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Original Article

Cubital Tunnel Syndrome Caused by Ulnar Neuropathy Caused by Post-Traumatic Free Bone: A Case Report

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Abstract:
The formation of free bone (loose body) after elbow trauma is a potential complication of elbow injury, which is mostly caused by intra-articular fracture, cartilage injury or dislocation. The formation of free bone leading to ulnar neuropathy caused by cubital tunnel syndrome is extremely rare. This paper reports a 51-year-old man who developed ulnar nerve compression due to free bone formation after elbow trauma, which eventually led to elbow syndrome. The patient was diagnosed as cubital tunnel syndrome by imaging and signs because of pain in the right elbow with limited movement for half a year, aggravation with ulnar numbness in the right hand for one month. The free bone block was taken out by surgery and the right ulnar nerve was released. The symptoms of the patient were significantly relieved after surgery. Based on this case and literature review, this paper discusses the mechanism of cubital tunnel syndrome caused by ulnar neuropathy caused by free bone after trauma and the importance of timely surgical intervention.

Keywords : Cubital tunnel syndrome ; ulnar neuropathy ; trauma ; free bone ; surgical treatment

Introduction

Free bone refers to a small bone block that exists in or around the joint and is separated from the main bone. Trauma-induced fracture is an important cause of free bone formation[1] . Cubital tunnel syndrome is a common clinical peripheral nerve compression disease, mainly due to the ulnar nerve in the elbow ulnar nerve groove (cubital tunnel) by compression, traction and other causes of its dysfunction. Its etiology is diverse, including elbow fracture, dislocation, bone hyperplasia, tumor compression, etc[2, 3]. Cubital tunnel syndrome caused by free bone after trauma is relatively rare, but if it cannot be diagnosed and treated accurately in time, it may lead to irreversible damage to the ulnar nerve and affect the patient 's hand function. This case reports a rare cause of cubital tunnel syndrome : ulnar neuropathy caused by free bone formation after elbow trauma, which leads to cubital tunnel syndrome. This situation has not been reported in the literature before.

2. Case Report

A 51-year-old male patient was admitted to the hospital because of ' right elbow pain with limited activity for half a year, aggravation with ulnar numbness of the right hand for one month '. The patient complained of falling down half a year before admission. After the right elbow touched the ground, he developed right elbow pain with limited movement. At that time, he did not pay attention to it and did not undergo examination. After resting at home, the pain symptoms were slightly relieved, but the joint movement limitation persisted, and gradually developed a sense of compression in the right elbow joint (felt

foreign body sensation in the joint during flexion and extension of the right elbow joint) with numbness in the ulnar side of the right hand (little finger, ring finger and ulnar palm). The numbness was aggravated when the elbow joint was straightened. He went to a private clinic for intra-articular injection of the right elbow joint (the specific injection drug was unknown). After that, the pain of the right elbow joint was slightly relieved, but the activity of the right elbow joint was limited, and the sense of compression and numbness of the right hand were not improved. In the past month, the numbness gradually increased. In order to further clarify the diagnosis and treatment, we went to the outpatient department of our hospital today. The X-ray film of the elbow joint showed that the posterior edge of the olecranon of the right ulna saw a patchy bone density shadow (Figure 1), and CT examination was recommended if necessary. The outpatient department was admitted to our department with 'elbow joint pain '.

Figure 1 | Anteroposterior and lateral X-ray of the patient 's right elbow joint, white arrow pointing to the position of free bone

During the course of the disease, the patient had no dizziness, headache, chest tightness, shortness of breath, abdominal pain, diarrhea and other symptoms, and the diet and sleep were good, and the urine and urine were normal.Physical examination : T : 36.4CP : 89 times / min R : 19 times / min BP : 137 / 77mmHg. The skin of the right elbow was as normal, the medial side of the elbow joint was slightly swollen, the ulnar nerve groove area was slightly full, the local tenderness on the medial side of the right elbow was positive, the hard mass could be touched at the ulnar nerve groove, and the Tinel sign was positive. The active flexion of the right elbow joint was 110 ° (140 ° on the healthy side), and the extension was-15 ° (0 ° on the healthy side). The acupuncture sensation on the ulnar side of the right hand decreased, the muscle strength and muscle tension of the right elbow joint and the right hand were normal, the right radial artery was normal, and the peripheral blood circulation was good. No abnormality was found in the remaining limbs. Physiological reflection exists, and pathological reflection is not elicited. No obvious abnormality was found in the electrocardiogram. Chest X-ray showed : lung texture thickening. CT of the right elbow joint showed : 1.Free bone at the right ulnar nerve groove ; 2. Local bone hyperplasia at the edge of the olecranon (Figure 2, Figure 3).

