

## **Supporting Information 3: Descriptions of additional fragmentary material**

### **Pterodactyloidea indet.**

#### **Metacarpal IV MGUAN-PA660**

MGUAN-PA660 (Fig. S3-1) is a proximal fragment of an extensively damaged right metacarpal IV. Although it remains three-dimensional, bone buckled inward on the anterior and posterior surfaces, particularly at the center of the shaft, which gives it a figure eight-shaped cross-section in proximal view. Sections of cortical bone have been eroded from sections on the anterior and posterior surfaces. Almost the entire ventral side of the fragment has been sheared off at a ventrodistal angle, corresponding to the exposed portion of the bone in situ. The proximal end of the fragment remains complete, although extensive weathering has exposed the trabecular bone on the posterior, dorsal, and anterior sides. The fragment measures 145.2 mm in preserved proximodistal length, and 49.2 mm in dorsoventral width at the proximal end. It measures 27.7 mm anteroposteriorly at its widest point and 16.6 mm anteroposteriorly at its narrowest complete point. The cortical bone ranges from about 0.4 mm to 1.1 mm in thickness.



**S3 Figure 1. MGUAN-PA660 proximal end right metacarpal IV.** (A) proximal, (B) posterior, (C) distal, (D) ventral, (E) anterior, and (F) dorsal views. Abbreviations: AF, articular facet; MS, muscle scar.

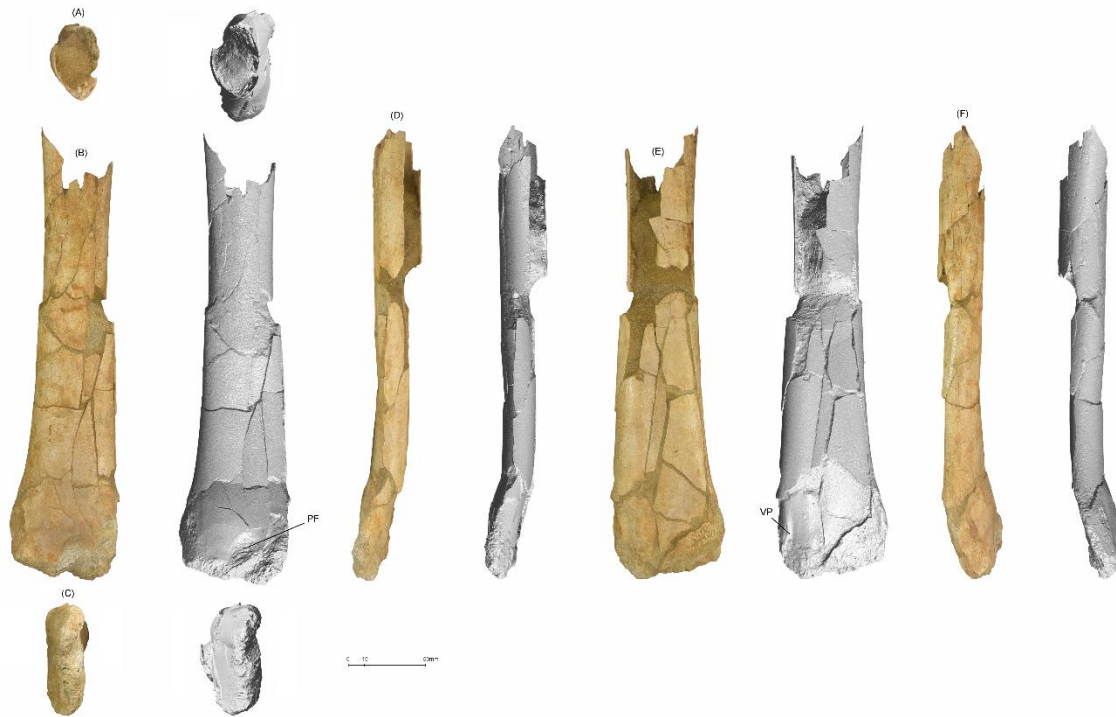
On the dorsal surface, rugose muscle scarring is evident close to the posterior margin, the area for attachment of the extensor carpi ulnaris. The bone surface is distinctly scratched, which could be related to post-mortem scavenging.

