Critic analysis of regression equation models used to associate isolated postcranial bones and tooth remains: the case of the South American Paleogene ungulates

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The taxonomy of fossil mammals is mostly based on dental characters as a consequence of the better preservation of teeth when comparing with other body parts. Paleogene South American native ungulates are well represented by teeth, and there are a large number of non-associated postcranial remains suspected to belong to them. Based on the high correlation between body mass and dental measurements, three different logarithmic equations have been proposed to assigned postcranial bones, particularly the astragalus, to the dental remains of native ungulates. These models considered the m2 area as a variable dependent or independent, and are: 1) Ln 'm2 area' = -0.77 + 1.55 * Ln 'astragalar length', based on 10 condylarths; 2) Ln 'length of the trochlea' = -0.283 + 1.345 * Ln 'm2 area', considering 6 condylarths and 2 litopterns; 3) Ln 'length of the trochlea' = -0.970 + 1.698 * Ln ($\sqrt{\text{m2 area}}$), based on 10 condylarths. In these models neither the original measurements for building the equation nor the residual standard deviation, both necessary for making predictions and calculate probabilities, are available. In order to solve this problem, a new dataset of 15 different astragalar variables, and length and width of molar series, was made from 24 articulated skeletons of bunodont artiodactyls, perissodactyls and primates. As in previous models the 'm2 area' is the best dental variable to use in correlations. In contrast, for the astragalus, the 'width of the neck' shows better r values for the regressions and higher loadings in a PCA than 'total length' or 'trochlea length'. The model fit to our database was calculated and the residuals used to produce a testable and predictable model to test previous re-association inferences.

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