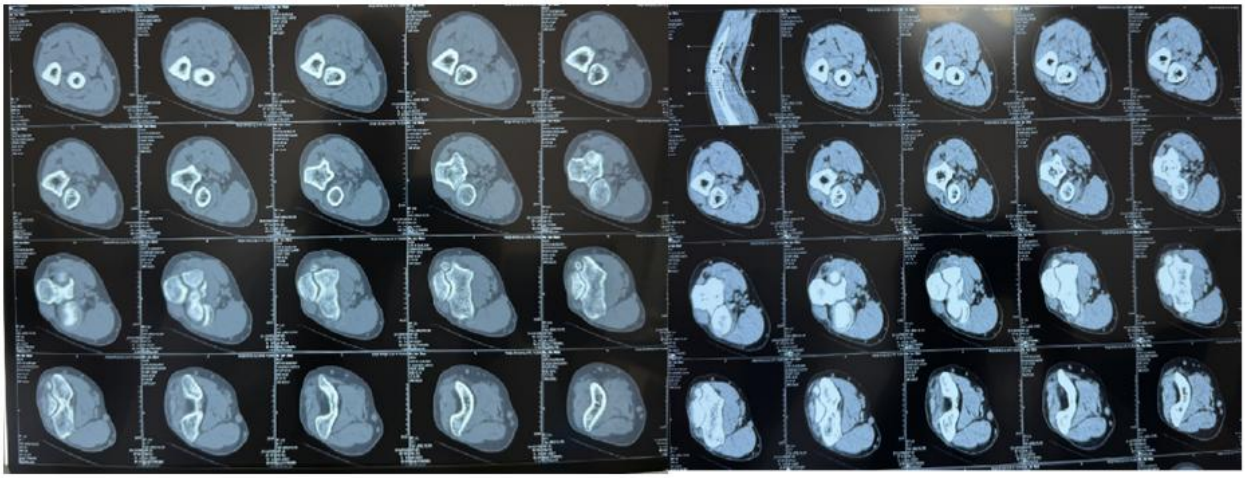

Figure 2 | CT of the patient 's right elbow joint

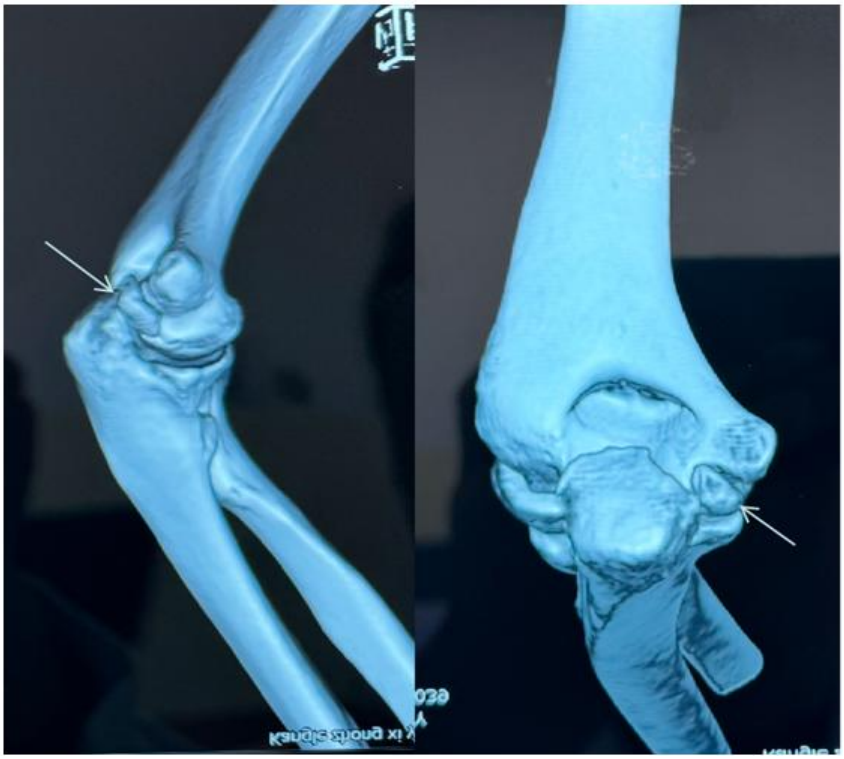

Figure 3 | CT three-dimensional reconstruction. white arrow pointing to the position of free bone