In proximal view, two distinct articular facets are visible, although notably eroded, the dorsal and ventral articular surfaces for the distal syncarpal. The preserved portion of the dorsal articular surface is heavily damaged, but subcircular in outline. The preserved portion of the ventral articular surface is larger than the dorsal, and a definite planar surface is visible oriented dorsoventrally.

## **Pterosauria indet.**

### **Ulna MGUAN-PA653**

MGUAN-PA653 (Fig. S3-2) is a distal right ulna fragment missing the proximal end, and the distal articular portion. Sections of cortical bone are missing on all sides, making features difficult to discern. The preserved specimen measures 185.8 mm in proximodistal length, 70.2 mm in dorsoventral width at the widest distal point, 48.6 mm in dorsoventral width at the narrowest complete proximal point, and in cross-section it measures roughly 20.6 mm anteroposteriorly throughout. It is slightly crushed anteroposteriorly, but this does not greatly affect its three-dimensional shape. The cortical bone ranges from 0.6 mm to 1.6 mm in thickness.

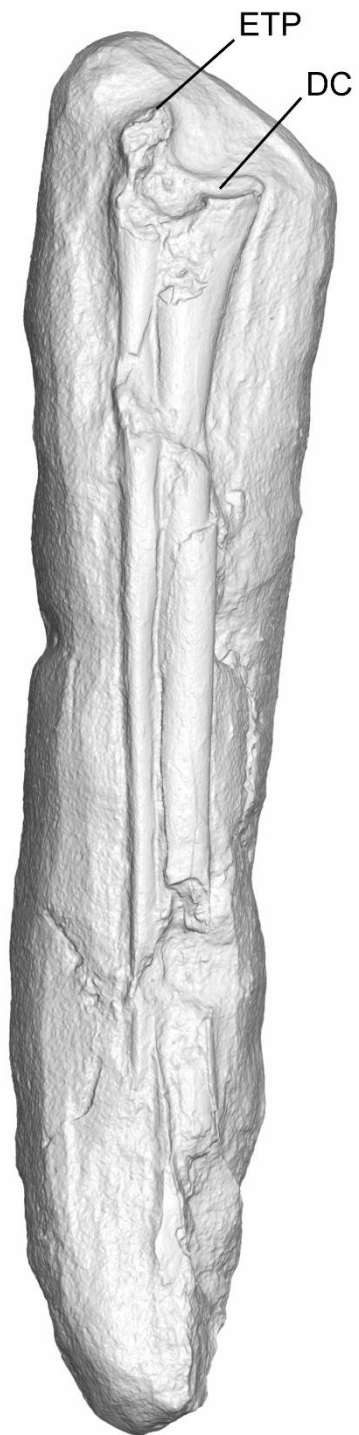


**S3 Figure 2. MGUAN-PA653 right ulna fragment.** (A) proximal, (B) posterior, (C) distal, (D) dorsal, (E) anterior (F) ventral views. Abbreviations: PF, pneumatic foramen; VP, ventral process.

In the transverse plane, the shaft expands gradually toward the distal end. The shaft is straight in the horizontal plane, curving posteriorly at the distal end. The shaft is elliptical in cross-section. In posterior view, part of a large foramen is visible on the distal end of the fragment. The cortical bone surrounding the preserved margins of this foramen slope inward. In anterior view, the shaft exhibits the ventral expansion, with a shallow flexor tendon groove along the dorsal end.

