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## Abnormal type III fusion between lunate and triquetrum: A case report

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## ABSTRACT

**INTRODUCTION:** The lunotriquetral coalition is the fusion of the lunate and triquetral bones of the wrist and is the most frequent carpal coalition type. It is frequently asymptomatic and discovered as an incidental due to chronic wrist pain, trauma, or fracture. This case aims to present an unusual unilateral lunotriquetral coalition and clinical significance for diagnosis and treatment.

**PRESENTATION OF CASE:** In this case, we presented a 37-year-old male who exhibited with right-sided trauma and wrist pain. He was diagnosed to have a type III complete osseous lunotriquetral coalition on the right side and detected by plain radiography and CT without lytic, destructive, and sclerotic lesions.

**DISCUSSION:** An avulsion fracture was recognized in the distal end of the right radius. A fragmented fracture was identified in the scaphoid bone, and an internal fixator extending from scaphoid bone to lunate bone. The internal fixators were observed among the lunate, capitate, and distal end of the radius bones. The plain anteroposterior, lateral radiograph and CT of the right wrist exhibited a right-sided unilateral type III osseous coalition between the lunate and triquetrum bones.

**CONCLUSION:** Knowledge of type III complete fusion is essential to the proper diagnosis and management of this variation when a subject exhibits unexplained wrist pain, trauma, or fracture. It should be noted that plain radiographs and CT can provide an accurate diagnosis in type III complete lunotriquetral coalition without pathological evidence.

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## 1. Introduction

The carpal coalitions occur between carpals more frequently in the same carpal row rather than in different rows [1]. Lunotriquetral coalition is the most frequent fusion of the lunate and triquetral bones of the wrist, with a prevalence of 0.08–0.13% [1–3]. Although the incidence is unsteady according to geographical areas and races, this variation is frequent in females, and in some cases, hereditary (autosomal dominant inheritance). The osseous coalitions of the lunotriquetral fusion are usually asymptomatic and identified incidentally on x-rays or CT due to chronic wrist pain, displacement, or trauma [2,4]. The fibrocartilaginous lunotriquetral coalitions might lead to ulnar-sided wrist pain, ulnar nerve paresthesia, and an enhanced risk of the degenerative complications due to the pseudarthrosis or a post-traumatic disturbance [1]. Embryological carpal fusion or congenital carpal synchondro-

sis occurs due to insufficient segmentation of the carpal cartilage, failure of cavitation of the cartilaginous hand bud precursor, or undifferentiated mesenchyme during the fourth to eighth week of gestation, which later develops to a complete or incomplete fusion [5]. Usually, apoptotic cell death results in cleft before the 10th intrauterine week, and the degree of this apoptosis defines the degree of complete or incomplete fusion. Lunotriquetral fusion stem from mal-segmentation of the cartilaginous carpal precursor of the lunate and triquetral bones [4]. In 1952, Minaar de Villiers [6] classified the lunotriquetral coalition into four types. Type I; Incomplete (non-osseous or fibrocartilaginous) fusion mimicking pseudoarthrosis and narrowed lunotriquetral fusion along with irregular sclerotic margins, subcortical cysts, bone marrow edema, damage to the surrounding cartilage, and concomitant pathology; Type II; Partial osseous fusion with variable depth notch and mostly a distal remnant of the joint space, Type III; complete osseous fusion, Type IV; complete osseous fusion with other carpal deformities accompanied by anomalies of the soft tissues [1,6]. The complete carpal coalitions might be related to congenital irregularities or an acquired anomaly. The hereditary intercarpal coalition might be derived from arthrogyposis, synphalangea, diastrophic dwarfism, dyschondrosteosis, Banki syndrome, Turner's syndrome, Ellis Van Creveld Syndrome (chondroectodermal dysplasia), hand-

**Abbreviations:** CT, computed tomography; L-T, lunotriquetral coalition; P, pisiform bone; R, radius; S, scaphoid bone; ST, slice thickness; U, ulna.

