Mapping the extras: Supernumerary bones of the limbs

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Learning objectives

The aim of this poster is to highlight through relevant diagrams and selected x-rays the incidence, topography and morphology of the most frequent accessory bones of the limbs found in everyday practice.

Supernumerary bones of both the upper and lower limb are reviewed, with special focus on the Os Trigonum Syndrome, a clinical entity caused by the presence of an accessory bone in the ankle.

Accessory ossicles must be differentiated from small fracture fragments thus knowing the morphology and topography of these bones is important in interpreting trauma x-rays

Background

Supernumerary bones are a relative frequent finding in plain x-rays.

They are of forensic importance in that, when seen in radiograms, they may be mistaken for fractures.

Knowing the topography and morphology of these bones is important both for the trauma radiologist and for students and radiology residents since most of these bones come as incidental findings.

Many bones develop from several centers of ossification, eventually the separate parts normally merge.

At times, one of these centers fails to fuse with the main bone thus giving the appearance of an extra bone. Callus, however, is absent, the bones are smooth, and they are often present bilaterally

Findings and procedure details

UPPER LIMB
• Wrist and Hand: Carpals, Metacarpals and Phalanges

The number of carpal bones is frequently and variably increased. Over 20 accessory ossicles have been described. These usually occur because of failure of fusion of ossification centers.

Fig. 1: Locations of accessory ossicles that may be visible on PA radiographs of the wrist: os centrale (1), Os vesalianum carpi (2) Os Gruberi (3), os radiale externum (4), os epitrapezium (5), os epilunatum (6), os radiostyloideum (7), os hypolunatum (8), os hypotriquetrum (9), os epitriquetrum (10), os triangulare (11), pisiforme secundarium (12), os hamuli proprium (13), os hamulare basale (14), os ulnare externum (15), os capitatum secundarium (16), os subcapitatum (17), os styloideum (18), os parastyloideum (19), os metastyloideum (20), os trapezium secundarium (21), os praetrapezium (22), os paratrapezium (23), os trapezoideum secundarium (24).

References: - Cluj-Napoca/RO
The **os centrale** (1) is an additional bone located on the dorsal aspect between the scaphoid, capitate, and trapezoid. It is formed when a small cartilagenous nodule fails to fuse with the scaphoid, and may be doubled.

The **os vesalianum carpi** (2) is a small bone at the lateral aspect of the carpus adjacent to the base of the fifth metacarpal and hamate. First described by Vesalius in 1543, it was not reported again until 1870 by Gruber. It has a reported frequency of about 0.1%.

The **os Gruberi** (3) a rare palmar ossicle, when present, is located at the radiodistal margin of the body of the hamate, between the hamate, capitate and the base of the third and fourth metacarpals.

The **os radiale externum** (4) is located at the distal lateral margin of the scaphoid tubercle, adjacent to the trapezium.

The **os epitrapezium** (5) is located on the dorso-lateral side of the os trapezium, distal to the site of the os radiale externum described before, at the distal lateral aspect of the scaphoid in close proximity to the trapezium.

The **os epilunatum** (6) is located in the region between the scaphoid and lunate, at the more distal aspect of the articulation between the scaphoid and the lunate.

The **os radiostyloideum** (7) (or **persistent radial styloid**) is located near the radial styloid process, slightly proximal to the lateral mid portion of the scaphoid.

The **os hypolunatum** (8) is located between the lunate and the capitate, just ulnar to the site of the os epilunatum.

The **os hypotriquetrum** (9) is located in the vicinity of the lunate, capitate, proximal pole of the hamate and the triquetrum.

The **os epitriquetrum** (10) is located between the lunate, hamate and the triquetrum just ulnar to the site of the os hypotriquetrum.

The **os triangulare** (11) is located between the lunate, triquetrum and the distal ulna.
The **pisiforme secundarium (12)** is an accessory bone that can be associated with the pisiform located at the proximal pole of the pisiform.

The **os hamuli proprium (13)** is a secondary ossification center in the hook of the hamate that does not fuse with the body. It is located in the palmar aspect of the mid-body, where the hook is situated.

The **os hamulare basale (14)** is located between the distal body of the hamate and the base of the IV metacarpal.

The **os ulnare externum (15)** is located ulnar to the distal body of the hamate, distal to the triquetrum.

The **os capitatum secundarium (16)** is located radial to the site of the os gruberi, at the radiodistal extremity of the body of the hamate, between the capitate and the bases of the third and fourth metacarpals.