## **Manual Digit IV Phalanx 1 MGUAN-PA659**

MGUAN-PA659 (Fig. S3-3) is a left manual digit IV phalanx 1, missing major sections of cortical bone and the distal end. The bone has been prepared out of the surrounding matrix on three sides. It measures 166.0 mm in preserved proximodistal length (including the extensor tendon process), 9.3 mm in anteroposterior width at the narrowest part of the preserved shaft, and 20.8 mm in anteroposterior width at the widest part of the articular area. It is 8.7 mm in dorsoventral height at the broken end of the shaft, and 16.1 mm in dorsoventral height at the articular end. The extensor tendon process is 7.9 mm in width at the base, and 7.6 mm in height. The cortical bone ranges from 0.5 mm to 0.8 mm in thickness and is cracked throughout. It is eroded in areas, but maintains its three-dimensional shape. The proximal end is missing the ventral cotyle entirely, yet the extensor tendon process appears fused, which is a sign of skeletal maturity [34]. Taphonomic distortion is evident in areas where sections of the bone have been offset from their original positions. The shaft is relatively straight and subtriangular in cross-section.



0 10 50mm

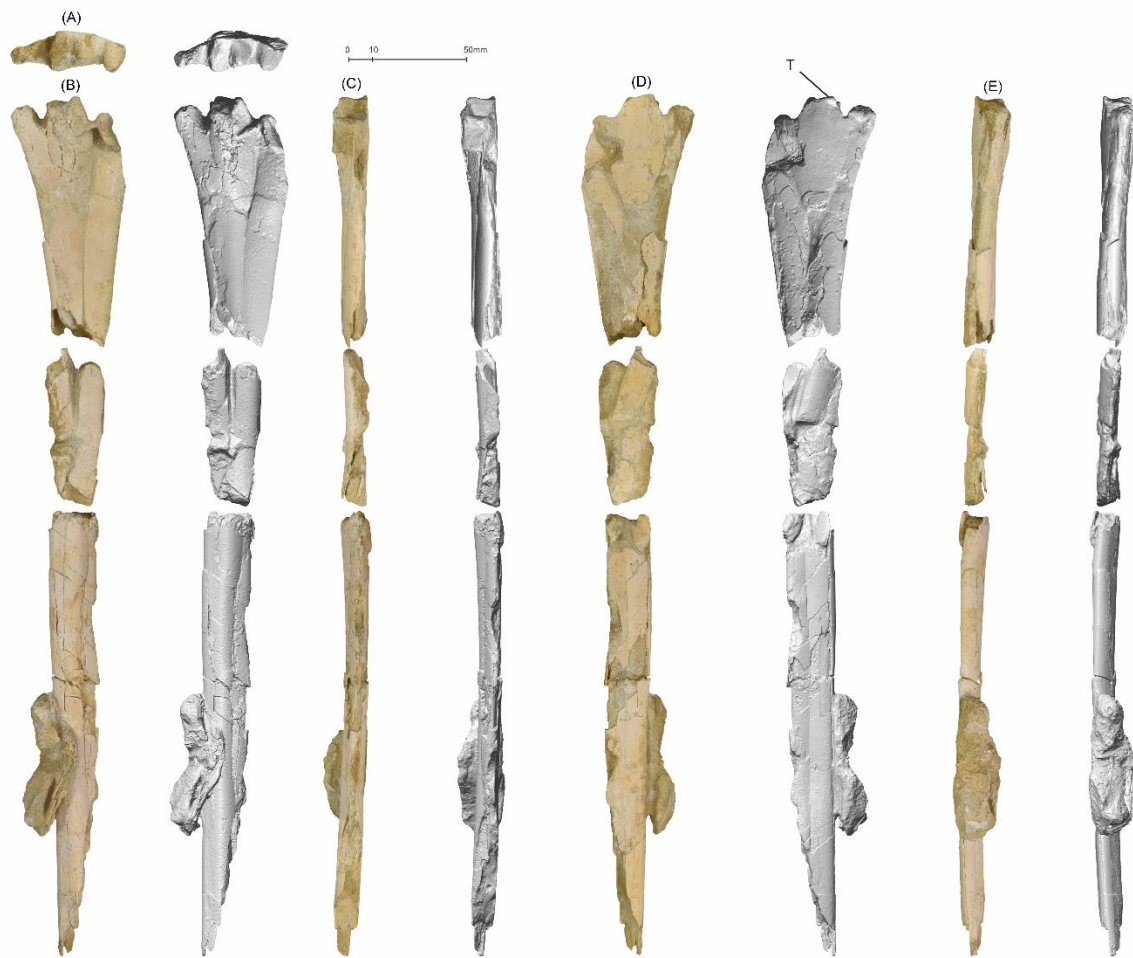
**S3 Figure 3. MGUAN-PA659 left manual digit IV phalanx 1.** In dorsal view. Abbreviations: DC, dorsal cotyle; ETP, extensor tendon process.