On the third day of admission, the removal of loose bodies in the right elbow joint and the release of the right ulnar nerve were performed under general anesthesia. After successful anesthesia, the patient was placed in a supine position, and a longitudinal incision was made on the posterior side of the right elbow, about 6cm long. The skin and subcutaneous tissue were cut in turn to expose the ulnar nerve groove and the ulnar nerve. The free bone block in the ulnar nerve groove directly compressed the ulnar nerve. It was found that the outer membrane of the ulnar nerve was intact, but there was local congestion and edema, and the nerve fibers were continuous. There was a small amount of exudate around. The deep fascia was cut inside the olecranon of the ulna to expose the posterior joint capsule of the elbow joint. The joint capsule was cut and explored. A free bone block (about 3.0cmx2.0cm) in the ulnar nerve groove was found. The surface was smooth and there was no adhesion to the surrounding tissue, and it is completely removed with a small mosquito clamp (Figure 4).

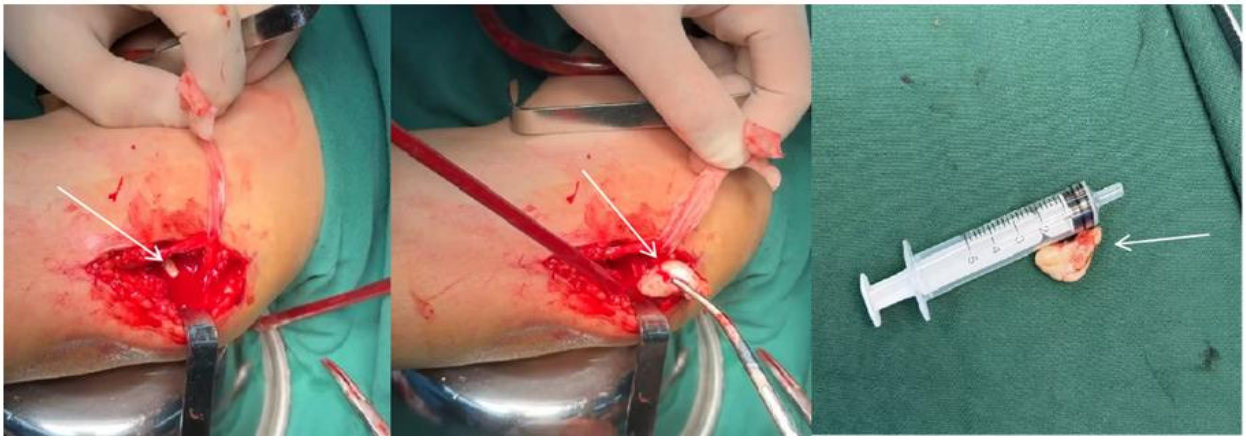

Figure 4 | A free bone block in the ulnar nerve groove was seen during the operation, and the white arrow pointed at the free bone block.

Further exploration of the articular cavity showed no other loose bodies, mild wear of articular cartilage, and hyperosteogeny at the edge of the olecranon, which was not repaired. Dissociate along the ulnar nerve to the distal end, release the fiber bundle around the ulnar nerve, relieve the compression in the elbow tube, and ensure that the ulnar nerve has no tension and no torsion.Fully stop bleeding, saline flush the surgical field, suture the joint capsule, suture the subcutaneous tissue and skin layer by layer, place the drainage skin graft, bandage and fix it with sterile dressing, the flexion and extension of the right elbow joint is normal, the operation is completed, the operation is smooth, the intraoperative bleeding is about 10 ml, the anesthesia is satisfactory, and the patient returns to the ward. Postoperative X-ray films of the right elbow joint showed no obvious abnormalities in the bone structure and joint space of the right elbow joint (Figure 5).