The **os subcapitatum (17)** is located on the palmar side of the carpus, distal to the os capitatum, between this bone, and the base of the third metacarpal.

The **os styloideum (18)** is located between the capitate and the bases of the second and third metacarpals, ulnar to the site of the os parastyloideum.

The **os parastyloideum (19)** is located between the capitate and the bases of the second and third metacarpals, radially to the site of the os styloideum.

The **os metastyloideum (20)** is located between the capitate, trapezoid and the base of the second metacarpal.

The **os trapezium secundarium (21)** is located between the trapezium and the base of the first metacarpal, developing as an appendage to the tubercle of the trapezium.

The **os praetrapezium (22)** is located between the distal trapezium and the central portion of the base of the first metacarpal.

The **os paratrapeziun (23)** is located between the trapezium and the radial aspect of the base of the first metacarpal.
The **os trapezoideum secundarium** (24) is located between the trapezium, trapezoid and bases of the index and thumb metacarpals, representing an unassimilated epiphysis.

Sesamoid bones of the hand
Fig. 2: Locations of sesamoid bones that may be visible on PA radiographs of the hand. In purple-frequent sites. In red-rare sites.

References: - Cluj-Napoca/RO

Most people have 5 sesameid bones in each hand: 2 at the thumb metacarpophalangeal (MCP) joint, 1 at the interphalangeal joint of the thumb, 1 at the MCP joint of the index finger, and 1 at the MCP joint of the small finger. They may be mistaken for fractures, and can themselves be fractured or develop as bipartite sesamoids making the diagnosis, in traumatic context, difficult at times.

- Elbow and forearm

Accessory ossicles in the elbow are often diagnosed as osteochondritis dissecans or chondromatosis.

Three sites for accessory ossicles around the elbow have been commonly described: distal to the medial epicondyle; proximal to the tip of the olecranon (the patella cubiti); and in the olecranon fossa (the os supratrochleare dorsale).

Fig. 3: Location of the Os supratrochleare dorsale (1) The os patella cubiti (2) and of the medial epicondyle accessory ossicle (3) on the elbow lateral and AP views.

References: - Cluj-Napoca/RO

Os supratrochleare dorsale (1) is an accessory ossicle of the elbow located in the olecranon fossa of the humerus. It may become symptomatic due to trauma during elbow extension and as such may require surgical removal. The differential diagnosis is an intra-articular loose body but the treatment, if symptomatic, remains the same.
The os patella cubiti (2)

This ossicle occurs in the triceps tendon near its insertion and is considered a true sesamoid bone. The proximal position is so characteristic in appearance that there should be little doubt about its origin.

Medial epicondyle accessory ossicle (3)

An accessory ossicle to the medial epicondyle has been described in literature. Because calcification can follow injury to the medial collateral ligament, whether the radiographic lesion reflects a traumatic or a congenital variant is often hard to evaluate. However, a discrete, rounded, smooth ossicle in patients who have no history of injury to this region suggests an accessory structure.

A sesamoid bone may develop in the bicipital tendon over the radial tuberosity.

Another sesamoid (os coronoides) may also be found at the tip of the coronoid process.

- Shoulder and arm

Clavicle

The roughened area on the superior surface of the clavicle, called the deltoid tubercle, may be elongated to form a deltoid process.

Bifurcate clavicle and duplication of the clavicle have been described.

Scapula

An os acromiale represents an unfused accessory center of ossification of the acromion of the scapula. They are relatively common, seen in approximately 8% of the population and may be bilateral in 60% of individuals.

They are usually asymptomatic. If they clinically manifest they may cause shoulder impingement, rotator cuff tear or degenerative AC joint disease.

A step off deformity of the os acromiale is associated with a greater incidence of rotator cuff tears than those without such deformity.

The subtypes develop due to the fusion pattern of the three acromial ossification centres (preacromion, mesoacromion and metacromion) and are classified on their pattern of
articulation with the acromion (from proximal to distal) basi-acromial, meta-acromial, meso-acromial, pre-acromial.

On plain film the unfused anterior acromial ossification center is best seen on axillary views.

The scapular angles have apophyseal centres that appear between the age of sixteen and eighteen. If the apophyseal center of the inferior angle persists, it is termed the os infrascapulare.