The shaft expands posteriorly and slightly anteriorly as it approaches the proximal end. The posterior side of the proximal end is delineated by the tip of the dorsal cotyle. The dorsal cotyle forms a concavity on the posterior half of the proximal end, the dorsal and ventral margins of which are rimmed. The ventral cotyle is too damaged to distinguish. The extensor tendon process has a slightly constricted base, although most of it is too eroded to glean information.

### **Manual Digit IV Phalanx 1 MGUAN-PA657**

MGUAN-PA657 (Fig. S3-4) is a fragmentary left proximal manual digit IV phalanx 1, broken into three pieces with minimal sections of bone missing from between each, as can be inferred from the overall dimensions of the shaft as the articular end is approached. It is missing the proximal and distal ends. The shaft is well-preserved and has almost no taphonomic distortion, and the element is virtually uncrushed with three-dimensional shape. The shaft is straight, flattened anteroposteriorly, and subrectangular in cross-section at the proximal end. It approaches a more subtriangular cross-section at the distal preserved end, which is so eroded as to diminish into an interior sediment mold. Some segments of cortical bone are missing entirely from the surfaces. In the transverse plane, the shaft expands dorsoventrally as it approaches the proximal end. The cortical bone ranges from 0.7 mm to 1.5 mm in thickness. On the anterior

surface, centered on the proximal-most edge of the bone, a tuberosity is visible, extending proximoanteriorly away from the bone shaft.



**S3 Figure 4. MGUAN-PA657 left manual digit IV phalanx 1 fragment.** (A) proximal (B) dorsal (C) anterior (D) ventral (E) posterior views. Abbreviation: T, tuberosity.

