

# Molecular development of fibular reduction in birds and its evolution from dinosaurs

Por: Botelho, JF (Francisco Botelho, Joao)<sup>[1]</sup>; Smith-Paredes, D (Smith-Paredes, Daniel)<sup>[1]</sup>; Soto-Acuna, S (Soto-Acuna, Sergio)<sup>[1,2]</sup>; O'Connor, J (O'Connor, Jingmai)<sup>[3]</sup>; Palma, V (Palma, Veronica)<sup>[4]</sup>; Vargas, AO (Vargas, Alexander O.)<sup>[1]</sup>

## EVOLUTION

Volumen: 70

Número: 3

Páginas: 543-554

DOI: 10.1111/evo.12882

Fecha de publicación: MAR 2016

[Ver información de revista](#)

## Resumen

Birds have a distally reduced, splinter-like fibula that is shorter than the tibia. In embryonic development, both skeletal elements start out with similar lengths. We examined molecular markers of cartilage differentiation in chicken embryos. We found that the distal end of the fibula expresses Indian hedgehog (IHH), undergoing terminal cartilage differentiation, and almost no Parathyroid-related protein (PTHrP), which is required to develop a proliferative growth plate (epiphysis). Reduction of the distal fibula may be influenced earlier by its close contact with the nearby fibulare, which strongly expresses PTHrP. The epiphysis-like fibulare however then separates from the fibula, which fails to maintain a distal growth plate, and fibular reduction ensues. Experimental downregulation of IHH signaling at a postmorphogenetic stage led to a tibia and fibula of equal length: The fibula is longer than in controls and fused to the fibulare, whereas the tibia is shorter and bent. We propose that the presence of a distal fibular epiphysis may constrain greater growth in the tibia. Accordingly, many Mesozoic birds show a fibula that has lost its distal epiphysis, but remains almost as long as the tibia, suggesting that loss of the fibulare preceded and allowed subsequent evolution of great fibulo-tibial disparity.

## Palabras clave

**Palabras clave de autor:** Bird-dinosaur transition; fibula; IHH; mesozoic birds; PTHrP; zeugopod

**KeyWords Plus:** HORMONE-RELATED-PROTEIN; INDIAN HEDGEHOG

CONTROL; REGULATED BONE-GROWTH; SKELETON FORMATION; ENDOCHONDRAL BONE; CARTILAGE DIFFERENTIATION; ALLIGATOR-MISSISSIPPIENSIS; SAPEORNIS-CHAOYANGENSIS; TETRAPOD LIMB; BASAL BIRD

## Información del autor

**Dirección para petición de copias:** Botelho, JF; Vargas, AO (autor para petición de copias)



Univ Chile, Fac Ciencias, Dept Biol, Lab Ontogenia & Filogenia, Santiago, Chile.

## Direcciones:

- + [ 1 ] Univ Chile, Fac Ciencias, Dept Biol, Lab Ontogenia & Filogenia, Santiago, Chile
- [ 2 ] Museo Nacl Hist Nat, Area Paleontol, Santiago, Chile
- + [ 3 ] Chinese Acad Sci, Inst Vertebrate Paleontol & Paleoanthropol, Beijing, Peoples R China
- + [ 4 ] Univ Chile, Fac Ciencias, Dept Biol, FONDAP Ctr Genom Regulat, Santiago, Chile

Direcciones de correo electrónico: [joaofranciscobotelho@gmail.com](mailto:joaofranciscobotelho@gmail.com); [alexvargas@uchile.cl](mailto:alexvargas@uchile.cl)

## Financiación

Entidad financiadora	Número de concesión
FONDECYT, Government of Chile	1150906

[Ver texto de financiación](#)

## Editorial

WILEY-BLACKWELL, 111 RIVER ST, HOBOKEN 07030-5774, NJ USA

## Categorías / Clasificación

Áreas de investigación: Environmental Sciences & Ecology; Evolutionary Biology; Genetics & Heredity

Categorías de Web of Science: Ecology; Evolutionary Biology; Genetics & Heredity

## Información del documento

Tipo de documento: Article

Idioma: English

Número de acceso: WOS:000372464600003

ID de PubMed: 26888088

ISSN: 0014-3820

eISSN: 1558-5646

## Información de la revista

- Impact Factor: [Journal Citation Reports®](#)

## Otra información

Número IDS: DH0HP

Referencias citadas en la Colección principal de Web of Science: **81**

Veces citado en la Colección principal de Web of Science: **0**