SM2: Anatomical description of the 3D landmarks of the 14 phalanges and the tarsometatarsus used in the geometric morphometrics analysis

Phalanges

Landmark n°	Definition	Type	Source
1	Ventral-most point of proximal articular facet in contact with the body of the phalanx. Define the limit where the trochlea articulate ventrally with the facet.	II	This study
2	Dorsal-most point of proximal articular facet in contact with the body of the phalanx. Define the limit where the trochlea articulate dorsally with the facet.	II	This study
3	Lateral distal-most point of the distal trochlea	II	This study
4	Middle point between point 3 and 4	III	This study
5	Medial distal-most point of the distal trochlea	II	This study

Terminal phalanges

Landmark n°	Definition	Type	Source
1	Apex of the curve of the proximodorsal medial convexity at the articulation of the ungual phalanx with previous phalanx	II	Hedrick et al. 2019
2	Apex of the curve of the proximoventral medial convexity at the articulation of the ungual phalanx with previous phalanx	II	Hedrick et al. 2019
3	Apex of the curve of the proximoventral-most medial extension of the flexor tubercle	II	Hedrick et al. 2019
4	Apex of the curve of the proximodorsal lateral convexity at the articulation of the ungual phalanx with previous phalanx	II	Hedrick et al. 2019
5	Apex of the curve of the proximoventral lateral convexity at the articulation of the ungual phalanx with previous phalanx	II	Hedrick et al. 2019
6	Apex of the curve of the proximoventral-most lateral extension of the flexor tubercle	II	Hedrick et al. 2019
7	Middle point between point 3 and 6, most dorsal point of the articulation	III	Hedrick et al. 2019
8	Middle point between point 1 and 4, most ventral point of the articulation	III	Hedrick et al. 2019
9	Distal tip of the ungual phalanx	II	Hedrick et al. 2019
C1	Curve from LM 7 to LM 9	SM	This study
C2	Curve from LM 8 to LM 9	SM	This study

Tarsometatarsus

Landmark n°	Definition	Type	Source
1	The proximal-most point of the medial ridge of the trochlea IV on its dorsal surface. Define the dorsal medial base of the trochlea IV.	II	Bjarnason & Benson,2021
2	The proximal-most point of the lateral ridge of the trochlea III on its dorsal surface. Define one of the dorsal lateral base of the trochlea III.	II	Bjarnason & Benson,2021
3	The proximal-most point of the medial ridge of the trochlea III on its dorsal surface. Define the dorsal medial base of the trochlea III.	II	Bjarnason & Benson,2021
4	The proximal-most point of the lateral ridge of the trochlea II on its dorsal surface. Define one of the dorsal lateral base of the trochlea II.	II	Bjarnason & Benson,2021
5	Deepest point of the depression on the lateral part of the trochlea IV.	II	This study
6	Deepest point of the depression on the medial part of the trochlea II.	II	This study
7	The apex point on the lateral margin of the trochlea IV.	II	This study
8	The apex point on the medial margin of the trochlea IV.	II	This study
9	The apex point on the lateral margin of the trochlea III.	II	This study
10	The apex point on the medial margin of the trochlea III.	II	This study
11	The apex point on the lateral margin of the trochlea II.	II	This study
12	The apex point on the medial margin of the trochlea II.	II	This study
13	The proximal-most point of the medial ridge of the trochlea IV on its ventral surface. Define the ventral medial base of the trochlea IV.	II	Bjarnason & Benson,2021
14	The proximal-most point of the lateral ridge of the trochlea III on its ventral surface. Define one of the ventral lateral base of the trochlea III.	II	Bjarnason & Benson,2021
15	The proximal-most point of the medial ridge of the trochlea III on its ventral surface. Define the ventral medial base of the trochlea III	II	Bjarnason & Benson,2021
16	The proximal-most point of the lateral ridge of the trochlea II on its ventral surface. Define one of the ventral lateral base of the trochlea II.	II	Bjarnason & Benson,2021
17	Maximum of convexity of between the trochlea I and the metatarsal I on the ventral lateral margin.	II	This study
18	Maximum of convexity of between the trochlea I and the metatarsal I on the ventral lateral margin.	II	This study
19	Deepest point of the depression on the lateral part of the trochlea I	II	This study
20	Deepest point of the depression on the medial part of the trochlea I.	II	This study

21	The apex point on the lateral margin of the trochlea II.	II	This study
22	The apex point on the medial margin of the trochlea II.	II	This study
23	Proximal-most point in contact between the metatarsal I and the body of the tarsometatarsus. If the metatarsal if not in contact with the tarsometatarsus-most proximal-most point of the metatarsal I.	II	This study
24	Proximal-most point in contact between the metatarsal I and the body of the tarsometatarsus. If the metatarsal I if not in contact with the tarsometatarsus, -most closed point on the tarsometatarsus body relative to the point 23	II	This study
25	Distal-most point in contact between the metatarsal I and the body of the tarsometatarsus. If the metatarsal if not in contact with the tarsometatarsus, this point represent the distal-most point of the ventral part of the metatarsal I.	II	This study
26	Distal-most point in contact between the metatarsal I and the body of the tarsometatarsus. If the metatarsal I if not in contact with the tarsometatarsus, most closed point on the tarsometatarsus body relative to the point 25.	II	This study
27	The dorsodistal point of the medial hypotarsal crest where it merges with the shaft of the tarsometatarsus.	I	Bjarnason & Benson,2021
28	The dorsoproximal point of the medial hypotarsal crest where it contacts the body of the tarsometatarsus.	I	Bjarnason & Benson,2021
29	The ventral-most point of the medial cotyle.	II	This study
30	The medial-most point of the medial cotyle.	II	This study
31	The dorsal-most point of the medial cotyle.	II	This study
32	Deepest point of the medial cotyle depression.	II	Bjarnason & Benson,2021
33	The apex or point of greatest projection of the intercotylar eminence between the lateral and lateral cotyle.	II	This study
34	The dorsal-most lateral point of the lateral cotyle.	II	This study
35	The lateral-most point of the lateral cotyle.	I	This study
36	The ventral-most point of the lateral cotyle in contact with the tendinous canals region.	I	This study

References

Bjarnason, A., & Benson, R. B. J. (2021). A 3D geometric morphometric dataset quantifying skeletal variation in birds. *MorphoMuseuM*, *7*(1).

Hedrick, B. P., Cordero, S. A., Zanno, L. E., Noto, C., & Dodson, P. (2019). Quantifying shape and ecology in avian pedal claws: the relationship between the bony core and keratinous sheath. *Ecology and evolution*, *9*(20), 11545-11556.