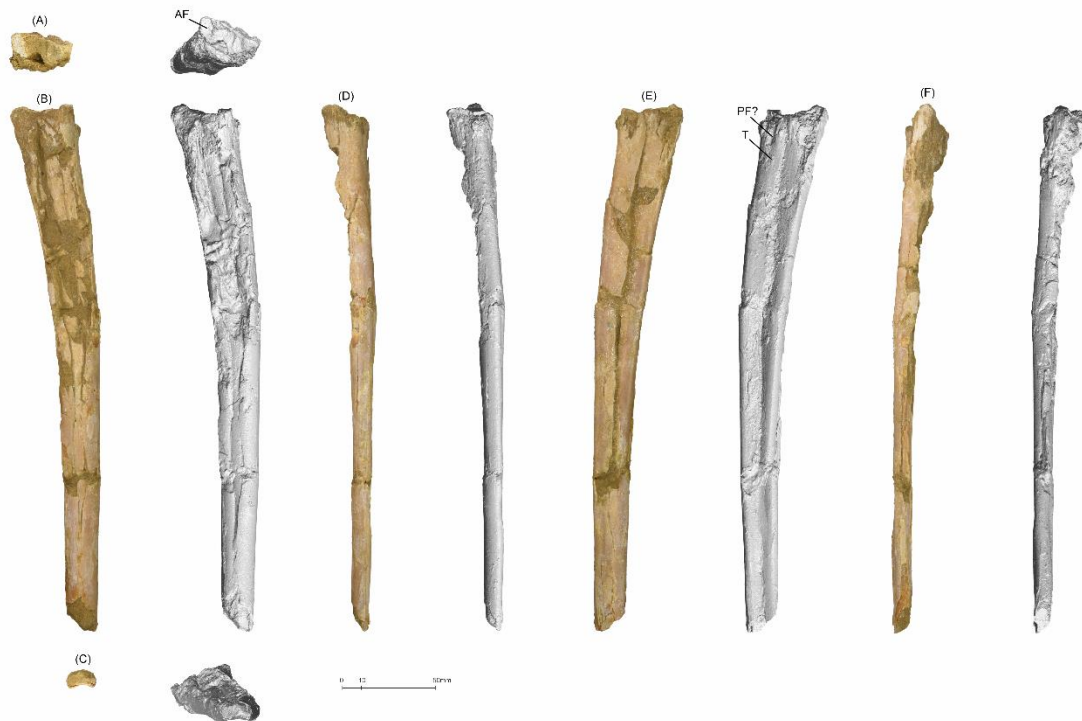


The proximal fragment measures 100.6 mm in proximodistal length, 41.2 mm in dorsoventral width at the proximal end and 25.4 mm in dorsoventral width at the distal end. The center fragment measures 62.5 mm in proximodistal length, 24.1 mm in dorsoventral width at the proximal end and 17.1 mm in dorsoventral width at the distal end. The distal fragment measures 179.0 mm in proximodistal length, 20.1 mm in dorsoventral width at the proximal end and 17.1 mm in dorsoventral width at the distal end.

The proximal fragment measures 15.1 mm in anteroposterior breadth at the proximal end and 12.1 mm in anteroposterior breadth at the distal end. The center fragment measures 8.3 mm in anteroposterior breadth at the proximal end and 9.1 mm in anteroposterior breadth at the distal end. The distal fragment measures 11.2 mm in anteroposterior breadth at the proximal end and 9.6 mm in anteroposterior breadth at the distal end.

### **Manual digit IV phalanx 3 MGUAN-PA652**

MGUAN-PA652 (Fig. S3-5) is the proximal end and shaft of an extensively damaged left manual digit IV phalanx 3. There is significant fracturing of the cortical bone surface, with some segments missing entirely from the dorsal, ventral, and posterior sides. Some of the longitudinal fractures along the shaft length have buckled inward. The fragment measures 282.0 mm in preserved proximodistal length, 38.6 mm in anteroposterior width at the widest part of the proximal end, and 18.3 mm in anteroposterior width at the distal end of the preserved shaft. It is 21.9 mm in dorsoventral height at the widest part of the proximal end, and 10.0 mm in dorsoventral height at the distal end of the preserved shaft. Cortical bone ranges from about 0.6 mm to 1.3 mm in thickness.



**S3 Figure 5. MGUAN-PA652 left manual digit IV phalanx 3 fragment.** (A) proximal, (B) ventral, (C) distal, (D) anterior, (E) dorsal, and (F) posterior views. Abbreviations: AF, articular facet; PF, pneumatic foramen; T, tuberosity.

The shaft expands gradually as it approaches the proximal end, both anteroposteriorly and dorsoventrally. The cross-section of the shaft is difficult to distinguish because of damage, but it appears to be suboval to subrectangular at the preserved proximal end of the shaft, gradually assuming a kidney shape approaching the distal preserved end with the concavity on the ventral surface. The shaft is anterodistally curved. The proximal end of the phalanx is

incomplete, with extensive erosion exposing trabecular bone on all sides.

