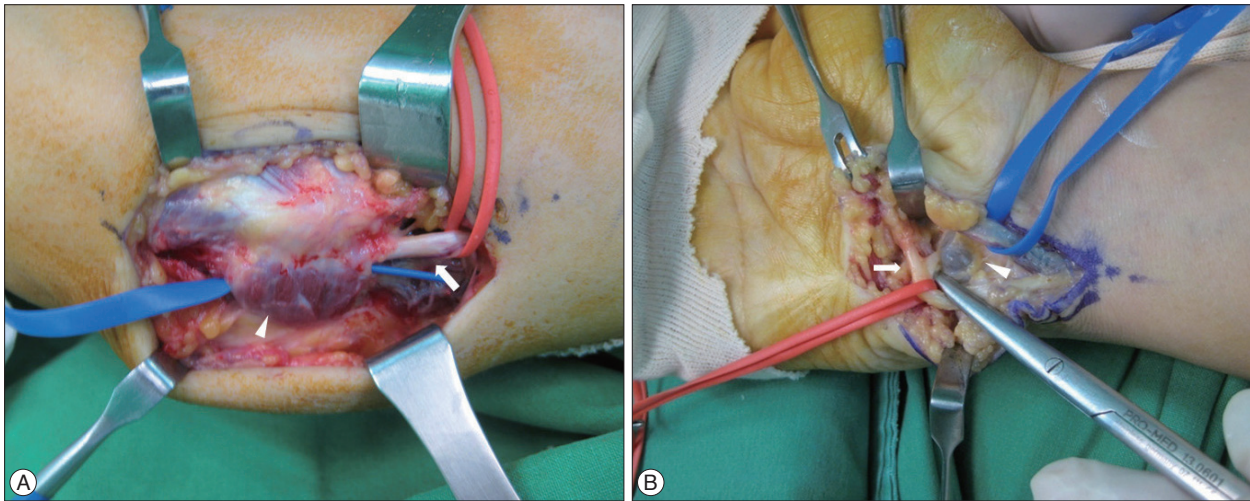
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**Fig. 1.** Ultrasonographic findings, revealing (A) the anconeus epitrochlearis muscle (arrowhead) in close proximity to a swollen ulnar nerve (arrow), and (B) a hypoechoic ganglion cyst (G) and ulnar nerve (circle) between the hamate hook (HAM) and pisiform.



**Fig. 2.** Operative findings, showing (A) the anconeus epitrochlearis muscle (arrowhead) compressing the ulnar nerve (arrow), and (B) a ganglion (arrowhead) compressing the ulnar nerve (arrow).

(Fig. 1B). The cross-sectional area of the ulnar nerve was  $0.083 \text{ cm}^2$  at the elbow with a hypoechoic appearance, and  $0.087 \text{ cm}^2$  at the wrist.

During surgery, the anconeus epitrochlearis muscle (Fig. 2A), extending from the medial epicondyle to the olecranon, was found to be compressing the ulnar nerve at the elbow level. The muscle was tight in flexion, and it significantly compressed the ulnar nerve. The aberrant muscle and flexor retinaculum were split longitudinally, and an anterior subfascial transposition of the ulnar nerve was performed. There was a  $2.5 \times 2.0$ -cm, well-defined, encapsulated, cystic mass compressing the motor branch of the ulnar nerve at the wrist (Fig. 2B). The mass was excised, and histopathology confirmed a ganglion. Symptoms improved immediately after surgery, and the patient was symptom free 1 year later.

## DISCUSSION

The term “double crush” is appropriate in cases in which a nerve is compressed at 2 separate levels. Multiple compressions can produce vague, nonspecific, or atypical symptoms. The diagnosis and treatment of variable compression at multiple levels is difficult, as multiple compressions along a nerve have a cu-

mulative effect on both antegrade and retrograde conduction<sup>12)</sup>. Double compression of a peripheral nerve is not rare in medical practice. Other researchers have reported series of patients showing the frequent association of proximal and distal nerve compression syndrome, including carpal tunnel syndrome, associated with cervical radiculopathy or brachial plexus compression<sup>4,11)</sup>.

Double compression of the ulnar nerve is a very rare condition, however. The most important finding of the present study is that the double crush syndrome occurred in the ulnar nerve, including Guyon’s canal syndrome associated with cubital tunnel syndrome caused by the anconeus epitrochlearis muscle. Furthermore, this study demonstrated that double crush syndrome cannot be fully diagnosed by electrodiagnostic findings. To the best of our knowledge, there is only 1 report in the literature on ulnar nerve neuropathy along the elbow and wrist segments<sup>10)</sup>; however, the ulnar nerve neuropathy of the elbow was not caused by the anconeus epitrochlearis muscle in that case.

Ulnar nerve compression in the cubital tunnel can have different causes, including the arcade of Struthers, medial intermuscular septum, cubital tunnel retinaculum, humeroulnar aponeurotic arcade, ligament of Osborne, and an anatomic elbow deformity<sup>7)</sup>. In the present report, compression neuropathy of

the ulnar nerve at the elbow was caused by the anconeus epitrochlearis muscle. The anconeus epitrochlearis muscle was first described by Wood<sup>16)</sup> in 1868 as an accessory muscle of the medial elbow that originates from the medial epicondyle of the humerus and inserts onto the olecranon process of the ulna. The prevalence of an anconeus epitrochlearis muscle is 4–34% in cadaver studies<sup>5)</sup>. Although it is rarely seen in clinical practice, ulnar nerve compression due to the anconeus epitrochlearis muscle is reported to range from 5% to 16% in the operative series<sup>3,9,13,15)</sup>.

