

Regulation of immature cartilage growth by IGF-I, TGF- β 1, BMP-7, and PDGF-AB: role of metabolic balance between fixed charge and collagen network

Anna Asanbaeva · Koichi Masuda ·
Eugene J-M. A. Thonar · Stephen M. Klisch ·
Robert L. Sah

Abstract Cartilage growth may involve alterations in the balance between the swelling tendency of proteoglycans and the restraining function of the collagen network. Growth factors, including IGF-I, TGF- β 1, BMP-7, and PDGF-AB, regulate chondrocyte metabolism and, consequently, may regulate cartilage growth. Immature bovine articular cartilage explants from the superficial and middle zones were incubated for 13 days in basal medium or medium supplemented with serum, IGF-I, TGF- β 1, BMP-7, or PDGF-AB. Variations in tissue size, accumulation of proteoglycan and collagen, and tensile properties were assessed. The inclusion of serum, IGF-I, or BMP-7 resulted in expansive tissue growth, stimulation of proteoglycan deposition but not of collagen, and a diminution of tensile integrity. The regulation of cartilage metabolism by TGF- β 1 resulted in tissue homeostasis, with maintenance of size, composition, and function. Incubation in basal medium or with PDGF-AB resulted in small volumetric and compositional changes, but a marked decrease in tensile integrity. These results demonstrate that the phenotype of cartilage growth, and the associated balance between proteoglycan content and integrity of the collagen network, is regulated differentially by certain growth factors.

A. Asanbaeva · R. L. Sah (✉)
Department of Bioengineering and Whitaker Institute
of Biomedical Engineering, University of California-San Diego,
9500 Gilman Dr., Mail Code 0412, La Jolla,
CA 92093-0412, USA
e-mail: rsah@ucsd.edu

K. Masuda · E. J-M. A. Thonar
Departments of Orthopedic Surgery and Biochemistry,
Rush University Medical Center, Chicago, IL, USA

E. J-M. A. Thonar
Department of Internal Medicine, Rush University Medical Center,
Chicago, IL, USA

S. M. Klisch
Department of Mechanical Engineering,
California Polytechnic State University, San Luis Obispo,
CA, USA