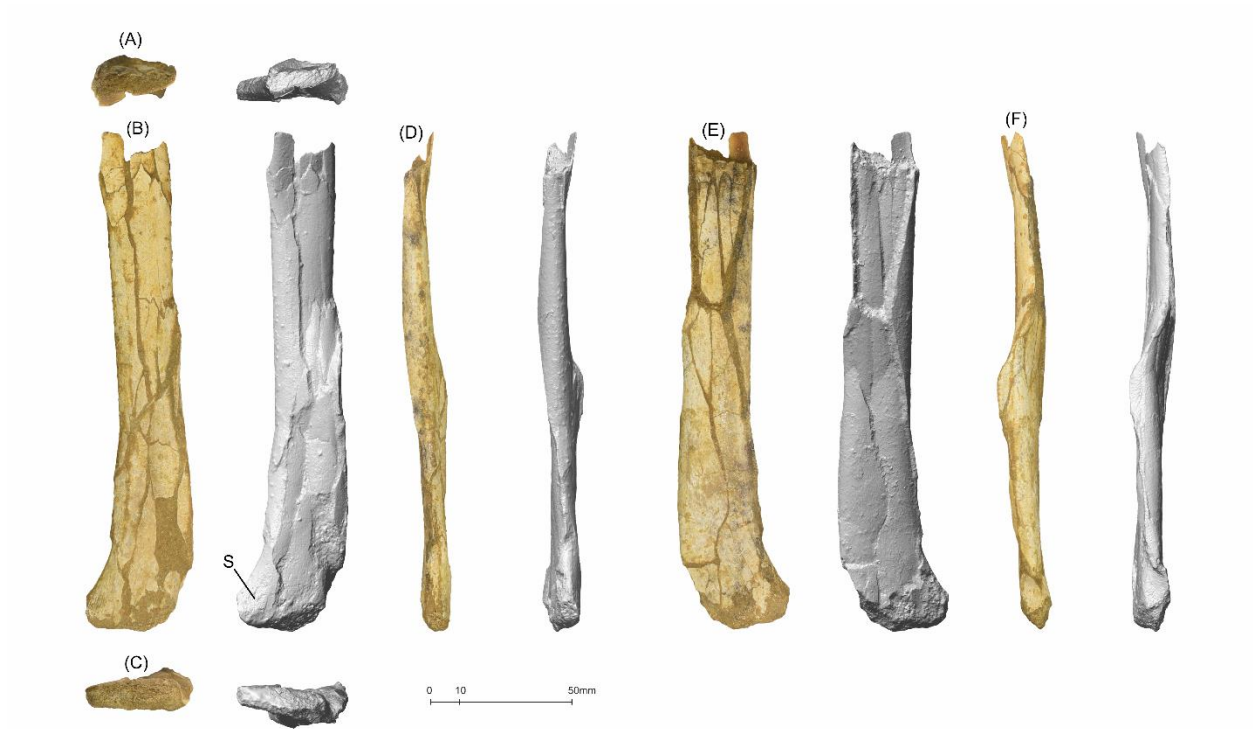
In proximal view, the articular surface is kidney-shaped, with the convexity facing ventrally. Part of the articular facet is distinctly visible on the posterodorsal corner, the distal edge of which is ventrally tilted.

In ventral view, a lenticular foramen extends proximodistally, and is visible on the posterior proximal-most end of the shaft, although it may also be a product of erosion. The proximal margin of the foramen has been eroded away. Distal to the foramen, a small tuberosity is visible.

## **Manual Digit IV Phalanx 2 MGUAN-PA656**

MGUAN-PA656 (Fig. S3-6) is the distal half of a left manual digit IV phalanx 2. It measures 166.0 mm in preserved proximodistal length. It measures 22.5 mm in anteroposterior width at the proximal part of the preserved shaft and 29.7 mm in anteroposterior width at the distal end. It is 6.3 mm in dorsoventral height at the proximal end of the shaft, and 10.2 mm in dorsoventral height at distal end. The cortical bone ranges from about 0.5 mm to 1.0 mm in thickness. It is well-preserved, maintains its three-dimensional shape, but is eroded in places. A region of cortical bone is missing around the proximal dorsal part of the shaft. Taphonomic distortion is evident where sections of the bone have been offset from their original position. The shaft seems to have been relatively straight and elliptical in cross-section. It expands slightly anteroposteriorly as it approaches the distal articular end. The articular end is too eroded to glean much information, save for some longitudinal proximodistal striations at the anterodorsal tip of

the bone.

