

Supernumerary carpal bones in Larsen syndrome: A review of the literature and case study

Alexander Govshievich MDCM¹, Abdulwahab Shararah PharmD MD², Salah Aldekhayel MD Med²,
Walla Al-Hertani MD MSc FRCPC FCCMG³, H Bruce Williams MD FRCSC FACS⁴

A Govshievich, A Shararah, S Aldekhayel, W Al-Hertani, HB Williams. Supernumerary carpal bones in Larsen syndrome: A review of the literature and case study. *Plast Surg Case Studies* 2015;1(3):73-75.



Larsen syndrome is a rare congenital disorder commonly associated with dysmorphic facies, large joint dislocations, equinovarus or equinovalgus foot deformities, and various hand anomalies, including supernumerary carpal bones. The authors present a case of Larsen syndrome with bilateral supernumerary carpal bones as the sole clinical manifestation. A literature review investigating skeletal anomalies in patients with Larsen syndrome was performed and revealed that the present case represents a unique presentation of this disorder, lacking all of the major clinical features previously described in the literature. An approach to patients with supernumerary carpal bones is discussed.

Key Words: *Carpal bones; Larsen syndrome; Supernumerary*

Numerical variants of carpal bones have been extensively documented in the literature. More than 20 accessory ossicles scattered across the carpus have been described by O'Rahilly (1) and later by Senecail et al (2). Their incidence in the general population can vary from 0.4% to 1.6%, as demonstrated by O'Rahilly (1) and Bogart (3), respectively. The most frequently observed accessory ossicles are the os centrale, located between the scaphoid, capitate and trapezoid, and the os triangulare, found in the triangular cartilage just distal to the ulnar styloid (4). They present as cartilaginous nuclei in the developing embryo and occasionally persist into adult life as normal anatomical variants (5). Supernumerary carpal bones can also arise from failure of fusion of ossification centres resulting in congenital anomalies such as a bipartite scaphoid (6). The entirety of these congenital variations may be found in isolation or occur in the context of a genetic disorder such as Larsen syndrome and otopalatodigital syndrome type 1. Other syndromes associated with accessory carpal bones include brachydactyly type A1 (Farabee-type brachydactyly; mainly shortening of middle phalanges), Ellis-van Creveld syndrome and Holt-Oram syndrome [4].

First described by Larsen et al (7) in 1950, Larsen syndrome is a rare congenital disorder occurring in one in 100,000 live births. It is characterized by a wide variety of craniofacial and musculoskeletal features such as hypertelorism, prominent forehead, depressed nasal bridge, flattened midface, cleft palate, short stature, equinovarus or equinovalgus foot deformities, and dislocations of the hips, knees and elbows. It may also manifest with several hand anomalies, which may be of relevance to the hand surgeon. These include long cylindrical-shaped fingers, spatula-shaped thumbs, short metacarpals and supernumerary carpal bones (8). Cervical kyphosis is the most serious manifestation of Larsen syndrome, predisposing patients to potentially life-threatening paralysis.

Genetically, Larsen syndrome is primarily inherited through an autosomal dominant mode of transmission and associated with mutations in the Filamin B (*FLNB*) gene (8). Mapped to chromosome 3p14, Filamin B is a cytoskeletal protein that plays an important role in actin polymerization and signal transduction pathways that help control and guide proper skeletal development (9). A recessive form of the disease has also been described and found to be associated with more severe skeletal and extra-skeletal phenotypic features including perinatal fatality. Sporadic cases have equally been reported in the literature (8).

Larsen syndrome has a wide spectrum of clinical presentations ranging from intrauterine death to mild phenotypic expression with absence of major diagnostic features (8). We present a case of Larsen syndrome associated with bilateral supernumerary carpal bones. We discuss the importance of recognizing supernumerary carpal bones as an entity rarely occurring in isolation and often part of a larger clinical picture, requiring prompt and careful evaluation and follow-up.