LOWER LIMB

• Ankle and foot: Tarsals, Metatarsals and Phalanges

The tarsal bones are variable in size, form, and number. About 30 accessory tarsal ossicles have been described. The diversity has been related partially to their function in weight bearing. In the context of trauma these ossicles can be misdiagnosed as avulsion fractures.

The most common 14 of them (found in more than 0.1% of the population) are described below in the order of their frequency as findings on plain x-rays.
Fig. 4: Accessory bony elements of the foot in the lateral projection: Os tibiale externum (1), os trigonum (2), os peroneum (3), os intermetatarsale (4), os supranaviculare (6), os subtibiale (7), os supratalare (8), os calcaneus secundarius (9), os vesalianum (10), os intercuneiforme (11).

References: - Cluj-Napoca/RO
Fig. 5: Location of the accessory skeletal elements on a dorsoplantar projection of the tarsus. Os tibiale externum (1), os peroneum (3), os intermetatarsaeum (4), os vesalianium (10), os intercuneiforme (11), os cuboideum secundarium (12), os tallus accessorius (13).
References: - Cluj-Napoca/RO
Fig. 6: Accessory skeletal elements on an AP projection of the ankle: Os tibiale externum (1), os trigonum (2), os subfibulare (5), os subtibiale (7), os tallus accessorius (13).

References: - Cluj-Napoca/RO

The **os tibiale externum**(1) also called the accessory navicular is the most commonly found accessory ossicle of the foot with reported incidence of about 25-30%. It is located on the posteromedial aspect of the foot adjacent to the posteromedial tuberosity of the navicular bone. Three types of accessory tibiale externum have been described in literature. Type I is considered to be a sesamoid bone in the distal insertion tendon of the posterior tibialis muscle. Type II results from a secondary ossification center adjacent to the navicular bone connected to the navicular tuberosity by a synchondrosis. Type III is the result of fusion of the secondary ossification center of the navicular.
Fig. 7: Os tibiale externum (arrow) visible in a 29 year old male patient on a
dorsoplantar view of the right tarsus.

References: - Cluj-Napoca/RO

The os trigonum(2) appears when a secondary ossification center of the talus located at
the posterolateral aspect of this bone fails to fuse and remains separate of the astagalus.
Fig. 8: Os trigonum (arrow) visible in a 29 year old female patient on a lateral view of the left ankle.

References: Cluj-Napoca/RO

Usually this secondary ossification center appears between the age of 8 and 13 and fuses within one year of its appearance.

The os trigonum articulates with the lateral tubercle through a fibrocartilagenous synchondrosis. On the plain x-ray the bone appears triangular but may also appear round and oval.

This bone may be radiographically misinterpreted as fractures of the lateral or medial tubercles of the posterior process of the talus. The fracture fragment often appears
• The os trigonum syndrome is usually triggered by an injury, such as an ankle sprain. The syndrome is also frequently caused by repeated downward pointing of the toes, which is common among ballet dancers, soccer players and other athletes. For the person who has this bone pointing the toes downward can result in a nutcracker injury. Like an almond in a nutcracker the os trigonum is crunched between the ankle heel bones. As the os trigonum pulls loose, the tissue connecting it to the talus is stretched and torn with subsequent inflammation in the area. The signs and symptoms associated with this syndrome may include deep pain in the back of the ankle when pushing off the the hallux or when pointing the toes downward, swelling in the area on inspection and tenderness on palpation. The differential diagnosis is made between the fracture described before, Achilles tendon injury, and ankle sprain. Treatment options include rest, immobilization, NSAIDs and steroid injections in the area. If symptoms persist, surgery may be considered, involving removal of the os trigonum.
Fig. 9: Large os trigonum (blue arrow) visible on the lateral view of the right ankle in a 38 year old male patient.

References: Cluj-Napoca/RO

The os peroneum(3) is located at the level of the calcaneocuboid joint within the substance of the peroneus longus tendon. When ossified it is visible on 4.7-30 % of radiographs. It is best evaluated in the oblique-lateral view of the foot.
The os intermetatarseum (4) is located proximally at the intermetatarseal space of the first and second metatarsals in about 0.2-7% of cases. It may form an articulation with the medial cuneiform.

The os subfibulare (5) is located under the tip of the lateral malleollus found in about 0.2-2.1% of cases. It has a round to elongated shape and well defined cortical margins.

The os supranaviculare (6) is located on the dorsal margin of the talonavicular joint space in about 1% of cases. It has a triangular to rounded shape, best seen on lateral radiographs.