Figure 5 | Postoperative X-ray examination of the right elbow joint

3. Discussion

In this case, the patient developed ulnar neuropathy due to the formation of free bone after elbow trauma, which led to cubital tunnel syndrome. The mechanism mainly involves the anatomical compression, mechanical injury and secondary pathological changes of the ulnar nerve in the elbow[4].Specifically, in terms of direct mechanical compression, the cubital tunnel is the channel of the ulnar nerve in the elbow, which is composed of the medial epicondyle of the humerus, the olecranon process of the ulna and the fibrous fascia (Osborne ligament) between them. The volume is narrow (the volume is reduced by about 55 % during flexion). After

trauma, if free bone such as fracture fragments, osteophytes, and intra-articular free bodies are displaced to the cubital tunnel or adjacent areas, it will directly occupy the lumen space and squeeze the ulnar nerve. When the elbow is flexed, the ulnar nerve needs to slide to the posteromedial side of the cubital tunnel, and the volume of the cubital tunnel is reduced. The presence of free bone further reduces the movable space of the nerve. The double compression of ' static placeholder + dynamic extrusion ' leads to the damage of nerve conduction fibers (especially myelin sheath) and demyelination or axonal edema[5, 6] .In terms of anatomical structure changes and increased nerve tension, free bone may lead to abnormal bone structure of the elbow joint (such as callus hyperplasia and uneven articular surface), change the normal path of the ulnar nerve, force the nerve to bypass the bone process, and form ' bowstring ' traction. Especially in the flexion and extension of the elbow joint, the nerve needs to be repeatedly rubbed or crossed the bone block, resulting in chronic mechanical tension injury. When the elbow joint is flexion and extension, the ulnar nerve needs to slide about 4 ~ 5mm to adapt to the joint activity, and the existence of free bone blocks the sliding trajectory of the nerve. The tension during flexion and extension increases significantly (the tension during flexion can be increased from 0.5N in extension to 2.3N). Long-term high tension leads to compression of capillaries in the nerve, causing ischemia and hypoxia, which further aggravates neurological dysfunction [7, 8].In terms of secondary inflammatory response and tissue damage, free bone acts as a foreign body or a source of traumatic stimulation, activates the local immune system, releases inflammatory factors such as prostaglandins and interleukin-6 (IL-6), causes vasodilation, plasma protein exudation and neutrophil infiltration, and forms perineural edema. Edema further reduces the effective volume of the elbow tube and forms a vicious cycle of ' compression-ischemia-inflammation '. Inflammatory mediators directly damage the nerve sheath and axons, reduce the activity of sodium channels, and affect the conduction of nerve electrical signals. At the same time, inflammation leads to increased permeability of the outer membrane of the nerve, protein leakage and deposition. Increase the tendency of local fibrosis[9-12] .In terms of fibrosis adhesion and nerve immobilization, during the wound healing process around the free bone, fibroblasts proliferate and secrete collagen fibers, forming scar tissue or adhesion. The adhesion between the ulnar nerve and the surrounding fascia, muscle, and periosteum limits its normal sliding. Especially when the elbow joint is active, the nerve cannot move freely with the joint movement, resulting in repeated friction damage, and the adhesion causes the nerve to form a fixed point at a specific point (such as the tip of the bone block). When the elbow joint is flexed and extended, the distal and proximal nerves of the fixed point are subjected to uneven stress, which is prone to nerve perineurium tear, axon fracture, and even neuroma formation at the fixed point. In terms of indirect mechanisms, if the free bone comes from intra-articular fractures or ligament injury, it may lead to a decrease in the stability of the elbow joint (such as ulnar collateral ligament injury). Joint instability causes the ulnar nerve to withstand additional shear force or traction in abnormal activities, and cooperates with the direct compression of the free bone to accelerate nerve degeneration. In addition, repeated micro-trauma of unstable joints can continuously activate the inflammatory pathway and promote the fibrosis process [13, 14].Timely surgical intervention is of great significance for cubital tunnel syndrome caused by post-traumatic free bone. The operation can quickly relieve the compression of the ulnar nerve by the free bone and restore the normal blood flow and conduction function of the nerve. In this case, the symptoms of the patient were significantly relieved after the free bone was removed and the ulnar nerve was released. The ulnar nerve is sensitive to ischemia and compression. If the compression time is too long, it may lead to irreversible damage to nerve fibers. Timely surgery can effectively avoid this irreversible damage, thereby protecting the patient 's hand function. In addition, patients can also restore hand function through rehabilitation training after surgery. Early functional exercise can help prevent nerve and tendon adhesion and further promote the recovery of nerve function [15].