In the present report, the electrodiagnostic findings of our patient were compatible with ulnar nerve neuropathy around the elbow. However, the patient presented with symptoms of ulnar nerve neuropathy around the elbow and tenderness in the hypothenar area. Ultrasonography revealed anatomic changes, showing that the Guyon's canal syndrome was caused by a ganglion cyst and that the cubital tunnel syndrome was caused by the anconeus epitrochlearis muscle. Although electrodiagnostic studies are the main tools for localizing and assessing nerve injuries, they do not reveal the exact location, intensity, or cause of the lesions, nor do they provide spatial information on the nerve and the surrounding structures<sup>1)</sup>. Flak et al.<sup>4)</sup> proposed that evaluation of double crush syndrome requires both structural and functional diagnosis of the peripheral nerve by imaging studies and electrophysiologic examination. Indeed, if physical examination had not been carefully performed, we could not have identified double crush syndrome of the ulnar nerve. Therefore, imaging studies may play an important role as an additional accurate diagnostic test.

Ultrasonography is a useful diagnostic tool when the results of electrodiagnostic studies are unclear, such as clinical ulnar neuropathy around the elbow<sup>17)</sup> or carpal tunnel syndrome<sup>6,8)</sup>. Sensitivity increases when ultrasonography is added to the electrodiagnostic test with ulnar neuropathy around the elbow<sup>2)</sup>. Ultrasonography can complement the electrodiagnostic examination, and it is readily available, painless, inexpensive, and does not involve radiation exposure. Therefore, we emphasize that double crush syndrome of the ulnar nerve may be diagnosed by careful physical examination, electrodiagnostic studies, and ultrasonography.

In summary, we describe a case of double crush syndrome of the ulnar nerve, including Guyon's canal syndrome associated with cubital tunnel syndrome caused by the anconeus epitrochlearis muscle, which has not been reported before. Careful physical examination and awareness of the double crush syndrome of the ulnar nerve with the use of preoperative diagnostic ultra-

sonography can improve the accuracy of the clinical diagnosis and prevent possible operative complications.

## References

1. Bargalló X, Carrera A, Sala-Blanch X, Santamaria G, Morro R, Llusá M, et al. : Ultrasound-anatomic correlation of the peripheral nerves of the upper limb. *Surg Radiol Anat* 32 : 305-314, 2010
2. Beekman R, Van Der Plas JP, Uitdehaag BM, Schellens RL, Visser LH : Clinical, electrodiagnostic, and sonographic studies in ulnar neuropathy at the elbow. *Muscle Nerve* 30 : 202-208, 2004
3. Chalmers J : Unusual causes of peripheral nerve compression. *Hand* 10 : 168-175, 1978
4. Flak M, Durmala J, Czernicki K, Dobosiewicz K : Double crush syndrome evaluation in the median nerve in clinical, radiological and electrophysiological examination. *Stud Health Technol Inform* 123 : 435-441, 2006
5. Jeon IH, Fairbairn KJ, Neumann L, Wallace WA : MR imaging of edematous anconeus epitrochlearis : another cause of medial elbow pain? *Skeletal Radiol* 34 : 103-107, 2005
6. Jung JH, Kim KH, Choi SK, Shim JH : Usefulness of ultrasound for detecting suspected peripheral nerve lesions in diagnosis of peripheral neuropathy : case report and brief review of the literature. *J Korean Neurosurg Soc* 53 : 132-135, 2013
7. Khoo D, Carmichael SW, Spinner RJ : Ulnar nerve anatomy and compression. *Orthop Clin North Am* 27 : 317-338, 1996
8. Koyuncuoglu HR, Kutluhan S, Yesildag A, Oyar O, Guler K, Ozden A : The value of ultrasonographic measurement in carpal tunnel syndrome in patients with negative electrodiagnostic tests. *Eur J Radiol* 56 : 365-369, 2005
9. Macnicol MF : The results of operation for ulnar neuritis. *J Bone Joint Surg Br* 61-B : 159-164, 1979
10. Monacelli G, Spagnoli AM, Pardi M, Valesini L, Rizzo MI, Irace S : [Double compression of the ulnar nerve at the elbow and at the wrist (double-crush syndrome). Case report and review of the literature]. *G Chir* 27 : 101-104, 2006
11. Richardson JK, Forman GM, Riley B : An electrophysiological exploration of the double crush hypothesis. *Muscle Nerve* 22 : 71-77, 1999
12. Simpson RL, Fern SA : Multiple compression neuropathies and the double-crush syndrome. *Orthop Clin North Am* 27 : 381-388, 1996
13. Suden R, Wilhelm A : [Proximal ulnar nerve compression syndrome with special reference to the m. epitrochleo-anconeus]. *Handchir Mikrokhir Plast Chir* 19 : 33-42, 1987
14. Upton AR, McComas AJ : The double crush in nerve entrapment syndromes. *Lancet* 2 : 359-362, 1973
15. Vanderpool DW, Chalmers J, Lamb DW, Whiston TB : Peripheral compression lesions of the ulnar nerve. *J Bone Joint Surg Br* 50 : 792-803, 1968
16. Wood J : Variations in human myology observed during the winter session of 1867-1868 at King's College, London. *Proc R Soci Lond* 16 : 483-525, 1868
17. Yoon JS, Walker FO, Cartwright MS : Ulnar neuropathy with normal electrodiagnosis and abnormal nerve ultrasound. *Arch Phys Med Rehabil* 91 : 318-320, 2010