CASE PRESENTATION

A 30-year-old, right-handed, Sri Lankan man who worked as a cook presented to the emergency department of the authors' institution with an acute onset of right-sided radial wrist pain following trivial trauma sustained at work. An x-ray of the right hand and wrist did not reveal any fracture, but rather revealed a markedly abnormal morphology and number of carpal bones. There was evidence of fragmented trapezium and trapezoid bones and an accessory ossification centre at the base of the second metacarpal. The patient was initially managed by immobilization of his wrist while further work-up was performed. A contralateral control x-ray revealed similar anomalies. In addition, it showed a fragmented hamate bone, dysmorphic scaphoid and capitate bones, a hypoplastic triquetrum and an ossified body at the junction of the capitate, hamate and lunate (Figure 1). A subsequent computed tomography scan of the right wrist showed each carpal bone to be split into two or three oddly shaped fragments, scattered in a random fashion without evidence of fracture; a total of 13 to 14 carpal bones could be identified (Figure 2A, Figure 2B). The patient's pain started to improve slowly after a prolonged period of immobilization and he was referred to physiotherapy and occupational therapy for rehabilitation.

In addition, with radiological findings suggestive of Larsen syndrome (4), the patient was referred to the genetics department of the authors' institution for molecular analysis. Connective tissue gene testing was undertaken and DNA sequencing of the *FLNB* gene was performed. Exons of the *FLNB* gene were amplified by polymerase chain reaction and subsequently sequenced and analyzed for variations. Analysis revealed a c.4625T→C transition in exon 27 of the *FLNB* gene, confirming the diagnosis of Larsen syndrome.

A full-body examination of the patient was performed. He was found to be of normal stature and had no dysmorphic features, facial or other. Orthopedic examination revealed slight subluxation of both knees in full extension and some laxity of the patella and knee joint

¹Department of Plastic and Reconstructive Surgery, University of Montreal; ²Department of Plastic and Reconstructive Surgery; ³Department of Human Genetics; ⁴Division of Plastic & Reconstructive Surgery, McGill University, Royal Victoria Hospital, Montreal, Quebec

Correspondence: Dr Alexander Govshievich, Department of Plastic and Reconstructive Surgery, University of Montreal, Montreal, Quebec H3T 1J4. Telephone 514-839-3048, fax 514-839-3048, e-mail alexander.govshievich@gmail.com



This open-access article is distributed under the terms of the Creative Commons Attribution Non-Commercial License (CC BY-NC) (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits reuse, distribution and reproduction of the article, provided that the original work is properly cited and the reuse is restricted to noncommercial purposes. For commercial reuse, contact support@pulsus.com

