

Bioengineering Cartilage Growth, Maturation, and Form

GREGORY M. WILLIAMS, STEPHEN M. KLISCH, AND ROBERT L. SAH

Department of Bioengineering [G.M.W., R.L.S.], Whitaker Institute of Biomedical Engineering [R.L.S.], University of California, San Diego, California 92093; Department of Mechanical Engineering [S.M.K.], California Polytechnic State University, San Luis Obispo, California 93407

ABSTRACT: Cartilage of articular joints grows and matures to achieve characteristic sizes, forms, and functional properties. Through these processes, the tissue not only serves as a template for bone growth but also yields mature articular cartilage providing joints with a low-friction, wear-resistant bearing material. The study of cartilage growth and maturation is a focus of both cartilage biologists and bioengineers with one goal of trying to create biologic tissue substitutes for the repair of damaged joints. Experimental approaches both *in vivo* and *in vitro* are being used to better understand the mechanisms and regulation of growth and maturation processes. This knowledge may facilitate the controlled manipulation of cartilage size, shape, and maturity to meet the criteria needed for successful clinical applications. Mathematical models are also useful tools for quantitatively describing the dynamically changing composition, structure and function of cartilage during growth and maturation and may aid the development of tissue engineering solutions. Recent advances in methods of cartilage formation and culture which control the size, shape, and maturity of these tissues are numerous and provide contrast to the physiologic development of cartilage.