The os subtibiale (7) is located at the tip of the medial malleolus with an incidence varying from 0.2% to 1.2%. It is a rounded accessory bone formed from a secondary ossification center.

The os supratalare (8) is located on the dorsal aspect of the talar neck in about 0.2%-0.9% of cases. It is best seen in lateral foot and ankle radiographs.

The os calcaneus secundarius (9) is located adjacent to the anterior superior facet of the calcaneus in about 0.6-7% of cases. The bone is best visualized in oblique foot radiographs.

The os vesalianium (10) is located adjacent to the base of the fifth metatarsal, embedded in the peroneous brevis tendon in about 0.1-5.9% of cases. It is best evaluated in lateral oblique radiographs of the foot.

The os intercuneiforme (11) is located at the proximal ends of cuneiforms I and II, in the intercuneiform fossa in about 0.5% of cases.

The os cuboideum secundarium (12) is located proximal and plantar to the cuboid, adjacent to the calcaneus and found in about 0.1% of cases.

The os tallus accessorius (13) is located on the lateral aspect of the talus, beside the trochlea tali. It is found in about 0.5% of cases.

The os tallus secundarius (14) is located on the lateral aspect of the talus in about 0.1-0.5% of cases. The bone secures itself to the lateral body of the talus by either a
synchondrosis or synostosis and usually forms a set of articulations with the fibula, the superior lateral surface of the calcaneus, and a portion of the body of the true talus.

Fig. 10: A right os tallus secundarius (arrow) visible on the comparative AP projection of the ankles in a 62 year old male patient.

References: - Cluj-Napoca/RO

Sesamoid bones occur at joints other than the first metatarsophalangeal joint, but these are more rare than those found in the hand. In a study of 246 feet, Pfitzner found two sesamoids in the fifth toe in about 6%, and one sesamoid in the second toe in about 2%. Sesamoids also were found at the interphalangeal joint of the great toe in 55% and in the same joint of the second toe in about 1%.

- Hip and knee

The os acetabuli
These bony elements are usually located in close proximity of the superior acetabular rim. They may be small and multiple, or take larger, solid forms. It is uncertain whether they actually represent persistent apophyses or epiphyses, foci of metaplastic bone formations or even older bony capsular avulsions that the patient cannot recall, but ultimately there is no practical value in making the distinction.

**The fabella** is a sesamoid bone, elliptical or circular in shape situated in the lateral head of the gastrocnemius muscle present in about 13-16% of the population, generally bilaterally, and may be duplicated. Its occurrence in the medial head of the gastrocnemius muscle is rare. The fabella articulates with its respective (medial or lateral) femoral condyle.
Fig. 11: Location of the fabella (F), if present, on the lateral view of the knee.

References: - Cluj-Napoca/RO

The **cyamella** is a rare sesamoid bone that exists as a normal variant within the popliteus tendon, usually at the lateral aspect of the distal femur in the popliteal groove.

Soft tissue calcifications, especially when located adjacent to the medial femoral epycondyle are referred to as **Kohler-Pellegrini-Stieda** shadows. They comprise the Stieda I (Fibro-ostosis or ossified avulsion of the adductor magnus or ossifications in the soft tissues adjacent to that site). Stieda II (Paraosseous ossifications near the junction of the shaft with the inner surface of the condyle). Stieda III (Ossification of the collateral ligament-after an avulsion-the displaced bone fragment fits a matching defect in the adjacent condyle or epicondyle).

A special variant is the **bipartite, tripartite or multipartite patella** caused by incomplete fusion of ossification centers. It is usually bilateral and involves the superolateral quadrant of the bone.

The bipartite patella is a synchondrosis, found in 1% to 2% of the population. Bipartite patellas are classified into 3 types. Type I is located at the inferior pole (5% of all cases), type II is at the lateral patellar margin (20%), and type III is at the superolateral margin (75%). Most (98%) remain asymptomatic, but direct trauma may disrupt the synchondroses. A dorsal defect of the patella is sometimes associated with bipartite or multipartite patella, which is seen as a focal lucency in the superolateral patella, covered by articular cartilage.
**Fig. 12:** Patella bipartita visible in a 41 year old male patient on AP and axial views of the left knee.

*References:* Cluj-Napoca/RO

*Images for this section:*
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Conclusion

Accessory ossicles must be differentiated from small fracture fragments thus knowing the morphology and topography of these bones is important in interpreting trauma x-rays.

Personal information

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