Marine Turtle Newsletter

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PRELIMINARY STUDIES ON SKELETAL MORPHOLOGY OF THE LEATHERBACK TURTLE

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The leatherback turtle (Dermochelys coriacea) is known to have an extensively cartilaginous skeleton, but no study of the internal architecture of its appendicular bones has ever been undertaken. We have examined longtitudinal sections of freshly preserved limb bones from several adult marine turtles, including 4 leatherbacks, 2 loggerheads and 2 Kemp's ridleys. Additional dried bones of 2 leatherbacks, 1 hawksbill and 3 greens were also examined.

The hard-shelled marine turtles have a pattern of chondro-osseous morphology highly reminiscent of terrestrial or aquatic turtles (Haines, 1938; Suzuki, 1963). A thick, distinct compacta is clearly delineated from a medullary cancellous region. The epiphyses are covered by a very thin avascular cartilage which serves the purpose both of articular cartilage and physis, or growth cartilage. The subchondral plate of the epiphyseal bone surface is smooth. The only difference in marine turtles is the failure of development of a medullary cavity.

Dermochelys exhibits several important differences in skeletal morphology (Fig. 1). Each epiphyseal end of the long bones develops large, thick cartilaginous epiphyses. The articular and physeal portions of the cartilage are well separated and oriented in different planes from each other. Each of the chondroepiphyses is filled with an extensive cartilage canal vascular system. The vessels are both perichondral and transphyseal in origin and allow continuity of circulation between metaphysis and epiphysis. Both large and small vessels cross the physis, the smaller ones probably participating in endochondral chondro-osseous replacement, the large ones probably involved with cartilaginous expansion and nutrition of the epiphysis itself. No secondary calcification or ossification centers develop in any of the chondro-epiphyses. The subchondral plate is extensively fenestrated by the vascular channels. The diaphysis and metaphysis are filled with relatively dense cancellous trabecular bone without secondary medullary cavity formation. The metaphysis appears to be almost totally derived from endochondral bone formation and the diaphysis from a combination of endochondral and periosteal membranous growth. This is dramatically evident because of a combination of dark pigmentation in the periosteally derived bone and lack of internal ontogenetic remodeling. Cones of light endochondral and dark periosteal bone are therefore formed, radiating in a well-delineated fashion from the central nutrient artery.

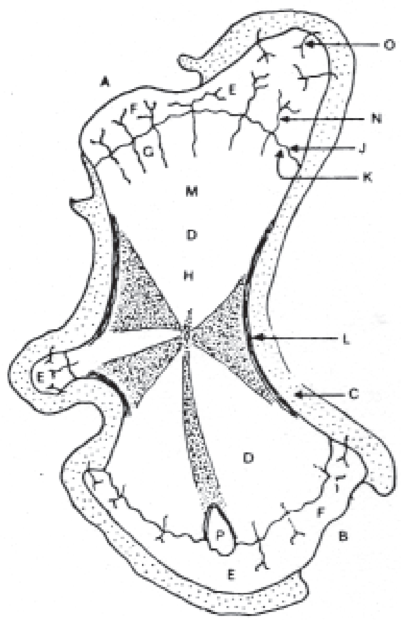

Figure 1:

Longtitudinal section of humerus of a medium-sized adult leatherback. A = shoulder joint with capsule; B = elbow joint with capsule; C = soft tissues attached to bone, composed of periosteum along bone surface and perichondrium along cartilage surface; D = bone; E = cartilage; F = epiphysis; G = metaphysis; H = diaphysis; J = physis (growth cartilage) = site of endochondral bone formation; K = subchondral plate (bone directly under physis); L = compacta = site of membranous (periosteal) bone formation; M = medullary cancellous region; N = transphyseal vessels; O = perichondral vessels; P = ectepicondylar foramen.

No other extant reptile known exhibits this combination of chondro-osseous developmental features. Whereas some extant reptiles (e.g. varanid lizards, Agama and Chamaeleo) vascularize their chondroepiphyses, this vascularization is always perichondrally or circumphyseally derived, never transphyseally across the growth cartilage. In addition, the vascularization is invariably followed by secondary calcification and ossification of the epiphysis. All other turtles plus all crocodilians, including species of large body size, fail to vascularize their chondroepiphyses, which also remain thin and cartilaginous throughout adulthood.

Certain marine mammals, notably whales and manatees, show remarkably similar chondro-osseous morphology (Felts and Spurrell, 1966; Fawcett, 1942) with the only real differences being the development of secondary ossification centers and a reversal of the pigmentation pattern in the endochondral and periosteal cones. In view of the well-developed homoiothermic, if not endothermic, qualities of the leatherback (Frair et al., 1972; Greer et al., 1973) and the striking similarity of its chondro-osseous morphology to marine mammals, Dermochelys can become a valuable model in studies relating to the phylogeny of endothermy or of the evolution of mammals from reptiles.

Further work will be needed to delineate the ontogenetic skeletal development of Dermochelys, comparing it to hard-shelled marine turtles, as well as to marine mammals. We have been able to examine both adults and hatchlings. However, we have been unable to secure any post-hatchling juveniles for study. We would greatly appreciate hearing from any one who has access to fresh or preserved juvenile leatherbacks (carapace length 10 to 100 cm) and who would be willing to allow us to examine one set of flippers (front plus rear) from each specimen. Please contact us if you have suitable material available.

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