MASARYKOVA UNIVERZITA

Mechanisms of skeletal growth: from stem tetrapods to stem cell niches

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Lecture Abstract

Childhood growth occurs in small discs of cartilage, so-called epiphyseal growth plates, located near the ends of all long bones in the body and consisting of chondrocytes. Articular cartilage covers the end of bones and serves for their articulation. These structures are separated from each other by a bony element called epiphysis or secondary ossification center. However, in the beginning of evolution of tetrapods both these cartilaginous structures constituted a single element. Why the growth plate evolved as a separate organ is not clear.

By bringing together an evolutionary approach with comparative analysis of whales and bats, mathematical modeling including growth of dinosaurs, and both physical and biological experiments we revealed that separation of epiphyseal cartilage into a separate organ protects chondrocytes from mechanical stress associated with weight bearing. At the same time such a separation limits the number of chondro-progenitors, which are substituted by the bony epiphysis. To understand how mammals grow with limited number of chondro-progenitors we explored the cellular kinetics in the growth plate employing clonal genetic tracing with Confetti mice. Those experiment revealed that the bony epiphysis creates a stem cell niche, which allows chondro-progenitors to renew themselves for the entire growth period, e.g. 18 years in humans or lifetime in rodents.

Summarizing, our data suggest that in order to be able to grow on land tetrapods developed the growth plate into a separate structure, but to overcome growth limitations associated, they evolved a new stem cell niche.