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Relationship of Donor Site to Chondrogenic Potential of Periosteum *In Vitro*

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Summary: Periosteum has been shown *in vitro* and *in vivo* to have a chondrogenic potential that permits it to be used for cartilage regeneration. A useful donor site should have good chondrogenic potential, availability of a large quantity of periosteum, and relative ease of access, and it should be associated with a low rate of morbidity. We hypothesized that the chondrogenic potential of periosteum varies from one bone to another and among different regions of the periosteum from a single bone. A total of 370 periosteal and 37 fascia lata (control) explants were taken from the skull, the ilium, the scapula, the upper, middle, and lower medial proximal tibia, the posterior proximal tibia, and the distal tibia of 2-month-old New Zealand rabbits. The explants were cultured for 6 weeks in agarose/Dulbecco's modified Eagle medium to which 10 ng/ml of transforming growth factor-β1 was added during the first 2 weeks. Skeletal muscle and fascia lata were used as controls. In addition, the thickness, cell density, and total cell count of the cambium layer were measured in 24 explants from the donor sites on the ilium and the upper, middle, and lower proximal tibia. At 6 weeks, histomorphometry and quantitative collagen typing were performed. The periosteal donor sites could be grouped into three categories according to chondrogenic potential: ilium (best), scapula and tibia, and skull (no chondrogenesis). The scapular periosteum was slightly better than that from the tibia. Within the tibia, the upper and middle zones of the proximal region were similar and were slightly better than the lower proximal tibia or the distal tibia. The cellularity of the cambium layer correlated positively with the amount of cartilage as a percentage of the total area. The results of this study indicate that iliac periosteum exhibited the best overall chondrogenic potential *in vitro* but that periosteum from the traditionally used medial proximal tibia also was excellent. Periosteum from the skull was not chondrogenic. The chondrogenic potential of periosteum varies from bone to bone and within the periosteum from one bone. This variation in chondrogenic potential among donor sites may be due to a difference in the total cell count of the cambium layer.

Damage to articular cartilage as a result of trauma, sports, or osteochondritis dissecans typically affects children, adolescents, and young adults. Small full-thickness defects in articular cartilage have been shown experimentally to be capable of healing with hyaline-like cartilage (3,7,10,12,15,32), but large defects have not (3,5,10,11,21,22). Thus, there is an obvious need for a procedure to regenerate articular cartilage. Periosteum has been shown experimentally to express a significant chondrogenic potential *in vivo* (11,19,21-23,26,29-31,38,40). In addition, the feasibility of its use in biological resurfacing of large articular cartilage defects also has been shown (9,11,21-23,29-31). The optimum donor site for periosteal grafts is an important and clinically relevant question.

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