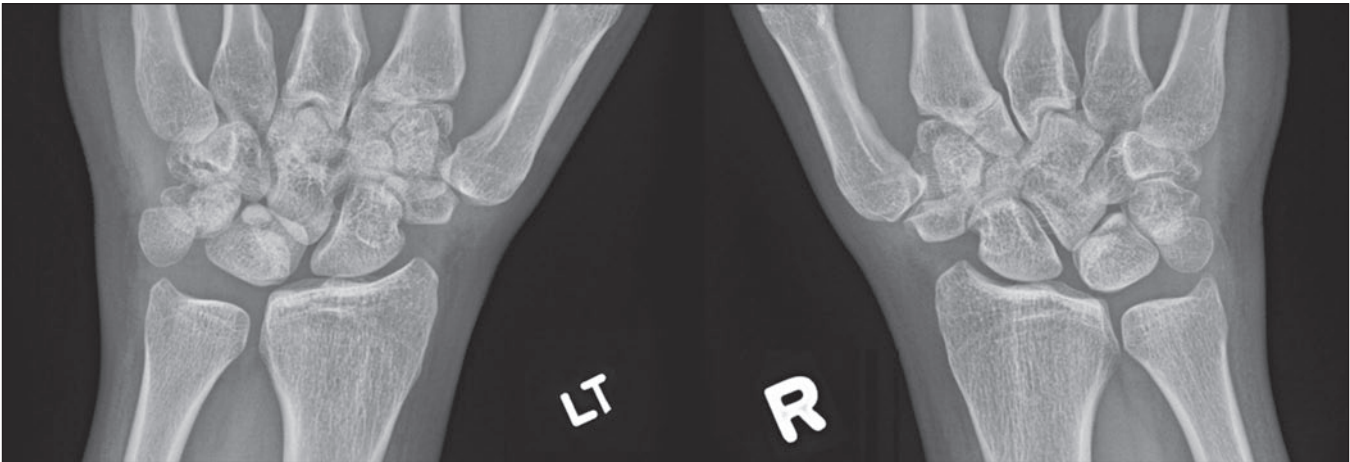


Figure 1) Plain radiographs of bilateral wrists. LT Left; R Right

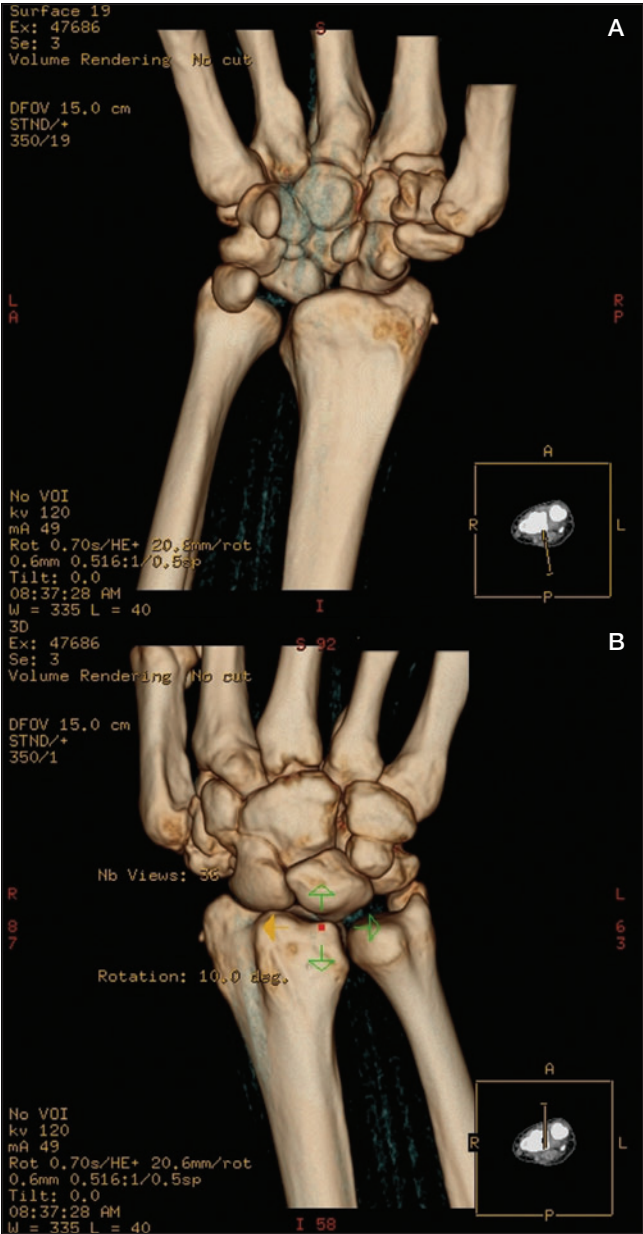


Figure 2) A Computed tomography scan of the right wrist with three-dimensional reconstruction (volar aspect). B Computed tomography scan of the right wrist with three-dimensional reconstruction (dorsal aspect)

TABLE 1
Summary of skeletal survey findings

Cervical spine	Abnormal morphology of the cervical vertebrae, particularly posterior elements. Nonfusion of the posterior elements of C6 and C7 and incomplete fusion at C2 Abnormal articular processes of all cervical levels with hypertrophy at C2-C5 The facet joints within the cervical spine appear dysplastic Mild increase in anteroposterior width of C2-C4 vertebral bodies Inferior end plate depression is also noted at multiple levels Anterolisthesis of C2-C3
Thoracic spine and ribs	Unremarkable Alignment is anatomic
Lumbar spine	Possible rudimentary ribs at L1 and L2 Alignment is anatomic
Pelvis	Sacroiliac joints and pubic symphysis are congruent Hips are unremarkable
Bilateral humeri	Unremarkable
Bilateral forearms	Normal alignment at the elbow Mild remodelling of distal articular surface of the right radius
Bilateral femora	Mild lateral bowing of the distal femoral metadiaphysis bilaterally
Bilateral tibia and fibula	Rounded appearance of the talar domes bilaterally (ball-and-socket)
Feet	Abnormal configuration around the Lisfranc joints Evidence of medial angulation of the little toes bilaterally Tiny left calcaneal bony spur is noted
Full-length weight-bearing legs	The right leg is shorter by 7 mm compared with the left

