

Greater Growth of Proximal Metatarsals in Bird Embryos and the Evolution of Hallux Position in the Grasping Foot

Botelho, João Francisco

Smith-Paredes, Daniel

Soto-Acuña, Sergio

Núñez-León, Daniel

Palma, Verónica

Vargas, Alexander O.

© 2016 Wiley Periodicals, Inc. In early theropod dinosaurs?the ancestors of birds?the hallux (digit 1) had an elevated position within the foot and had lost the proximal portion of its metatarsal. It no longer articulated with the ankle, but was attached at about mid-length of metatarsal 2 (mt2). In adult birds, the hallux is articulated closer to the distal end of mt2 at ground level with the other digits. However, on chick embryonic day 7, its position is as in early theropods at half-length of mt2. The adult distal location is acquired during embryonic days 8?10. To assess how the adult phenotype is acquired, we produced fate maps of the metatarsals of day 6 chicken embryos injecting the lipophilic tracer Dil. The fates of these marks indicate a larger expansion of the metatarsals at their proximal end, which creates the illusory effect that d1 moves distally. This larger proximal expansion occurs concomitantly with growth and early differentiation of cartilage. Histological analysi