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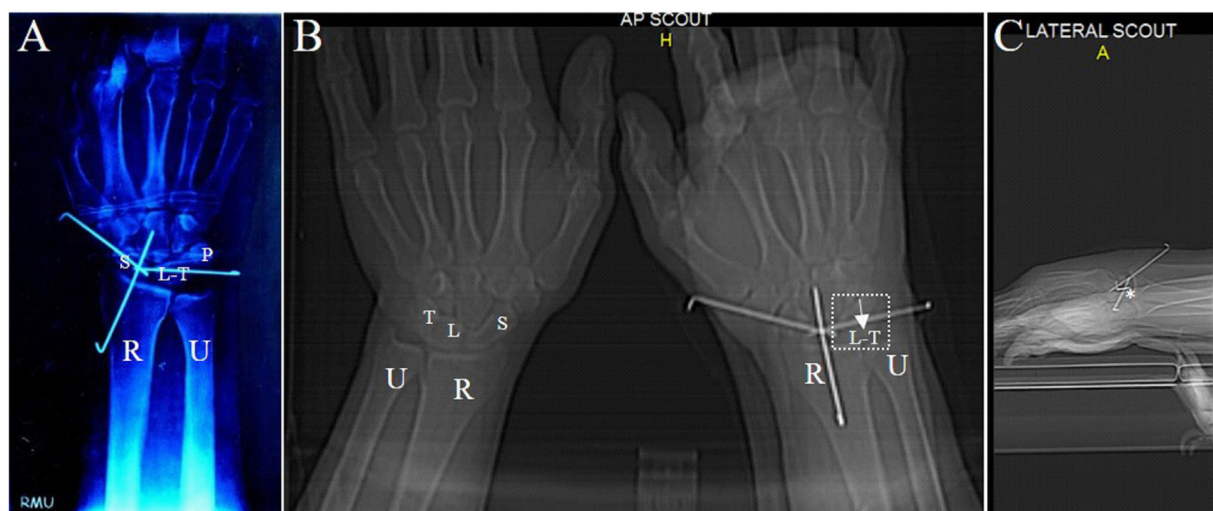
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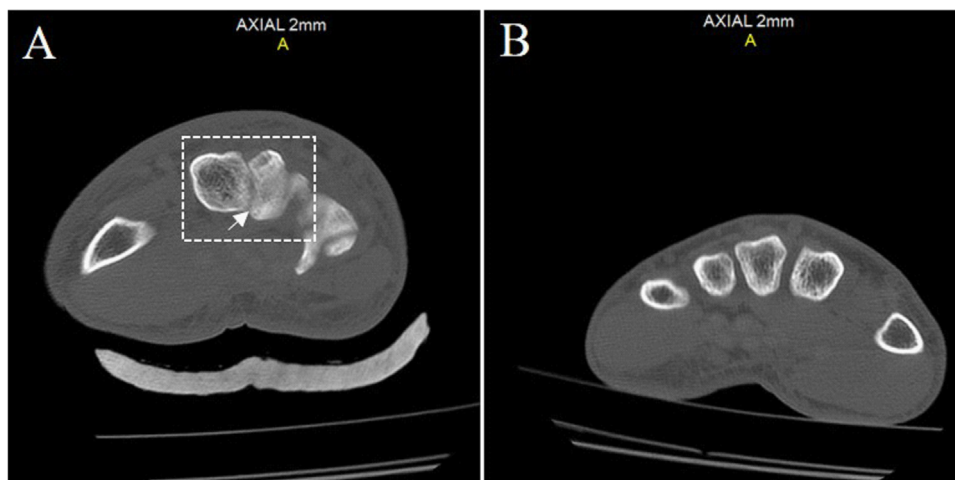
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**Fig. 1.** A. The plain radiograph of the right wrist demonstrating type III complete fusion of lunotriquetral bones B. The posteroanterior radiograph of the right wrist revealing complete osseous coalition between the LT bones (Minnaar Type III) of the proximal row of the carpal bone (arrow) C. The lateral radiograph of the right wrist of a male patient showing type III complete fusion of the lunotriquetral bones of the proximal row of the carpal bone (\*) R: Radius, U: Ulna, S: Scaphoid bone, L-T: Lunotriquetral fusion, P: Psiform bone.



**Fig. 2.** Asymptomatic variant. Axial CT (2 mm) A. The lunotriquetral (arrows) type III was found during axial CT examination after major trauma B. The axial CT of the left wrist.

foot-uterus, Holt-Oram, otopalatodigital and Nievergelt-Pearlman syndrome [1]. The acquired intercarpal coalition might result from rheumatoid arthritis, juvenile arthritis, reiter's syndrome, wrist infection, or surgical arthrodesis. The anteroposterior (AP), lateral X-ray, plain radiography, and computed tomography (CT) may provide more data as to bone surfaces for symptomatic cases [3]. The present case aimed to describe a case of a complete type III lunotriquetral coalition and to assess the AP, lateral plain radiography and axial CT results of this coalition, and clinical significance of complete fusion.

**2. Case description**

A 37-year-old male patient applied to the Department of Orthopaedics and Traumatology following trauma in the right hand and evaluated by plain radiography and CT in the axial planes. Written informed consent was obtained from the patient in this case. An avulsion fracture was recognized in the distal end of the right radius. An internal fixator was noted between the lunate

bone and the radius. A fragmented fracture was identified in the scaphoid bone, and an internal fixator extending from scaphoid bone to lunate bone. The second internal fixator was observed between lunate and capitate bones. The radiocarpal, ulnocarpal, and metacarpophalangeal joint spaces, connections, and contours were normal on the right side. No pathological appearance was observed in the muscular structures, intermuscular fatty tissue, skin, and vascular structures. The AP and lateral plain radiographs were obtained. The AP scout slice thickness (ST) 1 mm, W 400/ C 40, zoom factor 2,65 ma 10 KV 120. Lateral scout ST:1 mm, W 400/ C 40, zoom factor 1,14 ma 10 KV 120 (Fig. 1). The AP, lateral radiographs and CT exhibited fusion of the lunate and triquetral bones of the wrist (type III lunotriquetral fusion, complete osseous fusion) (Fig. 1). On further investigations, a plain AP radiograph of the right wrist presented a right-sided unilateral type III osseous coalition between the lunate and triquetrum bones, as shown in Fig. 1. There were no associated soft tissue abnormalities, and the surrounding joints were normal. The axial 2 mm W 2000/ C 350 KV:120 ma:110 ST: 2 mm. zoom factor 1.14. images were obtained (Fig. 2).