4. Conclusion

This case reports for the first time the rare clinical phenomenon of cubital tunnel syndrome caused by direct compression of ulnar nerve by free bone of elbow joint after trauma, and systematically

reveals its pathological mechanism and key points of diagnosis and treatment. Due to the long-term retention of free bone in the ulnar nerve groove after elbow trauma, the ulnar nerve is subjected to mechanical compression, limited sliding and ischemic injury through the dual effects of ' static space occupation ' and ' dynamic extrusion '. At the same time, the release of local inflammatory mediators and the fibrosis process aggravate the neurological dysfunction. The clinical manifestations are characterized by progressive limitation of elbow joint activity and ulnar sensory abnormalities. Combined with CT images, accurate positioning of the anatomical relationship between free bone and nerve is the key to diagnosis. Timely surgical removal of free bodies and ulnar nerve release can effectively block the vicious cycle of nerve injury, and the symptoms of patients are significantly improved after operation. This case suggests that for patients with post-traumatic elbow pain and neurological symptoms, it is necessary to be highly alert to the possibility of secondary nerve compression of free bone. Early imaging evaluation and surgical intervention are crucial to prevent irreversible nerve injury and functional recovery, providing new ideas and evidence-based basis for clinical diagnosis and treatment of such diseases.

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Declarations

Ethics Approval and Consent to Participate This study was approved by the Ethics Committee of the 940th Hospital of the Joint Logistics Support Force of the Chinese People's Liberation Army. We confirm that this study was conducted in accordance with the 1964 Declaration of Helsinki and its subsequent amendments. Any images or data that may identify individuals in this article have been published with the written consent of the relevant individuals, who agreed to their publication in this article.

Competing Interests: The authors declare no competing interests.

References

1. Schwab A, Pap T, Krenn V, et al. Loose Bodies Found in the Human Intra-Articular Space Showed Characteristics Similar to Endochondral Bone Formation [J]. Cartilage, 2024, 15(4): 353-62.
2. Burahee A S, Sanders A D, Shirley C, Power D M. Cubital tunnel syndrome [J]. EFORT Open Rev, 2021, 6(9): 743-50.
3. Sun J, Mao L, Wu X, et al. Research progress on the diagnoses and rehabilitation for cubital tunnel syndrome: A narrative review [J]. Journal of Neurorestoratology, 2024: 100116.
4. Anderson D, Woods B, Abubakar T, et al. A comprehensive review of cubital tunnel syndrome [J]. Orthopedic reviews, 2022, 14 (3): 38239.
5. Akhavan A A, Catterall L C, Deune E G. Bony cubital tunnel syndrome: A case report of heterotopic ossification causing circumferential ulnar nerve encasement at the elbow and review of current management [J]. Annals of Plastic Surgery, 2023, 90(1): 41-6.
6. Lee S K, Hwang S Y, Choy W S. Validity of computed tomographic measurements and morphological comparison of cubital tunnel in idiopathic cubital tunnel syndrome [J]. BMC Musculoskeletal Disorders, 2020, 21: 1-9.
7. Chin K, Hussain S, Mazis G, Arya A. Clinical anatomy and biomechanics of the elbow [J]. Journal of Clinical Orthopaedics and Trauma, 2021, 20: 101485.
8. De Haan J, Schep N, Eygendaal D, et al. Stability of the elbow joint: relevant anatomy and clinical implications of in vitro biomechanical studies [J]. The Open Orthopaedics Journal, 2011, 5: 168.
9. Abdulkhaleq L, Assi M, Abdullah R, et al. The crucial roles of inflammatory mediators in inflammation: A review [J]. Veterinary world, 2018, 11(5): 627.
10. Aliyu M, Zohora F T, Anka A U, et al. Interleukin-6 cytokine: An overview of the

immune regulation, immune dysregulation, and therapeutic approach [J]. International immunopharmacology, 2022, 111: 109130.
11. Maruyama M, Rhee C, Utsunomiya T, et al. Modulation of the inflammatory response and bone healing [J]. Frontiers in endocrinology, 2020, 11: 386.
12. Ms R P, Kulkarni C, Mukartihal R K, Pai P K. Cubital tunnel compression with ulnar claw hand-A rare presentation of primary elbow osteoarthritis [J]. Journal of Orthopaedic Reports, 2023, 2(2): 100138.
13. Cialdai F, Risaliti C, Monici M. Role of fibroblasts in wound healing and tissue remodeling on Earth and in space [J]. Frontiers in bioengineering and biotechnology, 2022, 10: 958381.
14. Kaneguchi A, Ozawa J. Inflammation and fibrosis induced by joint remobilization, and relevance to progression of arthrogenic joint contracture: a narrative review [J]. Physiological Research, 2022, 71(4): 447.
15. Shelke S, Ambade R, Shelke A. From conservative measures to surgical interventions, treatment approaches for cubital tunnel syndrome: a comprehensive review [J]. Cureus, 2023, 15(12).