Interpretation of Primate Behavior, Ambulation and Biomechanics: Caveat Arthritis

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Analysis of ambulation or biomechanics on the basis of functional morphology (anatomical shape of bones and location of muscle origins and insertions) seems predictive of potential behaviors [1-3]. It delineates possible range of limb motion and potential uses of the limb, and may seem all that is available for examination of the fossil primates. Actually, evidence of new bone formation at sites of muscle or tendon insertion (entheses) and osteoarthritis further identify how the limb is actually utilized [4-6]. The stress of limb activity promotes osteoelastic reaction [4], with visible evidence. The combination of these physical manifestations allows speculation as to organizational behavior. Establishing confidence (that a given speculation accurately portrays the life of a primate) requires an additional step: Observation of limb utilization in vivo in the natural setting. This requires observations in the wild. Performance of such observations in artificial environments allows more controlled study, but the character of the artificial environment must also be considered. Caya Santiago contains a phenomenal project, in which rhesus macaques have been given their own island. It is a natural habitat in a hurricane-susceptible region. In contrast to the two-three levels of canopy in their natural environment [7], there is generally only one layer of canape on this Puerto Rican island. The macaques appear to spend more time on the ground than they do in their “home” environment. A behavior alteration, with osseous manifestations: They have a higher frequency of osteoarthritis than do their conspecifics in Africa [8-11]. Osteoarthritis is extremely rare in the natural habitat, with frequency less than 1% in primates [8-12]. There is another factor which may affect behavioral observations, both in generated habitats (e.g., Caya Santiago) and in the wild, what might be referred to as the behavioral analogy to the Heisenberg uncertainty issue in physics. Does the very fact of observation alter behavior? And, some investigators do more than just observe (e.g., Diane Fossey).

There is an additional issue that should be considered in the evaluation not only of direct observations on behavior but also those related to functional morphology and pathology. That is accurate diagnosis of pathology. Primates are susceptible to several varieties of arthritis. Osteoarthritis can be considered a mechanical response to the environment and even as evidence of behavior [13]. The challenge is its recognition. There is only one significant identifier for osteoarthritis and that is the overgrowth of joint margins referred to as osteophytes [14-16]. Unfortunately, some studies are a source of confusion, as they [13,17-21] have mistakenly utilized unrelated porosity [7] and eburnation [22] to identify osteoarthritis. Eburnation is the result of sufficient cartilage loss that allows bones to rub on each other with a polishing effect. That can occur with any form of severe arthritis and unfortunately, there is another form of arthritis which is actually much more common and results in more cartilage damage than osteoarthritis, an inflammatory disease referred to as spondyloarthopathy [9-11,23-32]. A further source of error in the published literature on osteoarthritis in primates is related to vertebral alterations [33]. Overgrowth of vertebral centra margins is also referred to as osteophytes. Herein, semantics causes a major problem [34] like osteophytes at joint margins, identifying pathological osteoarthritides [5,6,35-37] and osteophytes at vertebral margins, identifying spondylosis deformans [29,38]. They are asymptomatic and apparently a phenomena of aging [37], but have often been misidentified as indicative of osteoarthritis [13].

Presence of either osteoarthritis or spondyloarthopathy alters behavior both directly and indirectly. Alteration of bone shape alters biomechanics directly. Pain related to arthritis alters many aspects of behavior and is not directly relatable to severity [6,39,40]. Thus, it is important to assure that observed/evaluated animals are healthy (at least joint-wise) if observations on biomechanics, locomotion and behavior are to be extractable beyond the study sample. Arthritis-induced gait and other modifications are often striking but can be quite subtle. Collaborative approaches are recommended to facilitate identification of confounding factors.

References

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