The coronal and sagittal CT of the left wrist was also obtained in the axial planes (Fig. 2). The radiocarpal, ulnocarpal, and metacarpophalangeal joint spaces, relations, and contours were normal on the left side. The contours and structures of other carpal bones were normal (Fig. 2). The lytic, destructive, sclerotic lesion was not recognized.

### 3. Discussion

The lunotriquetral coalition is the most frequent type of carpal coalition, representing 90% of all carpal fusions [3]. DeFazio M et al. stated that the most frequent coalition was the lunotriquetral coalition, which was present in 89.3% of identified cases without clinical or radiographic evidence of carpal instability. Moreover, sixty-nine cases were Minnaar Type III lunotriquetral coalition without trauma, infection, disease, or symptoms [2]. The fusion of carpal bones may be congenital or an acquired anomaly and usually was diagnosed incidentally on plain radiographs or CT obtained for fracture or trauma [1]. The lunotriquetral fusion appears embryologically due to the incomplete separation of cartilaginous zones of the adjacent carpals. The coalitions with a partial development of a central zone are considered incomplete fusions, whereas coalitions with no central zone development are complete fusions. One variant of the coalition is the presence of a complete type III osseous fusion, as in our patient. Such a finding is correlated with ulnar impaction syndrome that mimics the wrist pain that our patient presents with. The lunotriquetral fusion at the wrist is usually asymptomatic, but Singh et al. [4] stated that fusion might become symptomatic pathology following fracture, trauma, or excessive load to the wrist's affected side. Knezvich et al. [7] asserted that loss of motion between the fused bones and an increase in the movement at surrounding joints influences subjects to repetitive sprains and pain due to the extreme mechanical stress. Most patients are treated conservatively; however, in severe cases, surgical treatments may be considered. Gross et al. [8] conducted wrist arthrodesis to five cases with symptomatic lunotriquetral fusion due to trauma or excessive stress loading, and as a result of the procedure, they obtained a painless, full range of motion, asymptomatic wrist. The CT is an essential method for distinguishing symptomatic stress injury and characterization of lunotriquetral fusion [9]. However, carpal fusions can cause wrist instability and arthritis. Therefore, it is suggested to first exhaust all conservative management before proceeding for surgical intervention. In some cases, wrist denervation, immobilization, elevation, and anti-inflammatory drugs are also be advised [10].

On the other hand, a partial joint with thin insufficient cartilage causes painful degenerative arthritis in trauma or stress. Limited wrist arthrodesis, isolated carpal excision, proximal row carpal excision, or decompression of neuropathy in patients with severe arthritis can be recommended for the symptomatic lunotriquetral coalition [10]. In the present study, a case of painful wrist movement on the right side of a complete osseous type III of the lunate bone and the triquetral bone coalitions have been reported without a pathogenetic mechanism, lytic, destructive, and sclerotic lesions. As a demonstrated case, complete lunotriquetral fusion is frequently an asymptomatic condition recognized incidentally on plain radiographs and CT taken for fracture, trauma, or unrelated reasons. The surgical treatment of fusion has revealed pain relief, restored mobility, and acceptable effects on postoperative wrist motion. Moreover, comprehensive postoperative rehabilitation is required to ensure the optimal improvement of wrist motion and functional grip strength. Thus, knowledge of the lunotriquetral coalition provides an enhanced understanding of unexplained carpal wrist pain or trauma, which is the necessity to grasp the cross-sectional or radiographic confirmation for underlying conditions.

### 4. Conclusion

Clinicians should know the significance of the complete lunotriquetral coalitions in their differential diagnoses when a subject exhibits unexplained wrist pain, trauma, or fracture. It should be noted that plain radiographs and CT can provide an accurate diagnosis in type III complete lunotriquetral coalition. The data revealed from the present case can provide improvements in the management of patients who present with a complete lunotriquetral coalition.

### Declaration of Competing Interest

The authors report no declarations of interest.

### Source of funding

No source of funding.

### Ethical approval

The study is exempt from ethical approval in my institution.

### Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. The patient and their families were informed that data from the case would be submitted for publication and gave their consent.

### Author contribution

EÖ, FBY, NO contributed to the development of the project, study design, and drafting of the manuscript. MU and FO are involved in data collection. EÖ, FBY contributed to data management. EÖ and FBY analyzed the data. EÖ participated in the writing of the manuscript. All authors have read and approved the final manuscript.

### Registration of research studies

N/A.

### Guarantor

The corresponding author (Dr. Eren OGUT) accepted the full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish.

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