bilaterally. On questioning, the patient mentioned that he experienced knee pain, more pronounced on the right. Both ankle joints were hypermobile and fell into pronated position when standing. There was mention of similar findings in the patient's father. No large joint dislocations were noted.

A skeletal survey was performed to detect any underlying radiological findings. X-rays revealed several anomalies, which were most notable at the level of the cervical spine. There was evidence of dysmorphic

TABLE 2
Comparison of reported skeletal anomalies in patients with Larsen syndrome

	Author (reference)						Total, n/n (%)
	Babat and Ehrlick (11)	Bicknell et al (8)	Percin et al (12)	Rahalkar et al (13)	Stanley and Seymour (14)	Steel and Kohl (10)	
Total patients, n	3	52	1	1	8	3	68 (–)
Patients with accessory carpal bones, n	2	48	1	1	6	2	60 (–)
Short stature (<10th percentile)	2 of 2	44 of 48	1 of 1	1 of 1	0 of 0	0 of 0	48/52 (92.3)
Characteristic facies	0 of 2	47 of 48	1 of 1	1 of 1	6 of 6	2 of 2	57/60 (95.0)
Hip dislocations	1 of 1	46 of 48	1 of 1	0 of 0	3 of 6	2 of 2	53/58 (91.4)
Knee dislocations	2 of 2	45 of 48	0 of 0	0 of 1	2 of 6	2 of 2	51/59 (86.4)
Elbow dislocations	0 of 0	42 of 48	1 of 1	0 of 0	6 of 6	1 of 2	50/57 (87.7)
Foot anomalies	1 of 1	43 of 48	1 of 1	0 of 1	6 of 6	2 of 2	53/59 (89.8)
Spatulate thumbs	0 of 0	47 of 47	1 of 1	0 of 0	6 of 6	2 of 2	56/56 (100)
Scoliosis	0 of 0	41 of 48	1 of 1	1 of 1	2 of 6	1 of 2	46/58 (79.3)
Cervical spine anomalies	2 of 2	41 of 47	1 of 1	0 of 0	0 of 0	0 of 0	44/50 (88.0)

posterior elements, abnormal articular processes, dysplastic facet joints, inferior end plate depressions and anterolisthesis at the level of C2-C3. The remaining findings are summarized in Table 1.

DISCUSSION

We present a case of bilateral supernumerary carpal bones as the main clinical finding in a patient with Larsen syndrome. To our knowledge, this is a unique presentation of this disorder, lacking all of the major diagnostic features previously described in the literature.

Supernumerary carpal bones were not emphasized in the original description of Larsen syndrome in 1950. Rather, other features, such as multiple large joint dislocations, characteristic facies and equinovarus foot deformities were considered to be the cardinal features of this disorder (8). Accessory carpal bones were first reported in the context of Larsen syndrome by Steel and Kohl (10) in 1972. Since then, only a few other articles reported supernumerary carpal bones in Larsen syndrome. Despite being an infrequently reported finding, Bicknell et al (8) suggested that supernumerary carpal bones are an invariant feature of the syndrome because it was found in 47 of their 48 patients. In their series, accessory carpal bones were described more frequently than large joint dislocations. Although the pathogenesis of this skeletal dysplasia remains unknown, supernumerary carpal bones scattered in a random fashion with bizarre deformations of their shape is a feature highly characteristic of Larsen syndrome (3,4).