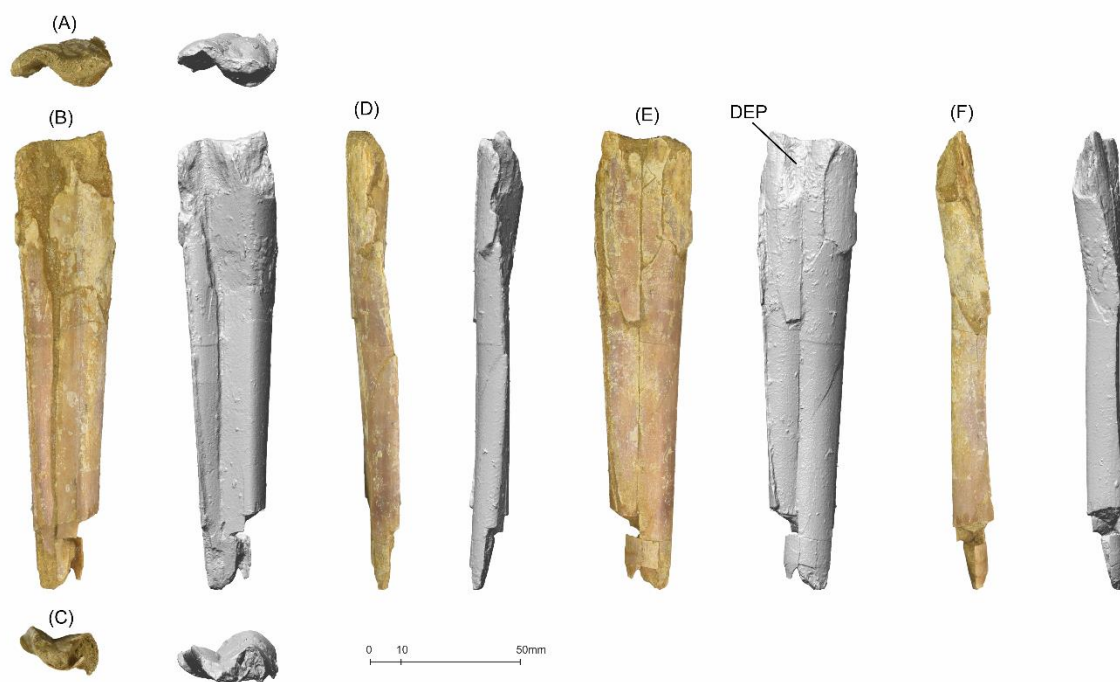


**S3 Figure 6. MGUAN-PA656 left manual digit IV phalanx 2 distal fragment.** (A) proximal, (B) ventral, (C) distal, (D) anterior, (E) dorsal, and (F) posterior views. Abbreviation: S, striations.

### **Shaft Fragment MGUAN-PA658**

MGUAN-PA658 (Fig. S3-7) is an indeterminate shaft fragment, which is likely a wing finger element based on its shape. It is extensively damaged, but retains some three-dimensionality.

Cortical bone portions are missing entirely from both ends. Some of the longitudinal fractures along the shaft length are inwardly compressed toward the center of the shaft, creating a false sigmoidal cross-section, when the original cross-section may have actually been closer to subrectangular. The fragment is straight and measures 140.1 mm in preserved length, 21.2 mm at the narrowest width of the complete shaft, 30.3 mm at the widest part of the shaft, 10 mm at the narrowest depth of the shaft, and 21.9 mm at the greatest depth. Cortical bone ranges from about 0.6 mm to 0.7 mm in thickness. The preserved shaft shows a gradual expansion, indicating the approach to an articular end. The most expanded end of the fragment is eroded, although a depression is visible, slightly off-center on the shaft.



**S3 Figure 7. MGUAN-PA658 indeterminate shaft fragment.** (A) proximal, (B) ventral, (C) distal, (D) anterior, (E) dorsal, and (F) posterior views. Abbreviation: DEP, depression.