We performed a literature review of studies describing cases of Larsen syndrome with supernumerary carpal bones. Six studies with a total of 68 patients were identified. Hand radiographs were unavailable for six patients. A total of 60 patients were found to have supernumerary carpal bones. This subgroup was further analyzed and the following characteristics were noted: 95.0% (57 of 60) had dysmorphic facies, 100% had at least one large joint dislocation, 89.8% (53 of 59) had clubfeet or other foot deformities, 100% (55 of 55) had spatulate thumbs, 92.3% (48 of 52) were of short stature, 79.3% (46 of 58) had scoliosis and 88% (44 of 50) had cervical spine anomalies (Table 2). From the above-mentioned features, only cervical spine anomalies and supernumerary carpal bones were found in our patient.

Accessory carpal bones are generally asymptomatic; however, they may be associated with wrist subluxations (10). All cases reviewed were managed conservatively and no surgical intervention was required. Despite not having frank joint dislocations, our patient manifested mild joint laxity at the levels of the ankles, knees and patellas bilaterally. Although not a commonly used defining feature, ligamentous joint laxity has been described by some authors as characteristic of Larsen syndrome (9). In this generalized mesenchymal disorder, ligamentous laxity may be related to large joint dislocations on a spectrum of connective tissue involvement, ranging from laxity to subluxation to dislocation.

Despite the rarity of this condition, it is important to recognize supernumerary carpal bones as an entity rarely occurring in isolation. This finding should prompt a careful evaluation and appropriate investigations for potentially serious underlying manifestations such as cervical spine abnormalities. We recommend imaging of the wrists bilaterally as well as a full skeletal survey. Referral for genetic counseling and molecular analysis is crucial for diagnosis because Larsen syndrome may present with supernumerary carpal bones as a sole clinical finding.

DISCLOSURES: The authors have no financial disclosures or conflicts of interest to declare.

REFERENCES

- O'Rahilly R. A survey of carpal and tarsal anomalies. *J Bone Joint Surg Am* 1953;35-A:626-42.
- Senecail B, Perruez H, Colin D. Numerical variants and congenital fusions of carpal bones. *Morphologie* 2007;91:2-13.
- Bogart FB. Variations of the bones of the wrist. *Am J Roentgenol* 1932;28:638-46.
- Castriota-Scanderbeg A, Dallapiccola B. Abnormal Skeletal Phenotypes From Simple Signs to Complex Diagnoses. Heidelberg, Berlin: Springer, 2005:432-3.
- Tardif B, Duparc F, Muller JM, Freger P. Embryologie des os du carpe humain (Cartilage triangulaire, os central du carpe, morphogenèse du scaphoïde). *Ann Chir Main (Ann Hand Surg)* 1998;17:266-76.
- Doman AN, Marcus NW. Congenital bipartite scaphoid. *J Hand Surg (Am)* 1990;15:869-73.
- Larsen LJ, Schottstaedt ER, Bost FC. Multiple congenital dislocations associated with characteristic facial abnormality. *J Pediatr* 1950;37:574-81.
- Bicknell LS, Farrington-Rock C, Shafeghati Y, et al. A molecular and clinical study of Larsen syndrome caused by mutations in *FLNB*. *J Med Genet* 2007;44:89-98.
- Zhang D, Herring JA, Swaney SS, et al. Mutations responsible for Larsen syndrome cluster in the *FLNB* protein. *J Med Genet* 2006;43:e24.
- Steel HH, Kohl EJ. Multiple congenital dislocations associated with other skeletal anomalies (Larsen's syndrome) in three siblings. *J Bone Joint Surg Am* 1972;54:75-82.
- Babat LB, Ehrlich MG. A paradigm for the age-related treatment of knee dislocations in Larsen's syndrome. *J Pediatr Orthop* 2000;20:396-401.
- Percin EF, Percin S, Sezgin I, Akbas AK. Larsen's Syndrome with mixed-type hearing loss. *Acta Orthopaedica Belgica* 1994;60:328-31.
- Rahalkar MD, Rahalkar AM, Patwardhan SA. Images – Extra (too many) carpal bones in Larsen's syndrome. *Indian J Radiol Imaging* 2009;19:158-9.
- Stanley D, Seymour N. The Larsen syndrome occurring in four generations of one family. *Int Orthop* 1985;8:267-72.